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DESIGN MEMORANDUM REPORT FOR THE ENVIRONMENTAL RESTORATION STORAGE AND DISPOSAL FACILITY

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CONTENTS

APPENDICES:

ACRONYM LIST

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AREA	American Railroad Engineers Association
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSI	Construction Specificiations Institute
CWC	Hanford Central Waste Complex
D&D	decommissioning and decontamination
DAS	Data Acquisition System
DM	Design Memorandum
DOE	U. S. Department of Energy
DOT	U. S. Department of Transportation
Ecology	State of Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERSDF	Environmental Restoration Storage and Disposal Facility
FDC	Functional Design Criteria
GDC	General Design Criteria
IDO	Indefinite Delivery Order
lbs/ft^3	pounds per cubic foot
lbs/yd^3	pounds per cubic yard
nCi/g	nanocuries per gram
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Act
RCRA	Resource Conservation and Recovery Act
SDC	Hanford Plant Standard Design Criteria
SWITS	Solid Waste Information Tracking System
TM	Technical Memorandums
TRU	Transuranic
UBC	Uniform Building Code
USACE	U. S. Army Corps of Engineers
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Retrieval and Packaging
yd^3	cubic yards

1.0 INTRODUCTION

This Design Memorandum (DM) addresses issues which are relevant to the design of the Environmental Restoration Storage and Disposal Facility (ERSDF).

1.1 BACKGROUND

The U. S. Department of Energy (DOE) has tasked the U. S. Army Corps of Engineers (USACE) to perform detailed planning for the development of the conceptual design for the ERSDF at the Hanford site near Richland, Washington. The production of plutonium and related activities since 1943, have resulted in significant environmental (primarily soil) contamination on the Hanford site. The ERSDF will serve as the disposal facility for the majority of wastes excavated during remediation of waste management sites in the 100 Area, 200 Area and 300 Area of the Hanford Facility. The primary features of the ERSDF include disposal units, rail and tractor/trailer container handling capability, equipment and personnel decontamination facilities, maintenance facilities, fencing, roads, railroads, inventory control systems, and administration offices. The overall project has been designated by Westinghouse Hanford Company (WHC) as project W-296, and is defined as the design and construction of facilities for the disposal of waste generated through the year 2001 which includes wastes from the 100 Area and 300 Area only. The operation of the facility and disposal of remaining wastes will be performed under another project. The USACE has tasked Montgomery Watson to conduct the engineering study under Delivery Order No. 0017, under the Indefinite Delivery Order (IDO) Contract Number DACW68-92-D-0001, with the Walla Walla District.

The current concept for the ERSDF calls for disposal of Environmental Restoration (ER) derived waste in cells which have criteria based on the type of waste stream it receives. These criteria vary from a double lined cell with a leachate collection system to a simple unlined trench. It is anticipated that the design will need to meet the substantive requirements of the Resource Conservation and Recovery Act (RCRA). However, the specific design requirements of the disposal cells will be dependent upon the results of the current regulatory negotiations with the U.S. Environmental Protection Agency (EPA) and the State of Washington Department of Ecology (Ecology). Closure of the disposal cells will be accomplished through the placement of the Hanford Barrier over the disposal cells under another project. This barrier is specifically designed for this site to prevent infiltration and limit access to the waste. Along with the disposal cells, the ERSDF will include waste handling, decontamination, and transportation systems (within the ERSDF), and various related support facilities such as an administration building.

It is anticipated that the ERSDF will be located near the 200 Area, in the center of the Hanford site. This location was selected due to the central location and the favorable geologic conditions associated with this portion of the Hanford site. The recommended site selection is currently being evaluated by DOE and the regulators. It is anticipated that the final site selection will occur shortly.

1.2 PURPOSE AND SCOPE

The purpose and scope of this DM is to address the following issues:

- Batch Plant Sizing
- Automation Strategy Development
- Transuranic (TRU) Waste Storage and Handling
- Evaluation of Applicable Regulations and DOE Orders

- Material Balance Evaluation
- Site Capability Assessment

These issues are discussed in depth in the appendiced Technical Memorandums (TM). The site capability assessment is continuing to be performed and detailed information is not presented in this document. This DM provides a synopsis of the TMs and where applicable provides recommendations for consideration for the design of the ERSDF.

1.3 APPLICABLE CRITERIA

In general the criteria that apply to this effort are found in DOE design standards, as well as the multitude of regulations that are being evaluated under this DM. These include Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RCRA, National Environmental Policy Act (NEPA), National Fire Protection Association (NFPA), U. S. Department of Transportation (DOT) Requirements, Washington State DOT Requirements and the Ecology regulations. A more comprehensive evaluation of this criteria will be provided in the Evaluation of Regulations and DOE Orders TM of this DM.

1.4 OBJECTIVES OF DESIGN MEMORANDA ELEMENT DESCRIPTIONS

The following sections provide the objectives of the TMs, which are provided in their entirety as appendices to this DM.

1.4.1 Batch Plant Sizing (Appendix A)

The batch plant provides for filling voids in the waste materials generated by decommissioning and decontamination (D&D) activities and excavation of the burial grounds. It is anticipated that the voids formed by waste materials such as the oversized blocks of concrete and the long, thin planks of wood will allow adjacent soil material to migrate and potentially cause subsidence. This subsidence could cause damage to the Hanford Barrier. This study reviews the types of material present in the burial grounds and evaluates the potential volume of void space which could be associated with that type of material. A production rate and associated batch plant size is determined based upon the evaluation of potential void space.

1.4.2 Automation Strategy Development (Appendix B)

Automation Strategy, as the name implies, evaluates what type of automation is best suited for the ERSDF. Topics discussed include recordation of waste materials source location, quantity and location of burial as well as to how best to collect this information and store it for future retrieval, telemetry systems for site monitoring, radiological surveys for facility exit, and remote controlled decontamination of equipment. Interviews of personnel working at similar facilities are included as a part of this effort to determine the advantages and disadvantages associated with existing and proposed automation strategies.

1.4.3 Transuranic Waste Storage and Handling (Appendix C)

TRU Waste Storage and Handling provides guidance on how to store, classify and handle this material. Based on Nuclear Regulatory Commission (NRC) and DOE requirements, it is not appropriate to dispose of TRU at the ERSDF. The appropriate disposal facility is the Waste Isolation Pilot Plant (WIPP) which is not yet operational. Determination is made in this assessment as how to best deal with the TRU waste.

1.4.4 Evaluation of Applicable Regulations and Department of Energy Orders (Appendix D)

Evaluation of regulations and DOE orders as they pertain to the ERSDF are evaluated in this TM. The list of appropriate regulations, and DOE orders for this facility is quite comprehensive. This TM reviews the regulations and DOE orders and provides guidance as to the appropriateness of these documents to the design of the ERSDF.

1.4.5 Material Balance Evaluation (Appendix E)

The Materials Balance Evaluation TM considers the quantities of excess material generated by construction of the disposal cells with respect to the existing grade of the ERSDF site. This information is required to optimize the material handling aspects of the ERSDF and determine how the material from the required excavation can be best utilized. This material may be utilized for restoration at the operable units where remediation activities will be taking place or for the eventual closure of the ERSDF. This analysis attempts to optimize the construction of the disposal cells to provide the highest beneficial use of the material at the ERSDF.

1.4.6 Site Capability Assessment (Appendix F)

The existing facilities and operations at the Hanford site were surveyed to determine what future ERSDF functions could be provided by existing services. This survey was conducted by written requests to the relevant department heads. Of the organizations surveyed, only the following indicated that they had capacity to provide services to the ERSDF:

- Fire Protection
- Industrial Safety and Hygiene
- Security.

2.0 RECOMMENDATIONS AND APPLICABLE CONCLUSIONS

The following abstracts summarize five TMs that are appended to the Design Memorandum. The TMs contain the information which supports the recommended conclusions presented below. The entire text of the following studies are attached and provide more in-depth information.

2.1 BATCH PLANT SIZING (APPENDIX A)

2.1.1 Summary and Conclusions

The batch plant required must produce a minimum output of 40 cubic yards (yd^3) and a maximum of about 140 yd^3 per day of cement grout. Batch plant operation will require between 2,000 and 10,000 gallons of water per day. The batch plant should be placed within the disposal area to use water from decontamination operations, if possible. This would provide the advantage of having the batch plant in close proximity to the disposal cells and the ability to use contaminated water and possibly contaminated sand, thus disposing of these problem materials as a part of the batching operations.

2.1.2 Introduction and Background

This TM evaluates the issues associated with subsidence of the materials in the ERSDF. The majority of the waste to be disposed at the ERSDF consists of bulk soils which can be compacted adequately to support the disposal facility cap. However, disposal of metal wastes, demolition debris, and wastes removed from existing burial grounds would create voids, a high probability of soil subsidence over time, and a threat to the integrity of the facility Hanford Barrier. Several methods for consolidation of material such as stacking, compaction, or cutting were considered. These methods, due to the nature of the waste material, were ruled out as impractical. Grouting to bind and seal the material appears to be the best solution. Following that conclusion, it is apparent that the sizing of the cement batch plant based on the quantity and scheduled arrival of materials to the ERSDF is necessary.

The TM indicates that organic wastes are a concern due to the potential biodegradation over time. Since grouting would not be a totally viable solution for this problem if done in place, it is recommended that it be done at the source for wastes which would be placed in non-reusable containers before being sent to the ERSDF.

2.1.3 Data and Assumptions

Projected waste types, volumes and schedules are presented in the document entitled *On-Site Transportation Network Engineering Study for the ERSDF* (DOE/RL/12074--12 Rev. 0). The tables presented in this TM summarize the first 5 years of waste scheduled to be sent to the ERSDF, and the type of wastes that would require stabilization by grouting. The following assumptions apply to this TM:

- Wastes which would be placed in non-reusable containers will be stabilized at the source, not at the ERSDF.
- Size reduction such as crushing, cutting and stacking will be done at the source, not at the ERSDF.
- Grouting will be done with Portland cement with the following properties:
  - a. Sand aggregate at 150 pounds per cubic foot (lbs/ft^3)
  - b. Cement weight is 1,000 pounds per cubic yard (lbs/yd^3)
  - c. Water/cement ratio is 0.6 on a weight basis.
- The batch plant will operate only 5 days per week to allow for equipment maintenance down time.
- The grout will fill void space within the waste and will not significantly increase the disposal volume.

2.1.4 Alternatives Identification and Development

The following two alternatives were developed:

- Non-contaminated batch plant using clean water and sand
- A mobile contaminated batch plant using contaminated water and contaminated (low-level, low-activity, rad only) sandy soil.

2.1.5 Alternatives Evaluation

The non-contaminated batch plant would minimize health and safety requirements and eliminate the need to decontaminate the batch plant. The trucks used to haul the grout would have to be decontaminated upon completion of their trip to the point of deposition of the grout.

The mobile contaminated batch plant could use contaminated water and contaminated sand to produce grout which would help solve the problem of disposing of contaminated water. However, the mobile contaminated batch plant would have to be decontaminated or disposed of in the ERSDF at the conclusion of the project, as would the ancillary equipment such as trucks, cement pumps, etc.

2.1.6 Findings and Recommendations

The following findings and recommendations were developed:

- Grout production is expected to be between 7,700 and 36,000 yd^3 per year. This translates to between 40 and 140 yd^3 of grout per day.
- Estimated grout production will demand between 2,000 and 10,000 gallons of water per day.
- Review of historical records from the 105-B burial grounds indicate that 70 percent of the metals and buried waste would leave voids estimated at 40 percent of the total volume when buried at the ERSDF.
- Since fly ash and chemical additives could increase the strength of the grout, source and costs of these should be investigated.
- Sources for sand should be researched as soon as possible.
- The mobile contaminated batch plant is recommended since it will use and dispose of contaminated water and sand.

2.2 AUTOMATION STRATEGY DEVELOPMENT (APPENDIX B)

2.2.1 Summary and Conclusions

The following functions for automation were considered:

- Weighing, logging and tracking of incoming wastes,
- Centralized monitoring and control of site specific operational, maintenance, utility and energy management, and other production related functions,
- Historical data and records storage,
- Air emissions and environmental monitoring,
- Decontamination and radiological survey of equipment,
- Site security, safety, fire alarm systems, and other site communications.

The automation strategy utilizes electronic tagging and vehicle-mounted load cells to provide a highly automated system for incoming wastes. A computer database will be used for data management. Automatic sampling and reporting will be used for environmental monitoring, except where manual sampling is appropriate. Manually sampled data will be entered into the database. Presently, WHC is developing a Data Acquisition System (DAS) to manage characterization data at the remediation sites. This system may be integrated with the ERSDF system. However, the data collection and record storage retrieval system for the ERSDF must be functionally compatible with the waste site characterization system and the data management requirements of the Solid Waste Information Tracking System (SWITS). Decontamination and verification of decontamination will be automated as much as possible. Site communications will provide for data transfer with centralized control of radio communications.

2.2.2 Introduction and Background

This TM evaluates automation strategies for optimizing waste handling at the ERSDF. It evaluates alternatives for automation of waste handling; computer database storage and retrieval; environmental data acquisition; decontamination procedures and monitoring of decontamination results; and communication requirements for alarms, security, safety and data transfer.

2.2.3 Automation Goals

The following goals were established for the automation system:

- Increased safety,
- More complete and consistent documentation,
- Increased productivity (throughput),
- Energy conservation,
- Minimize operations personnel for cost and safety reasons,
- Increased reliability, and
- Reduced cost.

The first two goals had a higher priority than the second two.

2.2.4 Data and Assumptions

The basic description of the ERSDF presented in the Functional Design Criteria (FDC) and the information provided in the *On-Site Transportation Network Engineering Study for the ERSDF* (DOE/RL/12074--12 Rev. 0) are used for basic data and assumptions for this TM.

2.2.5 Automated Functions

The following paragraphs provides the functions for automation that were investigated.

2.2.5.1 Weighing, Logging, and Tracking of Incoming Waste. Containers and materials will be coming from various remediation sites with different waste types. Verification and documentation of the waste from source to ultimate disposal is paramount to the operation of the ERSDF. The tracking system is essential to demonstrate that the ERSDF is meeting regulatory requirements.

2.2.5.2 Database. Information that will have to be stored, retrieved, and be available for cross reference includes: waste types, waste volumes, location of origin, location of disposal, weather data, environmental monitoring information, personnel records to include health and safety information, and accounting. Some information requiring a degree of confidentially may be put on a separate and smaller computer database.

2.2.5.3 Emissions Monitoring. Disposal operations within the ERSDF may result in fugitive dust emissions. Automated air monitoring would be used to demonstrate the effectiveness of dust control activities.

2.2.5.4 Decontamination and Radiation Survey. Trucks, reusable containers, trains and other equipment that leaves the ERSDF will require decontamination. The decontamination procedure can be automated to various degrees to eliminate worker contact. The automation of the decontamination facility is addressed in the *Engineering Study for the Decontamination and Wastewater Treatment Facility for the ERSDF* (DOE/RL/12074--10 Rev. 0).

2.2.5.5 Operational Functions. Automated or semi-automated control systems consistent with SWITS should be provided for the day-to-day (minute-to-minute) operations of the ERSDF. This will allow for real time or near real time acquisition of data to assure safe and efficient operation is continually maintained. Controls should be in effect that not only track and log incoming waste, but also assure that the required throughput is being maintained. Interlocks will be provided to prevent unsafe conditions or procedures. The systems will be required to monitor and control fuel and energy usage, equipment status and run times, and other processes not yet identified.

2.2.5.6 Communications. Normal procedures for site safety and security rely on the ability to sound alarms. Major stationary equipment is generally protected by alarms, and it may be appropriate to extend this to mobile equipment. If a decision is made to install an automation system at the site to serve a function such as waste logging and tracking, consideration must be given to use of the same data transmission hardware and software for other alarm and communications functions.

2.2.6 Alternatives Identification and Development

The objective of this TM is to develop a consistent automation strategy for the entire ERSDF. To develop this strategy, the following degrees of automation are identified:

- A manual system is the lowest level and generally involves a paper record system. Storage of the records would be through a paper filing system or the use of microfiche. Communication is through normal phone lines.

- A semi-manual system is a system where data is manually collected and entered into a computerized data management system. Some manually controlled robotics equipment such as the decontamination facility and verification of decontamination would fit into this category. Manually operated conventional phone systems would be the means of communication.

- A highly automatic system would use load cells on the transportation systems to measure weights and digitally transmit the information to a computer database. Loads leaving the ER site could be scanned for bar codes or transducer tags, along with the information from load cells to automatically codify data regarding material from source to disposal area. All functions would be automated from data collection to data storage and retrieval.

2.2.7 Findings and Recommendations

This section provides the findings and recommendations for ERSDF automation strategy.

2.2.7.1 Waste Receiving. Because of the importance of accurate and consistent waste tracking, full automation of the waste receiving system is recommended. This recommendation is consistent with the use of the DAS for the full remediation project. This includes load cells in off-loading equipment and electronic tagging of cars, containers, and trucks transporting wastes.

2.2.7.2 Data Storage. Because full automation is recommended for waste receiving facilities, the fully computerized database should also be implemented to accept the volume and consistency of data that would be generated from waste receiving facilities.

2.2.7.3 Environmental Monitoring. Real time monitoring of those weather parameters (such as wind) which are needed to alert staff that the ERSDF operations should be suspended is recommended. Other environmental data for which real time information is not needed should be monitored by semi-automatic means. Because of the installation of the DAS to manage environmental remediation data, any similar or related data gathered at the ERSDF should be managed by the same system.

2.2.7.4 Decontamination and Radiation Survey. This function is tied to monitoring results of the decontamination efforts. It is recommended that this function be automated to the maximum practical extent based on current availability of equipment.

2.2.7.5 Communications. A high level centralized control technology system for communication, alarms and site security is recommended for the ERSDF site.

2.2.7.5 Equipment Options. Once the overall automation strategy is determined the equipment can be specified during the process of design development.

2.3 TRANSURANIC WASTE STORAGE AND HANDLING (APPENDIX C)

2.3.1 Summary and Conclusions

Encountering TRU wastes during remediation is anticipated but not certain. The handling, storage and disposal of this material requires special considerations. There is also a fine line between the definition of "temporary storage" and "interim storage" for TRU material. Interim storage would require the full-scale, intensive requirements of the DOE's WIPP packaging and certification program. This TM reviewed four alternatives for dealing with TRU waste. Three of the alternatives deal with requirements for storage of TRU wastes. The fourth alternative suggests determining if TRU waste is really present at critical concentrations in the 100B Area and 100C Area.

This TM recommended that the fourth alternative be pursued, along with "temporarily" storing wastes in large containers until they can be repackaged for shipment to the WIPP or "interim" storage at the Hanford Central Waste Complex (CWC).

2.3.2 Introduction and Background

TRU waste is defined as any waste contaminated with alpha-emitting transuranium radionuclides with an atomic number greater than 92. Other characteristics are also required, such as 20-year half life and specified concentrations. At Hanford, wastes were generally disposed of to the soil. Some TRU wastes may be generated during demolition activities. The actual amounts of TRU wastes that may be generated is unknown, and the quantities used in this TM are estimates. There is also a possibility that TRU waste will not be encountered at all.

2.3.3 Data and Assumptions

TRU wastes will have to be handled in accordance with DOE Order 5820.2A *Radioactive Waste Management* and DOE Order RL 5820.2A *Radioactive Waste Management-Richland.*

In anticipation of ultimate disposal at WIPP, TRU waste has been stored at Hanford since 1970. Currently, TRU waste is generated from existing processes and is small in quantities. The FDC for the ERSDF estimates that no TRU waste will be encountered through the year 2001, but this TM provides recommendations in the event that TRU waste is encountered.

The Waste Retrieval and Packaging (WRAP) facility at Hanford has been designated as the TRU waste handling facility, but has a capacity for processing only about 875 yd^3 per year. This may be less than the maximum quantity anticipated to be generated on a yearly basis from the ER activities at Hanford. Furthermore, the WRAP is not scheduled to be operational until 1998 or 1999. Presently, TRU waste is stored in the CWC storage area, awaiting completion of the WRAP and WIPP.

The WIPP certification process can take 2 to 3 years to complete. The only containers acceptable for shipping to WIPP are either 55 gallon drums or TRU-PAC II boxes which contain roughly 6 yd^3 of material each. Storing TRU waste "temporarily" rather than on an "interim" basis precludes the requirement for certification of wastes and the WIPP requirements for containerization and certification.

2.3.4 Alternatives Identification and Development

The following alternatives were considered:

1. Construct two packaging systems at the ERSDF. One for 55 gallon drums or standard boxes (approximately 2.5 yd^3) for TRU waste and 15 or 35 yd^3 containers for all other types of waste handled. Build a WIPP certified storage site.

2. Same as alternative 1, except TRU wastes would be packaged at the remediation site and sent to the CWC TRU waste facility for subsequent shipment to WIPP.

3. "Temporarily" store the TRU wastes at the ERSDF in 15 yd^3 containers, and eventually ship to WRAP for repackaging for shipment to WIPP.

4. Conduct a limited and focused site characterization study at the three identified potential TRU contaminated sites in the 100B Area and 100C Area to determine if TRU waste exists above the level of 100 nanocuries per gram (nCi/g). If only minor amounts are present, then this can be transported to the WRAP for packaging to meet WIPP requirements. This alternative would better quantify the extent of the TRU waste and provide necessary information to develop other alternatives if necessary.

2.3.5 Alternatives Evaluation and Selection

Alternative 1 requires building a WIPP compliant storage facility at the ERSDF. It could take over 2 years to obtain the WIPP certification. Capacity could be designed to handle the estimated TRU wastes.

Alternative 2 involves following WIPP packaging procedures and using the existing TRU waste storage facilities. The current facilities are undersized for anticipated TRU wastes and additional storage capacity may have to be constructed. This could be done under the Environmental Restoration program funded under another project.

Alternative 3 anticipates "temporarily" storing the TRU wastes at the ERSDF in 15 yd^3 single-use containers at the ERSDF. It is assumed that movement of TRU waste to the ERSDF does not require WIPP certification, and agreement by Ecology and by EPA that a RCRA permit is not necessary. If either of these assumptions fail, then alternatives 1 or 2 could be exercised. This alternative also requires double handling of the waste and will cost more for final disposal.

Alternative 4 involves a limited study that would determine if TRU waste meeting the requirements necessary to trigger the WIPP standards exist in the 100B Area and 100C Area. If found, then a more accurate determination of the quantities would be possible and alternatives 1, 2, or 3 could be pursued to the extent necessary to meet the needs of handling the TRU waste.

2.3.6 Findings and Recommendations

It is recommend that Alternatives 2 and 4 be pursued simultaneously. Success with Alternative 4 could eliminate the need for the permitting, designing, building and operating of any TRU waste storage facilities at the ERSDF. Alternative 2 could be accomplished and would facilitate single handling of TRU waste. This alternative would require expansion of the CWC to meet the TRU waste volumes generated by the remediation activities. This expansion could be phased to handle out-year volumes if TRU waste volumes are substantial. The storage requirements of DOE Order 5820.2A can probably be met by adopting the storage design parameters used by the CWC.

2.4 EVALUATION OF APPLICABLE REGULATIONS AND DEPARTMENT OF ENERGY ORDERS (APPENDIX D)

2.4.1 Introduction

The purpose of this TM is to provide the ERSDF design team with an interpretation and evaluation of the numerous applicable regulations and DOE orders. The document is divided into four specific sections describing DOE orders and regulatory requirements which are relevant to the design process. The sections are:

- Functional Requirements
- Waste Disposal Design Criteria
- ERSDF Design Criteria
- General Requirements.

2.4.2 Functional Requirements

A summary of the functional requirements is provided for the design, including:

- 30-year design life
- Sited southeast of the Hanford 200 West Area
- Two square miles are required for future expansion
- 55 personnel to operate the facility
- Existing Hanford site-wide services will be used
- Seven waste types identified
- No liquid wastes to be disposed at the ERSDF
- Hanford Barrier will be used as a final cap.

2.4.3 Waste Disposal Design Criteria

The waste disposal requirements cited in the FDC are:

- DOE Order 5820.2A, *Radioactive Waste Management*, provides design objectives to assure protection of the public and operating personnel.
- DOE Order 6430.1A, *General Design Criteria (GDC)*, document is arranged in the Construction Specificiations Institute (CSI) format and is applicable to all facilities except the disposal cells.
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, document specifies radiation dose limits and monitoring requirements.
- DOE Order 5480.11, *Radiation Protection for Occupational Workers*, Section 9 provides design guidelines to establish radiation protection standards and program requirements for the DOE and contractors with respect to worker protection.
- DOE-RL Order 5440.1A, *Implementation of the National Environmental Policy Act at the Richland Operations Office*, this is the precursor to an environmental impact statement.
- DOE-RL Order 5480.1A, *Environmental Safety and Health Program for Department of Energy for Richland Operations*, explanation of administration and implementation of large scale projects at the Hanford Site.
- WHC-CM-4-9, *Radiological Design*, all sections of this document are applicable. They establish safety requirements and standards for protection equipment and design for protection from radiological hazards at the support facilities and the waste handling facilities.
- WHC-CM-1-6, *WHC Radiological Control Manual*, Chapters 3 and 4 establish requirements for radiation barriers, entry controls, contamination controls, waste minimization, radioactive drains, and air-borne radioactivity areas.
- WHC-CM-4-11, *As Low As Reasonably Achievable (ALARA) Program Manual*, provides protection principles and a checklist.
- WHC-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*, this is not applicable to ERSDF design. Waste acceptance criteria for the facility is to be completed by WHC and incorporated into design.
- 29 CFR 1910, *Occupational Safety and Health Act (OSHA)*, specifically Section 1910.96 references; ionization radiation, signage, exposure limits, worker training, and record-keeping requirements.
- WAC 173-303, *Dangerous Waste Regulations*, this regulation designates solid wastes that are hazardous to public health and the environment and stipulates site design and operational guidance.

2.4.4 Environmental Restoration Storage and Disposal Facility Design Criteria

The FDC indicates that the general design of the ERSDF must use information contained in *Hanford Plant Standard Design Criteria (SDC) 5.1* The section referenced is the chapter on heating, ventilating and air conditioning. The entire manual, however, is applicable to design of facilities at Hanford and will be used as a key reference during design and planning activities.

2.4.4.1 Heating, Ventilation, and Air Conditioning. Design criteria is established in the DOE Order 6430.1A, *General Design Criteria* in Division 15, Mechanical Subsection 1550. Also applicable are the guidelines listed in SDC Section 5.1 HVAC.

2.4.4.2 Utilities (Department of Energy Order 6430.1A, General Design Criteria). The following sections are relevant:

Item	Section
Service and potable water design criteria	0260
Piped utility material	0262
Corrosion control	0266
Plumbing and service piping	1540
Electrical criteria	0278
Power and lighting (Division 16)	1630
Communications system (also DOE Order 5632.6, Physical protection of DOE property and unclassified property)	1630-1699.8
Sanitary and process sewer	0270
Water pollution controls	0273

2.4.4.3 Site Preparation. DOE Order 6430.1A, Section 0202, covers survey control, and 40 CFR 264.309 covers surveying and recordkeeping requirements for landfills.

2.4.4.4 Energy Conservation. DOE Order 6430.1A Section 110-12 provides guidance on life-cycle costing as a part of energy-conservation design. This section also cross references American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), Standard 90 specification.

2.4.4.5 Maintenance and Repair Facilities. WHC-CM-4-10, *Radiation Protection,* Section 11, Part 4.4.4, provides requirements for regulated vehicles and equipment.

2.4.4.6 Communications Systems. Communications systems are covered in DOE Order 6430.1A, Sections 1660, 1671, 1655 and 1694. Nonuniform lighting must follow the requirements of 41 CFR 101-20.116-2.

2.4.4.7 Fire Protection. Fire Protection issues are covered in the following documents:

- DOE Order 6430.1A, Sections 02060-2 and 0266-4
- DOE Order 5480.4A, references:
  - National Fire Protection Association (NFPA), *Handbook of Fire Protection*
  - Loss Prevention Data Sheets
  - RP-1 U.S. Department of Commerce, National Fire and Prevention Control Administration, 8-78, *Standard Practice for the Fire Protection of Essential Electronic Equipment Operations.*
- DOE Order 5480.7A, *Fire Protection Program Direction*

- WHC-CM-4-41, *Fire Protection Program Manual*
- *Hanford Plant Standards, Standard Design Criteria*, Section 7.8 "Fire Alarm Systems"
- WAC 173-303 *Dangerous Waste Regulations*, Sections 630 and 640
- *Uniform Fire Code*, to the extent implemented by WAC 173-303
- WAC 248-54-285, *Backflow Prevention, Public Water Supplies, and Cross Connection*. More criteria on cross connection is included in WAC 246-290-490
- NFPA 101 *Life Safety Code*, 13 Installation of Sprinkler Facilities, 801 Facilities Handling Radioactive Materials.

2.4.4.8 Support Facilities. Support facilities are to be constructed in accordance with the *Uniform Building Code* (UBC) and *American National Standards Institute* (ANSI) A117.1.

2.4.4.9 Railroad Requirements. Railway system and components are to be constructed in accordance with the *American Railroad Engineers Association* (AREA) *Manual for Railway Engineering*, and Federal Railroad Association, *Track Safety Standards*.

2.4.5 General Requirements

These references deal with all environmental standards applicable to low-level radioactive and mixed waste disposal facilities.

- Safety is addressed in DOE Order 6430.1, Division 13 (maximum safety class III), and WHC-CM-1-3, Sections 5.5, 5.7, 5.12, 5.23, 5.5.37, 5.38, and 5.46
- Traffic safety must comply with ANSI D6.1
- Environmental protection in accordance with the ALARA Manual, DOE Order 5400.1, *General Environmental Protection Program*, DOE-RL Order 5440.1A, *Implementation of the National Environmental Policy Act at the Richland Operations Office*, and DOE Order 5480.4, *Environmental Safety and Health Protection Standards*
- Liquid effluents treatment system is in accordance with DOE Order 6430.1A, Section 0237-3 and 0270
- Airborne emissions are covered in WHC-CM-7-5 *Environmental Compliance*, Section 2.0, Air Quality, and Section 7.0, Solid Waste Management
- Construction is also covered in WHC-CM-7-5 *Environmental Compliance*, Section 2.0, Air Quality
- Noise is covered in 29 CFR 1910.95 "Occupational Noise Exposure"
- Exposure to chemicals would be covered under 29 CFR 1910 Subpart Z
- Security is governed under DOE Order 6430.1A, *General Design Criteria*, Section 0110, for access control; Section 0800, for doors and windows; Section 1640, for interior electrical and Section 1615 for lighting. The Life Safety Code of NFPA 101, addresses emergency exit lighting. DOE Order 5632.6, *Physical Protection of DOE*

Property and Unclassified Facilities, provides requirements for protection of DOE property

- Drawing requirement standards are addressed in Hanford Plant SDC 1.3
- Quality assurance and quality control are referenced in DOE Order 5700.6C, *Quality Assurance*, and EPA/530-SW-86-031, *Construction Quality Assurance for Land Disposal Facilities*
- There are no specific orders to govern decontamination and decommissioning. The FDC itself provides design considerations
- Natural forces criteria is governed by Hanford Plant SDC 4.1, "Design Loads for Facilities"
- Automatic data processing is covered in 40 CFR 264.309 "Surveying and Recordkeeping".

2.5 MATERIAL BALANCE EVALUATION (APPENDIX E)

2.5.1 Summary and Conclusions

A total of 34 million yd^3 of materials will be excavated during the development of the disposal cells for the ERSDF. Of this total amount there will be about 7.5 million yd^3 of materials that can be used for cover, filter materials, and other uses in the ERSDF. This will create a total of 18.9 million yd^3 of sand that will be available for other uses. Due to the natural gradation of the native material, an additional 7.5 million yd^3 of material will be required in the 2-inch or greater size range, unless the 1 to 2-inch material specified for the capillary break material, drainage and filter materials can be modified. If this modification is appropriate, then the required imported amount can be reduced by 1.9 million yd^3 with corresponding reduction of the material available for other uses. The excess material would most economically be disposed of at the remediation areas and used for recontouring.

2.5.2 Introduction and Background

This TM evaluates the balance between material excavated from the disposal cells at the ERSDF and requirements for the use of this material.

The general gradation of the material that is to be excavated was evaluated from limited soils boring data. It was determined that the northern portion of the ERSDF site is overlain with roughly 20 feet of a gravelly soil. The remainder of the ERSDF area is underlain by a sandy sequence of the Hanford Formation.

The total amount of disposal cell excavation will be approximately 34 million yd^3. Certain excavated materials will be required for construction of the disposal cells such as filter rock, under drain, cover and lining material. The type of material expected from the disposal cell excavation will provide approximately 15.1 million yd^3 of materials that will be reusable at the ERSDF while another 18.9 million yd^3 of materials will be available for other uses. A summary of the materials derived from the excavation of the ERSDF disposal cells is as follows:

Size	Quantity From Excavation (Million yd^3)
2-inch plus	1.5
1-inch to 2-inch	1.9
1-inch to U.S. #10 Sieve	4.4
Less than U.S. #10 Sieve	1.4
Unprocessed Sand	24.8
Silt	0
Silt/Pea Gravel Admix	0

2.5.3 Material Balance Per Linear Foot of Excavation

The gravel portion of the disposal cell excavation will yield roughly 187 yd^3 of gravel and 88 yd^3 of sand per each linear foot of excavation. The sand sequence area will yield 274 yd^3 of sandy soils per linear foot of excavation.

Useful materials for construction of the ERSDF trenches follow the following distribution and requirements:

Size	Quantity Required for Construction (Million yd^3)
2-inch plus	9.0
1-inch to 2-inch	0.0
1-inch to U.S. #10 Sieve	6.8
Less than U.S. #10 Sieve	1.4
Unprocessed sand	7.8
Silt	5.9
Silt/Pea Gravel admix	5.9

It would not be economical to screen the ERSDF for material less than the U.S. #10 sieve since the naturally occurring quantities of this material are insignificant.

Since there are 1.9 million yd^3 of material available in the 1 to 2-inch range in lieu of the 2-inch for the capillary break material, this could reduce the amount required from another source by 1.9 million yd^3. However, more study into this possibility is necessary before this recommendation can be adopted.

2.5.4 Site Wide Material Balance

The amount of ERSDF disposal cell excavation is estimated at a total of 125,000 feet. This will yield about 275 yd^3 per linear foot of disposal cell. Based on the utilization of excavated material which is within the specifications of disposal cell requirements, the amount of excavated material that be available for other uses is estimated to be 18.9 million yd^3 unless the 1.9 million yd^3 of material can be used for the capillary break material.

Since the specified requirements for the construction of the ERSDF disposal cells can not be met from the excavated material, there will be a requirement of 21.7 million yd^3 of imported material. The quantities and type of materials required are as follows:

Size	Additional Quantities Required for Construction (Million yd^3)
• 2-inch plus	7.5
• 1-inch to U.S. #10 Sieve	2.4
• Silt	5.9
• Silt/Pea Gravel admix	5.9

2.5.5 Disposal of Excess Soil

Two options were evaluated for the disposal of the excess material. The first option would be to dispose of the material on the southern portion of the ERSDF site. The topography would allow this with an increase of 10 feet at the southern end of the site. The second option would be to back haul the soils from the ERSDF to the areas under remediation. The soils could then be used for recontouring these areas.

The unit costs were evaluated and it was determined that the cost of back hauling to the remediation sites would be about \$4.99 per yd^3 and the cost, for placing on the southern side of the ERSDF and excavating fill material near the remediation site, would be about \$5.15 per yd^3. Although the cost for back hauling this material to the remediation area is slightly less expensive, the uncertainties in the estimates are enough to offset this. Therefore, the selection between options should be made on other factors.

2.6 SITE CAPABILITY ASSESSMENT (APPENDIX F)

The existing facilities and operations at the Hanford site were surveyed to determine what future ERSDF functions could be provided by existing services. This survey was conducted by written requests to the relevant department heads. Of the organizations surveyed, only the following indicated that they had capacity to provide services to the ERSDF:

- Fire Protection
- Industrial Safety and Hygiene
- Security.

REFERENCES

29 CFR 1910, 7/1/91, *Occupational Safety and Health Act* (OSHA)

40 CFR 260-270, 7/1/92, *Resource Conservation and Recovery Act*

40 CFR Part I, 7/1/92, *Safe Drinking Water Act*

COE, 7/12/93, *Engineering Study for the Trench and Engineered Barrier Configuration for the Environmental Restoration Storage and Disposal Facility*, DOE/RL/12074--13 Rev. 0., U.S. Army Corps of Engineers, Walla Walla, Washington

COE, 7/13/93, *On-Site Transportation Network Engineering Study for the Environmental Restoration Storage and Disposal Facility*, DOE/RL/12074-12 Rev. 0., U.S. Army Corps of Engineers, Walla Walla, Washington

COE, 7/23/93, *Engineering Study for the Decontamination and Wastewater Treatment Facility for the Environmental Restoration Storage and Disposal Facility*, DOE/RL/12074--10 Rev. 0., U.S. Army Corps of Engineers, Walla Walla, Washington

COE, 7/29/93, *Engineering Study for the Volume Reduction System Dewatering and Stabilization System for the Environmental Restoration Storage and Disposal Facility*, DOE/RL/12074--11 Rev. 0., U. S. Army Corps of Engineers, Walla Walla, Washington

DOE Order 5400.1, 7/30/90, *General Environmental Protection Program*

DOE Order 5400.5, Revision 1, 6/5/90, *Radiation Protection of the Public and the Environment*

DOE Order 5400.7A, 2/17/93,*Fire Protection*

DOE Order 5480.11, Revision 3, 6/17/92, *Radiation Protection for Occupational Workers*, 12/21/88

DOE Order 5480.23, 4/30/92, *Nuclear Safety Analysis Reports*

DOE Order 5480.4, 5/15/84, *Environmental Protection, Safety and Health Protection Standards*

DOE Order 5632.6, 2/9/88, *Physical Protection of DOE Property and Unclassified Facilities*

DOE Order 5700.6C, 8/21/92, *Quality Assurance*

DOE Order 5820.2A, 9/26/93, *Radioactive Waste Management*

DOE Order 6430.1A, 4/6/89, *General Design Criteria*

DOE-RL Order 5440.1A, 2/3/87, *Implementation of the National Environmental Policy Act at the Richland Operations Office*

DOE-RL Order 5480.4A, 9/7/88,*Environmental Safety and Health Program for Department of Energy Operations for Richland Operations*

DOE-RL Order 6430.1C, 3/5/90, *Hanford Plant Standards*

EPA/530-86-031, 7/1/86, *Construction Quality Assurance For Land Disposal Facilities*

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Means, R. S., 1992, *Means 1993 Site Work and Landscape Cost Data*, R.S. Means Company, Inc., Kingston, Massachusetts

USGS, Gable Butte Quadrangle, Washington State Benton County, 7.5 Minute Series Topographic, United State Geological Survey, Denver, Colorado.

WAC 173-303, 4/1/91, *Dangerous Waste Regulations*

WAC 173-480, 5/7/86, *Ambient Air Quality Standards and Emissions Limits for Radionuclides*

WAC 246-290-490,1/31/92, *Cross Connection Control*

WHC-CM-1-3, 1/31/89, *Management Requirements and Procedures*

WHC-CM-4-10, 1/21/91, *Radiation Protection*

WHC-CM-4-11, 4/20/92, *ALARA Program Manual*

WHC-CM-4-2,1/21/91, *Quality Assurance Manual*

WHC-CM-4-3, 1/21/93, *Industrial Safety Manual Safely Standards*

WHC-CM-4-41, 9/7/92,*Fire Protection Program Manual*

WHC-CM-4-46, 1/21/91,*Non-Reactor Facility Safety Analysis Manual*

WHC-CM-4-9, 9/15/93, *Radiological Design*

WIPP/DOE - 069, Revision 4, UC-70, 12/91, *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*

APPENDICES

APPENDIX A

BATCH PLANT SIZING TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM
BATCH PLANT SIZING
FOR THE HANFORD ENVIRONMENTAL RESTORATION
AND STORAGE DISPOSAL FACILITY

1.0 SUMMARY AND CONCLUSIONS

A batch plant will be provided as part of the Environmental Restoration and Storage Disposal Facility (ERSDF), to supply grout to fill voids left during the burial of large metal objects (e.g., pipe). Based on the currently expected waste characteristics, the plant should be sized to produce a maximum of 140 cubic yards (yd^3) of grout per day, and to turn down to a minimum capacity of 30 yd^3 per day. The batch plant will utilize between 2,000 and 10,000 gallons per day (gpd) of water.

2.0 INTRODUCTION AND BACKGROUND

This TM is prepared as one of the appendices for the conceptual level Design Memorandum (DM) for the ERSDF for the Hanford site. Additional background information for this project is presented in the introduction to the DM.

2.1 PURPOSE OF TM

The purpose of this TM is to assess the volume and anticipated receipt date of waste that may require stabilization by in-place grouting during disposal at the ERSDF. Based on this information, a tentative size is selected for a waste stabilization batch plant.

2.2 BACKGROUND

The majority of the wastes expected at the ERSDF consist of bulk soils that can be placed and compacted to adequately support an appropriate final cover, such as the Hanford Barrier. However, the burial of metals wastes, wastes from demolition and decommissioning (D&D) actions, and wastes removed from existing burial grounds may leave voids in the final landfill. Eventual migration or collapse of soil into these voids could result in long-term subsidence or differential settlement that may threaten the integrity of the final cover.

Several alternatives are available for dealing with this subsidence problem. The waste can be compressed or crushed to eliminate voids. The waste can be cut up, chopped, or reduced in size by some other means, so that it can be placed and compacted without significant voids. Size-reduced waste can be blended with a mixture of soil and cement, which then sets up after placement to form a rigid matrix. Another method for preventing this subsidence is to fill the voids in the landfill with a grout, after placement of the waste. This is the method to be implemented at the ERSDF, in part because it avoids the need to size-reduce the waste. Size reduction may be difficult to achieve due to safety, operational, and maintenance concerns.

It should be noted that some of the wastes from D&D and existing burial grounds may consist of wood, paper, or other materials that will eventually biodegrade. The low moisture level in the ERSDF will retard this degradation, but it may be very difficult to demonstrate that it will not happen within the indefinite design life of the ERSDF. Grouting is not as effective for prevention of the subsidence that results from biodegradation as compared to burial of metals. If the grout is structurally strong, and completely surrounds the biodegradable object (so that it prevents soil from migrating into the future void), it may stand without subsidence. This type of structural integrity will be difficult to assure using in-place grouting. It may be possible to achieve if the waste can be reduced in sized (chopped or crushed), and then blended with the proper proportion of grout or concrete prior to placement. However, this type of grouting operation is assumed to be not acceptable for use at the ERSDF. Instead, such biodegradable wastes are assumed to be packaged at the source in non-reusable containers, and grouted in the container (if necessary), at the source.

3.0 DATA AND ASSUMPTIONS

The projected waste volumes and character for the ERSDF, as well as the schedule for delivery, are presented in detail in the *On-Site Transportation Network Engineering Study Report for the ERSDF* (DOE/RL/12074--12 Rev. 0), and are not repeated here. The summary presented in Table A-1 lists the projections for waste types that may require stabilization, during the first five years of ERSDF operation.

The following assumptions were used in the development of this TM:

- It is assumed that stabilization for waste in non-reusable containers will be performed at the source, and not at the ERSDF. Therefore, the ERSDF batch plant will handle only wastes that are to be placed in bulk.
- It is assumed that size-reduction, crushing, or other waste form modification (i.e. treatment) will not be performed at the ERSDF.
- It is assumed that grouting will be accomplished with a flowable, Portland cement grout. For the purposes of this initial estimate of grout quantities, the following mix design is proposed on the basis of typical practice for high-strength grout:
  - Aggregate is sand, with a weight of approximately 150 pounds per cubic foot (lbs/ft^3)
  - Cement content is 1,000 pounds per yd^3 (lbs/yd^3)
  - Water/cement ratio is 0.6, on a weight basis.

These proportions can be changed to suit site conditions, with some potential for savings on cement and water. It may be possible to utilize fly ash in the mix, in place of part of the cement, to yield the same mix consistency with reduced strength and greatly reduced cost. If suitable fly ash is not available, an alternative fine-grained material may serve, although with greater loss of strength. The water content of the mix may be reduced using a water-reducing agent, although at considerable cost. This approach will provide the required flowable consistency while minimizing the amount of water used in the mix. This will reduce the already small chance that all the water will not be permanently bound in the grout. Excess water may be seen to be a possible cause of percolation transport of the buried waste. These mix design issues can be dealt with at a later stage

Table A-1. ERSDF Waste Volume Summary (Volumes in Cubic Yards)

Waste Form	Waste Type	Total Volume per Year					Five Year
		1997	1998	1999	2000	2001	Total
Overburden	Low-Act/ Rad	123300	345180	437950	500740	568850	1976020
	TRU	130	340	430	500	570	1970
	Other Types	520	1380	1760	1980	2300	7940
Soil	Low-Act/ Rad	92420	502590	567970	620480	645470	2428930
	TRU	490	2630	5280	3430	3940	15770
	Other Types	3860	21040	28410	26350	28160	107820
Metals	Low-Act/ Rad	10940	51040	52260	50550	47090	211880
	High-Act/ Rad	50	270	290	270	260	1140
	Dangerous/Low-Act	220	1090	1120	1070	1020	4520
	Dangerous/High-Act	50	270	290	270	260	1140
	TRU	50	270	290	270	260	1140
	Dangerous/Non-Rad	130	540	540	550	510	2270
	Non Danger/Non-Rad	220	1090	1120	1070	1020	4520
Buried Waste	Low-Act/ Rad	8060	35870	36770	35010	33250	148960
	High-Act/ Rad	590	2590	2660	2540	2400	10780
	Dangerous/Low-Act	1180	5220	5340	5080	4820	21640
	Dangerous/High-Act	590	2590	2660	2540	2400	10780
	TRU	130	520	540	510	480	2180
	Dangerous/Non-Rad	580	2590	2660	2540	2400	10770
	Non Danger/Non-Rad	580	2590	2660	2540	2400	10770
Demolition	Low-Act/ Rad	12540	57060	58460	56100	52780	236940
	High-Act/ Rad	70	320	340	320	300	1350
	Dangerous/Low-Act	60	320	350	340	320	1390
	Dangerous/High-Act	70	320	340	320	300	1350
	TRU	70	320	340	320	300	1350
	Dangerous/Non-Rad	160	640	670	640	590	2700
	Non Danger/Non-Rad	1440	6560	6720	6450	6070	27240
							0
Decommissioning	Low-Act/ Rad	330	3660	3680	3640	3890	15200
	High-Act/ Rad	40	110	110	190	190	640
	Dangerous/Low-Act	20	20	20	20	20	100
	Dangerous/High-Act	20	10	20	0	0	50
	TRU	190	210	550	310	120	1380
	Dangerous/Non-Rad	40	30	30	20	20	140
	Non Danger/Non-Rad	0	0	0	0	0	0
		259140	1049280	1222630	1326960	1412760	5270770

of design development. They need not be finalized now because they do not have as much impact on the quantities of materials used in comparison to the possible variations in waste character and void space.

4.0 ALTERNATIVES

4.1 ALTERNATIVES IDENTIFICATION AND DEVELOPMENT

Two main alternatives have been identified for in-place grouting of subsidable ERSDF wastes, including:

- A non-contaminated batch plant, utilizing clean water and sand.
- A contaminated batch plant for production of grout using water and derived from the decontamination facility or Volume Reduction System (VRS) stabilization facility, along with contaminated (low-level, low-activity, radiation only) waste sandy soil.

A non-contaminated batch plant could be assembled in an uncontaminated area in the ERSDF, close to railroad or roadway access for cement and sand supply. Along with appropriate measuring and mixing equipment, the plant would include storage (bins, stockpiles, tanks, etc.) for cement and admixtures, as well as for aggregate (sand) and water. Grout prepared in the plant would be loaded onto mixer trucks, and trucked to the grouting site, where a mobile grout pumping system would accomplish the actual grouting operation.

A contaminated batch plant would include the same type of mixing and measuring equipment, mounted on a mobile base. It could be moved out close to the point of grout application, within the contaminated area of the disposal cells, where local sandy soil or incoming waste could be used for aggregate. The required water would be drawn from the waste stream from the decontamination system, thus converting a troublesome waste material to a useful raw material substitute.

4.2 ALTERNATIVES EVALUATION

Working with a non-contaminated batch plant would minimize health and safety requirements, and avoid the need to eventually decontaminate or dispose of the entire batch plant. However, neither of these concerns is expected to dominate the decision. A contaminated batch plant offers the distinct advantage of disposing of some quantity of decontamination wastewater. If this capacity is significant in comparison to the amount of decontamination wastewater produced, it may be the deciding factor. In addition, a mobile batch plant would place the production of the grout close to the point of use, and minimize the investment in permanent material storage facilities.

As noted above, the water use rate is an important factor in selecting the batch plant concept, as also in the volume of grout to be produced. An estimate has been made of expected grout usage based on the waste volume projections summarized in Table A-2, in combination with other estimates and assumptions. First, an estimate has been made of the amount of subsidable waste that will be received, within each of the waste categories listed on Table A-2. As seen on Table A-3, the large soil and overburden waste streams are assumed to include no significant amounts of subsidable material. On the other hand, the metals and buried wastes are expected to

Table A-2. ERSDF Grout Volume Estimate (Volume in Cubic Yards)

Waste Form	Waste Type		Grout Volume By Year					Five Year
			1997	1998	1999	2000	2001	Total
Overburden	Low-Act/ Rad		0.0	0.0	0.0	0.0	0.0	0.0
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Other Types		0.0	0.0	0.0	0.0	0.0	0.0
Soil	Low-Act/ Rad		0.0	0.0	0.0	0.0	0.0	0.0
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Other Types		0.0	0.0	0.0	0.0	0.0	0.0
Metals	Low-Act/ Rad		3063.2	14291.2	14632.8	14154.0	13185.2	59326.4
	High-Act/ Rad		14.0	75.6	81.2	75.6	72.8	319.2
	Dangerous/Low-Act		61.6	305.2	313.6	299.6	285.6	1265.6
	Dangerous/High-Act		14.0	75.6	81.2	75.6	72.8	319.2
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Dangerous/Non-Rad		36.4	151.2	151.2	154.0	142.8	635.6
	Non Danger/Non-Rad		61.6	305.2	313.6	299.6	285.6	1265.6
Buried Waste	Low-Act/ Rad		2256.8	10043.6	10295.6	9802.8	9310.0	41708.8
	High-Act/ Rad		165.2	725.2	744.8	711.2	672.0	3018.4
	Dangerous/Low-Act		330.4	1461.6	1495.2	1422.4	1349.6	6059.2
	Dangerous/High-Act		165.2	725.2	744.8	711.2	672.0	3018.4
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Dangerous/Non-Rad		162.4	725.2	744.8	711.2	672.0	3015.6
	Non Danger/Non-Rad		162.4	725.2	744.8	711.2	672.0	3015.6
Demolition	Low-Act/ Rad		1003.2	4564.8	4676.8	4488.0	4222.4	18955.2
	High-Act/ Rad		5.6	25.6	27.2	25.6	24.0	108.0
	Dangerous/Low-Act		4.8	25.6	28.0	27.2	25.6	111.2
	Dangerous/High-Act		5.6	25.6	27.2	25.6	24.0	108.0
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Dangerous/Non-Rad		12.8	51.2	53.6	51.2	47.2	216.0
	Non Danger/Non-Rad		115.2	524.8	537.6	516.0	485.6	2179.2
Decommissioning	Low-Act/ Rad		26.4	292.8	294.4	291.2	311.2	1216.0
	High-Act/ Rad		3.2	8.8	8.8	15.2	15.2	51.2
	Dangerous/Low-Act		1.6	1.6	1.6	1.6	1.6	8.0
	Dangerous/High-Act		1.6	0.8	1.6	0.0	0.0	4.0
	TRU		0.0	0.0	0.0	0.0	0.0	0.0
	Dangerous/Non-Rad		3.2	2.4	2.4	1.6	1.6	11.2
	Non Danger/Non-Rad		0.0	0.0	0.0	0.0	0.0	0.0
			7676.4	35134.0	36002.8	34571.6	32550.8	145935.6
		Tons Cement =	3838	17567	18001	17286	16275	72968
		lb/d Cement =	21031	96258	98636	94718	89178	79965
		lb/d Water =	12619	57755	59183	56830	53508	47979
		gpd Water =	1513	6925	7096	6814	6416	5753

Table A-3. ERSDF Subsidable Waste Volume Estimate (Volume in Cubic Yards)

Waste Form	Waste Type	Percent Subsidable	Subsidable Waste Volume	Subsidable Waste Void Space	Subsidable Waste Grout Volume	Grout Cement tons	Grout Water gallons
			Total				
Overburden	Low-Act/ Rad	0%	0.0	0.3	0.0	0.0	0.0
	TRU	0%	0.0	0.3	0.0	0.0	0.0
	Other Types	0%	0.0	0.3	0.0	0.0	0.0
Soil	Low-Act/ Rad	0%	0.0	0.3	0.0	0.0	0.0
	TRU	0%	0.0	0.3	0.0	0.0	0.0
	Other Types	0%	0.0	0.3	0.0	0.0	0.0
Metals	Low-Act/ Rad	70%	148316.0	0.4	59326.4	0.0	0.0
	High-Act/ Rad	70%	798.0	0.4	319.2	0.0	0.0
	Dangerous/Low-Act	70%	3164.0	0.4	1265.6	0.0	0.0
	Dangerous/High-Act	70%	798.0	0.4	319.2	0.0	0.0
	TRU	0%	0.0	0.4	0.0	0.0	0.0
	Dangerous/Non-Rad	70%	1589.0	0.4	635.6	0.0	0.0
	Non Danger/Non-Rad	70%	3164.0	0.4	1265.6	0.0	0.0
Buried Waste	Low-Act/ Rad	70%	104272.0	0.4	41708.8	0.0	0.0
	High-Act/ Rad	70%	7546.0	0.4	3018.4	0.0	0.0
	Dangerous/Low-Act	70%	15148.0	0.4	6059.2	0.0	0.0
	Dangerous/High-Act	70%	7546.0	0.4	3018.4	0.0	0.0
	TRU	0%	0.0	0.4	0.0	0.0	0.0
	Dangerous/Non-Rad	70%	7539.0	0.4	3015.6	0.0	0.0
	Non Danger/Non-Rad	70%	7539.0	0.4	3015.6	0.0	0.0
Demolition	Low-Act/ Rad	20%	47388.0	0.4	18955.2	0.0	0.0
	High-Act/ Rad	20%	270.0	0.4	108.0	0.0	0.0
	Dangerous/Low-Act	20%	278.0	0.4	111.2	0.0	0.0
	Dangerous/High-Act	20%	270.0	0.4	108.0	0.0	0.0
	TRU	0%	0.0	0.4	0.0	0.0	0.0
	Dangerous/Non-Rad	20%	540.0	0.4	216.0	0.0	0.0
	Non Danger/Non-Rad	20%	5448.0	0.4	2179.2	0.0	0.0
Decommissioning	Low-Act/ Rad	20%	3040.0	0.4	1216.0	0.0	0.0
	High-Act/ Rad	20%	128.0	0.4	51.2	0.0	0.0
	Dangerous/Low-Act	20%	20.0	0.4	8.0	0.0	0.0
	Dangerous/High-Act	20%	10.0	0.4	4.0	0.0	0.0
	TRU	0%	0.0	0.4	0.0	0.0	0.0
	Dangerous/Non-Rad	20%	28.0	0.4	11.2	0.0	0.0
	Non Danger/Non-Rad	20%	0.0	0.4	0.0	0.0	0.0
			364839.0		145935.6	0.0	0.0
			Notes:	Tons Cement per cubic yard = 0.5			
				Water/Cement Ratio = 0.6			

be predominantly subsidable, while decontamination and D&D wastes will include a smaller subsidable component.

Historical records for 105-B burial ground were inspected to determine the nature of the wastes buried in trenches at this site. This waste is considered to be comparable to the metals waste classification, as well as to the buried waste stream noted on Tables A-2 and A-3. The historical records indicated burial of the following materials:

- High-void wastes: Pipes, process tube sections, perforated aluminum pipe or tube, and complex equipment,
- Lower-void wastes: lead bricks, steel plate, concrete block, horizontal control rods (HCRs), Vertical Safety Rods (VSRs), and solid aluminum,
- Potentially biodegradable waste: Trash, paper, wood, and rope,
- Backfill materials and contaminated soil, with low subsidence potential.

High-void waste includes materials that cannot be buried without leaving void spaces, generally inside of pipes. Lower-void materials could theoretically be buried with lower-void volumes, but only if particular care is taken to stack the material neatly. However, in practice, the void volume may be nearly the same as for the first group of materials. The records for 105-B burial ground indicated that 50 to 60 percent of the wastes buried were high-void types, while another 10 to 20 percent were the low-void type. For the purposes of this TM, these wastes are estimated to make up a combined total of 70 percent of the material in the metals and buried waste categories, and they are assumed to exhibit a void capacity of 40 percent. The D&D waste is presumed to contain a larger volume of soil and other non-subsidable materials, so the net subsidable fraction is about 20 percent. These percentages are listed on Table A-3, which also provides the total volumes of subsidable wastes expected for the first five years of ERSDF operation. Table A-1 then provides the volumes of grout needed to fill the voids in the subsidable wastes on a yearly basis between 1997 and 2001.

The remaining 30 percent of the "buried wastes" and "metals" consist of small objects that can be buried without significant voids, and biodegradable wastes. Biodegradable wastes buried at the 105-B burial ground include wood (e.g. "wooden dummies"), paper, trash, and rope. These materials make up 10 to 25 percent of the waste, with the remainder (about 10 percent) being soil, (particularly for the burial ground wastes). While the biodegradable wastes could possibly pose a subsidence problem in the distant future, they are not assumed to require any grout during placement.

Using the grout mix design proposed in section 3.0, Table A-2 and Table A-3 present estimates of the amount of cement and water that will be required for the grout plant. Within the accuracy of this memo, the amount of sand (aggregate) needed for the grout will be essentially the same as the volume of grout. As seen on the table, the grout demand will vary between 7,700 yd^3 per year and 36,000 yd^3 per year. If it assumed that the grout plant only operates 5 days per week to allow for maintenance downtime, relocation, and other non-productive time, these demands correspond to a minimum of 40 yd^3 and a maximum of 140 yd^3 per day of grout production. This is the projected batch plant size.

If the batch plant is built and operated to produce 40 to 140 yd^3 of grout per day, it will demand between 2,000 and 10,000 gpd of water. This represents a significant water demand, and may provide a valuable means of disposal for decontamination water, if acceptable or required.

5.0 FINDINGS AND RECOMMENDATIONS

The following conclusions can be drawn from this TM:

1. An inspection of historical records from the 105-B burial ground indicated that about 70 percent of the metals and burial ground wastes would leave voids (estimated at 40 percent) when buried at the ERSDF.

2. Based on the current estimate of ERSDF waste volumes, along with several assumptions regarding void volumes and grout mix design, the required grout, cement, and water quantities for the ERSDF are estimated and presented in Table A-2 and Table A-3.

3. Assuming that the batch plant operates 5 days per week on the average, the grout demand can be met with a production rate that ranges between 40 and 140 yd^3 per day.

4. The water required for preparation of grout will be between 2,000 and 10,000 gpd, also based on a 5 day week.

5. It is recommended that work be done to review and improve the waste volume estimates, when additional data becomes available. This may not occur until the early phases of operation.

6. It is recommended that the assumed grout mix design described above be optimized to meet the needs of the ERSDF site. Consideration should be given to the use of fly ash or chemical additives.

7. It is recommended that the "contaminated" batch plant concept be selected for further design development, largely because this type of system will facilitate disposal of significant quantities of decontamination water.

8. A search should be initiated to locate several local sources of aggregate (sand) to be used for grouting.

APPENDIX B

AUTOMATION STRATEGY DEVELOPMENT TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM AUTOMATION STRATEGY DEVELOPMENT FOR THE HANFORD ENVIRONMENTAL RESTORATION AND STORAGE DISPOSAL FACILITY

1.0 SUMMARY AND CONCLUSIONS

The automation strategy for the ERSDF calls for utilizing appropriate instrumentation and computer equipment to perform the following functions:

- Weighing, logging, and tracking of incoming waste
- Centralized monitoring and control of site specific operational, maintenance, utility and energy management, and other production related functions.
- Historical data and records storage (database)
- Air emissions and environmental monitoring
- Decontamination and radiological survey of equipment (vehicles and containers)
- Site security, safety, fire alarm systems, and other site communications.

The automation strategy utilizes electronic tagging and vehicle-mounted load cells to provide a highly-automated system for waste weighing, logging, and tracking. A computerized control system will be provided to allow centralized control and monitoring of most site production activities in addition to waste tracking and logging. Production activities will include utility and energy management, personnel utilization, maintenance management, fuel usage, and other production activities related to safe and efficient operation.

A computerized database will be used to provide reliable and consistent data management, storage and retrieval. Some Graphic Information System (GIS) capability will be provided for data reporting and analysis, but not in a real-time mode. Automatic sample collection equipment will be used for environmental monitoring whenever it provides a more accurate and complete sample, but manual sampling will also be used where appropriate. Most monitoring results will be entered into the database manually (or by batch electronic files transfer) from laboratories, but fully automatic monitoring is recommended for quick-response parameters (e.g., weather data). Additionally, when manual data entry is necessary, means should be provided to allow the technicians responsible for reading and analyzing the data to immediately and directly enter the data into the electronic format. Decontamination and radiation survey functions will be automated as much as reasonably practical based on commercially available equipment. The site communications system will provide for digital data transfer and centralized control of radio communications.

2.0 INTRODUCTION AND BACKGROUND

The purpose of this TM is to evaluate various automation strategies to optimize the waste handling, equipment decontamination, and other functions at the facility. This includes a qualitative evaluation of alternatives for automation in the waste receiving and measuring area (waste data acquisition), as well as automation of decontamination activities. Note that the evaluation of possible remote operation of waste placement equipment is excluded from the scope of this TM, as it will be addressed in a separate later study.

At the same time this TM is being prepared for the ERSDF, a conceptual design is being developed by WHC for a Data Acquisition System (DAS) to manage the waste site characterization system for the "Large Scale" remediation program at Hanford. The data collection and record storage and retrieval system for the ERSDF must be functionally compatible with the waste site characterization system and the data management requirements of the Solid Waste Information Tracking System (SWITS).

3.0 AUTOMATION GOALS

The use of automatic control systems (in place of manual methods) offer the opportunity to achieve a number of different goals that may or may not be appropriate for the Hanford ERSDF, including:

- increased safety,
- more complete and consistent documentation,
- increased productivity (throughput),
- energy conservation,
- minimize operations personnel for cost and safety reasons,
- increased reliability,
- reduced cost.

In view of the sometimes unavoidable health and safety risks inherent in remediation of radioactive and other hazardous waste, an exceptionally high priority is placed on safety at the ERSDF. Thus, automation systems that reduce risk to site workers are considered valuable for this project. Likewise, a unusually high value is placed on consistent and complete documentation of the quantity and nature of the incoming waste, its ultimate location in the landfill, decontamination of outgoing equipment, and monitoring of possible emissions, because of the need to demonstrate protection of the surrounding community and environment. Therefore, the first two goals listed above are assumed to be of primary importance for the ERSDF.

On the other hand, the reliability of individual pieces of equipment or functional units in the ERSDF may not need to be as high as long as parallel capacity is available. A certain level of reliability will be necessary to handle peak waste loads without impacting site remediation schedules, but automation may not be the best way to provide it, relative to providing spare equipment. Likewise, a high priority should not be given to the use of automation simply for operating cost reduction, because the changes in the incoming waste stream may require a very short economic payback period. If an automatic system has a lower first cost than a manual system, it should be used, but this is not commonly the case. Therefore, the use of automatic controls to increase equipment reliability or to reduce operation and maintenance (O&M) costs is not given a high priority for the ERSDF.

3.1 DATA AND ASSUMPTIONS

A general description of the ERSDF is presented in the Design Memorandum and not repeated here. A more detailed description of the waste transportation system, the projected waste volumes and character for the ERSDF, and the schedule for waste deliveries, are presented in detail in the *On-Site Transportation Network Engineering Study Report for the ERSDF* (DOE/RL/12074--12 Rev. 0), and are not repeated here.

3.2 AUTOMATED FUNCTIONS

Based on the above automation goals and the scope of the ERSDF (as explained in the Design Memorandum), the following functions are considered for potential automation:

- Weighing, logging, and tracking of incoming waste
- Historical data and records storage (database)
- Air emissions monitoring (and other environmental monitoring)
- Decontamination and Radiological Survey of equipment (vehicles and containers)
- Site security, safety, and fire alarm systems, and other site communications
- Site specific operational functions and data; fuel and energy usage; equipment status and run times; and process data not yet identified.

Each of these functions is described in the following paragraphs.

3.2.1 Waste Tracking

Proper management of the ERSDF requires a reliable system for weighing, logging, and tracking of incoming waste. Containers and vehicles will be coming from different remediation sites, each equipped with different waste measurement capabilities. The ERSDF needs to be able to verify the nature and quantity of incoming waste, both for regulatory purposes and for day-to-day operations planning purposes. The ERSDF then needs to keep track of both waste and containers as the waste is placed in the landfill, to generate a documentation record that can be used to demonstrate that all waste has been accounted for and safely placed in appropriate locations. This waste tracking system is necessary to show both the regulators and the community that the ERSDF is accomplishing its mission.

3.2.2 Database

ERSDF records and data will include waste volume data with associated characterization and source information. The system will also collect and store environmental monitoring data, weather data, and various types of operational data (equipment maintenance management, procurement and inventory, health and safety records, etc.). There are a number of means of recording and storing this data which includes the following:

- Paper (log records)
- Microfiche
- Computerized database (including Graphic Information System).

The system used at the ERSDF must be functionally compatible with the waste site characterization system and data management requirements of SWITS.

3.2.3 Emissions Monitoring

As there will be no cover over the ERSDF landfill operation, fugitive dust emission control will be accomplished by means of operational measures (e.g., water spraying, foam, careful equipment use, shutdown during high winds, etc.). Careful and consistent air monitoring will be needed to verify the effectiveness of dust control measures, and to provide feedback to help improve dust control where possible. Other environmental monitoring (e.g., groundwater monitoring) may also be needed.

3.2.4 Decontamination and Radiation Survey

As containers and vehicles leave the site, they must be decontaminated using water sprays, wipes, air jets, or other means. Then a survey must be conducted to verify the effectiveness of the decontamination procedures. All potentially contaminated surfaces must be cleaned and then checked to show compliance with the applicable U.S. and Washington State Department of Transportation (DOT) criteria.

3.2.5 Operational Functions

Automated or semi-automated control systems consistent with SWITS should be provided for the day-to-day (minute-to-minute) operations of the ERSDF. This will allow for real time or near real time acquisition of data to assure safe and efficient operation is continually maintained. Controls should be in effect that not only track and log incoming waste, but also assure that the required throughput is being maintained. Interlocks will be provided to prevent unsafe conditions or procedures. The systems will be required to monitor and control fuel and energy usage, equipment status and run times, and other processes not yet identified.

3.2.6 Communications

Normal procedures for site safety rely on the ability to sound alarms in case of fire or accident. Major stationary equipment is generally protected by alarms, and it may be appropriate to extend this to mobile equipment at the ERSDF. In addition to alarms, the large size of the ERSDF site will require some type of communication system to coordinate waste deliveries and general site operations. If a decision is made to install an automation system at the site to serve a function such as waste logging and tracking, consideration must be given to the possible use of the same data transmission hardware and software for other alarm and communications functions.

4.0 ALTERNATIVES EVALUATION

4.1 ALTERNATIVES IDENTIFICATION AND DEVELOPMENT

While each of the above functions can be automated to a greater or lesser degree independently of the others, the objective of this TM is to develop a consistent guiding strategy for the ERSDF as a whole. Therefore, general automation alternatives have been developed for all functions together and are presented below.

4.1.1 Manual

This alternative utilizes a relatively low level of instrumentation to accomplish the following functions:

- Waste weighing and tracking using manual (paper) manifesting, with a conventional truck or railcar scale, and paper record system.
- Records, data, and other documentation can be stored in paper form or microfiche.
- Manual air sampling with laboratory analysis, manual well sampling with laboratory analysis, and paper records system.
- Manual decontamination (using wipes or hand-washdown equipment).
- Manual decontamination survey using hand-held instruments and paper records.
- Decentralized site communications using cellular phones and independent portable radios. Hardwired alarm systems for buildings and major stationary equipment.

4.1.2 Semi-Manual

- Semi-manual waste tracking system, with manual data collection and computerized data management.
- Storage of records and data in separate paper and computerized databases for each operational function at the ERSDF.
- Automatic air sampling using remote equipment with recording capability. While paper chart recording units are still available, most modern systems use digital electronic recording units. Data would be periodically collected (by a person) from the remote units and then downloaded to a data management system. Well monitoring would remain manual. The system can also incorporate an automated weather station to provide early notification of rain or high winds.
- Remote controlled container and vehicle decontamination using robotic washing and container handling equipment, intended to avoid human contact with containers. The robotic equipment would be controlled (in real time) by human operators.
- Remote controlled radiological survey, using robotic instruments, controlled by human operators.
- Centralized, non-integrated site communications, including a site telephone system, a site radio repeater system, and separate hard-wired fire and trouble alarm systems.

4.1.3 Highly Automatic

- Automatic waste receiving data acquisition, using electronic tagging of containers, load cells in unloading equipment, etc.
- Data storage in a fully automatic (computerized) centralized data acquisition and management system, with GIS capability and capacity for all ERSDF data storage needs.

- On-line data collection from remote sensing air monitoring equipment. with a central data management system. Manual well monitoring with laboratory analysis, with data entry to electronic data management and GIS system.

- Automatic decontamination system, capable of moving containers through the decontamination system and washing or wiping them without a human operator. The system would be programmed to perform a set of decontamination actions on each container handled.

- Automatic radiological survey, designed to check all surfaces on equipment as it is shifted automatically through the decontamination system.

- Centralized, integrated, digital site communications, (e.g., using optical technology), providing voice communication, electronic mail, electronic fire and safety alarm transmissions, all on the same basic computer system. This will essentially be the facility command and control center which will allow operators real time access to the information and control systems including material/container tracking, environmental and weather forecasting data, alarm management, energy usage, equipment status and other variables essential to the safe and efficient operation of the ERSDF.

4.2 ALTERNATIVES EVALUATION AND SELECTION

Several alternatives have been developed and are discussed below.

4.2.1 Waste Receiving

The prior decision to utilize a highly automated DAS to manage environmental remediation data at Hanford leads to a corollary decision to consider the use of the same approach within the ERSDF. Moreover, even without this prior decision, current practice in large-scale waste handling operations is shifting to a highly-automatic system. Automatic weighing at the pickup source is replacing manual manifesting (with weighing at the disposal site) for invoicing purposes because it is far less subject to human alteration or error. Some 20 companies market various types of tagging systems that enable electronic recognition of a vehicle or container and immediate access to a file of data that includes the equipment identification, the tare weight, and the currently assigned site. The cost of an in-ground weigh-scale can be avoided by installing load cells in off-loading equipment. This also avoids the necessity for routing all loads through a single weigh scale checkpoint (i.e. bottleneck). The tags can be designed to be readable at distances of up to 30 feet, and at speed. This would enable each container on an incoming train to be electronically identified as the train approached the ERSDF. Tagging equipment ranges in complexity and effectiveness from simple bar-code reading systems to passive (battery-less) transponder systems (e.g., induction type or frequency response identification type). Because this type of technology is readily available and cost-effective, because of the prior selection of an automated DAS for site-side environmental data management, and because of the importance of accurate and consistent waste tracking, full automation of the waste receiving system is recommended.

4.2.2 Data Storage

The selection of a fully automatic approach for waste receiving leads to the simultaneous decision to provide a computerized database in which to maintain the data. Such a database can be enlarged incrementally to provide capacity for other documentation functions. In general, each such incremental enlargement will be cost-effective relative to establishing an independent, free-standing database for each new function, as long as there is a functional and operational relationship between the data sets. However, one database should not be used if there will be two separate operating organizations with independent functions, because it will be difficult to set priorities for the system.

Assuming that a site-wide DAS database is implemented to manage environmental remediation data, any similar or related data gathered at the ERSDF should be managed by the same system. For example, records on the volume and character of waste received, along with the ultimate disposal location in the ERSDF would be input to and managed by the site-wide DAS database. However, because the operators of the ERSDF will need to make daily decisions regarding excavation, waste placement, cover installation, and soil stockpiling that do not require access to the entire environmental database, it may be wise to operate a separate "material balance" database to support landfill operations. This will assure that the priorities of the ERSDF will govern the management of the data needed for normal operations.

This ERSDF operational database would include some of the same information as the site-wide DAS database (e.g., waste volumes), along with additional information (equipment availability and capacity, temporary stockpile material quantities, etc.) relevant only for operations. The database should have a similar structure to the site-wide DAS database, but should be reduced in size to make it more manageable. It may include maintenance management data, decontamination data, etc. In addition, several smaller separate databases may be provided to provide confidentiality for health and some financial records.

4.2.3 Environmental Monitoring

The use of remote sampling equipment for air monitoring for particulates can provide for collection of both discrete and composite samples, while manual sampling is generally limited to discrete sample collection. Thus, a semi-automatic or fully automatic strategy is needed to provided a complete air monitoring capability. Real-time reporting of weather monitoring results would speed the response to changing weather patterns (e.g., shutdown caused by high winds or rain). However, real-time reporting of data that will not be used to make fast-response decisions is not useful. Real-time reporting of particulate or radiation levels will not provide any added information, and the accuracy of automatic field analyses may not meet the requirements of regulatory agencies.

If it is assumed that laboratory analyses will be needed for a significant portion of the monitoring functions, a complete real-time data collection system cannot be justified. Real-time data collection should be provided for key weather monitoring parameters, because it will yield a significant improvement in response time when a shutdown is needed because of high winds or rain. Other environmental monitoring functions should be either manual or semi-manual, depending on the preferred method of analysis. Table B-1 presents a preliminary list of data collection methods for various environmental monitoring functions.

4.2.4 Decontamination and Radiation Survey

The level of automation of the decontamination survey function should be consistent with the level of automation of the decontamination operation itself. This may vary for different waste types (low-level soil vs. transuranic [TRU]). The capability for automation of both decontamination and survey functions may be limited by available equipment, particularly for decontamination of large trucks with many irregular surfaces. On the other hand, if waste containers can be built with smooth and consistent external and internal surfaces, automation of container decontamination may improve worker safety at the same time as it provides a more consistent result. Therefore, it is likely that fully automatic decontamination and survey equipment should be provided (if practical) for some wastes, while other wastes continue to be handled manually.

4.2.5 Communications

Central control of site radio communications is needed to avoid interference between high and low priority communications. Digital transmission of alarm signals may be cost-competitive with hard-wired signals, particularly if long distances are involved. Thus, a high level of technology is recommended for the site communications system.

On the other hand, after off-site remediation decisions have been made at the waste sources, the response time allowable for interpretation of environmental data collected relative to placement of the waste is expected to be relatively long (on the order of years). While some system is needed for monitoring the position of the landfill face and the condition of any interim covers, it need not consider the waste constituents in detail. Therefore, an on-line waste-location GIS system is not a necessary portion of the ERSDF automation system. As this system would not contribute substantially to site safety, it is not recommended. GIS should be utilized as a "background" capability of the ERSDF data and communications system.

Table B-1. Preliminary Automation Strategies for ERSDF Environmental Monitoring Functions.

Environmental Monitoring Function	Automation Strategy
Weather Monitoring (Wind, Rain, Temperature)	Automatic measurement, Automatic real-time reporting, Automatic input to database
Radiological air monitoring	Automatic sample collection, Manual sample transportation, Lab analysis, Manual entry of data to database
Particulate air monitoring	Automatic sample collection, Manual sample transportation, Lab analysis, Manual entry of data to database
Groundwater well monitoring	Manual sample collection, Manual sample transportation, Lab analysis, Manual entry of data to database
Landfill lysimeter monitoring	Automatic measurement, Automatic real-time reporting, Automatic input to database
Landfill leachate monitoring	Manual sample collection, Manual sample transportation, Lab analysis, Manual entry of data to database

4.3 EQUIPMENT OPTIONS

Having selected an overall automation strategy as outline above, a number of types of computer and instrumentation hardware are available for implementation. Examples of these will be provided later in the process of design development.

4.4 FINDINGS AND RECOMMENDATIONS

- Provide highly automatic waste weighing and tracking system, using electronic tagging of vehicles and containers, and load-cell weighing on transportation and handling equipment. Consider the integration of this system with both the site-wide DAS database and with SWITS.

- Provide a single computerized control system database for managing site operations and data, including waste quantities and character, weather data, operational alarms, and maintenance management data. Smaller separate databases may be used for data requiring confidential treatment (e.g., health and financial records). These databases should be compatible with but not necessarily integrated with the site-wide DAS database.

- A semi-automatic approach is recommended for environmental data collection and storage (as detailed in Table B-1), with real-time monitoring for data used for quick-response decisions (e.g., weather data), and a less automated approach for other data, particularly if lab accuracy is needed.

- The level of automation of decontamination and radiological survey functions should be based on the availability of practical, commercially available equipment.

- The site communication system should provide centralized control over potentially interfering radio system, and should provide capability for digital data and alarm communication throughout the site.

APPENDIX C

TRANSURANIC WASTE STORAGE AND HANDLING TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM TRANSURANIC WASTE STORAGE AND HANDLING FOR THE HANFORD ENVIRONMENTAL RESTORATION STORAGE AND DISPOSAL FACILITY

1.0 SUMMARY AND CONCLUSIONS

Current plans do not anticipate encountering transuranic (TRU) wastes during the Large Scale Remediation (LSR), but, in the event that it is encountered, it should be segregated out of that waste and package for storage at the Hanford Central Waste Complex (CWC). It is not clear whether the radiological contamination is present at concentrations which would result in the classification of the waste as TRU. This TM outlines four alternatives for dealing with the storage of TRU waste at the Environmental Restoration Storage and Disposal Facility (ERSDF). Three of the alternatives describe the requirements for processing and storing the waste. The fourth alternative deals with determining if TRU waste is present in the initial LSR area (100B Area and 100C Area) at concentrations above the definitional level of TRU wastes.

This TM recommends a simultaneous pursuit of two alternatives, one to determine if TRU is even present in triggering concentrations and the other is to store the wastes in WIPP containers for "interim" storage at the CWC.

2.0 INTRODUCTION AND BACKGROUND

TRU wastes are defined by DOE Order No. 5820.2A as "Without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides (atomic number greater than 92) with half-lives greater than 20 years and concentrations greater than 100 nanocurries per gram (nCi/g) at the time of assay." These radionuclides are singled out for special attention because of their persistence (long half lives) and their toxicological concerns as alpha emitters. At Hanford, TRU waste was generated when the cladding on the fuel rods ruptured and the TRU material entered the cooling basins. The TRU contaminated water was treated prior to release to the soil column. TRU waste was found in the basin sludges and may exist in the soils surrounding the basins because of the history of leaks from the basins and related piping. At Hanford, the resulting wastes were generally treated in the basins before being disposed, generally to the soil column. TRU waste may also be generated during future decommissioning and decontamination (D&D) operations.

3.0 DATA AND ASSUMPTIONS

Hanford has been storing TRU wastes since 1970 in anticipation of a permanent long-term disposal site, such as WIPP. The inventory in 1988 was 20,000 cubic yards (yd^3) of Contact Handled and 435 yd^3 of Remotely Handled TRU. The threshold for contact versus remote handled waste is 200 millirems (mr). Most TRU waste generated today comes from existing processes and the volumes are relatively small compared to the current inventory. The Functional Design Criteria (FDC) indicates that no TRU waste will be shipped to the ERSDF, but accommodations for such wastes have been studied. Table C-1 compares the volume of TRU waste stored at Hanford since 1970, current TRU waste generation rates from current operations, and the maximum TRU waste figures anticipated for the ERSDF.

Table C-1. Comparison of Hanford Transuranic (TRU) Waste Volumes vs. Planned Disposal Capacity

Year	Current Storage and Future Generation Rates (Cubic Yards)	Disposal Capacity[a] (Cubic Yards)	Expected ERSDF Requirement (Cubic Yards)
1988	20,450	NA	NA
1993	20,600	1,330 (retrieved) 850 (new TRU)	NA
1997	13,950	1,330 (retrieved) 850 (new TRU)	1,060
1998	12,620	1,330 (retrieved) 850 (new TRU)	1,660
1999	11,290	1,330 (retrieved) 850 (new TRU)	7,430
2000	9,960	1,330 (retrieved) 850 (new TRU)	5,340
2001	8,630	1,330 (retrieved) 850 (new TRU)	5,670

[a]Disposal capacity is based on the WRAP I handling capacity. Current WRAP capacity was designed to work down the current Hanford TRU waste inventory beginning in 1993 and to deal with process generated TRU waste over a period of 17 years. At least one additional module was planned (WRAP II). The existence of a LSR requirement for dealing with TRU waste was not envisioned in planning for WRAP.

The Waste Retrieval and Packing (WRAP), Module 1 facility (WHC Project W026) has been identified in the Hanford Defense Waste Environmental Impact Statement (HDW-EIS, April 1988) as the TRU waste processing facility for waste currently stored at Hanford and to certify it for WIPP. The WRAP will also handle the TRU wastes generated from existing operations each year. The design capacity of Module 1 is to certify 875 TRU PAC boxes each year or a total volume of 23,600 cubic feet (ft^3) per year. This design capacity may not be adequate if larger amounts of TRU waste are encountered during the LSR project. In addition, Module 1 is not due to be operational until 1998 or 1999.

Presently, TRU waste is stored in Resource Conservation and Recovery Act (RCRA) permitted facilities (the 224-T facility and in metal buildings, in the CWC. The packaging of these wastes is in conformance with WIPP certification requirements.

DOE Order 5820.2A , Radioactive Waste Management and DOE Order RL 5820.2A, Radioactive Waste Management, require that the WIPP Waste certification procedures defined be applied at the source of waste generation. These requirements also specify that these wastes be certified to WIPP standards and prepared for shipment to WIPP. The certification process can take up to 2 to 3 years to achieve compliance and requires the use of only 55 gallon drums or TRU-PAC II boxes (approximately 5 by 8 by 4 feet) for shipping and storing TRU wastes. The Hanford LSR concept calls for single use 18 yd^3 waste containers for TRU waste. If the waste must be certified for WIPP, the only acceptable containers are the 55 gallon drums and the standard waste boxes. The ERSDF FDC states that WHC will develop waste acceptance criteria for the entire ERSDF, and it suggested that the requirements of DOE Order 5820.2A be considered. A possible option for handling of TRU waste may be to avoid the WIPP definition of "interim" storage and handle the TRU wastes at "temporary" storage facilities.

4.0 ALTERNATIVES IDENTIFICATION AND DEVELOPMENT

The following four options have been identified for the handling of TRU waste:

1. Conduct two distinctly different packaging systems for wastes at the site of generation (55 gallon barrels or standard waste boxes for TRU waste and all else in 18 or 35 yd^3 containers) and build a WIPP certified storage site at the ERSDF.

2. Conduct two distinctly different packaging systems and send the TRU waste directly to the present CWC TRU waste storage facility where it will wait for shipment to WIPP.

3. Take the position that any TRU wastes encountered will be "temporarily" stored at the ERSDF facility in the 15 yd^3 single-use containers, provided that the WIPP containerization and certification requirements are not required. These temporarily stored wastes can then be sent to WRAP facility for repackaging to meet WIPP requirements. This would require double handling of the waste and would cost more for final disposal.

4. Conduct a very limited and very focused site characterization study at the three waste sites identified in the 100B Area and 100C Area that are potentially the most radiologically contaminated (sites 118-B-1, 118-C-1, and 116-C-2C). The purpose of this study is to determine if TRU waste is present above the level of 100 nCi/g. If below the threshold, this will eliminate the need for WIPP packaging and storage.

If the characterization study indicates the presence of TRU waste above the threshold, the TRU wastes can be packaged into standard waste boxes (approximately 2.5 yd^3) at the remediation site and sent to the CWC under their existing RCRA permit. If volumes are substantial, the CWC may need to be expanded to accommodate out-year projections for it's remaining life. If volumes of TRU waste are above quantities that can be handled in this manner, then temporary storage (alternative 3) will need to be utilized.

5.0 ALTERNATIVES EVALUATION AND SELECTION

This section evaluates each of the alternatives identified above.

Alternative 1—This alternative involves following WIPP packaging procedures and build a WIPP compliant storage facility at the ERSDF. This alternative will require 2 to 3 years to work through the WIPP certification procedures. The facility could be funded and built but the actual volume of TRU waste, if present, may not be realized until the overall LSR project starts to generate wastes in 1996. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a permit for this facility will not be required but the RCRA requirements will be applicable for this facility.

Alternative 2—This alternative involves following the WIPP packaging procedures and use of existing TRU waste storage facilities located at the CWC. This approach avoids having the LSR comply with the requirements of WIPP. This alternative utilizes existing TRU waste storage capability/permits and the use of the WRAP facility when it becomes operational. The Environmental Restoration program may have to fund additional storage buildings at the CWC if TRU waste volumes are substantial, however, this would be funded under another project.

Alternative 3—This alternative involves storing TRU waste in the 15 yd^3 single-use containers at the ERSDF. This approach is an attractive alternative but the success is dependent on the following assumptions: (a) the movement of TRU waste to the ERSDF does not trigger WIPP requirements, and (b) the agreement by the State of Washington Department of Ecology (Ecology) and the Environmental Protection Agency (EPA) that a RCRA permit is not required under CERCLA. This option would require double handling of waste but if no other option exists, this would have to be pursued.

Alternative 4—This alternative involves conducting a limited characterization effort at the three 100B Area and 100C Area waste sites to determine if TRU waste above the level requiring compliance with WIPP standards is encountered and if so, determine the expected soil volumes. The study results could yield a determination that a TRU waste storage facility is not required or that alternatives 1, 2, or 3 should be pursued further.

6.0 FINDINGS AND RECOMMENDATIONS

It is recommend that alternatives 2 and 4 be pursued simultaneously. Success with alternative 4 could eliminate the need for the permitting, designing, building and operating of any TRU waste storage facilities at either the CWC or the ERSDF. Alternative 2 could be accomplished at the remediation site and would facilitate single handling of TRU waste. This alternative would require expansion of the CWC which could be completed at a later date to handle out-year volumes if TRU waste volumes are substantial. The storage requirements of DOE Order 5820.2A can probably be met by adopting the storage design parameters used by the CWC. Additional facilities may have to be constructed to meet the TRU waste volumes generated by the remediation activities at some future time.

Attachment C-1

DESIGN PARAMETERS FOR TRANSURANIC WASTE STORAGE AT THE ENVIRONMENTAL RESTORATION AND DISPOSAL FACILITY

1.0 INTRODUCTION

It is anticipated that transuranic (TRU) waste will be placed in 55 gallon drums or standard waste boxes at the remediation site and transported to the Hanford Central Waste Complex (CWC) for interim storage. However, if large quantities of TRU wastes are encountered, shipment to CWC may not be feasible due to space limitations.

Although not the preferred alternative for the handling of TRU wastes, the design parameters developed in this attachment assume that TRU waste will be sent to the Environmental Restoration and Disposal Facility (ERSDF) and facilities will need to be built to store the waste. It is assumed that the TRU wastes will be transported to the ERSDF in non-reusable 15 cubic yard (yd^3) containers. These waste containers will be temporarily stored (with their overpack) at the ERSDF. Under a future project, the TRU waste will be packaged in 55 gallon drums and/or standard waste boxes for certification and shipment to the appropriate receiving facility. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), it is not anticipated that a Resource Conservation and Recovery Act (RCRA) permit will be required for the storage of TRU waste at the ERSDF. However, the substantive requirements under the RCRA permit for the CWC will be incorporated in the design of the ERSDF TRU waste storage facility. The design parameters identified in this Attachment are similar to the CWC storage area for TRU waste.

TRU wastes are stored at several locations at Hanford but the major storage site is the 224T Transuranic Waste Storage and Assay Facility (224-T TRUSAF). The RCRA, parts A and B have been filed for this facility. Even though Building 224-T TRUSAF was not originally designed for TRU waste storage, modifications made in the 1970s and later, have been addressed in the RCRA permit application for that facility. The conceptional requirements spelled out in the 224-T TRUSAF Permit have been adopted, where appropriate, as conceptual design criteria for TRU storage at the ERSDF facility.

Although U. S. Department of Energy (DOE) Order 5820.2A, *Radioactive Waste Management*, pertains mainly to the design of "interim" storage facilities, it should be adhered to for design of the ERSDF TRU waste storage facility.

2.0 SPECIFIC CRITERIA

DOE Order 5820.2A requires that the ERSDF TRU waste storage facility be designed to minimize the exposure of personnel to the waste. The placement of TRU wastes into overpacked single use 15 yd^3 containers is expected to address this concern. It is recommended that the containers be inspected following receipt at the ERSDF facility. The facility should also be designed to prevent the following:

- Degradation of ground water or surface water quality
- Degradation of air quality
- Unstable hillsides, slopes or soils
- Endangerment to the health of employees or the public near the area
- Incompatibility with other ERSDF operations.

2.1 MEASURES TO PREVENT DEGRADATION OF GROUNDWATER OR SURFACE-WATER QUALITY

The TRU waste containers would be sealed to prevent water from entering the containers during storage at the ERSDF. The TRU waste containers should be stored on sealed concrete pads which have ramps, a sloping floor and are curbed to collect any water or liquids that may accumulate. Pad thickness will be dependent on the weight of the filled containers and the vehicles needed to deliver the containers to the specific storage location on the pad. The pads will be covered by a structure similar to current storage facilities now used at Hanford or the inflatable buildings used at Idaho National Engineering Laboratory (INEL) for TRU waste storage. These covers will provide protection from the weather under normal circumstances. Any liquid collected on the pad will be removed through the use of hand pumps, liquid absorbents, or vacuum equipment. Separate pads will be used to store non-compatible TRU wastes such as acids and basics so that any runoff from the containers will not mix with other incompatible liquids.

2.2 MEASURES TO PREVENT DEGRADATION OF AIR QUALITY

Since the containers will be overpacked from the time of arrival to the time of departure to the Waste Retrieval and Packaging (WRAP) facility, air quality degradation should not be a problem except for the possibility of emissions generated during the handling of the waste. However, the potential for emissions appears to be minimal due to the paved facilities and the containerized waste.

2.3 MEASURES TO PREVENT PROBLEMS ASSOCIATED WITH UNSTABLE HILLSIDES, SLOPES OR SOILS

The concrete pads for storing TRU wastes will be constructed on grade in an area with no significant elevation change. All roads will also be constructed on level grade using the American Association of State Highway and Transportation Officials, HS–20–44 ratings (AASHTO, 1983). Design criteria for the roads and rail associated with the TRU waste storage area will be the same as other areas of the ERSDF.

2.4 MEASURES TO PREVENT ENDANGERMENT TO THE HEALTH OF EMPLOYEES OR THE PUBLIC NEAR THE AREA

In addition to safety related measures already outlined in this attachment, As Low As Reasonably Achievable (ALARA) procedures will be employed during the construction and operation of the TRU waste storage facility. The ALARA requirements are defined in the Westinghouse Hanford Company (WHC) *ALARA Program Manual* (WHC–CM–4–11). The TRU waste storage facility will be designed to prevent hazards and exposure to the public. A Security Plan, Inspection Schedule and Check Lists, Documentation of Preparedness and Prevention, Health and Safety Plan, Training Plan, Waste Minimization Plan, and a Building Emergency Plan will be prepared according to mandated Department of Energy and other pertinent directives, as identified in the RCRA, Part B Permit Application, for the 224–T TRUSAF (DOE, 1992).

2.5 MEASURES TO ASSURE COMPATIBILITY WITH OTHER ERSDF OPERATIONS

It is assumed that the TRU waste will be transported in non-reusable 15 yd^3 containers. Should the containers selected for overall ERSDF operations or the transportation system change, TRU waste handling procedures and requirements specific to the ERSDF should be changed to be consistent with the overall requirements. The location of the TRU waste storage facility should be located adjacent to the rail and road network to facilitate transfer to the WRAP facility at a future date. The facility should also be located in an area to minimize the impact to existing operations.

APPENDIX D

EVALUATION OF APPLICABLE REGULATIONS AND DEPARTMENT OF ENERGY ORDERS TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM EVALUATION OF APPLICABLE REGULATIONS AND DEPARTMENT OF ENERGY ORDERS FOR THE HANFORD ENVIRONMENTAL RESTORATION AND STORAGE DISPOSAL FACILITY

1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

This technical memorandum (TM) has been prepared to provide the conceptual design team with an interpretation and evaluation of the many potentially applicable regulations that will affect the conceptual design of the Environmental Restoration and Storage Disposal Facility (ERSDF). The applicable requirements considered in this TM were identified in various sections of WHC-SD-W296-FDC-001, Rev. 1, Functional Design Criteria (FDC) for the ERSDF, prepared by Westinghouse Hanford Company (WHC).

1.2 OUTLINE OF TECHNICAL MEMORADUM

The information presented in the FDC document has been divided into categories and subjects that apply to each separate design element or discipline element that will be integrated into the conceptual design. This TM has been organized to present a summary of the existing functional design criteria outlined in the FDC. This document parallels the FDC and focuses on the references quoted in each of the sections and subsections within the document. Where a particular reference is cited in summary, a paragraph follows with an expanded description of the requirement or a cross reference to further information.

Two attachments are included in this TM. Attachment 1 is the FDC document, without the attachments, and Attachment 2 is a collection of forms that identify the requirements of each of the references discussed in the text. These forms have information on the source of the document, a summary of the reference, revision dates, and applicable design data.

2.0 FUNCTIONAL REQUIREMENTS

2.1 REVIEW OF FUNTIONAL DESIGN CRITERIA

The FDC document lists the preliminary criteria and requirements for initial conceptual design of the ERSDF. The document is divided into specific sections which are:

- Functional Requirements
- Waste Disposal Design Criteria
- ERSDF Design Criteria
- General Requirements.

Each of these sections list specific design criteria, or quotes Department of Energy (DOE) orders, federal regulations, and/or state regulations that must be complied with during the design process.

2.2 SPECIFIED REQUIREMENTS

Some of the specific functional criteria described in the FDC for the ERSDF includes:

- Design life: 30 year
- Location: southeast of the Hanford 200 West Area
- Size: approximately four square miles with two additional square miles for future expansion
- Operating staff: approximately 55 permanent personnel required to operate the facility
- Administrative support: existing Hanford accounting, procurement, security, and other site-wide services.

2.3 FUNCTIONAL FLEXIBILITY

The ERSDF facility is being designed to accommodate waste from various remedial action sites throughout the Hanford area. Additional functional guidelines have been established that address waste handling as follows:

- Project W-296 will provide disposal units for the first 5 years of remediation activities, which is estimated at 5 million cubic yards (yd^3). The ultimate disposal quantity for the design life of the ERSDF facility is estimated at 25 million yd^3.
- The solid waste that this facility will receive has been limited to low-level and mixed waste types.
- Design of the ERSDF must be integrated with design of the Hanford barrier, a permanent, large-scale final cover. During operation, the ERSDF will temporarily cover the waste disposal units to restrict infiltration of run-on/run-off and to prevent fugitive emissions.
- To the extent possible, all incidental waste effluents resulting from operations shall be minimized and, if necessary, treated within the ERSDF facility. No liquid effluents, except for sanitary sewer effluents and treated effluents, will be disposed of within the confines of the facility.
- Environmental Restoration (ER) waste will be treated before it is delivered to the ERSDF, if required to accommodate appropriate disposal.

3.0 WASTE DISPOSAL DESIGN CRITERIA

This section of the FDC details proper classification, handling, and disposal of remediation wastes. Safety is an important aspect of the design process and has been discussed at length under this criteria.

3.1 WASTE DISPOSAL REQUIREMENTS

This section discusses both safety and environmental requirements as listed below:

- DOE Order 5820.2A, *Radioactive Waste Management*
- DOE Order 6430.1A, *General Design Criteria* (GDC)
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*
- DOE Order 5480.11, *Radiation Protection for Occupational Workers*
- DOE-RL Order 5440.1A, *Implementation of the National Environmental Policy Act* (NEPA) *at the Richland Operations Office*
- DOE-RL Order 5480.1A, *Environmental Safety and Health Program for Department of Energy for Richland Operations*
- WHC-CM-4-9, *Radiological Design*
- WHC-CM-1-6, *WHC Radiological Control Manual*
- WHC-CM-4-11, *As Low As Reasonably Achievable* (ALARA) *Program Manual*
- WHC-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*
- 29 CFR 1910, *Occupational Safety and Health Act* (OSHA)
- Washington Administrative Code (WAC) 173-303, "Dangerous Waste Regulations"

A summary of each of these documents is provided below. More information is presented in the summary forms in Attachment 2.

DOE Order 5820.2A, *Radioactive Waste Management*. This document contains policies, guidelines, and minimum requirements by which the DOE manages its radioactive and mixed waste, and containment facilities. This order was designed to provide guidelines for managing high-level, transuranic, low-level, and mixed waste. The requirements in this volume offer design objectives to assure protection of the public and operating personnel from hazards associated with this facility. There are design objectives written into Chapter 1, Chapter 3, and Chapter 5. More information is presented in the summary form in Attachment 2.

DOE Order 6430.1A, *General Design Criteria* (GDC). The DOE GDC are directly applicable to construction of this facility, its support buildings, and all other associated construction. It is organized by divisions in a Construction Specifications Institute (CSI) format that addresses each of the design disciplines and special construction requirements necessary for any facility at the Hanford Site. No information is provided in the GDC for construction of the disposal cells planned for the ERSDF.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. This document was produced to establish standards and requirements for operations of the DOE and DOE contractors to protect members of the public and the environment from ionizing radiation. This document lists a number of references used to develop this protection plan and suggests responsibilities and authorities for each of the administrators of the plan. This order also specifies dose limits and monitoring requirements to prevent any public exposure to radiation. This order is applicable to shielding, disposal cell cover and monitoring designs for the ERSDF.

DOE Order 5480.11, *Radiation Protection for Occupational Workers.* This order establishes radiation protection standards and program requirements for the DOE and DOE contractor operations to protect workers from ionizing radiation. Section 9 of this document contains a few guidelines for design of interior features within the plant facility to protect workers. Paragraphs J and K of Section 9 quote standards for physical controls such as confinement, ventilation, and remote handling and shielding to protect workers. Other design objectives are offered in Paragraph J such as optimization, radiation exposure objectives, and maintenance and decontamination objectives. Some references to design of entry control areas are suggested in Section 9.

DOE-RL Order 5440.1A, *Implementation of the NEPA at the Richland Operations Office.* This is a front-end document used during the preparation phase for any project or activity at the site. This document provides an environmental evaluation checklist to evaluate the impact of the project or activity. It is a precursor to an environmental assessment (EA) or an environmental impact statement (EIS). WHC will have the responsibility for providing compliance documentation for the ERSDF with NEPA.

DOE-RL Order 5480.1A, *Environmental Safety and Health Program for the DOE for Richland Operations.* This document is an explanation of the administration and implementation of a large-scale administrative plan for new projects at the Hanford Site. This order has been broken down into redesignated chapters as explained in Attachment 1 of DOE Order 5480.1B. The former chapters have been redesignated as separate order numbers. DOE-RL Order 5480.4C, *Environmental Protection, Safety, and Health Protection Standards for RL*, is applicable to the design of the ERSDF and is discussed in Section 4.7 of this TM.

WHC-CM-4-9, *Radiological Design.* This manual provides radiological safety requirements, standards, and information for designing facilities that will operate without unacceptable risk to personnel, the public, or the environment. Design criteria outlined in this manual have been divided into sections that focus on facility layout, piping, and construction of employee protection equipment and devices. Criteria for layout of the facility are suggested, divided into controlled and uncontrolled, regular-radiation and high-radiation areas, and corridors and normal-traffic patterns through the facility. Section 3 addresses contamination control within the work spaces; Section 4 outlines requirements for heating, ventilation, and air conditioning (HVAC) and process piping; Section 5 documents criteria for exposure levels, shielding, and storage; Section 6 provides instructions for the design of glove boxes; Section 7 lists the requirements for the design of hot cells; and Section 8 defines the criteria for radiation shields. Section 10 provides guidelines for sampling and monitoring of air and liquids within the facility, and Section 11 sites the criteria for construction of solid and liquid radioactive waste handling and storage areas. Each of the sections within WHC-CM-4-9 are directly applicable to design of the support facilities and the waste handling facilities.

WHC-CM-1-6, *WHC Radiological Control Manual.* This manual combine radiation protection criteria and standards of the *Hanford Site Radiological Control Manual* with supplemental requirements of WHC. The radiation protection requirements of this manual are responsive to the applicable requirements of DOE orders and other regulatory agencies. Chapter 3 provides requirements for barriers, entry controls , and contamination controls. Chapter 4 discusses requirements for waste minimization, radioactive drains, and airborne radioactivity areas.

WHC-CM-4-11, *As Low As Reasonable Achievable* (ALARA) *Program Manual.* The purpose of the WHC ALARA Program Manual is to delineate and specify authorities, responsibilities, requirements, policies, procedures, and guidelines for implementing

ALARA principles. This manual describes the ALARA Checklist which has two sections. Section 1 identifies criteria to be used for facility review, and Section 2 identifies the criteria for system design. This program manual describes the requirements for completing the checklist, complying with the applicable codes, and completing a cost benefit analysis and other ALARA analysis documentation. The program manual does not have a copy of the checklist, but the checklist is to be completed during the conceptual design phase and updated as required during modifications. The ALARA Checklist is intended to be used as a guidance tool in conjunction with established design criteria.

WHC-EP-0063, *Hanford Site Solid Waste Acceptance Criteria.* Not applicable to ERSDF design. Waste acceptance criteria for the facility are to be completed by WHC.

29 CFR 1910, *Occupational Safety and Health Act* (OSHA). Document 29 CFR 1910.96 (listed as 40 CFR 1910 in the FDC) contains a section entitled "Ionizing Radiation" that sets definitions and exposure limits for work areas and workers. It also outlines proper signage and administration practices, including notification of incidence, training, and record keeping. WHC will have the responsibility of defining design details for compliance with OSHA requirements.

WAC 173-303, *Dangerous Waste Regulations.* This regulation implements the Hazardous Waste act of 1976. It designates solid wastes that are hazardous to public health and the environment and stipulates siting design and operational guidance. This document is applicable to ERSDF planning and should be reviewed during siting phases.

3.2 WASTE DEFINITIONS AND CHARACTERISTICS

As part of the design criteria for the ERSDF facility, the design waste types, categories, and volumes are summarized in Figure 1 of the FDC as guidance for the design phase. The ERSDF must be capable of receiving and disposing of the environmental wastes listed in this figure. Environmental wastes are discussed further in the *100 B/C Environmental Restoration Predesign Guidance Document*, WHC-SD-EN-DGS-001, Rev. 0.

3.3 INTERFACE WITH WASTE SITE AND TRANSPORTATION ACTIVITIES

Waste will be delivered to the ERSDF in railcars, and single-use and reusable containers. The ERSDF must be capable of receiving and handling the containers at a rate compatible with the waste being generated at the remediation site and be capable of returning the containers and equipment on the same schedule. A new connecting roadway will be built from the facility along the north side to the existing Hanford road system to support operations traffic. Waste packaging and shipping shall meet the requirements of WHC-CM-2-14. This document requires that radioactive material be shipped in approved U. S. Department of Transportation (DOT), Washington State DOT, DOE, and Nuclear Regulatory Commission (NRC) packages or equivalent, and that safety concerns addressed in DOE Order 5480.1 be met. All waste delivered to the ERSDF will have been previously analyzed, categorized, and separated to facilitate delivery to the correct disposal units. The ERSDF will use a waste identification/tracking system which will be integrated with the waste site characterization systems used at the individual waste sites. Requirements for the identification/tracking system have not been detailed, but data collection and operational monitoring are discussed in later sections.

3.4 DECONTAMINATION OF EQUIPMENT

Another important function of the ERSDF facility will be a decontamination capability that will allow continuous use of all tractor/trailer, rail, container, and support equipment required in the remediation/storage operation. An important design criteria for decontamination is the use of materials that can be recycled and are not restricted by regulatory agencies.

4.0 ENVIRONMENTAL RESTORATION STORAGE AND DISPOSAL FACILITY DESIGN CRITERIA

Design of the ERSDF must comply with several standards quoted in the FDC, including information contained in *Hanford Plant Standard, Standard Design Criteria* (SDC). This manual covers nearly all areas of design and requirements are summarized in Attachment 2. Support facilities will be designed in accordance with the OSHA regulations. The FDC for these facilities emphasize energy efficiency and redundant capacity to support operations, maintenance, and repair. The requirements for completing the design of these facilities will be addressed in more detail by discipline areas under subsections below.

An important design criterion stressed throughout the FDC is to provide a return to the safest mode of operation for all electrical, mechanical, and instrumentation systems in the facility. Interlocks and alarms must be provided on all systems or components that could impact worker or public safety. The following requirements are listed in the ERSDF Design Criteria section of the FDC:

- Systems required for environmental monitoring, safety, and/or processes shall be provided with redundant or backup systems.
- Human factor engineering shall be used throughout the design to minimize the chance or operating error.
- All buildings and facilities within the ERSDF shall be designed with decontamination in mind.
- The system or systems functions operating within the facility must be reliable enough to operate throughout the life of the ERSDF without undo maintenance and repair.

4.1 HEATING, VENTILATION, AND AIR CONDITIONING

This section references DOE Order 6430.1A, GDC. Within this document, design criteria for HVAC systems are listed in Division 15, "Mechanical," Subsection 1550.

Some of the target HVAC design criteria for the ERSDF are as follows:

- The facility or portions of the facility that require normal personnel occupancy shall be heated and cooled.
- Buildings or portions of the buildings housing equipment and components that are not normally occupied but require access by operators or maintenance personnel shall be heated and cooled.

- The degree of heating and cooling provided shall be based on the requirements of the equipment and human factors regarding the operations and maintenance personnel.
- The HVAC system shall maintain airflow from noncontaminated areas to areas of progressively higher potential contamination.

Also listed in the FDC is SDC 5.1, "Heating, Ventilation, and Air Conditioning." This document provides guidance to ensure protection of equipment, components, and personnel from environmental conditions at the Hanford site.

4.2 UTILITIES

The ERSDF shall be designed to include all utilities required for safe and reliable operation. These are listed as the following:

- Service and Potable Water. Information on installation of piped utility materials is contained in Section 0260 of DOE Order 6430.1A, GDC, and begins on Page 2-31. More information is offered in subsequent Sections 0262, "Corrosion Control and Section 0266, "Water Distribution Systems." Additional information is provided in Section 1540, "Plumbing/Service Piping", beginning on Page 15-17.
- Electrical Power. Design criteria for this utility are listed in DOE Order 6430.1A, GDC, Section 0278, "Power and Lighting", beginning on Page 2-52. Further information is discussed in Division 16, "Electrical." Section 1630, "Exterior Electrical Utility Service," begins on Page 16-5 and details specific utility requirements for electrical power.
- Communications Systems. The requirement for communications is also addressed in DOE Order 6430.1A, GDC, in Section 1630-1699.8, beginning on Page 16-10. This information refers specifically to telecommunications alarm and radio repeater stations. For general communications and alarms, refer to Section 1670, beginning on Page 16-24. The importance of communications is discussed elsewhere in the reference materials including DOE Order 5632.6, *Physical Protection of DOE Property and Unclassified Facilities*. Communications equipment is discussed in Paragraph D of Section 6. An additional reference is made to exterior communications and alarm systems in Section 0279, Page 2-52.
- Sanitary and Process Sewer. Design criteria for sanitary wastewater collection systems are outlined in Section 0270 of DOE Order 6430.1A, GDC. Information begins on Page 2-37 and should be cross-referenced with Section 0273, "Water Pollution Controls," beginning on Page 2-43.

All the utility systems planned for the new facility should be referenced to GDC Section 0260, "Piped Utility Materials." Utility service connections will be available to the ERSDF for sanitary and service water and electrical power from the southeast portion of the 200 West Area. Any resulting needs to upgrade the existing utility system to service the ERSDF will be provided. Backflow prevention devices must be provided on all water and system supplies to the ERSDF.

4.3 SITE PREPARATION

The design of the ERSDF must include provisions for maintaining horizontal and vertical survey control at the site. Requirements for survey control are explained in DOE Order 6430.1A, GDC, under Section 0202 beginning on Page 2-11 and 40 CFR Section 264.309, "Surveying and Recordkeeping," Page 284 of Parts 260-299, 1992. It requires that the owner or operator of a landfill must maintain specific surveying and recordkeeping information in the operating record. More information is provided in the summary attached as Attachment 2.

4.4 ENERGY CONSERVATION

This section refers to DOE Order 6430.1A, GDC, Section 110-112, beginning on Page 1-59. This section of the GDC refers to conducting a life-cycle cost analysis as part of conducting an energy conservation design. Section 110-112 cross-references the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), Standard 90 specification. ASHRAE Standard 90, should be used in conjunction with the material presented in DOE Order 6430.1A, GDC.

4.5 MAINTENANCE AND REPAIR FACILITIES

This section of the FDC provides specific guidelines for maintenance with provisions for equipment and material removal, lubrication, and testing. Equipment used within the ERSDF radiation-controlled area shall be considered regulated equipment as defined in WHC-CM-4-10, *Radiation Protection*. Section 11, Part 4.4.4, "Regulated Vehicles and Equipment."

4.6 COMMUNICATIONS SYSTEMS

The FDC recommends specific communications systems within the ERSDF. These include internal and external telecommunications, various alarm systems, transmittal of alarms to Hanford Fire Department, transmittal of data to and from the Hanford Local Area Network, and the Solid Waste Information Tracking System (SWITS) support interface. The design must provide for a radio-frequency base system to accommodate direct data-entry in the field. Design criteria on this subject can be found in the general requirements DOE Order 6430.1A, GDC Information on special systems including emergency power, interior communications and alarm systems, and specific lighting requirements are contained in Section 1660, "Special Systems", and Section 1671, "Interior Communications and Alarm Systems". The FDC quotes the general design criteria for setting the lighting levels in the office areas. Section 1655-1 refers to the *IES Lighting Handbook* for design of the interior lighting systems. Nonuniform lighting practices must comply with 41 CFR 101-20.116-2 and with the energy-conservation requirements of the GDC, Section 1694.

4.7 FIRE PROTECTION

The ERSDF must be designed according to the following fire protection criteria:

- DOE Order 6430.1A, *General Design Criteria* (GDC)
- DOE Order 5480.4A, *Environmental Protection, Safety, and Health Protection Standards for RL*
- DOE Order 5480.7A, *Fire Protection*
- WHC-CM-4-41, *Fire Protection Program Manual*
- *The Uniform Fire Code*, to the extent it is implemented by WAC-173-303.

- Backflow prevention must meet the requirements of WAC 248-54-285, "Public Water Supplies, Cross Connection Control."
- American Waterworks Association (AWWA), Pacific Northwest Section, *Accepted Procedure and Practice in Cross Connection Control Manual.*

The references listed in above in this section include the following requirements:

DOE Order 6430.1A, *General Design Criteria* (GDC). The fire protection standards are referenced in several locations within DOE Order 6430.1A including:

- Section 0260-2, "Exterior Utilities," Page 2-31; and Section 0266-4, "System Design Considerations," Page 2-34.
- Section 1530, "Fire Protection Criteria", are explained, beginning on Page 15-2.

DOE Order 5480.4A, *Environmental Protection, Safety, and Health Protection Standards for RL.* This reference applies mainly to a collection of cited administrative and regulatory codes that apply to fire protection. These include:

- National Fire Protection Association (NFPA), *Handbook of Fire Protection*
- Factory Mutual (FM), Loss Prevention Data Sheets
- RP-1, U.S. Department of Commerce, *National Fire and Prevention Control Administration*, 8-78, "Standard Practice for the Fire Protection of Essential Electronic Equipment Operations".

DOE Order 5480.7A, *Fire Protection.* The purpose of this document is to establish requirements for comprehensive fire protection and related perils protection program. More information on the contents of this order is supplied in Attachment 2.

WHC-CM-4-41, *Fire Protection Program Manual.* This manual provides requirements for testing, inspection, handling, and storage of flammable materials; the use of equipment in hazardous areas; and fire protection requirements and responsibilities for WHC facilities.

WAC 173-303, "Dangerous Waste Regulations." This order implements the Waste Act of 1976. In the context of fire protection, this code references Sections 630 and 640, which apply to container storage and tanks, respectively. Information in Section 630, begins on Page 136, and the requirements of Section 640, begin on Page 138.

***Backflow Prevention*, WAC 248-54-285, "Public Water Supplies, Cross-Connection Control."** This reference requires installation and maintenance of cross-connection control devices throughout the facility. More information on cross-connection control is supplied in Document WAC-246-290-490 and the *AWWA*, Pacific Northwest Section, "Accepted Procedure and Practice in Cross Connection Control Manual."

The FDC requires that fire protection design features be determined by a Fire Hazard Analysis (FHA) in accordance with the memorandum from EH-31.3, "Guidance on the Performance of Fire Hazards Analysis," November 7, 1991 and WHC-CM-4-41 *Fire Protection Program Manual*. The memorandum provides general information required to prepare a FHA for a DOE facility.

Other fire protection references have been identified as applicable to the design of the ERSDF facility. These include the NFPA 101, "Life Safety Code," NFPA 801, "Facilities Handling Radioactive Materials," and NFPA 13, "Installation of Sprinkler Systems."

NFPA 101, "Life Safety Code." This document provides general and specific guidelines for building layout and the design and implementation of fire control equipment. Chapters 2, 5, 6, and 7 define requirements for all structures and Chapters 26 and 28 provide more detail on planning and design for new office buildings and industrial facilities. These codes will be useful in cross-checking the DOE requirements during design.

NFPA 13, "Installation of Sprinkler Facilities." This is a manual describing approved water supply and sprinkler delivery systems. It contains specific design criteria and recommends specific calculation methods.

NFPA 801, "Facilities Handling Radioactive Materials." This recommended practice provides guidance for personnel responsible for the design or operation of facilities that involve the storage, handling, or use of radioactive materials. It is a practical guide for establishing and designing a safe working environment for personnel working with and around radioactive materials.

A fire hazards analysis (FHA) must be prepared in conjunction with the Conceptual Design Report and released in conjunction with the ERSDF Final Safety Analysis Report. The FHA must be determined in accordance with the memorandum from EH-31.3, "Guidance on the Performance of Fire Hazards Analysis", November 7, 1991.

4.8 SUPPORT FACILITIES

The ERSDF is to be constructed with the support facilities outlined in the FDC. These include an administrative building, change rooms, material handling facilities, decontamination facilities, and waste verification facilities. Emergency egress from these facilities must meet the requirements of NFPA 101. In addition, the facilities must be accessible to the handicapped in accordance with the Uniform Building Code (UBC) and ANSI A117.1. The 1991 UBC uses Chapter 31 to list the accessibility design requirements for handicapped personnel. ANSI A117.1 provides detailed guidance for nearly all aspects of accessible design. This document should be followed during all facility design.

4.9 RAILROAD REQUIREMENTS

The FDC references the *American Railway Engineering Association (AREA) Manual for Railway Engineering,* Volumes I and II for criteria relating to railroad design. This manual provides extensive information relating to railway system designs, and should be used during any railway design. Also, all design activities shall be interfaced with the existing Hanford railroad operation and maintenance organizations.

In addition to the documents cited, there are other standards available for review during design including the "Track Safety Standards," March 1992, and DOE Order 6430.1A, Section 0245, "Railroad Design." These references are fairly general, but do provide some information on design requirements.

5.0 GENERAL REQUIREMENTS

The FDC states that the ERSDF must comply fully with all environmental standards applicable to low-level radioactive and radioactive mixed waste disposal facilities. This includes compliance with all federal and state regulations pertinent to hazardous waste and DOE orders pertaining to disposal of low-level radioactive waste.

WHC will have the responsibility for compliance with safety requirements during operations.

5.1 SAFETY

5.1.1 General Classification

The ERSDF has been classified as a low-hazard, non-reactor nuclear facility in accordance with the criteria set forth in the hazard classification report, WHC-SD-W296-HC-001, and DOE Order 5480.23, *Nuclear Safety Analysis Reports*. According to this classification, the ERSDF must comply with the requirements for radioactive solid-waste facilities specified in DOE Order 6430.1A, GDC. Safety Class III, according to WHC-CM-1-3, *Management Requirements and Procedures*, is the highest classification anticipated for any system, component, and/or structure which will be required by the ERSDF. The FDC document specifies which sections of the GDC will apply to design. They are listed in the FDC document on Page 10. In addition to the sections listed, the FDC indicates that Safety Class III will apply to the waste unloading crane/system, the automatic fire protection system, and the electrical power supply. The Safety Analysis report will meet the requirements of DOE Order 5480.23, *Nuclear Safety Analysis Reports*.

5.1.2 Traffic Safety

The FDC indicates that signage for vehicular traffic must comply with ANSI D6.1, Manual on Traffic Control Devices. This manual provides detailed information on signs, as well as markings, signals, and other traffic control systems.

5.2 ENVIRONMENTAL PROTECTION

During design of the ERSDF, there must be an assessment of the environmental impacts to the Hanford area in accordance with DOE-RL Order 5440.1A, *Implementation of the National Environmental Policy Act at the Richland Operations Office*. The ERSDF must restrict environmental impacts and releases of radionuclides and hazardous materials to the levels quoted in the ALARA Manual. In addition, DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 5480.4, *Environmental Safety and Health Protection Standards*, must be followed to minimize the impact of the facility on the environment.

DOE Order 5400.1, *General Environmental Protection Program*. This document outlines the various reports and documents that must be submitted as part of an environmental protection program. It also lists the main responsibilities of the key members or directors of the program and explains the need for submitting workplans and monitoring plans prior to the design phase of the project. WHC will have the responsibility for completion of environmental permitting and reporting.

DOE Order 5480.4, *Environmental Safety and Health Protection Standards*. This document specifies requirements for the application of the mandatory environmental protection safety and health standards applicable to DOE and DOE contractors. This document has a complete list of reference environmental safety and health standards with sources for obtaining these standards. WHC will have the responsibility for compliance with environmental protection requirements that do not pertain to facility design.

5.2.1 Liquid Effluents

The FDC indicates that no effluent will leave the site. Sanitary wastewater will be routed to a subsurface drain field located downgradient of the site where it will not contaminate any monitoring wells. The facility must have surface run-on/run-off control to ensure that storm water and surface water is always diverted away from the disposal units. Selection and design of the wastewater treatment system is discussed in DOE Order 6430.1A, GDC, Section 0237-3, beginning on Page 2-43. Run-on and run-off control is also discussed in the GDC under Section 0270, "Sanitary Wastewater Collection and Stormwater Management Systems," beginning on Page 2-37.

5.2.2 Airborne Emissions

The ERSDF is to be designed to control fugitive emissions and emissions from ventilation systems. This includes dust, windblown contaminants, exhaust fans, vents and other sources of air emissions. The reference WHC-CM-7-5, *Environmental Compliance Manual*, Section 2.0, "Air Quality," and Section 7.0, "Solid Waste Management," is a criteria guide for airborne emissions.

WHC-CM-7-5, *Environmental Compliance Manual*, Section 2, defines requirements for design with respect to air emissions. This section details limits and requirements for stationary sources, treatment storage and disposal units, and construction activities. Section 7 provides guidance for the planning, construction, and operation of waste facilities. More information on contents is given in Attachment 2.

5.2.3 Construction

The FDC document requires construction measures that will minimize airborne particulate emissions during construction. These include periodic watering of the construction areas and stabilizing spoil piles and unpaved roads using chemical means. All activities shall be compliant with the requirements of WHC-CM-7-5, *Environmental Compliance Manual*, Part C, "Nonradioactive Airborne Emissions," and OSHA.

WHC-CM-7-5, *Environmental Compliance Manual*, Section 2, Air Quality. Part 2.6 provides details dealing with new or modified stationary sources or emission units. Part 2.6.1 deals specifically with dust generation caused by construction or related activities, or by operation activities.

5.2.4 Noise

This section quotes 29 CFR Section 1910.95, "Occupational Noise Exposure." This reference sites an allowable worker exposure limit to noise by defining noise and establishing exposure periods for certain frequency and decibel levels. Section 1910.95 does provide reference information regarding a contact person at the State and a source for further written information.

5.2.5 Exposure

The ERSDF shall be designed to mitigate any chemical exposure to on-site workers and the public in accordance with 29 CFR Section 1910, Subpart Z. This reference lists the allowable exposure limits for several different types of chemicals and hazardous materials. This includes vapor phase and liquid phase contaminants as well as solid or soil contamination. This guide provides worker protection and exposure limitation information rather than design criteria.

5.3 SECURITY

Personnel and vehicular access to the ERSDF shall be restricted by use of fencing and gates. The referenced criteria for this requirement is DOE Order 6430.1A, GDC. Since this facility is designed to handle radioactive wastes, security is paramount to public safety and worker protection. Several references to security measures, procedures, and devices are referenced in the general design criteria. Access control security is discussed in Section 0110, starting on Page 1-68. This intent of this requirement is to prevent any unauthorized personnel from entering this site. Security alarms and control systems are discussed on Page 1-85. Security for doors and windows is discussed in Section 0800, "Doors and Windows," beginning on Page 8-2. More information on security is provided in Section 1640, beginning on Page 16-3 which refers to power service for security, communications, and alarm systems. Specific design criteria for interior and exterior communications and alarm systems begin on Page 16-24.

All building exterior doors are to be provided with security locks and the exterior of buildings must be illuminated with exterior lighting controlled by photoelectric sensors. A reference to NFPA 101, "Life Safety Code," is offered for design guidance on emergency exit lighting. DOE Order 5632.6, *Protection of DOE Property*, is established to offer procedures for the physical protection of DOE property and unclassified facilities. Section 6, Paragraphs A through F of this reference describe procedures which should be implemented to protect property and facilities and to institute access controls, physical barriers, and adequate illumination. More information on this reference is supplied in Attachment 2. This section also references DOE Order 6430.1A, GDC, with regard to lighting within 25 miles of an observatory. This is discussed in Section 1650, starting on Page 16-15. It states that maximum use shall be made of high efficiency high intensity discharge lamps such as metal Halide or high-pressure sodium vapor lamps. However, HID lamps shall not be used for exterior lighting within 25 miles of observatories.

5.4 DRAWING REQUIREMENTS

The drawings generated as a result of design activities for the ERSDF must be controlled according to SDC, 1.3. The FDC indicates that design drawings do not need to be generated using an AutoCAD system.

GDC, SDC 1.3. This manual provides for two categories of drawings: H indicates permanent facilities that will be "as-built," and SK drawings are temporary. Drawing numbers are issued and controlled by the Hanford "Records Storage/Retrieval and Microfilming Group. The drawing arrangement generally conforms to ANSI Y 14.1-1980, except for parts or materials lists, and revision block. Drafting practice shall generally follow ANSI Y 14 and abbreviations shall conform to ANSI Y 1.1. This information applies to predesign activities and conceptual design activities as well.

5.5 QUALITY ASSURANCE

Quality assurance (QA) and quality control (QC) activities are to be carried out through all phases of design, construction, and testing. The FDC outlines specific objectives of the project-specific QA plan for design of the ERSDF. These requirements reference DOE Order 5700.6C, *Quality Assurance*, and EPA/530-SW-86-031, *Construction Quality Assurance for Land Disposal Facilities*.

DOE Order 5700.6C, *Quality Assurance*. This is a requirement to have the DOE approve the quality assurance program for all work. The U.S. Army Corps of Engineers, recently revised their QA Program Plan to comply with DOE Order 5700.6C. Montgomery Watson is currently revising the contractor QA Program Plan, which complies with the requirements of both the USACE's QA Program Plan and DOE Order 5700.6C. More information on this section is provided in Attachment 2.

EPA/530-SW-86-031, *Construction Quality Assurance for Land Disposal Facilities*. This document presents guidance for preparing a site-specific construction quality assurance plan for a hazardous waste landfill disposal facility (i.e., landfill, surface impoundment, or waste pile) that will meet or exceed all U.S. Environmental Protection Agency (EPA) specifications. This document is intended to provide guidance for implementing a construction QA plan, although it may be useful as a reference while compiling the specifications for the design of this facility.

5.6 DECONTAMINATION AND DECOMMISSIONING

The FDC suggests several items that should be considered during the design of the ERSDF to facilitate decontamination, decommissioning, and closure activities. These recommendations are listed in the FDC, Section 5.6, "Decontamination and Decommissioning."

5.7 NATURAL FORCES CRITERIA

The FDC requires that the ERSDF must be designed in accordance with specific loading from natural forces as described in the GDC, 4.1, "Design Loads for Facilities." This document provides specific design loadings and combination loadings. More information is provided in Attachment 2.

5.8 AUTOMATIC DATA PROCESSING

Since the ERSDF is to be a landfill facility, the FDC recommends that a data management system be designed to record information about the receipt, handling, and placement of waste into the landfill cells. This section cites 40 CFR, Section 264.309, "Surveying and Recordkeeping." This brief reference states that the owner or operator of a landfill must maintain operating records on a map detailing the exact location and dimensions, including depth, of each cell with respect to permanently surveyed benchmarks. It also indicates that the contents of each cell must be recorded. The requirements of 40 CFR Section 264.309 are summarized in Attachment 2.

ATTACHMENT D-1

FUNCTIONAL DESIGN CRITERIA FOR THE ENVIRONMENTAL RESTORATION STORAGE AND DISPOSAL FACILITY

FUNCTIONAL DESIGN CRITERIA
Environmental Restoration Storage and Disposal Facility
Project W-296

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) has identified an Environmental Restoration major systems acquisition (MSA), which contains activities such as characterization, treatment, storage, design of remediating systems, waste minimization, and feasibility studies. The Environmental Restoration Storage and Disposal Facility (ERSDF) is a subproject within this MSA and will provide a facility for the final disposal of waste generated from the remediation of past-practice sites at Hanford. The ERSDF will be designed, constructed, and operated to accommodate all solid low-level and mixed waste derived from environmental restoration, including decontamination and decommissioning (D&D) activities. Project W-296 will provide the initial facilities necessary for startup and operation through fiscal year (FY) 2001.

A significant portion of the waste characterization data will not be available until actual waste site excavations are under way. Attachment A presents waste forms and volume projections estimated by the Environmental Division of Remediation and Restoration.

1.1 BACKGROUND

The Hanford Project was established in 1943 for the purpose of producing plutonium for nuclear weapons. To accomplish this defense mission, nine nuclear reactors were constructed in the 100 Area located along the Columbia River. The 200 Areas have been used for waste management functions, associated with the processing of spent nuclear fuels and byproducts. The 300 Area has been used for various support roles to the 100 and 200 Areas. A significant amount of waste generated during these activities were disposed of to or buried in the ground, generating many areas that are radiologically and chemically contaminated.

Plans to discontinue the defense production mission at the site were announced in 1990. The current site mission reflects the cleanup of Hanford. This includes remediation of past-practice sites and permanent disposal of this remediated waste.

1.2 SCOPE

Project W-296 will be designed and constructed for the permanent disposal of containerized and bulk waste derived by environmental restoration and D&D activities of past-practice sites through the end of 2001. Project W-296 will provide disposal facilities, rail and tractor-trailer container handling capability, equipment and personnel decontamination facilities, maintenance facilities, fencing, roads, utilities, inventory control systems, communication systems, and administrative offices.

2.0 FUNCTIONAL REQUIREMENTS

2.1 DESIGN LIFE

Disposal in the ERSDF is intended to be permanent. For the physical plant portion of the ERSDF (e.g. administrative building, decontamination facilities, etc.), the design life is 30 years.

2.2 LOCATION

The ERSDF will be sited southeast of the Hanford 200 West Area and occupy approximately 4 square miles. An additional 2 square miles will be set aside to accommodate future expansion of the site, if needed.

2.3 NUMBER OF PERSONNEL

Approximately 55 people will be required to operate the ERSDF. They will consist of management, engineering, clerical and maintenance personnel.

For design purposes, the ERSDF will operated two shifts per day, 5 days/week, during 6 months of the year, based on daylight and weather considerations. The ERSDF will operate on a single shift basis during the remainder of the year.

2.4 EXTENT OF SERVICES PROVIDED

The ERSDF will operate similar to other Hanford facilities and rely on existing site-wide support services, (e.g. accounting, procurement, security, etc).

2.5 FUNCTIONAL FLEXIBILITY

2.5.1 Waste Volumes

Project W-296 will provide disposal units for the first five years of remediation activities, approximately five million cubic yards (see Attachment 1). An estimated 25 million cubic yards of waste, including 2 million cubic yards from decontamination and decommissioning activities, will eventually be disposed of in the ERSDF.

2.5.2 Waste Categories

The waste categories are shown on Attachment 1.

2.5.3 Waste Treatment

Any treatment of environmental restoration waste required for disposal shall happen prior to receipt at the ERSDF.

No liquid effluents except for sanitary sewer effluents will be disposed of at the ERSDF site.

3.0 WASTE DISPOSAL DESIGN CRITERIA

3.1 WASTE DISPOSAL REQUIREMENTS

The design of the ERSDF must satisfy the requirements of DOE 5820.2A, *Radioactive Waste Management*, DOE 6430.1A, *General Design Criteria*, DOE 5400.5, *Radiation Protection of the Public and the Environment*, and DOE 5480.11, *Radiation Protection for Occupational Workers*. It must also comply with WHC control manuals WHC-CM-4-9, *Radiological Design*, WHC-CM-1-6, *WHC Radiological Control Manual*, WHC-CM-4-11, *ALARA Program Manual*, and federal regulation 40 CFR 1910, *Occupational Safety and Health Act*), WAC 173-303, *Dangerous Waste Regulations* and WHC-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*.

The design of the ERSDF must satisfy the requirements of DOE-RL 5440.1A *Implementation of the National Environmental Policy Act* at the Richland Operations Office, and DOE-RL 5480.1A *Environmental Safety and Health Program* for Department of Energy for Richland Operations.

3.2 WASTE DEFINITIONS AND CHARACTERISTICS

3.2.1 Environmental Restoration Waste

The ERSDF must be capable of receiving and disposing of environmental wastes as discussed in the *"100 B/C Environmental Restoration Predesign Guidance Document"*, WHC-SD-EN-DGS-001, Rev. 0. The design waste types, categories, and volumes are presented in Attachment A to this document.

3.2.2 Decontamination and Decommissioning Waste

Decontamination and Decommissioning waste to be disposed of at the ERSDF for the first five years is approximately 17,000 cu. yds.

3.3 INTERFACE WITH WASTE SITE AND TRANSPORTATION ACTIVITIES

Waste disposed of at the ERSDF originates throughout the Hanford Site. Waste disposed of in the portion of the facility being designed by Project W-296 is from the 100 Areas, and the 300 Area. Waste from the 100 and 300 Areas will arrive along the northern side of the ERSDF by rail in reusable containers (32-cubic yard). The containers will be enclosed in shielded and unshielded overpacks, on modified rail flatcars. Rail lines included in the scope of this project start at the Hanford Railroad System "Suzie Switch" north of 200 West Area. Packaging and shipping shall meet the requirements of WHC-CM-2-14.

The ERSDF must be capable of receiving trains and handling the containers at a rate compatible with waste site activities as detailed in Attachment A. It must also be capable of returning containers and equipment by the same schedule.

Site vehicular transportation shall be tied into Route 3.

The ERSDF design shall make use of off-the-shelf equipment wherever possible.

All waste delivered to the ERSDF will have been previously analyzed, categorized, separated at the waste sites, such that disposal consists of routing containers to the correct disposal unit(s). The disposition location will be added to the tracking system with sufficient detail to ensure traceability and documentation of the disposed waste material. The waste identification/tracking system used at the ERSDF must be interfaced and compatible with the waste site characterization systems used at the individual waste sites.

3.4 DECONTAMINATION OF EQUIPMENT

The ERSDF shall provide decontamination capabilities sufficient to allow repeated use of all tractor/trailer, rail, container, and support equipment required in the remediation/storage operation.

The design shall use materials for decontamination that are not restricted by regulatory agencies. Minimization techniques shall be utilized in the recycling of all decontamination materials.

4.0 ENVIRONMENTAL RESTORATION STORAGE AND DISPOSAL FACILITY DESIGN CRITERIA

The ERSDF shall be designed to facilitate operations and maintenance while minimizing the number of operations personnel, project and operational cost, and equipment down time. All structures shall protect equipment, components, and personnel from environmental conditions on the Hanford Site. The design shall use information contained in *Hanford Plant Standard*, Standard Design Criteria 5.1, *Heating Ventilating, and Air Conditioning*. Support facilities, such as change rooms, rest rooms, showers, and lunch rooms shall be provided in accordance with Occupational Safety and Health Administration (OSHA) regulations. The facilities shall be designed in an energy efficient manner, without jeopardizing the integrity or the performance of ERSDF systems. The facilities shall provide sufficient redundant capacity to support operations, maintenance and repair.

The design of all electrical, mechanical, and instrument systems shall provide for return to the safest mode in event of failure. Systems required for environmental monitoring, safety, and/or processes (where recovery operations would be expensive and/or hazardous) shall be provided with redundant or backup systems. Human factor engineering shall be used throughout the design to minimize the chance of operator error.

The degree of reliability provided shall enable the system or systems to function efficiently throughout the intended operating life of the ERSDF without undue maintenance and repair under normal operating and accident conditions, for which they are designed.

4.1 HEATING, VENTILATION, AND AIR CONDITIONING

The facilities or portions of the facilities that require normal personnel occupancy shall be heated and cooled. Buildings or portions of the buildings housing equipment and components that are not normally occupied, but require access by operators or maintenance personnel, shall be heated and cooled. The degree of heating and cooling provided shall be based on the requirements of the equipment and human factors regarding the operations and maintenance personnel. The systems shall comply with the requirements of DOE 6430.1A, *General Design Criteria*.

The heating, ventilating, and air conditioning (HVAC) system shall maintain airflow from noncontaminated areas to areas of progressively higher potential contamination.

4.2 UTILITIES

The ERSDF shall be designed to include all utilities required for safe and reliable operation. Utilities include the following components:

- service and potable water
- electrical power
- communication systems
- sanitary and process sewer.

Utility systems shall be sized for the specific building or ERSDF demands. Utility service connections will be available to the ERSDF for sanitary and service water and electrical power, from the southeast portion of the 200 West Area. The water and electrical power requirements and interface location shall be determined during conceptual design. Upgrades to existing utilities distribution systems necessary for the operations of the ERSDF shall be provided.

Backflow prevention devices will be provided on all water and system supplies to the ERSDF. The utility system shall be designed with consideration given to the capacity appropriate with this project and the future expansion of the ERSDF.

Lighting levels shall meet the requirements of DOE 6430.1A, *General Design Criteria*. Office lighting shall be the recessed type, and designed to minimize glare on cathode ray tube (CRT) screens.

4.3 SITE PREPARATION

The ERSDF design shall make provisions for horizontal and vertical land survey control.

4.4 ENERGY CONSERVATION

The ERSDF shall comply with energy conservation requirements and shall be justified by Life Cycle Cost Analysis (LCCA) as defined in DOE 6430.1A. *General Design Criteria*, Section 110-12.

4.5 MAINTENANCE AND REPAIR FACILITIES

4.5.1 Maintenance Access

The facilities and equipment design shall facilitate access for maintenance with provisions for equipment and material removal, lubrication, and testing. Where possible, the ERSDF components shall be designed to:

- Use interchangeable parts
- Provide access for visual inspection
- Provide access for disassembly
- Allow maintenance with standard tools
- Provide labeled piping, valves, instrumentation, and equipment.

4.5.2 Maintenance Order

Design shall reflect the following order of preference for performing maintenance:

- Adjust or repair item or unit in place
- Repair item or unit by contact maintenance with radiation dose rates consistent with ALARA principles
- Replace item or unit with spare unless it is more resource efficient to remove, decontaminate, repair, and return to service or perform remote maintenance
- Lable equipment systems, instrumentation, valves, etc.

4.5.3 Special Equipment

Equipment items that require special and unique maintenance tool(s) shall be identified. Special instructions shall be included with the equipment, and any special tools required to maintain equipment shall be provided.

Equipment used within the ERSDF radiation controlled area shall be considered regulated equipment as defined in WHC-CM-4-10, *Radiation Protection*, Section 11, Part 4.4.4.

4.6 COMMUNICATIONS SYSTEMS

The project shall provide the following communication systems:

- Internal and external telecommunications
- Crash alarm and evacuation siren
- Emergency alarms for all areas
- Transmittal of essential alarms to Hanford Fire Department
- Transmittal of data to and from the Hanford Local Area Network (HLAN).
- Solid Waste Information Tracking System (SWITS) support interface

This system shall be integrated with the existing Solid Waste Information Tracking System (SWITS).

Carpeting for the ERSDF shall be anti-static to reduce static interference with computer equipment.

4.7 FIRE PROTECTION

The minimum ERSDF requirements for fire protection shall be in accordance with DOE 6430.1A, *General Design Criteria*, DOE-RL 5480.4A, *Environmental Protection, Safety, and Health Protection Standards for RL*, DOE 5480.7A, *Fire Protection*, WHC-CM-4-41, *Fire Protection Program Manual*, and the *Uniform Fire Code* to the extent it is implemented by *WAC-173-303*. Backflow prevention shall meet the requirements of *WAC 248-54-285*, Public Water Supplies. Gross Connection Control, and the American Waterworks Association (AWWA), Pacific Northwest Section, Accepted Procedure and Practice in Cross Connection Control Manual.

Fire protection design features shall be determined by a Fire Hazard Analysis (FHA) in accordance with the memorandum from *EH-31.3*, Guidance on the Performance of Fire Hazards Analysis, November 7, 1991, and *WHC-CM-4-41*, Fire Protection Program Manual. The FHA shall be developed in conjunction with the Conceptual Design Report and revised as necessary to incorporate additional design features. A final FHA shall be released in conjunction with the ERSDF Final Safety Analysis Report (FSAR).

Noncombustible construction materials shall be used to the greatest extent possible.

4.8 SUPPORT FACILITIES

Support facilities shall be provided for personnel required to operate the ERSDF. The following is a listing of the basic required support facilities within the ERSDF:

- Administrative building
- Men's and women's rest rooms and change rooms with Special Work Permit (SWP) clothing areas separate from personal clothing areas (design shall assume 70% men and 30% women)
- SWP and nonregulated (soiled and clean) clothing receiving storage, and loadout areas
- Decontamination facility
- Waste verification facilities

Emergency egress systems shall be designed in accordance with *NFPA 101*. Exits, stairs, platforms, handrails and rest rooms shall meet the requirements for proper access and egress. Handicapped considerations shall be incorporated into the Administrative building in accordance with *UBC* and *ANSI A117.1*.

4.9 RAILROAD REQUIREMENTS

The design and construction of railway facilities and equipment shall meet the requirements as set forth in the *American Railway Engineering Association Manual for Railway Engineering, Volumes I and II*. All design activities shall be interfaced with the existing Hanford railroad operation and maintenance organizations.

5.0 GENERAL REQUIREMENTS

The ERSDF shall comply fully with all environmental standards applicable to low-level radioactive and radioactive mixed waste disposal facilities. This includes compliance with all Federal and State regulations pertinent to hazardous waste, and DOE orders pertaining to disposal of low-level radioactive waste.

5.1 SAFETY

The ERSDF has been classified as a low hazard, nonreactor nuclear facility in accordance with the criteria set forth in the hazard classification report, WHC-SD-W296-HC-001, and DOE Order 5480.23, *Nuclear Safety Analysis Reports*, and shall be designed to comply with the requirements for radioactive solid waste facilities specified in DOE 6430.1A, *General Design Criteria*. The ERSDF shall be designed to meet worker and public exposure criteria.

Safety classification of systems, components and structures is defined in WHC-CM-1-3, *Management Requirements and Procedures (MRP 5.46)* Safety Classification. The ERSDF systems, structures, and components safety classifications will be identified during the Preliminary Safety Evaluation (PSE) prior to commencement of Title I Design activities. Safety Analysis Reports (SARs) will be prepared in accordance with DOE 5480.23, *Nuclear Safety Analysis Reports*.

Vehicular signs shall comply with *American National Standards Institute (ANSI) D6.1.*

5.2 ENVIRONMENTAL PROTECTION

The ERSDF shall be designed to minimize the impact on the environment in accordance with DOE 5400.1, *General Environmental Protection Program*, DOE 5480.4, *Environmental Safety and Health Protection Standards*, DOE-RL 5440.1A, *Implementation of the National Environmental Policy Act at the Richland Operations Office*. The design of the ERSDF shall be in sufficient detail to allow an assessment of its environmental impacts.

5.2.1 Liquid Effluents

Sanitary waste drain field(s) shall be located downgradient of the site, and situated in such a way as to preclude influencing monitoring well results.

Surface runon/runoff shall be controlled to insure that runoff and runon is always diverted from disposal units and support facilities.

5.2.2 Airborne Emissions

Provisions to control both fugitive emissions and emissions from ventilation systems shall be included in the ERSDF design.

Dust emissions from waste disposal operations (haul roads, dumping, etc.) shall be in accordance with WHC-CM-7-5, *Environmental Compliance Manual*, Section 2.0 Air Quality and Section 7.0 Solid Waste Management.

5.2.3 Construction

Measures shall be implemented to minimize airborne particulate emissions during construction. Such measures may include, but are not limited to:

- Periodically watering disturbed areas
- Stabilizing spoils piles and unpaved roads using approved chemical fixatives, coverings, or watering.

During construction, all activities shall be compliant with the requirements of WHC-CM-7-5, *Environmental Compliance Manual*, Part C, Nonradioactive Airborne Emissions, and *Occupational Safety and Health Act* requirements.

5.2.4 Noise

Occupational standards as set forth in 29 CFR 1910.95, "*Occupation Noise Exposure*" pertaining to noise abatement shall apply.

5.2.5 Exposure

The ERSDF shall be designed to mitigate chemical exposure to onsite workers and the public in accordance with 29 CFR 1910, *Subpart Z*.

5.3 SECURITY

The ERSDF shall be designed in accordance with DOE 6430.1A, *General Design Criteria*. Personnel and vehicular access to the ERSDF shall be restricted by use of fencing and gates. No unauthorized personnel will be permitted onto the site.

All building exterior doors shall be provided with security locks. The exterior of buildings shall be illuminated and the exterior lighting shall be automatically controlled by photoelectric sensors. Emergency exit lighting shall be provided as required by *NFPA 101*. The requirements as specified in DOE 6430.1A, *General Design Criteria*, regarding lighting within 25 miles of an observatory, shall be followed.

Design of the ERSDF shall comply with DOE 5632.6, Physical Protection of DOE Property and Unclassified Facilities.

5.4 DRAWING REQUIREMENTS

All drawings generated as a result of ERSDF design activities shall be controlled as required by *Standard Design Criteria (SDC) I.3*, (Preparation and Control of Engineering and Fabrication Drawings). Design drawings need not be generated using AutoCAD, but must be capable of transfer to AutoCad.

5.5 QUALITY ASSURANCE

Quality assurance (QA) activities for all contractors involved in design, construction, and testing phases of the ERSDF shall be formulated and executed in accordance with a DOE approved, project-specific QA plan. The plan shall ensure the following objectives:

- The facility is designed to meet the program requirements
- Prepared plans and specifications adequately cover QA requirements
- Construction is performed in accordance with the design
- Testing is performed to confirm the adequacy of design, quality of construction, and quality of manufactured components.

QA and quality control (QC) activities shall be performed in accordance with DOE 5700.6C, *Quality Assurance*, and EPA/530-SW-86-031, *Construction Quality Assurance for Land Disposal Facilities*. Assurance that the QA and QC requirements have been effectively implemented shall be confirmed by periodic audits and surveillance oversight.

5.6 DECONTAMINATION AND DECOMMISSIONING

The following items shall be considered during the design of the ERSDF to facilitate decontamination, decommissioning, and closure activities:

- Polished surfaces, coatings or liners on walls, floors, and ceilings suitable for washing or wipedown.

- Air exhaust filters at or near individual radioactive material or other containment enclosures to minimize contamination of ventilation ducts.

- Surfaces free of crevices, corners, ledges and/or protrusions that can collect contaminated materials.

- Surfaces that can be easily flushed with a minimum quantity of water or decontamination solution.

- Surface coatings compatible with decontaminating agents, taking into consideration any degradation expected to occur.

- Access ports (e.g. doorways, ventilation ducts) designed to minimize problems when closing and/or sealing penetrations at the time of decommissioning.
- Waterproofed penetrations to provide protection during spraying and hosing-type decontamination efforts.
- Processing and chemical storage areas with monolithic, nonporous floors and sloped towards the sumps or drains.
- Continually sloped and trap-free piping systems.
- Physical provisions for cleaning and draining the piping.
- Construction materials resistant to radiation, process solutions, and decontamination agents (materials that are not resistant shall be nonabsorbent or easily replaceable).
- Wide aisles to facilitate movement of equipment and material.
- Adequate overhead clearance for remote transfers.
- Skid-mounted equipment or systems with fasteners, piping, and service connections designed for easy access and manipulation.
- Rigging and attachment points to facilitate removal of skids and/or equipment.
- Piping and service connections designed for easy access.

5.7 NATURAL FORCES CRITERIA

The ERSDF shall be designed in accordance with Hanford Plant Standard. Standard Design Criteria 4.1, *Design Loads for Facilities*; so that occurences of natural phenomena design basis accidents do not result in unacceptable safety consequences.

5.8 AUTOMATIC DATA PROCESSING

A ERSDF data management system shall be designed to record information concerning the receipt, handling, and placement of waste as required by 40 CFR Part 264.309, "*Surveying and Record Keeping*" and WHC-EP-0063. The system shall include all the required hardware and software to track all incoming waste containers (volumes) utilizing electronic Bar Code Systems interfaced with existing SWITS database for archiving.

6.0 CODES, STANDARDS, AND CRITERIA

This project shall be designed and construction in accordance with the regulations, codes, and standards listed below. The division 13 and section "-99" requirements of DOE 6430.1A, *General Design Criteria*, are applicable as the ERSDF is a nonreactor, nuclear facility. The latest revision of these regulations, codes, and standards are applicable:

- DOE Order 5400.1, General Environmental Protection Programs
- DOE Order 5400.5, Radiation Protection of the Public and Environment
- DOE-RL 5440.1A, Implementation of the National Environmental Policy Act at the Richland Operations Office
- DOE-RL Order 5480.1A, Environmental Safety and Health Program for Department of Energy Operations for Richland Operations
- DOE-RL Order 5480.2A, Radiation Waste Management
- DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards
- DOE-RL Order 5480.4A, Environmental Protection, Safety, and Health Protection Standards for RL
- DOE Order 5480.7A, Fire Protection
- DOE Order 5480.11, Radiation Protection for Occupational Workers
- DOE Order 5480.23, Nuclear Safety Analysis Reports
- DOE-RL Order 5481.1, Safety Analysis and Review System
- DOE Order 5632.6, Physical Protection of DOE Property and Unclassified Facilities
- DOE Order 5700.6C, Quality Assurance
- DOE Order 5820.2A, Radioactive Waste Management
- DOE Order 6430.1A, General Design Criteria
- DOE-RL Order 6430.1C, Hanford Plant Standards (HPS) Program
- SDC 1.3, Preparation and Control of Engineering and Fabrication Drawings

- SDC 4.1, Design Load for Facilities
- SDC 5.1, Heating, Ventilating, and Air Conditioning
- EPA/530-SW-86-031, Construction Quality Assurance for land Disposal Facilities
- American Railway Engineering Association, "Manual For Railway Engineering, Volumes I and II"
- Title 29 CFR 1910, Subpart Z
- Title 29 CFR 1910-95, Occupation Noise Exposure
- Title 40 CFR 1910, Occupation Safety and Health Act
- Title 40 CFR 260-270, Resource Conservation and Recovery Act (RCRA)
- Title 40 CFR 264.309, Surveying and Record Keeping
- WAC-173-303, Dangerous Waste Regulations
- WAC-248-54-285, Public Water Supplies, Gross Connection Control
- WHC-CM-1.3, Management Requirements and Procedures
- WHC-CM-1.6, Radiological Control Manual
- WHC-CM-2-14, Hazardous Material Packaging and Shipping
- WHC-CM-4-2, Quality Assurance Manual
- WHC-CM-4-3, Industrial Safety manual
- WHC-CM-4-9, Radiological Design
- WHC-CM-4-11 "ALARA Program Manual"
- WHC-CM-4-41, Fire Protection Program Manual
- WHC-CM-4-46 "Non-reactor Facility Safety Analysis Manual"
- WHC-CM-7-5 "Environmental Compliance Manual"
- WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria
- ~~WHC-SD-W296-HC-001, Rev.~~ 0 "Project W-296 Hazard Classification Report" 7/26/93 "Low"

In addition to the above standards, applicable "National Consensus" Codes and Standards and pertinent state and local codes and standards will be used. The latest edition of all codes and standards will be used.

WASTE VOLUME FOR DISPOSAL BY YEAR (1,000 CUBIC YARDS)							
WASTE FORM	WASTE TYPE	1997	1998	1999	2000	2001	TOTAL
Overburden	**Contact Handled (CH) Low Level Waste (LLW) Cat.1**	**123.3**	**345.2**	**438**	**500.7**	**568.8**	**1976.0**
	Remote Handled (RH) LLW Cat.1	**0.1**	**0.3**	**0.4**	**0.5**	**0.6**	**1.9**
	Non-Hazardous, Non-Radioactive						**0.0**
	Contact Handled Mixed LLW Cat.1	0.1	0.4	0.4	0.5	0.6	2.0
	Remote Handled Mixed LLW Cat.1	0.1	0.3	0.4	0.5	0.6	1.9
	Hazardous/Dangerous	0.1	0.4	0.4	0.5	0.6	2.0
Soil	Contact Handled (CH) Low Level Waste (LLW) Cat.1	92.4	502.6	568	620.4	645.5	2428.9
	Remote Handled (RH) LLW Cat.1	0.5	2.6	5.3	3.4	3.9	15.7
	Non-Hazardous, Non-Radioactive						0.0
	Contact Handled Mixed LLW Cat.1	1.9	10.5	11.9	13	13.5	50.8
	Remote Handled Mixed LLW Cat.1	0.5	2.6	5.3	3.4	3.9	15.7
	Hazardous/Dangerous	1	5.2	6	6.5	6.7	25.4
Metals	Contact Handled (CH) Low Level Waste (LLW) Cat.1	10.9	51	52.3	50.6	47.1	211.9
	Remote Handled (RH) LLW Cat.1	0	0.3	0.3	0.3	0.3	1.2
	Non-Hazardous, Non-Radioactive	0.2	1.1	1.1	1.1	1	4.5
	Contact Handled Mixed LLW Cat.1	0.2	1.1	1.1	1.1	1	4.5
	Remote Handled Mixed LLW Cat.1	0	0.3	0.3	0.3	0.3	1.2
	Hazardous/Dangerous	0.1	0.5	0.5	0.6	0.5	2.2
Buried Waste	Contact Handled (CH) Low Level Waste (LLW) Cat.1	8.1	35.9	36.3	35	33.3	149.1
	Remote Handled (RH) LLW Cat.1	0.6	2.6	2.7	2.5	2.4	10.9
	Non-Hazardous, Non-Radioactive	0.6	2.6	2.7	2.5	2.4	10.8
	Contact Handled Mixed LLW Cat.1	1.2	5.2	5.3	5.1	4.8	21.6
	Remote Handled Mixed LLW Cat.1	0.6	2.6	2.7	2.5	2.4	10.8
	Hazardous/Dangerous	0.6	2.6	2.7	2.5	2.4	10.8
Demolition	Contact Handled (CH) Low Level Waste (LLW) Cat.1	12.5	57.1	58.5	56.1	52.8	237.0
	Remote Handled (RH) LLW Cat.1	0.1	0.3	0.3	0.3	0.3	1.3
	Non-Hazardous, Non-Radioactive	1.4	6.6	6.7	6.4	6.1	27.2
	Contact Handled Mixed LLW Cat.1	0.1	0.3	0.4	0.3	0.3	1.4
	Remote Handled Mixed LLW Cat.1	0.1	0.3	0.3	0.3	0.3	1.3
	Hazardous/Dangerous	0.2	0.6	0.7	0.6	0.6	2.7
Decommiss.	Contact Handled (CH) Low Level Waste (LLW) Cat.1	0.3	3.7	3.7	3.6	3.9	15.2
	Remote Handled (RH) LLW Cat.1	0	0.1	0.1	0.2	0.2	0.6
	Non-Hazardous, Non-Radioactive						0.0
	Contact Handled Mixed LLW Cat.1						0.0
	Remote Handled Mixed LLW Cat.1						0.0
	Hazardous/Dangerous						0.0
Total	Contact Handled (CH) Low Level Waste (LLW) Cat.1	247.5	995.5	1157.3	1266.4	1351.4	5018.1
	Remote Handled (RH) LLW Cat.1	1.3	6.2	9.1	7.2	7.7	31.5
	Non-Hazardous, Non-Radioactive	2.2	10.3	10.5	10	9.5	42.5
	Contact Handled Mixed LLW Cat.1	3.5	17.5	19.1	20	20.2	80.3
	Remote Handled Mixed LLW Cat.1	1.3	6.1	9	7	7.5	30.9
	Hazardous/Dangerous	2	9.3	10.3	10.7	10.8	43.1
	Total	257.8	1044.9	1215.3	1321.3	1407.1	5246.4

Notes: Near-term wastes for 1997 and 1998 are included in CH LLW Cat 1 and in CH Mixed LLW Cat 1

All volumes rounded to the nearest 100 cubic yards, items having less than 50 cubic yards are rounded to 0

WASTE FORMS

Contaminated Overburden - Soil, ranging in size from boulders to fine silt, dry to moist, free draining, may contain small amount of contaminants ("Hanford soils"). Typically, this material resides above, and to the side of recognized waste sites.

Contaminated Soil - Same description as contaminated overburden, except in-place location is the waste site itself.

Metals - Metallic debris, mixed with nominal amounts of contaminated or uncontaminated soil, within the bounds of recognized waste site. Typically, this past-practice operations waste material is tube and pipe, structural shapes, metallic plate, discarded equipment, and shielding metals.

Buried Waste - Contaminated wood articles (railroad ties, dimensional lumber, plywood, etc.), contaminated consumable (cardboard, rags, paper, plastic, etc.).

Demolition Waste - Contaminated or uncontaminated concrete, rebar, timber, roofing, electrical debris, insulation, HVAC debris. Typically this definition is meant to encompass wastes buried during past practice D&D activities.

REGULATORY DEFINITIONS FOR DESIGN PURPOSES

Contact Handled - Contaminants are radiological only (do not qualify as hazardous/dangerous). Radiologic contaminants do not exceed 200 mrem/hr at contact.

Remote Handled - Contaminants are radiological only (do not qualify as hazardous/dangerous). Radiologic contaminants exceed 200 mrem/hr at contact.

Contact Handled Mixed - Contaminants are low activity, mixed with wastes meeting the descriptions contained in WAC 173-303-070 through 103 for dangerous waste or 40 CFR 261 for hazardous waste.

Remote Handled Mixed - Contaminants are high activity, mixed with wastes meeting the descriptions contained in WAC 173-303-070 through 103 for dangerous waste or 40 CFR 261 for hazardous waste.

Transuranic (TRU) - Contaminants are TRU only, and TRU mixed.

> TRU Only - Contaminants are radiological only and exceed 100 nonocuries per gram (nCi/g) alpha.
>
> TRU Mixed - Contaminants are radiological exceeding 100 nCi/g alpha, mixed with wastes meeting the descriptions contained in WAC 173-303-070 through 103 for dangerous waste or 40 CFR 261 for hazardous waste.

TRU Waste - Contaminated with alpha-emitting TRU radionuclides with half-lives greater than 20 years and in concentrations greater than 100 nCi/g of the waste matrix at the time of assay. Defined in WHC-EP-0063, "Hanford Site Solid Waste Acceptance Criteria," Section 3.

Dangerous-Nonrad - Contaminants are wastes meeting the descriptions contained in WAC 173-303-070 through 103 for dangerous waste or 40 CFR 261 for hazardous waste, and do not contain radiological contaminants.

Nondangerous-Nonrad - Wastes that are not contaminated with radiological, dangerous, or hazardous constituents.

ATTACHMENT D-2

REQUIREMENTS IDENTIFICATION FORMS

ATTACHMENT D-2

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☒ DOE Order
☐ DOE RL Order
☐ Washington State Register (WSR)
☐ Washington Administrative Code (WAC)
☐ Federal Regulation (40 CFR)
☐ Federal Regulation (10 CFR)
☐ Federal Regulation (29 CFR)
☐ DOE Agreement
☐ DOE Bulletin
☐ WHC Code or Standard
☐ Local Law
☐ RCW
☐ EPA
☐ Other...

Title: GENERAL ENVIRONMENTAL PROTECTION PROGRAM

Document Number: DOE 5400.1 **Date:** 11-9-88

Revision: 1 **Revision Date:** 6-29-90

Purpose:

To establish environmental protection program requirements, authorities, and responsibilities for the United States Department of Energy (DOE) operations for assuring compliance with applicable Federal, State and local environmental protection laws and regulations, Executive orders, and internal Department policies. The order more specifically defines environmental protection requirements that are generally established in DOE Order 5480.1B.

Section or Paragraph Citation: **Other:**

Description of Requirement:

This Order outlines the various reports and documents that must be submitted as part of an environmental protection program.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

Attachment 1 of Order lists references.

Comments:

This document is focused more on program management than design issues. It is assumed that WHC will be responsible for complying with this order, although Montgomery Watson will provide input for the various requirements.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☒ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: RADIATION PROTECTION OF THE PUBLIC AND ENVIRONMENT

Document Number: DOE 5400.5 **Date:** 2-8-90

Revision: 1 **Revision Date:** 6-5-90

Purpose:

To establish standards and requirements for operations of the United States Department of Energy (DOE) and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.

Section or Paragraph Citation: **Other:**

Description of Requirement:

DOE Order 5400.5 addresses general requirements for airborne emissions, drinking water pathways, liquid discharges and phase-out of soil columns, management of low-level radioactive solid waste, and an introduction to the As Low As Reasonably Acheivable (ALARA) safety process.

This document lists a number of references used to develop a protection plan and suggests responsibilities and authorities for each of the administrators of the plan.

This order also specifies dose limits and monitoring requirements to prevent any public exposure to radiation.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

DOE 5820.2A: Radioactive Waste Management
40 CFR Part I: Safe Drinking Water Act

Comments:

This order applies mainly to complying with health and safety requirements for radiation protection.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

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☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION STANDARDS

Document Number: DOE 5480.4 **Date:** 5-15-84

Revision: 4 **Revision Date:** 1-7-93

Purpose:

To specify and provide requirements for the application of the mandatory environmental protection, safety, and health (ES&H) standards applicable to all Department of Energy (DOE) and DOE contractor operations; to provide a listing of reference ES&H standards; and to identify the sources of the mandatory and reference ES&H standards.

Section or Paragraph Citation: Section 4. **Other:**

Description of Requirement:

This order shall be followed during facility design, construction, operation, modification, and decommissioning.

Ensure designs comply with referenced documentation.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

Section 6 of this document provides a list of references.

Comments:

This document is intended mainly for ES&H personnel use and for safety during construction activities.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☒ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: FIRE PROTECTION

Document Number: DOE 5480.7A **Date:** 2-17-93

Revision: **Revision Date:**

Purpose:

To establish requirements for a comprehensive fire protection and related perils protection program sufficient to attain United States Department of Energy (DOE) objectives.

Section or Paragraph Citation: Section 9, Paragraph B, Physical **Other:**

Description of Requirement:

Item 1: A redundant fire protection system must be provided for the safety class equipment storage area and the safety class equipment must be located in a separate fire area.

Item 3: In accordance with National Fire Protection Association (NFPA) standards, all new structures over 5,000 square feet will require a complete automatic fire suppression system. The same system will be required in any structure having potential fire loss damage in excess of $1 million or where the maximum credible fire could result in a loss of use of a vital structure for a period longer than specified by the applicable Program Secretarial Officer (PSO).

Item 4: If the maximum projected fire loss damage exceeds $50 million, a redundant fire protection system must be provided. Also, if the maximum potential loss damage would exceed $150 million, a redundant fire protection system is required in addition to a 3-hour fire barrier to limit the maximum possible fire loss.

Item 6: New permanent structures in excess of 5,000 square feet shall be constructed of non-combustible or fire resistive construction.

Item 8: An automatic water supply for fire protection having a minimum 2 hours stored water capacity must be maintained. The water supply can be a combination of site and municipal water supplies. If the possible fire loss damage exceeds $50 million, the facility must have an additional, independent source of fire protection water.

The PSO will dictate whether the facility requires a dedicated water supply necessary to meet hose, stream, and sprinkler system demands. The water supply system to the facility must be able to deliver the fire demand plus the maximum daily domestic demand for the required duration.

Item 9: Underground piping for water feed to the facility must be sized for the largest fire flows anticipated, but in no case shall be less than 8 inches in diameter. Supply piping to individual fire sprinkler systems shall be at least as large as the fire sprinkler system riser.

Item 10: Liquid run-off from a maximum credible fire must be controlled so that contaminated or polluting liquids shall not escape the site.

Item 11: Fire suppression or fire alarm systems must be transmitted to an acceptable remote location for alarms.

Item 12: Facilities which require ventilation containment systems shall be protected from the effects of fire to preclude the release of radioactive, toxic, or other hazardous materials.

Item 14: The use of Halon for fire protection will be dictated by the DOE memorandum "Interim Position on the Installation of New Halon 1301 Fixed Fire Suppression Systems and Halon 1211 Portable Fire Extinguishers", September 27, 1990.

Item 15: The design of fire protection systems must comply with seismic design criteria developed by the National Fire Protection Association.

Item 16: A fire protection system impairment program must be designed to track impairments during periods when fire protection systems are out of service.

Relevant to Other Areas of Review?

☐ No **How?** Paragraph B should be consulted during planning of utility water supplies to the
☒ Yes facility.

References to Other Sources:

Reference Paragraphs 5 and 6 for fire protection criteria.

Comments:

There are specific references in Paragraph 6 that will be of use in preparing and reviewing the fire protection plans for the new facility.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☒ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: RADIATION PROTECTION FOR OCCUPATIONAL WORKERS

Document Number: DOE 5480.11 **Date:** 12-21-88

Revision: 3 **Revision Date:** 6-17-92

Purpose:

To establish radiation protection standards and program requirements for the United States Department of Energy (DOE) and DOE contractor operations with respect to the protection of the worker from ionizing radiation .

Section or Paragraph Citation: Section 9, Paragraphs J and K **Other:**

Description of Requirement:

DOE Order 5480.11 is mainly a health and safety reference but contains a few guidelines for design and interior features of the facility required to protect the workers inside. Paragraphs J and K of Section 9 quote some standards for physical controls such as confinement, ventilation, remote handling, and shielding to protect workers. Paragraph J states that during design of the facilities, the following objectives shall be applied:

Optimization: Optimization principles discussed in International Commission of Radiological Protection (ICRP) Publication 37, are to be used in developing design and physical controls.

Item B - External Radiation Exposure: The facility must be designed such that objectives for personnel exposure from external sources of radiation do not exceed 0.5 mrem per hour on average.

Item C - Internal Radiation Exposure: As a design objective, exposure of personnel to inhalation of airborne radioactive materials is to be avoided under normal operating conditions.

Item D - Ease of maintenance and decontamination and decommissioning is to be considered during facility design and selection of materials. Under Paragraph K, specific guidelines are given for signage and labeling to protect workers and to designate controlled areas.

There are further references in Section 9 to construction of entry control areas and other facilities that may be applicable depending on the design and purpose of the facility.

Relevant to Other Areas of Review?

☐ No ☒ Yes **How?** Health and Safety requirements should be reviewed during architectural design of the building or planning of internal space.

References to Other Sources:

Refer to Section 6 of DOE Order 5480.11 for references to other pertinent documents.

Comments:

During planning and architectural development stages, the contents of this order should be reviewed to ensure that the workers using the space are protected from any radiation exposure or hazards outlined in this document.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☒ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: NUCLEAR SAFETY ANALYSIS REPORTS

Document Number: DOE 5480.23 **Date:** 4-30-92

Revision: **Revision Date:**

Purpose:

To establish requirements for contractors responsible for the design, construction, operation, or decontamination of nuclear facilities to develop safety analyses that establish and evaluate the adequacy of the safety bases of the facilities. The Nuclear Safety Analysis Report (SAR) required by this Order documents the results of the safety analysis.

Section or Paragraph Citation: **Other:**

Description of Requirement:

This order is intended to require the contractor responsible for operation for DOE-owned nuclear facilities to submit a SAR in conjunction with the start-up of a new facility.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

This is a requirement that could affect the design and will be a consideration in the expense for start-up. It should also be considered another permit or report for planning purposes.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☒ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: PHYSICAL PROTECTION OF DOE PROPERTY AND UNCLASSIFIED FACILITIES

Document Number: DOE 5632.6 **Date:** 2-9-88

Revision: **Revision Date:**

Purpose:

To establish United States Department of Energy (DOE) policies and procedures for the physical protection of DOE property and unclassified facilities and to establish baseline physical protection requirements and standards for those interests.

Section or Paragraph Citation: Section 6, Paragraphs A through F **Other:**

Description of Requirement:

The guidelines offered in this order provide procedures which should be implemented to protect property and facilities consistent with the value of such property. The objectives are to protect the area from the impact of deliberate acts of arson, civil disorder, riot, sabotage, terrorism, vandalism, and theft.

Paragraph A - Access Controls: Access to a facility should be controlled by a receptionist, whose area must be considered during the planning phase, signage prohibiting trespassing and authorizing inspection/searches of vehicles and personal items.

Paragraph B - Physical Barriers: The facility must have fences to control or impede access, the facility should also have locks and lockable door hardware.

Paragraph C: Depending on the value and the impact of loss from the facility, an intrusion and detection system should be installed with alarms. In addition, adequate illumination shall provided to detect intruders, reveal unauthorized persons, and permit examination of credentials and vehicles at entrances to the facility.

Paragraph D: Communications equipment shall be provided to allow effective protection.

Relevant to Other Areas of Review?

☐ No **How?** Planning of support facilities must consider these criteria.
☒ Yes

References to Other Sources:

DOE Order 5632.1A.

Comments:

The requirements of this section are to be considered mostly in site development and architectural development of the facility.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☒ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: QUALITY ASSURANCE

Document Number: DOE 5700.6C **Date:** 8-21-91

Revision: **Revision Date:**

Purpose:

To establish quality assurance (QA) requirements for the United States Department of Energy (DOE).

Section or Paragraph Citation: Section 9, Paragraph B, Part 2b **Other:**

Description of Requirement:

This order is a requirement to have the DOE approve the quality assurance program for all work. There is a reference under Performance Criteria 2b for Design which reads as follows:

"Items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Design work, including changes, shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by individuals or groups other than those who performed the work. Verification and validation work shall be completed before approval and implementation of the design."

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

Attachment 1 to DOE Order 5700.6C.

Comments:

The attachment to this section provides more detail for each of the criteria mentioned in the order. On Page 10, Section 2, Criterion 6, "Design," more information is offered to delineate the design criteria. These criteria should be included in the QA plan for the project. The United States Army Corp of Engineers will review the Montgomery Watson QA plan to ensure compliance with the DOE approved project QA plan.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☒ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
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☐ Federal Regulation (29 CFR)	☐ Other...

Title: RADIOACTIVE WASTE MANAGEMENT

Document Number: DOE 5820.2A **Date:** 9-26-88

Revision: **Revision Date:**

Purpose:

To establish policies, guidelines, and minimum requirements by which the United States Department of Energy (DOE) manages its radioactive and mixed wastes (MW) and contaminated facilities.

Section or Paragraph Citation: Chapters I, II, III and V, and **Other:**

Description of Requirement:

This order was designed to provide guidelines for managing high-level waste (HLW), transuranic (TRU), low-level waste (LLW), and mixed waste.

Chapter I addresses HLW management. Section 3, Paragraph A-1 addresses design requirements for new facilities.

These requirements include design objectives that will assure protection of the public and operating personnel from hazards associated with normal, HLW operations, accident conditions, and the effects of natural phenomena. Other objectives are compliance with DOE policies regarding nuclear safety, quality assurance, fire protection, pollution control, and safeguards and security protection for HLW and protection of essential operations from the effects of potential accidents.

Designs for new storage and treatment facilities shall meet the requirements of DOE Order 6430.1, Applicable EH Orders and 40 CFR 264. In addition, designs for new storage facilities shall incorporate features to facilities retrieval capability.

Chapter II deals with management of TRU waste. Section 3(a) provides information required for waste classification. Section 3(b) describes requirements for TRU waste generation and treatment. Section 3(d) dictates proper packaging requirements for TRU waste, and Section 3(g) lists requirements for interim storage, including facility design.

Chapter III deals with LLW. This chapter is also a management guideline but does contain information about waste treatment which states that wastes shall be treated by appropriate methods so that the disposal site can meet the performance objectives stated in this document. The waste treatment criteria also states that waste treatment techniques such as incineration, shredding, and compaction to reduce volume and provide more stable waste forms, shall be implemented as necessary to meet performance requirements. Use of waste treatment techniques to increase the life of the disposal facility and approved long-term facility performance, by improved site stability and reduction of infiltrating water, is required to the extent it is cost effective.

Waste treatment of LLW must also include development of treatment options considered as rationale for selection of the proposed processes, a construction design report, and a safety analysis report. In addition, documentation must be provided to describe operation and maintenance of the treatment facilities.

Chapter V addresses decommissioning of radioactively contaminated facilities. Under Section 3, Paragraph B, Facilities Design, guidelines are given for complying with the requirements of this section: "Facilities in which radioactive or other hazardous materials are utilized shall be designed to simplify decontamination and decommissioning and/or increase the potential for reuse. Features and procedures that simplify and facilitate decommissioning shall be identified during the planning and design phase based upon a proposed decommissioning method or conversion to other use. Examples of features to be incorporated are identified in DOE Order 6430.1."

In Attachment 6, Page 5, all of the documentation and report requirements are listed as they refer to specific sections of DOE Order 5820.2A.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in Attachment 1 of the document.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

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☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: GENERAL DESIGN CRITERIA

Document Number: DOE 6430.1A **Date:** 4-6-89

Revision: **Revision Date:** 12/23/92

Purpose:

To provide general design criteria (GDC) for use in the acquisition of United States Department of Energy (DOE) facilities and to establish responsibilities and authorities for the development and maintenance of these criteria.

Section or Paragraph Citation: Entire document is applicable. **Other:**

Description of Requirement:

This document provides GDC that ensure implementation of DOE's policy covering the basic architectural and engineering disciplines, certain types of known facility requirements, and specialized requirements based on programmatic and operating experience. This document should be used in conjunction with the Hanford Plant Standards General Design Criteria as the main source of information for designs.

Division 1 provides general information related to all designs. Section 0101-4 provides requirements for handicapped provisions. Sections 0106 and 0109 provide regulatory requirements and reference standards and guides. Section 0110 provides general architectural and special design requirements. This section should be reviewed completely during planning and design. Section 0110-99.0 is applicable to the Environmental Restoration Storage and Disposal Facility (ERSDF) since it is a nonreactor nuclear facility. Section 0111 provides structural design requirements and should be used for design of all structures. Quality assurance requirements are listed in Section 0140.

Division 2 describes the requirements for site and civil engineering. All portions of Section 0200, "Site Development," are applicable and should be used for planning and design of facilities. Other applicable sections requiring review include: 0201, "Subsurface Investigations;" 0202, "Surveying;" 0210, "Site Preparation;" 0215, "Shoring and Underpinning;" 0220, "Earthwork;" 0235, "Building Foundations;" 0245, "Railroad Design;" 0250, "Paving and Surfacing;" 0260, "Piped Utility Materials;" 0262, "Corrosion Control;" 0266, "Water Distribution Systems;" 0267, "Industrial Water Treatment;" 0270, "Sanitary Wastewater Collection and Stormwater Management Systems;" 0273, "Water Pollution Controls;" 0275, "Industrial Wastewater Treatment;" 0278, "Power and Lighting;" 0279, "Exterior Communications and Alarm Systems;" 0280, "Site Improvements;" 0281, Vehicular and Pedestrian Circulation;" 0283, "Physical Protection;" 0285, "Solid Waste Systems;" 0290, "Landscaping;" and 0291, "Irrigation Systems."

Division 3 covers design and construction of concrete facilities. Any of the sections covered may be applicable depending on designs. This division should be reviewed and followed for any concrete work.

Division 4 discusses requirements associated with masonry construction. This division should be used for any masonry construction for the ERSDF.

Division 5 describes requirements for metal construction and use. Applicable sections to ERSDF design and construction include 0512, "Structural Steel;" 0514, "Structural Aluminum;" 0521, "Steel Joists;" 0531, "Steel Decks;" and 0532, "Metal Fastening."

Division 6 covers design of wood and plastics. Portions of this division may be applicable depending on materials selected during design.

Division 7 details requirements for thermal and moisture protection. This division should be reviewed and will be pertinent to many areas of design.

Division 8 describes requirements for doors and windows. Sections 0800, "General;" 0810, "Metal Doors and Frames;" 0820, "Wood and Plastic Doors;" 0850, "Metal Windows;" 0870, "Hardware;" and 0880, "Glazing" are applicable to design of administrative and support facilities. The remaining sections may be applicable to design of industrial type facilities.

Division 9 discusses types of finishes and the requirements for their use. All of the sections of this division will be applicable to design of ERSDF facilities. Some of the specific items discussed include metal support systems, lath and plaster, gypsum board, tile, acoustical treatment, resilient flooring, carpet, resinous flooring, conductive flooring, special coatings, painting, and wall coverings.

Division 10 details requirements for specialties. Applicable portions of this division include 1020, "Louvers and Vents;" 1024, " Grills and Screens;" 1050, "Lockers;" 1052, Fire Protection Specialties;" 1053, "Protective Covers;" and 1080, "Toilet and Bath Accessories."

Division 11 is applicable for enclosure design such as gloveboxes.

Division 12 describes requirements for furnishings. Information contained in this division that may be applicable includes manufactured casework, window treatments, and furniture and accessories for special facilities.

Division 13 pertains to Special Facilities. This division is very important to the design of the ERSDF facility. Section 1324, "Radioactive Solid Waste Facilities," should be thoroughly reviewed and followed during the planning and design phases of work.

Division 14 lists requirements for conveying systems. Portions of 1401, "General," 1440, "Lifts," and 1460, "Cranes" are pertinent to the ERSDF design.

Division 15 covers all aspects of mechanical systems design. Some of the larger portions of design contained in this division include mechanical insulation, fire protection, plumbing and service piping, heating, ventilating and air-conditioning systems, air pollution controls, and equipment controls. Applicable sections of this division should be reviewed during the design phase of this project.

Division 16 discusses equipment and materials associated with electrical design. The sections most applicable to design include 1600, "General Requirements;" 1605, "Basic Electrical Materials and Methods;" 1630, "Exterior Electrical Utility Service;" 1639, "Grounding;" 1640, "Interior Electrical Systems;" 1650, "Exterior Lighting;" 1655, "Interior Lighting;" 1660, "Special Systems;" 1670, "Exterior Communications and Alarm Systems;" 1671, "Interior Communications and Alarm Systems;" and 1694, "Energy Conservation."

Relevant to Other Areas of Review?

☐ No
☒ Yes

How? This manual is applicable to most areas of review during the entire planning and design phases.

References to Other Sources:

References to other documents are listed in the "Referenced Documents Index" contained within the order.

Comments:

This manual should be used in conjunction with the Hanford Plant Standards General Design Criteria manual during the entire process of planning and design.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☒ DOE RL Order
- ☐ Washington State Register (WSR)
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- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
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- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: IMPLEMENTATION OF THE NATIONAL ENVIRONMENTAL POLICY ACT AT THE RICHLAND OPERATIONS OFFICE

Document Number: RL 5440.1A **Date:** 2-3-87

Revision: **Revision Date:**

Purpose:

To supplement DOE 5440.1C, *National Environmental Policy Act*, of 4-9-85, for the Richland Operations Office (RL) and RL contractors.

This document provides an environmental evaluation checklist to evaluate the impact of the project or activity. It is a precursor to an environmental impact statement (EIS).

DOE-RL Order 5440.1A is a front end document used during the preparation phase for any new projects or activities at the site.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:
As listed in document.

Comments:
NEPA documentation is to be prepared by WHC.

Requirements Identification Form

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- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
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- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: ENVIRONMENTAL SAFETY AND HEALTH PROGRAMS FOR DEPARTMENT OF ENERGY OPERATIONS FOR RICHLAND OPERATIONS

Document Number: RL 5480.1A **Date:** 9-7-88

Revision: **Revision Date:**

Purpose:

Supplement for United States Department of Energy (DOE) Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*, of 9-23-86, for the Richland Operations Office (RL); included is a list of the RL Orders that supplement Attachment 1 of DOE Order 5480.1B.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

None.

Relevant to Other Areas of Review?

☒ No **How?**

☐ Yes

References to Other Sources:

DOE 5480.1B, Supersedes DOE 5480.1, 5/21/82

Comments:

Superseded again by Attachment 1 of DOE 5480.1B, 9/23/86

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

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- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION STANDARDS FOR RL

Document Number: RL 5480.4C **Date:** 11-6-92

Revision: **Revision Date:**

Purpose:

The purpose of this document is to supplement United States Department of Energy (DOE) Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards* with additional guidance and standards to be used by the U.S. Department of Energy, Richland Field Office (RL), and its subcontractors.

Section or Paragraph Citation: Attachment 1 **Other:**

Description of Requirement:

The following documents pertaining to facility design are envoked by this Order:

(1) American National Standards Institute (ANSI) A11.1/EIS RP-7 (Table 6 only), "Practices for Industrial Lighting."

(2) ANSI A132.1/IES RP-1 (Table 6 only), *Practices for Office Lighting.*

(3) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 62-1981 (or most current edition), *Ventilation for Acceptable Indoor Air Quality.*

(4) American Conference of Governmental Industrial Hygienists (ACGIH), *Industrial Ventilation Manual.*

(5) *Rules and Regulations of the State Board of Health Regarding Public Water Systems*, State of Washington.

These documents pertain to the ERSDF design and are recommended by this Order:

(1) TID-2423, *Glovebox Fire Safety*, Factory Mutual (FM) Research Corporation 1967.

(2) *Atomic Energy Commission Fire Protection Guide - Watchman Service*, issued in 1973.

(3) *Uniform Building Code (UBC).*

(4) Energy Research and Development Administration (ERDA) 76-45, SSDC-2, *Human Factors in Design.*

(5) *Human Factors Engineering Design Guidelines*, Westinghouse Hanford Company, SD-RG-DGS-003.

(6) WASH 1279, *Directory of Packagings for Transportation of Radioactive Materials*.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

References are listed in above text.

Comments:

This document is intended mainly for ES&H personnel use and for safety during construction activities, but referenced documents should be reviewed during design to ensure compliance.

Requirements Identification Form

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- ☐ Local Law
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- ☐ EPA
- ☐ Other...

Title: SAFETY ANALYSIS AND REVIEW SYSTEM

Document Number: RL 5481.1 **Date:** 10-5-83

Revision: **Revision Date:**

Purpose:

Supplement United States Department of Energy (DOE) Order 5481.1A, Safety Analysis and Review System, and establish requirements and procedures for preparation and review of safety analyses and authorization of operations under the jurisdiction of the DOE Richland Operations Office.

Section or Paragraph Citation: **Other:**

Description of Requirement:

The provisions of this order apply to RL and RL Contractor organizations and is applied more to an administrative requirement than a design requirement.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

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☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: RADIOACTIVE WASTE MANAGEMENT

Document Number: RL 5820.2A **Date:** 8-15-90

Revision: **Revision Date:**

Purpose:

To supplement United States Department of Energy (DOE) 5820.2A, "Radioactive Waste Management," of 9-26-88 by establishing Hanford-specific policies, guidelines, and requirements by which the DOE Richland Operations (DOE-RL) manages its radioactive waste, mixed waste and contaminated facilities.

Section or Paragraph Citation: Chapters II and III **Other:**

Description of Requirement:

The following are examples of DOE requirements that should be considered for the design of new waste management facilities.

(1) Siting approval shall be obtained from the Hanford Site selection team. The siting of new facilities shall comply with the requirements of DOE-RL Order 4320.2C.

(2) New Waste Management (WM) facilities shall incorporate DOE Order 4700.1 and the design requirements of DOE Order 6430.1A and DOE-RL Order 6430.1C.

(3) New WM facilities shall incorporate quality assurance requirements of DOE Order 5700.6B and DOE-RL Order 5700.1A.

(4) New WM facilities shall incorporate environmental protection, safety and health protection standards, DOE Order 5480.4 and DOE-RL Order 5480.4A.

(5) New WM facilities shall incorporate fire protection standards, DOE Order 5480.7 and DOE-RL Order 5480.7A.

(6) New WM facilities shall incorporate environmental standards found in DOE Order 5400.1, DOE Order 5400.2A, DOE Order 5440.1C, DOE-RL Order 5440.1A, DOE Order 5480.1B, and DOE-RL Order 5480.1A.

(7) New WM facilities that will handle transuranic mixed waste (TRU-MW), or low-level mixed waste (LLW-MW) shall incorporate the requirements of Title 40 LCode of Federal Regulations (CFR) 260-27, and State of Washington Administrative Code (WAC) 173-303 and WAC 175-480.

The following are requirements for shipping radioactive materials.

(1) Packaging and shipping shall be conducted in accordance with the DOE requirements, DOE Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes."

(2) Shipping of radioactive or mixed waste on Hanford roads open to public access shall be conducted in accordance with Department of Transportation (DOT) regulations. Other shipments shall be made in accordance with DOT regulations except where alternative procedures are authorized by an applicable DOE Order. Departure from the DOT regulations should be documented in a Safety Analysis Report for Packaging (SARP).

(3) Packaging and shipping of the hazardous constituents of mixed waste shall comply with the applicable provisions of WAC Chapter 173-303, "Dangerous Waste Regulations."

The following are requirements for Transuranic (TRU) Waste Packaging.

(1) As a minimum, containers for solid TRU waste shall be noncombustible and shall meet all the applicable requirements of 49 CFR 173.412 for Type A packaging.

(2) All TRU waste containers shall be equipped with a passive release device to mitigate the buildup of hydrogen as specified by the Waste Isolation Pilot Plant (WIPP)-WAC.

Solid low-level waste (LLW) shall be designed to meet the following objectives in accordance with schedule guidance in DOE 5820.2A, Chapter III, Paragraph 3a.

(1) Disposal systems for solid LLW shall be designed to ensure that exposure to any member of the public that results from disposal of solid LLW shall not exceed 25 millirem (mrem)/yr effective dose equivalent (EDE) through all exposure pathways for at least 1,000 years after disposal. The point of compliance shall be no further from the edge of the waste than the Hanford Site boundary during the period of active institutional control. After the active institutional control period (assumed to be not more that 100 years) the point of compliance shall be not more than 100 meters from the edge of the disposal site.

(2) Disposal systems shall be designed to ensure that disposal of LLW does not result in concentrations of radionuclides (above existing levels) in groundwater exceeding those corresponding to an EDE of 4 mrem/yr to any person who might drink 2 liters per day of water from a well drilled into the aquifer, for at least 1,000 years after disposal. The point of compliance shall be no further than 100 meters from the edge of the waste.

(3) Reasonable effort shall be made to design disposal systems in such a way that potential exposures are As Low As Reasonably Achievable (ALARA) for all times up to the year of maximum exposure. If the predicted population exposure is less than 500 person-rem/yr in the year of maximum exposure, the ALARA requirement is defined to have been complied with.

(4) Disposal closure systems shall be designed to ensure that exposure to individuals who inadvertently intrude the closed facility after the active institutional control period shall not exceed 100 mrem/yr for continuous exposure, or 500 mrem for a single acute exposure. For wastes that may remain hazardous to inadvertent intruders beyond 100 years, passive controls shall be incorporated to provide reasonable assurance that inadvertent intruders will be warned and deterred from disturbing the site for up to 500 years.

(5) Disposal systems shall be designed to meet the applicable requirements of 40 CFR 264 and 265, and WAC 173-303 for the disposal of LLW-MW.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

Applicable references are listed in the text above.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☒ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
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☐ Federal Regulation (29 CFR)	☐ Other...

Title: HANFORD PLANT STANDARDS (HPS) PROGRAM

Document Number: RL 6430.1C **Date:** 3-5-90

Revision: **Revision Date:**

Purpose:

This Order sets forth United States Department of Energy Richland Operations Office (RL) requirements for preparation, application, and use of the *Hanford Plant Standards*

Section or Paragraph Citation: Section 4 **Other:**

Description of Requirement:

This document lists the policies of RL to use all applicable Federal laws and departmental orders, health and safety, environmental, quality and security requirements during design, construction, and maintenance of facilities at the Hanford Site. Section 4 of this order outlines the policy for using *Hanford Plant Standards* and applicable policies and orders during the design and engineering phase of any project at the site.

This order is most applicable to management and planning issues and should probably be reviewed during the planning phase of the project.

Relevant to Other Areas of Review?

☐ No
☒ Yes

How? This order supersedes DOE-RL Order 6430.1B, *Hanford Plant Standards*, 10/31/88.

References to Other Sources:

References general design criteria provided in DOE Order 6430.1A.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
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- ☐ EPA
- ☐ Other...

Title: DANGEROUS WASTE REGULATIONS

Document Number: WAC-173-303 **Date:** 4-1-91

Revision: **Revision Date:**

Purpose:

This implements the Hazardous Waste Act of 1976. It designates those solid wastes that are hazardous to public health and the environment, provides for surveillance and monitoring of hazardous waste until it can be disposed of safely, and provides a form for tracking and labeling waste. This order establishes siting design guidance for operations and operational, financial, and monitoring requirements for hazardous waste facilities.

Section or Paragraph Citation: As listed below. **Other:**

Description of Requirement:

Washington Administrative Code (WAC) 173-303-016 defines solid waste as any discarded material that is not excluded by WAC 173-303-017(2), or that is not excluded by variance granted under WAC 173-303-017(5).

WAC 173-303-040 provides definitions of terms as used in the contents of this text.

WAC 173-303-070 through WAC 173-303-104 defines dangerous waste and requirements for designation as such.

WAC 173-303-110 discusses sampling and testing methods.

WAC 173-303-140 describes land disposal restrictions. Some of the restricted materials include extremely hazardous waste (EHW), liquid waste, ignitable and reactive waste, solid acid waste, organic/cargonaceous waste, leachable inorganic waste, dioxin containing wastes, and solvent wastes.

WAC 173-303-150 describes the requirements for division, dilution, and accumulation. This section states that any action taken to evade the intent of this regulation by dividing or diluting wastes to change their designation shall be prohibited, except for the purposes of treating, neutralizing, or detoxifing such wastes.

WAC 173-303-160 describes requirments for containers. This section defines when a container or inner liner is "empty."

WAC 173-303-210 and WAC 173-303-281 discusses generator, transporter, and waste management facilities recordkeeping and reporting requirements.

Under WAC 173-303-282: "Siting Criteria," Section 6 lists criteria that will be used for initial screening in the selection of sites. The criteria are divided into five categories including earth, air, water, plants and animals, and precipitation.

Under the earth category, the following requirements are listed. All waste management facilities shall be located such that the unit boundary is located at least 500 feet from a fault which has had displacement in Holocene times. No dangerous waste management facility shall be located such that the unit is within an area of subsidence. No facility shall be located such that the unit is within an area of slope or soil instability, nor in the areas affected by unstable slope or soil conditions.

This air subsection addresses air quality impacts from incinerator facilities.

The water subsection requires the following. No facility shall be located within the 100-year flood plain as indicated in the most current Federal Emergency Management Agency (FEMA) maps. Landbased facilities located near coastal areas shall not be located within the 500-year floodplain as indicated by the most current FEMA maps. Landbased facilities shall be located such that the unit boundary is at least 1/4 mile from a perennial surface water body. No facility shall be located in a water shed identified by the Department of Health. Landbased facilities shall be located such that the unit boundary is at least 1/4 mile from the nearest surface water intake for domestic water. Proposed landbased facilities shall comply with the contingent groundwater protection program, WAC 173-303-806(4)a(xxi), during the permitting process. Landbased facilities shall not be located in areas where there is less than 50 feet vertical separation between the lowest point of the management unit and the seasonal high level of the uppermost aquifer of beneficial use. No landbased facility shall be located over an area designated as a sole source aquifer. If the facility is within a groundwater management area, it should be identified prior to proceeding with planning and design. Landbased facilities shall be located such that the unit boundary is at least 1/4 mile from the nearest groundwater intake for domestic water. Landbased facilities shall not be located within groundwater special protection areas designated under 90.48 Revised Code of Washington (RCW).

The plants and animals subsection requires that landbased facilities be located such that the unit boundary is at least 1/4 mile from: wetlands, designated critical habitat for Federally listed threatened or endangered species, habitat essential to the maintenance or recovery of an endangered species, designated natural area preserves, State or Federally designated wildlife reserve, preserve, or bald eagle protection areas.

Landbased facilities should not be located in areas having a mean annual precipitation level of greater than 100 inches.

The criteria for siting facilities are used as initial screening tools in the selection of sites. Landbased facilities shall be located such that the unit boundary is at least 500 feet from the nearest point of the facility property line. Management facilities shall not be located within the view shed of users on wild and scenic rivers designated by the State or Federal Government. Landbased facilities shall be located such that the unit is at least 500 feet from state or Federally designated park recreation or national monuments, wilderness areas, land identified as prime farmland, and shall be located such that the unit boundary is at least 1/4 mile from residences or public gathering places. In addition, no management facility shall be located in an archeological site or historic site designated by the State or Federal Government.

WAC 173-303-283 provides general performance standards for designing, constructing, operating, and maintaining dangerous waste facilities. These standards require the owner/operator to design, construct, operate, or maintain the facility in a manner that, to the maximum extent practical given the limits of technology, prevents: degradation of groundwater quality; degradation of air quality by open burning or other activities; degradation of surface water quality; destruction or impairment of flora and fauna outside the active portion of the facility; excessive noise;

conditions that constitute a negative aesthetic impact; unstable hillsides; endangerment of the health of employees or the public; or the use of processes that do not treat, detoxify, recycle, reclaim, and recover waste material to the extent economically feasible.

WAC 173-303-310 describes security requirements including physical barriers, natural barriers, signage, and surveilance.

WAC 173-303-340, "Preparedness and Prevention," details requirements for communication and alarm systems.

WAC 173-303-610 describes closure and postclosure requirements for owners and operators of dangerous waste facilities.

WAC 173-303-630 discusses the use and management of containers. This section requires that containers are in good condition, identifiable, and compatible with waste types.

WAC 173-303-640 is applicable to design of tank systems for treatment or storage of dangerous waste.

WAC 173-303-650, "Surface Impoundments," states that a surface impoundment must have a liner that is designed, constructed, and installed to prevent any migration of wastes out of the impoundment. This section discusses methods for accomplishing this.

WAC 173-303-655 describes requirements for treatment of dangerous waste for land disposal.

WAC 173-303-665, "Landfills," provides requirements similar to those listed in WAC 173-303-650, but should be reviewed during design of the disposal cells.

WAC 173-303-800 through 830 provide permitting requirements. Applicable sections should be reviewed to ensure that MW has provided adequate information to United States Army Corp of Engineers (USACE).

Relevant to Other Areas of Review?

☐ No **How?** This guidance will impact the selection of the main landfill site.
☒ Yes

References to Other Sources:

As listed in document.

Comments:

Conflicts with the requirements listed in WAC 173-303-282 should be addressed prior to proceeding with design.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☒ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: AMBIENT AIR QUALITY STANDARDS AND EMISSION LIMITS FOR RADIONUCLIDES

Document Number: WAC 173-480 **Date:** 5-7-86

Revision: ______ **Revision Date:** ______

Purpose:

The purpose of this document is to define maximum allowable levels for radionuclides in the ambient air and control emissions from specific sources.

Section or Paragraph Citation: **Other:**

Description of Requirement:

"Emissions of radionuclides in the air shall not cause a maximum accumulated dose equivalent of more than 25 mrem/y to the whole body or 75 mrem/y to the critical organ of any member of the public. Compliance with the standard shall be determined by procedures in Washington Administrative Code (WAC) 173-480-070."

Paragraph 060 "Whenever the construction, installation, or establishment or a new emission unit subject to this chapter is contemplated, the project shall utilize best available radionuclide control technology (BARCT)."

This section references the As Low As Reasonably Achievable (ALARA) standards that have been adopted by Westinghouse Hanford Company (WHC).

Relevant to Other Areas of Review?

☐ No **How?** Must be cross-references to ALARA standards.
☒ Yes

References to Other Sources:

DOE Order 5400.5

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order
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☐ Washington State Register (WSR)
☒ Washington Administrative Code (WAC)
☐ Federal Regulation (40 CFR)
☐ Federal Regulation (10 CFR)
☐ Federal Regulation (29 CFR)
☐ DOE Agreement
☐ DOE Bulletin
☐ WHC Code or Standard
☐ Local Law
☐ RCW
☐ EPA
☐ Other...

Title: CROSS-CONNECTION CONTROL

Document Number: WAC-246-290-490 **Date:** 1-31-92

Revision: **Revision Date:**

Purpose:

To assign the responsibility of protecting the public water systems from contamination due to cross-connections by developing and implementing a cross-connection control program.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

To develop and implement a cross-connection control program acceptable to the United States Department of Health. The scope and complexity of the program shall be directly related to the size of the system and the potential public health risk. A department of Health Planning Handbook is available to assist in developing this program. The most recently published edition of the handbook titled "Accepted Procedure and Practice in Cross-Connection Control-Pacific Northwest Section-American Waterworks Association". This manual must be used in planning and designing at the facility to manage and control cross-connections.

In essence, this section prohibits the installation or design of cross-connections that may cause a potential health or system hazard. Systems are also to include backflow prevention assemblies which may include an air gap separation device or a reduced pressure principal backflow prevention assembly (RPBA). These devices, in combination with a double check valve backflow prevention assembly or a pressure vacuum breaker assembly, should be installed according to the guidance information. Installation of any system must be completed using approved cross-connection control assembly hardware which is listed by the State. The equipment must be properly maintained, inspected annually, and certified by a Washington State Certified Backflow Assembly Tester.

Relevant to Other Areas of Review?

☐ No **How?** Must be checked during the utility development portion of the design.
☒ Yes

References to Other Sources:

As listed in document.

Comments:

The manual entitled "Accepted Procedure and Practice in Cross-Connection Control" published by the American Waterworks Association should be obtained to ensure that the water supply system complies with the regulations outlined in this order.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☒ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: PUBLIC WATER SUPPLIES, CROSS-CONNECTION CONTROL

Document Number: WAC-248-54-285 **Date:** 11-10-89

Revision: OUT **Revision Date:** 1-31-91

Purpose:

None.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

None.

Relevant to Other Areas of Review?

☒ No **How?**

☐ Yes

References to Other Sources:

Recodified as Washington Administrative Code (WAC) 246-290-490

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☒ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: RESOURCE CONSERVATION AND RECOVERY ACT

Document Number: CFR 260-270 **Date:** 7-1-92

Revision: **Revision Date:**

Purpose:

The purpose of Resource Conservation and Recovery Act (RCRA) is to define hazardous waste and to set requirements for those who generate, transport, treat, store, and/or dispose of such waste products for the protection of our natural resources.

Section or Paragraph Citation: Entire document. **Other:**

Description of Requirement:

Part 260 describes general requirements for a hazardous waste management system. This part discusses definitions and rulemaking petitions requirements.

Part 261 identifies those solid wastes which are subject to regulation as hazardous wastes under parts 262 through 265, and parts 268, 270, 271, and 124, and are subject to the notification requirements of section 3010 of RCRA. Wastes can be considered hazardous by characteristics or by listing.

Part 262 details documentation requirements for generators of hazardous waste.

Part 263 establishes standards for transferring hazardous waste.

Part 264 defines minimum standards for the disposal of hazardous waste as follows:
Subpart C, "Preparedness and Prevention," describes design and operation of facilities, required equipment, and required aisle space to minimize consequences in the event of an accident.
Subpart E describes manifest systems, recordkeeping and reporting requirements which is applicable to automation strategy development.
Subpart G discusses closure and post-closure requirements. Section 264.111 describes closure performance standards.
Subpart H requires a cost estimate for closure to be performed during original design (264.142).

Subpart I dictates requirements for the use and management of containers.
Subpart J lists requirements for tank systems. The most applicable potion of this subpart is 264.192 which discusses design and installation of new tank systems or components.
Subpart K establishes requirements for surface impoundments. Section 264.221 details requirements for design and operation.
Subpart M sidcusses land treatments.

Subpart N lists landfill requirements. Section 264.301 details design and operating requirements. Appendix I provides recordkeeping instructions.

Part 265 provides interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities. This part is not applicable to Environmental Restoration Storage and Disposal Facility (ERSDF) design.

Part 266 details standards for the management of specific hazardous wastes and specific types of hazardous waste management facilities, particularly those dealing with recyclable materials.

Part 267 provides interim standards for owners and operators of new hazardous land disposal facilities.

Part 268 identifies and defines hazardous wastes that are restricted form land disposal.

Part 270 describes the hazardous waste permit program.

Relevant to Other Areas of Review?

☐ No **How?** Submittals required by this document will be submitted for EPA approval and
☒ Yes requirements may be modified during the review and approval process.

References to Other Sources:

As listed in document.

Comments:

WHC has the responsibility for completion of regulatory documentation, and specific design details will be defined as a part of this process. Montgomery Watson will be responsible for completion of submittals required for Part B Application, Chapters 2 and 4.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
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- ☐ Federal Regulation (40 CFR)
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- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Document Number: CFR 1910 **Date:** 7-1-91

Revision: **Revision Date:**

Purpose:

The purpose of this document is to establish standards with which industries are generally familiar for the protection of occupational workers.

Section or Paragraph Citation: As listed below. **Other:**

Description of Requirement:

Subpart D provides requirements for walking and working surfaces. This subpart details requirments for guarding floor and wall openings (1910.21), stairs (1910.24), ladders (1910.27), and scaffolding (1910.28).

Subpart E describes requirements for means of egress from facilities and working areas. This section is very important in facility design. Appllicable sections include Definitions (1910.35), General Requirements (1910.36), and Means of Egress, General (1910.37).

Subpart G discusses occupational health and environmental control. This includes ventilation (1910.94), noise (1910.95), and ionizing and noniodizing radiation (1910.96-97). This informatin may affect design choices in relation to equipment and operation.

Subpart H provides information in relation to hazardous materials. Section 1910.106, Flammable and Combustible Liquids, is applicable to design of aboveground and underground storage tanks, facilities layout, bulk plant storage, piping, valves and fittings. Sections directly affecting design include 1910.106(b)(2)(ii), (iv), (v), (vi), and (viii); 1910.106(b)(3); 1910.106(c); 1910.106(e); and 1910.106(f).

Subpart I provides requirements for personal protective equipment. Section 1910.134(d), Air Quality is applicable to breathing air system design.

Subpart J discusses general environmental controls which include sanitation (1910.141), and color code for marking physical hazards (1910.144(a)). The sanitation section discusses applicable requirements for water supply, toilet facilities, washing facilities, change rooms, eating and drinking areas and waste disposal.

Subpart L describes requirments for fire protection. Pertinent information includes requirements for all portable and fixed fire suppression systems (1910.159-163), fire detection systems (1910.164), and employee alarm systems (1910.165).

Subpart Q, Section 1910.254 provides information on arc welding environmental conditions and equipment design.

Subpart S provides electrical requirements, which include wiring design and protection (1910.304), and designs for hazardous locations (1910.307).

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in text.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

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- ☐ DOE Order
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- ☒ DOE Bulletin
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- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: GUIDANCE ON PERFORMANCE OF FIRE HAZARDS ANALYSIS

Document Number: DOE MEMO FROM EH-31.3 **Date:** 11-7-91

Revision: **Revision Date:**

Purpose:

The purpose of this memorandum is to provide interim guidance on the development of fire hazards analyses (FHA) for United States Department of Energy (DOE) facilities pending the development and issuance of a DOE standard.

Section or Paragraph Citation: Entire memorandum. **Other:**

Description of Requirement:

This document provides general information required to prepare a FHA for a DOE facility. This document should be followed during preparation of FHA for the Environmental Restoration Storage and Disposal Facility (ERSDF).

Relevant to Other Areas of Review?

☐ No **How?** FHA must be prepared and approved prior to final facility design.
☒ Yes

References to Other Sources:

As listed in document.

Comments:

Although this document is not directly related to design, the FHA will be very important to facility design.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
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- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: HANFORD PLANT STANDARDS DESIGN CRITERIA MANUAL

Document Number: HPSDCM **Date:** 10-2-91

Revision: 4 **Revision Date:** 12-23-92

Purpose:

To supplement United States Department of Energy (DOE) Order 6430.1A and to establish standards and requirements for the design of DOE facilities at the Hanford site.

Section or Paragraph Citation: Sections as listed below. **Other:**

Description of Requirement:

This manual provides standard design criteria (SDC) for design of all new facilities within the Hanford DOE Site. Requirements of national codes, standards, and specifications are, in many cases, modified, made more restrictive, or additional requirements imposed by this document. The criteria established in this manual are to be followed during the entire planning and design process.

Section 1 provides general information related to all types of design. SDC-1.2 provides reference to applicable Hanford Plant Standards, National Codes and Standards, and DOE Orders. SDC-1.3 provides information on preparation and control of engineering and fabrication drawings.

Sections 3 and 4 provide information on Architectural/Civil portions of the design. SDC-3.1 provides standard design criteria for railroads. SDC-3.2 specifies minimum depth requirements for underground water lines. SDC-4.1 provides design loads for facilities at the Hanford site. Parts A, "General Design Requirements;" C, "Safety Class 2, 3, and 4 Structures, Systems and Components;" D, "Elevated Steel Water Tanks, Standpipes, and Reservoirs;" E, "Chimneys and Stacks;" F, Foundations and Retaining Walls;" G, "Soil Pressures;" and H, "Load Combinations and Allowable Stresses" are applicable to the Hanford Site Environmental Restoration Storage and Disposal Facility (ERSDF). SDC-4.2 covers design and installation of expansion anchors.

Section 5 provides guidance on mechanical portions of the work. SDC-5.1 provides site- specific information for design of heating, ventilating, and air conditioning systems.

Section 7 details requirements for design and installation of electrical systems. SDC-7.2 provides requirements for outside lighting and aerial distribution systems. SDC-7.4 details underground power distribution requirements. SDC-7.5 describes requirements for interior power and lighting. SDC-7.7 provides guidance for communication, signaling, and low-voltage control sytems. SDC-7.8 covers requirements for fire alarm systems.

Section 8 lists requirements for safeguards and security system design. SDC-8.1 provides installation details for safeguards/security equipment.

Relevant to Other Areas of Review?

☐ No **How?** This manual modifies, makes more restrictive, or adds to requirements of
☒ Yes national codes, standards and specifications.

References to Other Sources:

References to other documents are described in SDC-1.2.

Comments:

This manual should be used in conjunction with DOE Order 6430.1A during the entire process of planning and design.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: MANAGEMENT REQUIREMENTS AND PROCEDURES

Document Number: WHC-CM-1-3 **Date:** 1-31-89

Revision: **Revision Date:**

Purpose:

This document establishes responsibilities, requirements, and procedures for the implementation of the provisions of applicable United States Department of Energy (DOE) Directives within Westinghouse Hanford Company (WHC). Including, but not limited to, General Management, Financial & Administrative Services, Information Resource Management, Human Resources, Operations Assurance, and Technical & Operational Services.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

None.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

Mostly applicable to program and project management, no specific design guidelines.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☒ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: WHC RADIOLOGICAL CONTROL MANUAL

Document Number: WHC-CM-1-6 **Date:** 4-30-93

Revision: 0 **Revision Date:**

Purpose:

This manual provides a consolidated summary of radiological safety requirements for Westinghouse Hanford Company (WHC) operations. It combines radiation protection criteria and standards of the Hanford Site Radiological Control Manual (HSRCM) with supplemental requirements of WHC. The radiation protection requirements of this manual are responsive to the applicable requirements of the U.S. Department of Energy and other regulatory agencies.

Section or Paragraph Citation: As listed in body of text. **Other:**

Description of Requirement:

Technical requirements for the conduct of work, including construction, modifications, operations, maintenance, and decommissioning, shall incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA.

Chapter 3, Section 311 requires that all permanent high radiation areas have barriers that prevent unauthorized entry, such as fences or walls with entrances that are locked or guarded at all times.

Chapter 3, Section 334 requires that at least one of the following systems be used for entry control into a very high radiation area: control devices on each access point that automatically prevent entry when a very high radiation area exists; a control device that causes a conspicuous visible or audible alarm; alarm devices that automatically cause audible and visible signals to alert personnel in the area before the radiation source is used or operated; or a key control system for locked access points shall be established, with the number of keys limited and their use controlled.

Chapter 3, Section 337 requires that measures be used to prevent the spread of contamination across the boundary of Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas. Requirements include: use of solid barriers to enclose areas wherever practicable; marking of items such as hoses and cords that cross the boundary; control and direction of airflow from areas of lesser to greater removable contamination potential; and use of engineering controls and containment devices such as glovebags, gloveboxes, and tents.

Chapter 4, Section 451 describes the requirements for minimization and control of radioactive liquid wastes. Section 452 lists requirements for radioactive drains. These sections should be reviewed during planning and design stages for the ERSDF Decontamination Facility.

Chapter 4, Section 453 requires that processes and activities that have the potential to produce airborne radioactivity include engineering controls to limit releases.

Relevant to Other Areas of Review?

☐ No **How?** Applicable sections of this document require further review during layout of
☒ Yes radiation control zones and design of radiation liquid waste generating facilities.

References to Other Sources:

See Appendix "References" contained within the manual.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☒ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☐ Other...

Title: HAZARDOUS MATERIAL PACKAGING AND SHIPPING

Document Number: WHC-CM-2-14 **Date:** 8-30-88

Revision: 9 **Revision Date:** 4-30-93

Purpose:

This manual defines the requirements, responsibilities, and procedures necessary to ensure all hazardous material shipments are packaged and transported in a manner that complies with all the appropriate regulations and minimizes risk to the employees, the shipping industry, the public, and the environment.

Section or Paragraph Citation: Part II, Section 3.5 **Other:**

Description of Requirement:

This document requires compliance with United States Department of Energy, Richland Operations Office (DOE-RL) Order 5480.1, "Environmental Protection, Safety, and Health Protection Program for RL," Chapter III, 'Safety Requirements for the Packaging of Fissile and Other Radioactive Materials.'

This order requires that all radioactive material at the Hanford Site is prepared, packaged, and transported according to the requirements of Chapter III, paragraphs 8.a through 8.f. In summary, this order requires that all radioactive material be shipped in approved Department of Transpertation (DOT)/DOE/Nuclear Regulatory Commission (NRC) packages whenever technically and economically practicable for onsite shipments. An equivalent degree of safety to DOT/DOE/NRC approved packages is provided for onsite shipments if DOT/DOE/NRC approved packages are not technically or economically feasible (see Attachment I of DOE-RL Order 5480.1, Chapter III, for requirements).

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:
None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

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- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: QUALITY ASSURANCE MANUAL

Document Number: WHC-CM-4-2 **Date:** 1-21-91

Revision: **Revision Date:**

Purpose:

The purpose of this document is to provide Westinghouse Hanford Company (WHC) Quality Assurance (QA) Program requirements for design, control, construction, and testing to ensure adequacy of design, quality of construciton, and quality of manufactured components.

Section or Paragraph Citation: Entire Document. **Other:**

Description of Requirement:

This procedure provides the WHC QA Program requirements for administrative, financial, process, test and document control. This procedure also provides the WHC QA Program requirements for instructions, procedures and drawings; identification and control of of items; handling, storage, and shipping; audits and corrective action.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

QA should be integrated into the design process.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: INDUSTRIAL SAFETY MANUAL SAFETY STANDARDS

Document Number: WHC-CM-4-3 **Date:** 1-21-93

Revision: **Revision Date:**

Purpose:

This is an overview of the Westinghouse Hanford Company (WHC) Industrial Safety Program and establishes the role of the Industrial Safety Manual in the overall program.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

Requirements for preparation of operation procedures.

Relevant to Other Areas of Review?

☐ No **How?** Use in conjunction with other safety planning documents.

☒ Yes

References to Other Sources:

Industrial Safety Manual Vol. 2-4.

Comments:

Cross-reference to :

29 Code of Federal Regulations (CFR), 1910, Occupational Safety and Health Act
United States Department of Energy, Richland Operations Office (DOE-RL) Order 5480.4A Environmental Protection, Safety and Health Protection Standards for RL
DOE Order 5481.1, Safety Analysis and Review System
DOE Order 5400.5, Radiation Protection of the Public and Environment

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
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- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: RADIOLOGICAL DESIGN

Document Number: WHC-CM-4-9 **Date:** 9-15-88

Revision: **Revision Date:**

Purpose:

The purpose of this manual is to provide radiological safety requirements, standards, and information necessary for designing facilities that will operate without unacceptable risk to personnel, the public, or the environment as required by the United States Department of Energy (DOE).

Section or Paragraph Citation: Sections as listed in text below. **Other:**

Description of Requirement:

This manual provides guidelines for design of all new facilities which handle or process radioactive wastes or materials.

The design criteria outlined in this manual have been divided into sections that focus on facility layout, piping, and construction of employee protection equipment and devices. Criteria for layout of the facility are divided into controlled and uncontrolled areas, regular radiation and high radiation areas, and corridors and normal traffic patterns through the facility.

Section 3 on contamination control makes recommendations for design of backup operation systems, radioactive contaminant confinement areas, and architectural and structural elements to the building that include change rooms, offices, laboratories, and decontamination areas.

Section 4 outlines requirements for mechanical portions of the design including ventilation and process piping, vessels and equipment.

Section 5 of this document details the requirements for selecting work places and gives criteria for exposure levels, shielding, confinement/enclosure, and applicable maintenance requirements for handling, storing, and disposing of different kinds of wastes.

Section 6 provides instructions for the design of gloves boxes, Section 7 lists the requirements for design of hot cells, and Chapter 8 defines the criteria for radiation shields.

Section 9 provides information for installing radiation generating devices like x-ray and gamma ray sources which are not expected to be used at the Environmental Restoration Storage and Disposal Facility (ERSDF) facility.

Section 10 offers guidelines for sampling and monitoring of air and liquids within the facility with specific guidelines on the design and function of the monitoring devices and systems.

Chapter 11 sites criteria for the construction of solid and liquid radioactive waste handling and storage areas as well as waste disposal procedures. The criteria apply to collection systems, piping waste transfer stations, and control and instrumentation for monitoring and sampling the waste streams.

Relevant to Other Areas of Review?

☐ No **How?** This manual must be consulted during design of all the non-landfill elements of
☒ Yes the facility.

References to Other Sources:

Each of the sections in this manual has a separate paragraph of listed references that should be reviewed during each aspect of design.

Comments:

Radiological design is intrinsic to good health and safety protection of the workers at the facility. The criteria listed in this manual must be closely referenced to information in DOE Order 6430.1A, *General Design Criteria.*

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: RADIATION PROTECTION

Document Number: WHC-CM-4-10 **Date:** 1-21-91

Revision: 14 **Revision Date:** 6-2-91

Purpose:

The purpose of this manual is to establish the requirements relative to the Westinghouse Hanford Company (WHC) radiation protection program. This program is established to ensure that radiation exposure to WHC employees, visitors, and the general public is maintained As Low As Reasonably Achievable (ALARA), and below U.S. Department of Energy (DOE) limits.

Section or Paragraph Citation: Sections as listed below. **Other:**

Description of Requirement:

Section 1, paragraph 5.1 states that the design of new facilities and modifications to existing facilities shall conform to the radiological design requirements of DOE Order 6430.1A, *General Design Criteria*," and the *Radiological Design manual*, WHC-CM-4-9.

Section 10, paragraph 3.3 requires project management to ensure that new or modified facilities, systems, and equipment are designed and constructed in accordance with accepted radiological control principles to minimize radiation levels in the workplace. Paragraph 4.2 defines requirements for control of radiation areas. Many of the control systems will be part of the facility design and need to be reviewed prior to facility layout. Paragraph 4.3 defines shielding requirements and paragraph 4.4 describes fixed radiation monitoring instrumentation requirements.

Section 11, 4.5.1 details the general requirements for radioactive material storage. Items 14 through 17 describe ventilation and barrier requirements.

Section 12, 4.4 discusses area classification and controls. This section should be referred to for establishing radiation control areas and the physical properties of them.

Section 15, 4.1 requires that the prevention of internal deposition of radionuclides shall be accomplished by the use of engineered control measures (containment, ventilation, etc.) to the extent practicable. The design, modification, and upgrade of air sampling and monitoring equipment and programs shall comply with WHC-CM-4-9, *Radiological Design*. Paragraph 4.2.4 describes the design and placement of fixed record samplers and continuous air monitoring units.

Relevant to Other Areas of Review?

☐ No **How?** The requirements of this document will impact the layout and design of
☒ Yes radiation control areas and facilities.

References to Other Sources:

DOE Order 5480.11, "Radiation Protection for Occupational Workers"
DOE-RL Order 5480.11 "Requirements for Radiation Protection"
WHC documents as listed in Section 1, paragraph 1.3

Comments:

Portions of this document should be reviewed during planning and architectural development stages to ensure adequate radiation protection.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: ALARA PROGRAM MANUAL

Document Number: WHC-CM-4-11 **Date:** 4-20-92

Revision: ______ **Revision Date:** ______

Purpose:

The purpose of the Westinghouse Hanford Company (WHC) As Low As Reasonably Achievable (ALARA) Program manual is to delineate and specify authorities, responsibilities, requirements, policies, procedures, and guidelines for implementing ALARA principles.

The goal and objective of the ALARA Program is to minimize human and environmental exposures to radiation and hazardous substances and conditions, commensurate with sound economics and operating practices.

Section or Paragraph Citation: Section 2 and Section 5.1.2. **Other:**

Description of Requirement:

This manual describes the ALARA checklist which has two sections. Section 1 identifies criteria to be used for facility review, and Section 2 identifies the criteria for system design. This program manual describes the requirements for completing the checklist, complying with applicable codes, and completing a cost benefit analysis and other ALARA analysis documentation. The program manual does not have a copy of the checklist.

Section 5.1.2, Paragraph 4, states that the checklist is to be completed during the conceptual design phase and updated as required during modifications to ensure that ALARA concepts are incorporated and considered throughout the design and modification phases. The ALARA checklist is intended to be used as a guidance tool in conjunction with established design criteria.

Relevant to Other Areas of Review?

☐ No **How?** The checklist sited in this manual is a required submittal according to WHC.
☒ Yes

References to Other Sources:

As listed in document.

Comments:

The ALARA checklist is Form #A-6000-291: macro WEF042. The manual indicates that this checklist should be managed using specific requirements and procedures. The program manual provides guidance on how that is done.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: FIRE PROTECTION PROGRAM MANUAL

Document Number: WHC-CM-4-41 **Date:** 9-7-92

Revision: **Revision Date:**

Purpose:

The first purpose of this manual is to provide employees who are not fire protection professionals with the information necessary to ensure that Westinghouse Hanford Company's (WHC) commitment to uncompromising integrity and adherence to the highest safety standards are met.

Section or Paragraph Citation: Entire document. **Other:**

Description of Requirement:

This manual provides requirements for testing, inspection, handling and storage of flammable materials, the use of equipment in hazardous areas, and fire protection requirements and responsibilities for WHC facilities.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

DOE 5480.7A Fire Protection
DOE 6430.1A General Design Criteria
NFPA

Comments:

Mostly handling and record keeping requirements, should be consulted during planning.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
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- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: NON-REACTOR FACILITY SAFETY ANALYSIS MANUAL

Document Number: WHC-CM-4-46 **Date:** 1-21-91

Revision: **Revision Date:**

Purpose:

This manual provides the uniform requirements for all Westinghouse Hanford Company (WHC) staff and management who have primary responsibilities for ensuring safe operation of a nonreactor facility and providing proper safety documentation, to aid in compliance with safety analysis-related requirements in United States Department of Energy (DOE) orders and WHC management policies, and to establish criteria, procedures, and standards for safety analysis activities. Compliance with this manual will help ensure the protection of the environment and that employees, and members of the general public are not subject to undue risk.

Section or Paragraph Citation: None. **Other:**

Description of Requirement:

This document provides requirements needed for producing operational procedures and safety documentation.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☒ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☐ Other...

Title: ENVIRONMENTAL COMPLIANCE MANUAL

Document Number: WHC-CM-7-5 **Date:** 3-1-93

Revision: 0 **Revision Date:** 3-1-93

Purpose:

The purpose of this document is to establish the environmental compliance requirements and guidelines for Westinghouse Hanford Company (WHC) in conjunction with applicable United States Department of Energy (DOE) Orders and Federal, State and local laws and regulations.

Section or Paragraph Citation: Sections as listed below. **Other:**

Description of Requirement:

This document contains specific guidance on regulatory requirements and WHC policies.

Section 2 defines requirements for design with respect to air emissions. Part 2.3(6) describes project management responsibilities for design and compliance. Part 2.4.2 provides general design requirements for nonradioactive stationary sources. Part 2.4.4 details ventilation requirements for treatment, storage, or disposal management units and recycling operations. Part 2.6 describes design limits for airborne emissions from new or modified stationary sources or emission units. Part 2.6.1 states that dust generation caused by construction or related activities, or by operation activities shall be minimized. Part 2.6.4 discusses requirements for the prevention of significant deterioration of air quality. Emission limits specified as significant should be reviewed during design to avoid impacts on air quality and additional permitting requirements.

Section 3 focuses on hazardous material management. Part 3.5.2 states that because many chemicals and materials are regulated after use as a waste, chemicals should be substituted whenever possible with environmentally compatible chemicals to minimize the costs associatecd with controlling and disposing of regulated substances. All designs and materials specifications should be reviewed for compliance with this section prior to purchase. Part 3.9 outlines requirements for underground and aboveground storage tanks. This section should be reviewed during the planning and design of any storage tanks.

Section 6 establishes the requirements for activities conducted within inactive waste sites (radioactive, nonradioactive, hazardous, and nonhazardous). This section deals mainly with operational activities, but should be reviewed during planning and design to ensure that designs accommodate compliance.

Section 7 defines the environmental requirements for the WHC's Solid Waste Disposal and control program. This section provides guidance for the planning, construction, and operation of waste facilities. Part 7.4 describes performance objectives and operational requirements for radioactive waste storage and disposal and Part 7.7 establishes WHC requirements for the generation, packaging, storage, and disposal of mixed waste. The Environmental Restoration and Storage and Disposal Facility (ERSDF) facility shall be designed to facilitate these specified requirements. Part 7.8, which describes the WHC dangerous and mixed waste control program for onsite generators, shall be reviewed during planning and design of facilities that generate waste. Part 7.9 should be used for guidance on planning and design of container and transportation systems. Part 7.10 refers mainly to operational procedures for treatment, storage, and disposal facilities, but this section should be reviewed to facilitate compliance. Part 7.12 defines control and management requirements for storage tanks. These requirements should be reviewed to ensure tanks are adequately equipped and located to allow compliance.

Section 8 establishes requirements for releases to the groundwater and usage of existing water under the Hanford site. This section should be reviewed during design of water systems and disposal.

Relevant to Other Areas of Review?

☐ No **How?** This document should be reviewed during design of facilities with emission sources.
☒ Yes

References to Other Sources:

Appendix B of the Environmental Compliance document provides references.

Comments:

Environmental compliance permitting and reporting will be completed by WHC, but this document should be reviewed to ensure that designs facilitate required compliance activities.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☒ EPA
- ☐ Other...

Title: CONSTRUCTION QUALITY ASSURANCE FOR LAND DISPOSAL FACILITIES

Document Number: EPA/530-SW-86-031 **Date:** 7-1-86

Revision: **Revision Date:**

Purpose:

This Technical Guidance Document presents guidance for preparing a site-specific construction quality assurance plan for a hazardous waste land disposal facility (i.e., landfill, surface impoundment, or waste pile) that meets or exceeds all United States Environmental Protection Agency (EPA) specifications.

Section or Paragraph Citation: Entire Document. **Other:**

Description of Requirement:

This document provides guidance on preparation of a site-specific construction quality assurance plan for the Environmental Restoration Storage and Disposal Facility (ERSDF). Specific requirements include:

Facility design.
Preparation of plans and specifications.
Construction performed in accordance with the designs.
Testing requirements to confirm adequacy of design, quality of construction and quality of manufactured components.

This document also covers personnel qualifications, sampling strategies, independence of inspection program, and documentation necessary to safisfy the final Part B of the Hazardous Waste Permit.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

This document provides guidance for implementing a construction quality assurance plan and may be useful as a reference while compiling the specifications for the design of this facility.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☒ Other...

Title: PROVIDING ACCESSIBILITY AND USABILITY FOR PHYSICALLY HANDICAPPED PEOPLE

Document Number: ANSI A117.1 **Date:** 2-5-86

Revision: **Revision Date:**

Purpose:

The specifications in this standard are intended to make buildings and facilities accessible to and usable by people with physical disabilities.

Section or Paragraph Citation: Section 4 **Other:**

Description of Requirement:

Section 4 describes requirements for accessible elements and spaces. These requirements are quite specific and should be followed for design of all buildings associated with the Environmental Restoration Storage and Disposal Facility (ERSDF). General categories of information are listed below:

4.1 Basic Components
4.2 Space Allowances and Reach Ranges
4.3 Accessible Route
4.4 Protruding Objects
4.5 Ground and Floor Surfaces
4.6 Parking Spaces and Passenger Loading Zones
4.7 Curb Ramps
4.8 Ramps
4.9 Stairs
4.10 Elevators
4.11 Platform Lofts
4.12 Windows
4.13 Doors
4.14 Entrances
4.15 Drinking Fountains and Water Coolers
4.16 Water Closets
4.17 Toilet Stalls
4.18 Urinals
4.19 Lavatories, Sinks, and Mirrors
4.20 Bathtubs
4.21 Shower Stalls
4.22 Toilet Rooms, Bathrooms, Bathing Facilities, and Shower Rooms
4.23 Storage

4.24 Grab Bars, and Tub and Shower Seats
4.25 Alarms
4.27 Detectable Warnings
4.28 Signage
4.29 Telephones
4.30 Seating, Tables, and Work Surfaces
4.31 Auditorium and Assembly Areas
4.32 Dwelling Units

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

Review Disability Act requirements to ensure that all requirements are met by compliance with this standard.

Requirements Identification Form

Hanford Site ERSDF Facility

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- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☒ Other...

Title: MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES

Document Number: ANSI D6.1 **Date:** 3-1-89

Revision: **Revision Date:**

Purpose:

The purpose of this manual is to ensure highway safety by providing for the orderly and predictable movement of all traffic, motorized and non-motorized, throughout the national highway transportation system, and to provide such guidance and warnings as are needed to insure safe operation of individual elements of the traffic stream.

Section or Paragraph Citation: Parts II, III, IV and VIII **Other:**

Description of Requirement:

Part II, "Signs," provides specifications on regulatory signs, warning signs, guide signs, and motorist service signs.

Part III, "Markings," discusses requirements for pavement and curb markings, object markings, colored pavements, barricades, and channelizing devices.

Part IV, "Signals," provides information on traffic and pedestrian signals.

Part VIII, "Traffic Control Systems for Railroad-Highway Grade Crossings," provides requirements for signs, markings, signals, gates, systems and devices as they relate to railroad crossings.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

As listed in document.

Comments:

This document should be reviewed and followed during design of transportation systems to ensure safe operation.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
☐ Washington Administrative Code (WAC)	☐ Local Law
☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☒ Other...

Title: 1993 MANUAL FOR RAILWAY ENGINEERING

Document Number: AREA 1993 MANUAL FOR RE **Date:** 8-1-93

Revision: ______ **Revision Date:** ______

Purpose:

The purpose of this manual is to provide requirements and guidance to ensure designs that allow safe and efficient operation of railway systems.

Section or Paragraph Citation: As listed below. **Other:**

Description of Requirement:

Volume I includes the following applicable chapters:

Chapter 1, "Roadway and Ballast," discusses requirements for roadbed, ballast, natural waterways, culverts pipelines, fencing, signs, tunnels, railroad vegetation control, and geosynthetics.

Chapter 3 provides requirements for wood ties, including specifications, preservation, testing, and service life.

Chapter 4 describes specifications and design requirements for rail.

Chapter 5, "Track," provides requirements for tie plates, track spikes, curves, track construction, track maintenance, track tools, rail anchors, and highway-railway crossings.

Chapter 6 describes a variety of buildings and support facilities. Any of these portions may be applicable to Environmental Restoration Storage and Disposal Facility (ERSDF) design.

Volume II includes the following applicable chapters:

Chapter 8 lists requirements for concrete structures and foundations. The specific items discusses include materials, tests and construction requirements; reinforced concrete design; footing and pile foundations; retaining walls and abutments; crib walls; reinforced concrete arches; rigid frame concrete bridges; reinforced concrete trestles, culvert pipe and box culverts; lining railway tunnels; cantilever poles; precast concrete box culverts; stone masonry; prestressed concrete design; elastomeric bridge bearings; flexible sheet pile bulkheads; geotechnical subsurface investigation; drilled shaft foundations; and slurry wall construction.

Chapter 10 provides requirements for concrete ties and fastenings.

Chapter 12 discusses rail transit and considerations.

Chapter 14 describes requirements for yards and terminals.

Chapter 15 provides specifications and design requirements for steel structures.

Chapter 28 contains clearance and equipement diagrams.

Chapter 29 provides principles governing the waterproofing or dampproofing of railway structures.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:
As listed in each section.

Comments:
This document covers all areas of concern for railway systems and should be followed during design of all associated items.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
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☐ Federal Regulation (40 CFR)	☐ RCW
☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☒ Other...

Title: TRACK SAFETY STANDARDS, FEDERAL RAILROAD ADMINISTRATION OFFICE OF SAFETY

Document Number: FRA 213 **Date:** 3-1-92

Revision: **Revision Date:**

Purpose:

The purpose of this document is to provide initial minimum safety requirements for railroad track designs.

Section or Paragraph Citation: Subparts A, B, C, D, and E, and **Other:**

Description of Requirement:

This document should be reviewed and followed during railroad layout and design. Applicable sections include Subpart A--General, Subpart B--Roadbed, Subpart C--Track Geometry, Subpart D--Track Structure, and Subpart E--Track Appliances and Track-Related Devices. Also applicable is Appendix A--Maximum Allowable Operating Speeds for Curved Track.

Relevant to Other Areas of Review?

☒ No **How?**
☐ Yes

References to Other Sources:

49 Code of Federal Regulations (CFR) Part 172
49 U.S.Code 11125

Comments:

None.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

☐ DOE Order	☐ DOE Agreement
☐ DOE RL Order	☐ DOE Bulletin
☐ Washington State Register (WSR)	☐ WHC Code or Standard
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☐ Federal Regulation (10 CFR)	☐ EPA
☐ Federal Regulation (29 CFR)	☒ Other...

Title: INSTALLATION OF SPRINKLER SYSTEMS

Document Number: NFPA 13 **Date:** 8-16-91

Revision: **Revision Date:**

Purpose:

The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through standardization of design, installation, and testing requirements for sprinkler systems based upon sound engineering principles, test data, and field experience.

Section or Paragraph Citation: Chapters 5 and 6 **Other:**

Description of Requirement:

The manual is a design-directed document that provides specific criteria and procedures for calculating and specifying sprinkler system designs. There are design approaches listed in Chapter 5 and Hydraulic calculations discussed in Chapter 6.

Relevant to Other Areas of Review?

☐ No **How?** Relates to general fire protection design criteria
☒ Yes

References to Other Sources:

References, National Fire Protection Association (NFPA) 101, Life Safety Code.

Comments:

This is a comprehensive design guide and is applicable to the design of the Environmental Restoration Storage and Disposal Facility (ERSDF) support facilities.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
- ☐ DOE RL Order
- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
- ☐ Federal Regulation (40 CFR)
- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☒ Other...

Title: LIFE SAFETY CODE

Document Number: NFPA 101 **Date:** 2-8-91

Revision: **Revision Date:**

Purpose:

The purpose of this Code is to establish minimum requirements that will provide a reasonable degree of safety from fire in buildings and structures.

Section or Paragraph Citation: Chapter 26 and Chapter 28 **Other:**

Description of Requirement:

This document is a broad guideline for fire prevention and fire fighting equipment required in an office environment for safety and protection of the inhabitants. The code has established requirements for new construction of facilities and gives fire exit specifications, fire protection requirements, alarm and communication systems, and recommendations for construction materials.

Relevant to Other Areas of Review?

☐ No **How?**
☒ Yes

References to Other Sources:

NFPA 801, Facilities Handling Radioactive Materials, National Fire Protection Association (NFPA) 13, Installation of Sprinkler Systems

Comments:

General buiding guidelines. Use in conjuction with specific references shown above.

Requirements Identification Form

Hanford Site ERSDF Facility

Source:

- ☐ DOE Order
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- ☐ Washington State Register (WSR)
- ☐ Washington Administrative Code (WAC)
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- ☐ Federal Regulation (10 CFR)
- ☐ Federal Regulation (29 CFR)
- ☐ DOE Agreement
- ☐ DOE Bulletin
- ☐ WHC Code or Standard
- ☐ Local Law
- ☐ RCW
- ☐ EPA
- ☒ Other...

Title: NFPA 801 FACILITIES HANDLING RADIOACTIVE MATERIALS

Document Number: NFPA 801 **Date:** 2-8-91

Revision: **Revision Date:**

Purpose:

This recommended practice provides guidance for personnel responsible for the design or operation of facilities that invove the storage, handling, or use of radioactive materials.

Section or Paragraph Citation: Section 3 General Facility Design **Other:**

Description of Requirement:

This document addresses the requirements for facility design incorporating fire safety codes. It specifically recommends design approaches and provides guidelines for heating, ventilating, and air conditioning (HVAC), selection of materials of construction, drainage, emergency lighting, and storage areas. It provides design guidelines for special radioactive storage facilities, fuel storage and reprocessing areas, and hot cells.

This document also discusses general fire fighting problems, and an explanation of the hazards involved with radioactive areas.

Relevant to Other Areas of Review?

☐ No **How?**

☒ Yes

References to Other Sources:

This document should be reviewed in conjuction with National Fire Protection Association (NFPA) 13, Installation of Sprinkler Systems and NFPA 101, Life Safety Code.

Comments:

None.

APPENDIX E

MATERIAL BALANCE EVALUATION TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM MATERIAL BALANCE FOR THE ENVIRONMENTAL RESTORATION AND STORAGE DISPOSAL FACILITY

1.0 INTRODUCTION AND BACKGROUND

The Environmental Restoration and Storage Facility (ERSDF) will provide permanent disposal for wastes from remediation activities in the 100 Area and 300 Area of the Hanford Site. The ERSDF will include a series of trenches that will be excavated below ground surface level. Because the trenches will be filled with waste, the excavated soils will need to be used for other purposes, such as liner or cover components, or disposed of in some other way. This technical memorandum (TM) identifies the potential end uses for excavated soil materials and estimates the quantities of the various materials

An initial evaluation of usable soil materials was performed in the *Engineering Study for the Trench and Engineered Barrier Configuration Study for the ERSDF* (DOE/RL/12074--13, Rev. 0). This study includes background information on the ERSDF liner system, the closure cover, the site geology, and soils characteristics that will not be repeated in detail here. The information from the *Engineering Study for the Trench and Engineered Barrier Configuration Study for the ERSDF* (DOE/RL/12074--13, Rev. 0) that is pertinent to the material balance includes the following:

- The ERSDF will be located between the 200 East Area and 200 West Area (see Figure E-1). The northwest corner of the site will be reserved for support facilities (administration buildings, maintenance shops, etc.) and will not be used for disposal trenches.

- The northern portion of the site contains gravelly soils from the Hanford Formation (see Figure E-1). These are assumed to be about 20 feet thick on average. The remainder of the site is underlain by the sandy sequence of the Hanford Formation.

- Trench excavation will generate approximately 34 million cubic yards (yd^3) of soil. This volume includes 28 million yd^3 of waste increased to allow for over-excavation required for the liner system, loss of airspace due to daily and interim cover, and other factors.

- Required trench capacity is 30 million yd^3 This total assumes a waste volume of 28 million yd^3, with an additional 2 million yd^3 for daily cover and interim covers.

- The finished (lined) waste trenches are 33 feet deep, 100 feet wide at the bottom, and have 3 horizontal:1 vertical (H:V) sideslopes.

- The liner system for the trenches will include a 3-foot-thick soil layer admixed with 10 percent bentonite to form a low-permeability liner over the entire trench area (floor and sideslopes). Two 1-foot-thick layers of drainage gravel will be placed on the floor of the trench. A 3-foot-thick operations layer will be placed as the uppermost component of the liner system over the entire trench area to provide a working surface and prevent damage. The liner system includes other layers of geosynthetic materials, but the soil layers described here are the only ones that affect the material balance.

- Two 6-inch-thick interim covers will be used during trench operations to provide dust control. The first will be installed when the trench is half full, and the second when the trench is completely full (even with ground surface).

- The trenches will be covered by the Hanford Barrier. Soil components of the Hanford Barrier that affect the material balance include, from the bottom up:

  - a 1-foot-thick layer of drainage rock,
  - a 5-foot-thick layer of coarse gravel and cobbles forming a capillary break,
  - a 1-foot-thick gravel filter layer, and
  - a 6-inch-thick sand filter layer.

The Hanford Barrier includes other soil, asphalt, and geosynthetic layers which do not affect the material balance described here.

- Excavated soils will be processed in an on-site screening plant to separate usable size fractions of material.

This material balance study will first determine the amount of usable material per linear foot of excavation for trenches located in that portion of the ERSDF that is underlain by gravelly soil and for trenches underlain only by sandy material. The uses of the processed soil components will be identified. Excess or deficit in available volumes will be determined. In the second phase, the available and required material will be evaluated on a site-wide basis, to account for the fact that only part of the site is underlain by gravelly soils. Finally, two potential uses for excess soil will be briefly evaluated.

2.0 MATERIAL BALANCE PER LINEAR FOOT OF EXCAVATION

The trenches at the ERSDF will be excavated in unconsolidated sediments consisting of sands and gravels. In the northern portion of the site, the trench excavations will encounter an estimated 20-foot-thick layer of gravelly soils underlain by sandy soils. Across the remainder of the site, the trench excavations will be in the sandy soils only. Figure E-2 and Figure E-3 illustrate the idealized excavated cross sections in the two material sequences. To accommodate construction of the liner system, the excavated volume of the trench is larger than the volume available for waste containment. Based on the excavated cross-sections, the gravel sequence will yield 187 yd^3 of gravel and 88 yd^3 of sand for each linear foot of excavation. The sand sequence will yield 274 yd^3 of sandy soils per linear foot of trench excavation.

Based on the analysis of potentially useful materials performed in the *Engineering Study for the Trench and Engineered Barrier Configuration Study for the ERSDF* (DOE/RL/12074--13, Rev. 0), the excavated gravelly soils would be screened into four size distributions:

- Greater than 2 inches,
- 1 to 2 inches,
- 1 inch to U.S. #10 sieve, and
- all sizes less than the U.S. #10 sieve.

Excavated sandy soils would not be screened because they are already almost entirely less than the U.S. #10 sieve in size and do not contain economically recoverable amounts of finer material. A summary of the material sources, screening fractions, and uses is presented in Figure E-4.

To represent the average composition of the two soil sequences, composite grain-size distributions were generated, as illustrated in Figure E-5 and Figure E-6. The composite gravel grain-size is an average of sample 1, sample 3, and sample 5 taken from the Hanford Formation gravels near the ERSDF site (COE 1993). The composite sand grain-size distribution is an average from 3 wells, 0699-032-072, 0699-032-070A, and 0699-032-062, and U.S. Ecology sand sample 4 (COE 1993). For the wells, the grain sizes were a composite of the grain sizes from 5-foot sampling intervals from 5 to 50 feet below the ground surface, while the U.S. Ecology sample is from a single depth, 15 feet, below the ground surface.

Using the grain-size distribution shown in Figure E-5, the percentages (by weight) of each of the screening products from the gravelly soils are shown in Table E-1. To convert these percentages into volumes, unit weights of the various materials are required. Based on assumed relative densities and materials with similar grain-size distributions (Hilf 1991), unit weights were assigned as shown in Table E-2. Applying the unit weights to the material percentages, the total volume available per linear foot of trench for each material was calculated. The results are shown in Table E-3. Details of the calculations are presented in Appendix A. For this material balance study, all volumes are assumed to be in-place, compacted volumes based on assumed relative densities.

Table E-1. Gravel Sequence Grain-Size Distribution by Processing Category.

Processing Category	Percent by Weight
2" +	17.6
1" to 2"	21.3
1" to U.S. #10 sieve	48.7
< U.S. #10 sieve	12.4

Table E-2. Estimated Dry Densities of Gravel Sequence Soils .

Material	Estimated In-place Relative Density (Dr)	USGS Soil Classification	Estimated In-place Dry Density (pcf)
In-Situ Gravel	0.7	GW	128
2" +	0.5	GP	125
1" to 2"	0.5	GP	125
1" to U.S. #10 Sieve	0.3	GP	120
< U.S. #10 Sieve	0.5	SW-SM/SP-SM	97

Table E-3. Estimated Volumes and Weights For Processed Gravel (per linear foot of trench).

Material	Weight (lbs)	Volume (yd^3)
2" +	114,000	34
1" to 2"	137,000	41
1" to U.S. #10 sieve	314,000	97
< U.S. #10 sieve	80,000	31
Combined Total	645,000	203

Soil requirements for trench liner, interim cover, and Hanford Barrier are summarized in Table E-4 on a linear foot of trench basis. For the Hanford Barrier, layers of silt and silt admixed with pea gravel, each 3-feet-thick, have been included for completeness, even though no silt will be available from excavated materials. Minor quantities of processed soil materials will be required for other uses such as road surfacing, utility trench backfill, grout production at the batch plant, etc. Because of the relatively small volumes involved, these requirements are not included in Table E-4; however, sufficient material is expected to be available.

Table E-4. Material Required For Liner, Interim Covers, and Hanford Barrier.

Component	Proposed Material	Volume per Linear Foot of Excavation (yd^3)
Liner - Admix	< U.S. #10 sieve + Bentonite and/or unprocessed sand + Bentonite	36
Liner - Gravel Drain	1" to U.S. #10 sieve	7
Liner - Operations Layer	1" to U.S. #10 sieve and/or unprocessed sand	43
Interim Cover Material - Cover 1 (trench half full)	< #10 U.S. sieve and/or unprocessed sand	4
Interim Cover Material - Cover 2 (trench full)	< U.S. #10 sieve and/or unprocessed sand	6
Hanford Barrier - Drain Rock	1" to U.S. #10 sieve	15
Hanford Barrier - Capillary Break	2"+	74
Hanford Barrier - Sand Filter	unprocessed sand	7
Hanford Barrier - Gravel Filter	1" to U.S. #10 sieve	15
Hanford Barrier - Silt Layer	Silt	49
Hanford Barrier - Silt/Gravel Admix	Silt + 15 % Pea Gravel	49
Total Liner + Interim Cover + Hanford Barrier	combination of above materials	305

The mass balance per linear foot for trenches excavated in the gravelly soils is shown in Table E-5. There are material deficits (available is less than required) for 2-inch + and the silt layers. However, if 1-inch to 2-inch gravel is suitable for use in the capillary break layer, then the deficit of 2-inch + material would be eliminated. Further studies and testing may show that the 1-inch to 2-inch processed gravels could be used as capillary break material, depending on the compatibility with the gravel filter and other factors. This question is discussed more completely in the *Engineering Study for the Trench and Engineered Barrier Configuration Study for the ERSDF* (DOE/RL/12074--13, Rev. 0) and should be resolved prior to ERSDF construction.

Table E-5. Gravel Sequence Trench Material Balance per Linear Foot of Excavation.

Material	Quantity From Excavation (yd^3)	Quantity Required (yd^3)	Excess (yd^3)	Deficit (yd^3)
2" +	34	74	-	40
1" to 2"	41	0	41	-
1" to U.S. #10 sieve	97	89	8	-
< U.S. #10 sieve	31	31	0	0
Unprocessed Sand	88	12	75	-
Silt	0	49	-	49
Silt/Pea Gravel Admix	0	49	-	49
Combined Total	291	304	124	138

The mass balance per linear foot for trenches excavated in the sandy sequence is shown in Table E-6. Because this material is essentially all smaller than the U.S. #10 sieve, but does not contain enough silt to warrant screening, there is a deficit of all coarse grained soils and silt, with a substantial excess of sandy soil.

Table E-6. Sand Sequence Trench Material Balance per Linear Foot of Excavation.

Material	Quantity From Excavation (yd^3)	Quantity Required (yd^3)	Excess (yd^3)	Deficit (yd^3)
2" +	0	74	-	74
1" to 2"	0	0	-	-
1" to U.S. #10 sieve	0	37	-	37
< #10 sieve	0	0	-	-
Unprocessed Sand	274	95	179	-
Silt	0	49	-	49
Silt/Pea Gravel Admix	0	49	-	49
Combined Total	274	304	179	209

3.0 SITE-WIDE MATERIAL BALANCE

The locations and lengths of trenches assumed for this study are shown in Figure E-1. Based on a waste capacity of about 250 yd^3 per linear foot, a total trench length of about 125,000 feet will be required. The inferred southern limit of gravely soil is also shown on Figure E-1. With this layout, approximately 47,000 feet of trench would be excavated in gravelly soils and about 78,000 feet in the sandy soils.

The mass balance for all trenches is shown in Table E-7. These results indicate that several materials will need to be imported because on-site sources will not provide sufficient volumes. These include capillary break material, drainage and filter rock, and silt materials. As mentioned above, use of the 1-inch to 2-inch gravel fraction in the Hanford Barrier will decrease both the excess material and the need for importing crushed basalt by about 1.9 million yd^3; this approach has been assumed for the quantities in Table E-7. As a result, the major excess material which must be disposed of is 17 million yd^3 of unprocessed sand.

Table E-7. Site-Wide Material Balance.

Material	Quantity From Excavation (Million yd^3)	Quantity Required for Construction (Million yd^3)	Excess (Million yd^3)	Deficit (Million yd^3)
2" +	1.5	9.0	0	7.5
1" to 2"	1.9	0	1.9	0
1" to U.S. #10 Sieve	4.4	6.8	0	2.4
< U.S. #10 Sieve	1.4	1.4	0	0
Unprocessed Sand	24.8	7.8	17.0	0
Silt	0	5.9	0	5.9
Silt/Pea Gravel Admix	0	5.9	0	5.9
Combined Total	34.0	36.8	18.9	21.7

The total volume for import and export is based on in-place densities. These volumes will increase during excavation and transport. Therefore, for transportation purposes, the estimated volumes presented in this mass balance study should be increased. The magnitude of this increase was estimated by assuming an in-situ relative density of 0.5 for the native sands and 0.7 for the native gravels, based on maximum and minimum densities for similar soils (Fang 1991). By assuming an excavated relative density equal to the minimum density of similar soils, the volume increase during is estimated to be 10 percent for the gravels and 15 percent for the sands.

4.0 DISPOSAL OF EXCESS SOIL

Two alternatives were considered for disposal of the excess soil resulting from the excavation of the trenches at the ERSDF site. One option is to back-haul the material to the remediation site to fill the excavations formed by removal of contaminated soil; this will restore the remediation site to a usable condition with a natural appearance. The second option is to spread the material over the southern portion of the ERSDF site. The rate at which excess material would generated is shown in Figure E-7 and appears to be relatively constant throughout trench construction. Therefore, land for spreading would be required almost immediately after the first trenches are begun. A spreading area in the northern portion of the site was not considered viable because of potential conflicts with trench construction. However, it is reasonable to assume that land in the southern portion of the ERSDF would be available for spreading at all times during ERSDF development. Initially, soil would be placed in the southwest portion of the site, with later placement in the southeast portion as trench development proceeds.

Topographic relief across the ERSDF site is on the order of 100 feet (United States Geological Survey [USGS] 1986). The site slopes to the southwest at approximately 1 percent. Calculations indicate that reducing the slope of the southern half of the site by less than 0.5 percent would allow for disposal of all the excess material generated from trench excavation. This would raise the land surface by about 25 feet at the south end of the site, tapering to 0 feet at the middle of the site. Adequate drainage would still be maintained.

In order compare the costs of the two alternatives, several assumptions were made. For the back-haul option, the following sequence of operations was assumed:

- Excess soil will be stockpiled about 1,500 feet from a railroad location suitable for loading into decontaminated waste containers on rail cars. The excess material will be transported by scrapers from the stockpile to the railroad.

- The excess soil will be loaded into the containers with a rubber-tired front end loader.

- The soil will be transported to the remediation site by rail. The cost of this transport was not included in the comparative analysis, because it is incurred in any case because the containers must be returned to the remediation area.

- The containers will be emptied at the remediation site, and the excess soil hauled 1,500 feet by scrapers for backfill. Costs for subsequent activities (regarding, compacting, etc.) are the same for both alternatives.

For the on-site placement option, the following operations are assumed:

- Excess soil is hauled from the site stockpile to the spreading area using scrapers. A 5,000 foot average haul distance is assumed. No compaction other than scraper tire weight is performed.
- At the remediation site, material for backfill is excavated and hauled with scrapers. A distance of 3,000 feet is assumed.

Using these assumptions and published cost data (Means 1992), a cost of \$5.15 per yd^3 was estimated for on-site placement and \$4.99 per yd^3 back-hauling to the remediation site. Within the uncertainty of the assumptions, these costs are the same.

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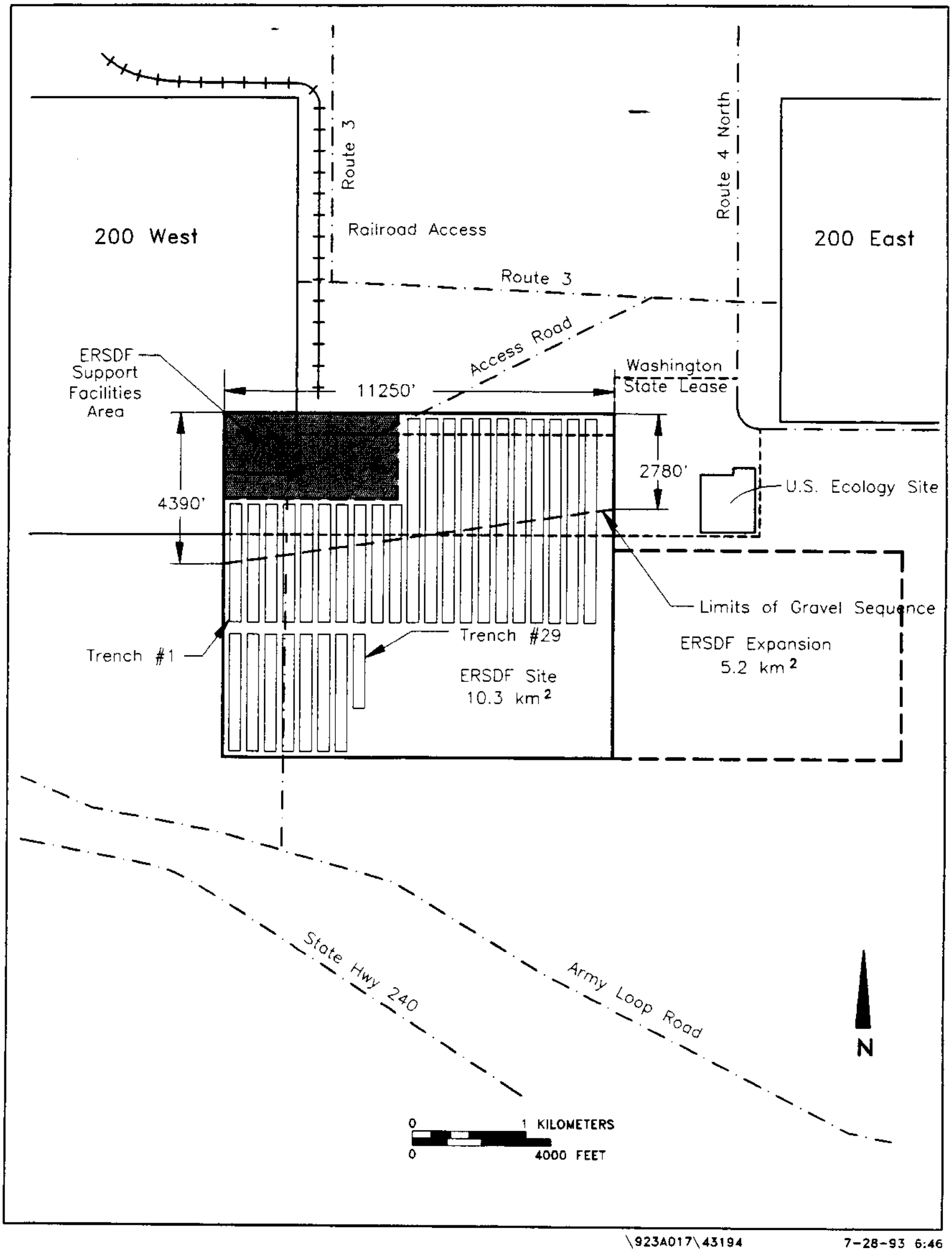

Figure 1. Trench Layout at ERSDF Site

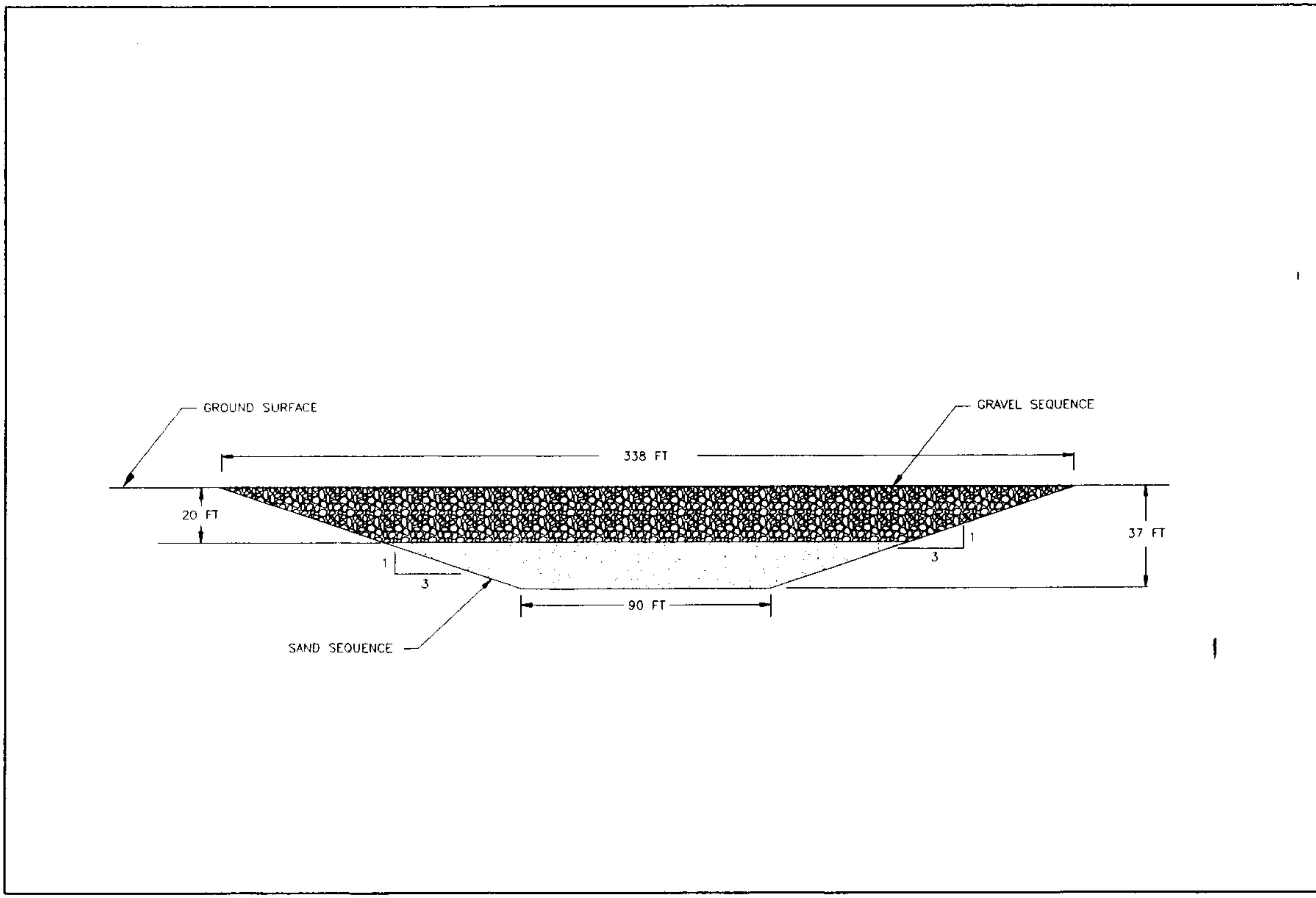

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Figure 2. Trench in Gravel Sequence, Excavation Cross Section

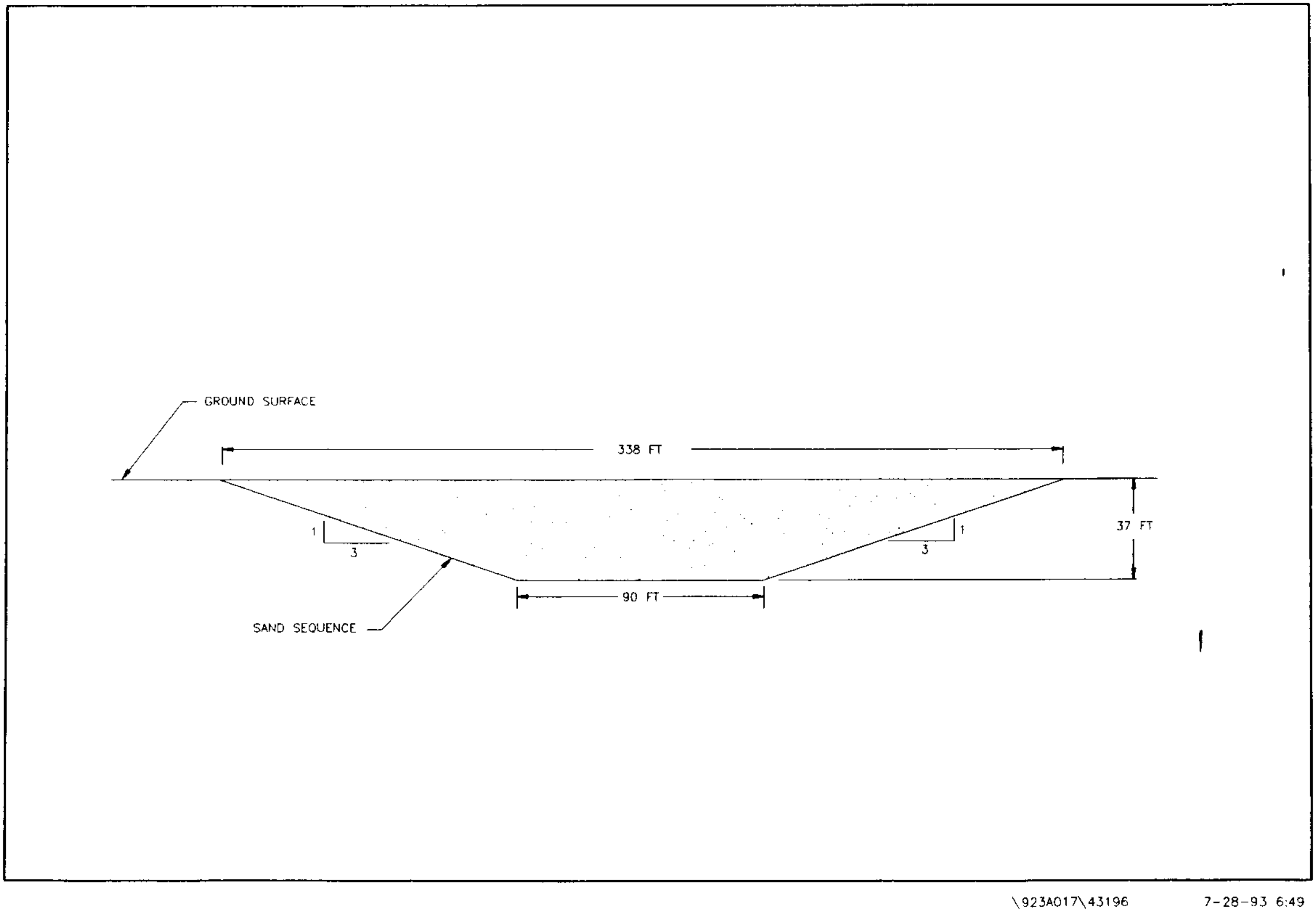

Figure 3. Trench in Sand Sequence, Excavation Cross Section

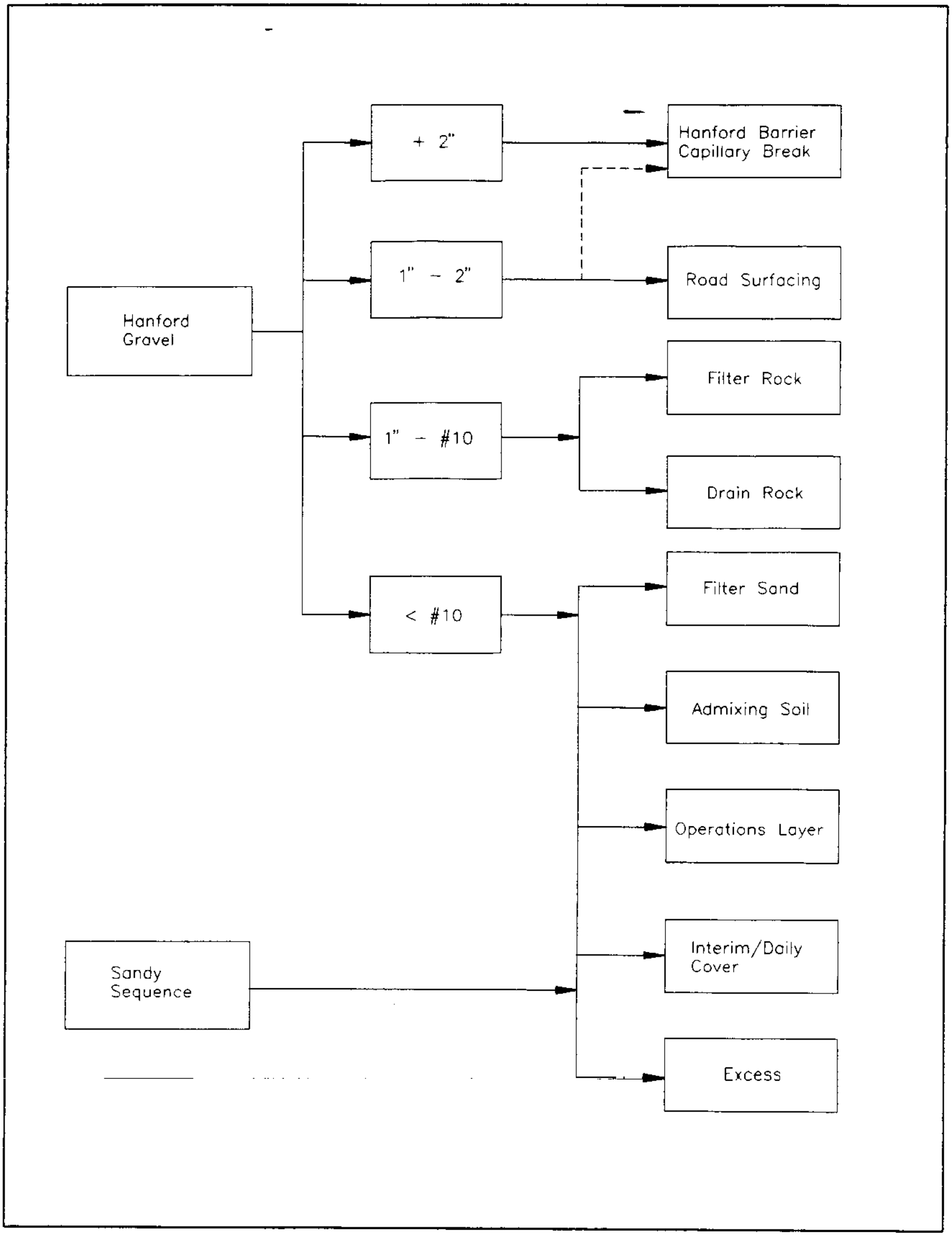

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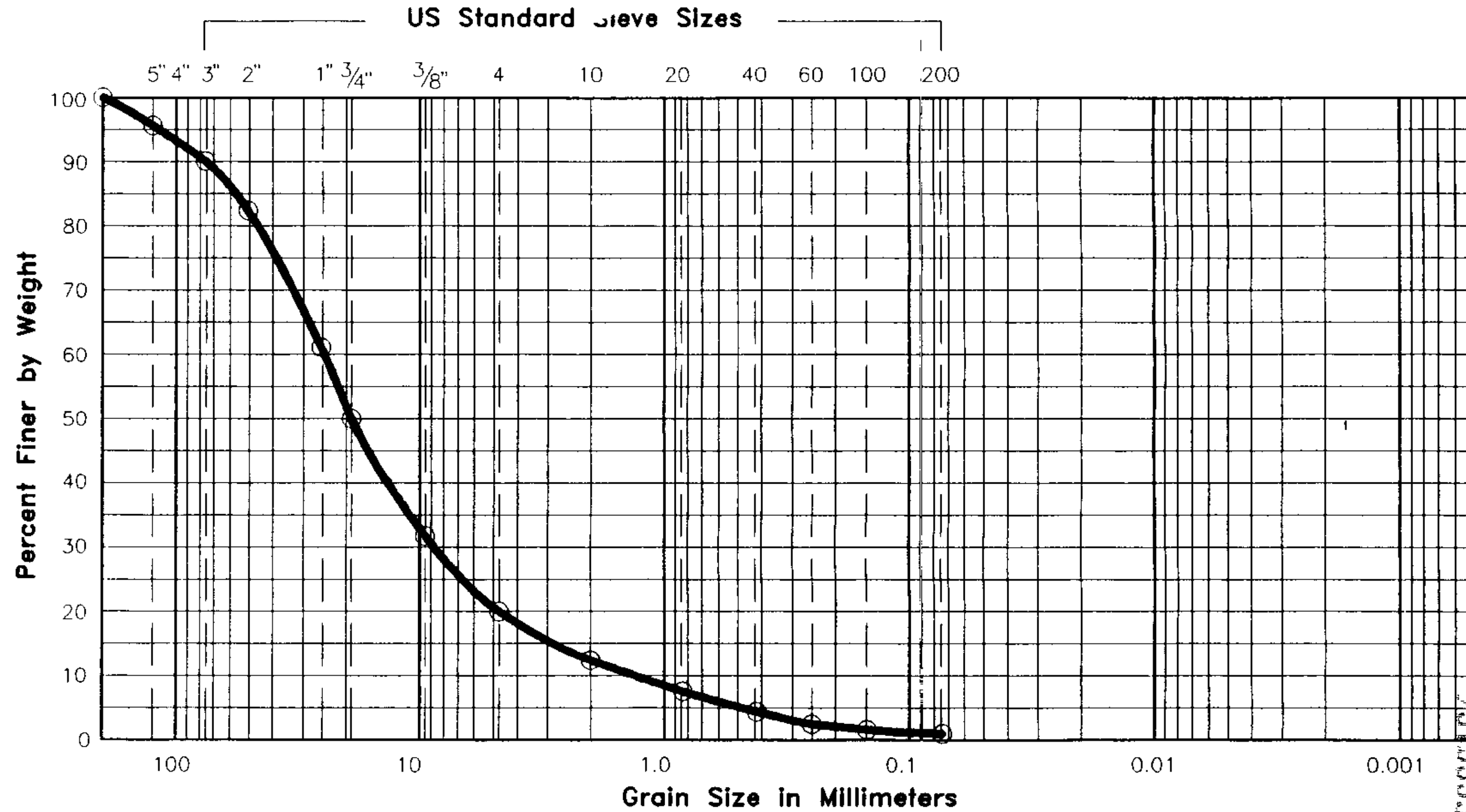
Figure 4. Excavated Material Uses at ERSDF Site

GRAIN SIZE DISTRIBUTION

Project COE/ERDSF DESIGN STUDIES/WA
Project No. 923-A017 Date 7-1-93 Tested By MF Reviewed By DPO

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
AVERAGE OF GRAVEL SAMPLES						
1	5 FT	0.5	–	–	–	
3	7 FT	0.9	–	–	–	
5	–	0.8	–	–	–	

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Figure 5. Composite Gravel Grain-Size Distribution For Samples 1, 3, and 5

9513333.1990

Project COE/ERSDF DESIGN STUDIES/WA
Project No. 923-A017 Date 6-1-93 Tested By WESTINGHOUSE Reviewed By DPO

GRAIN SIZE DISTRIBUTION

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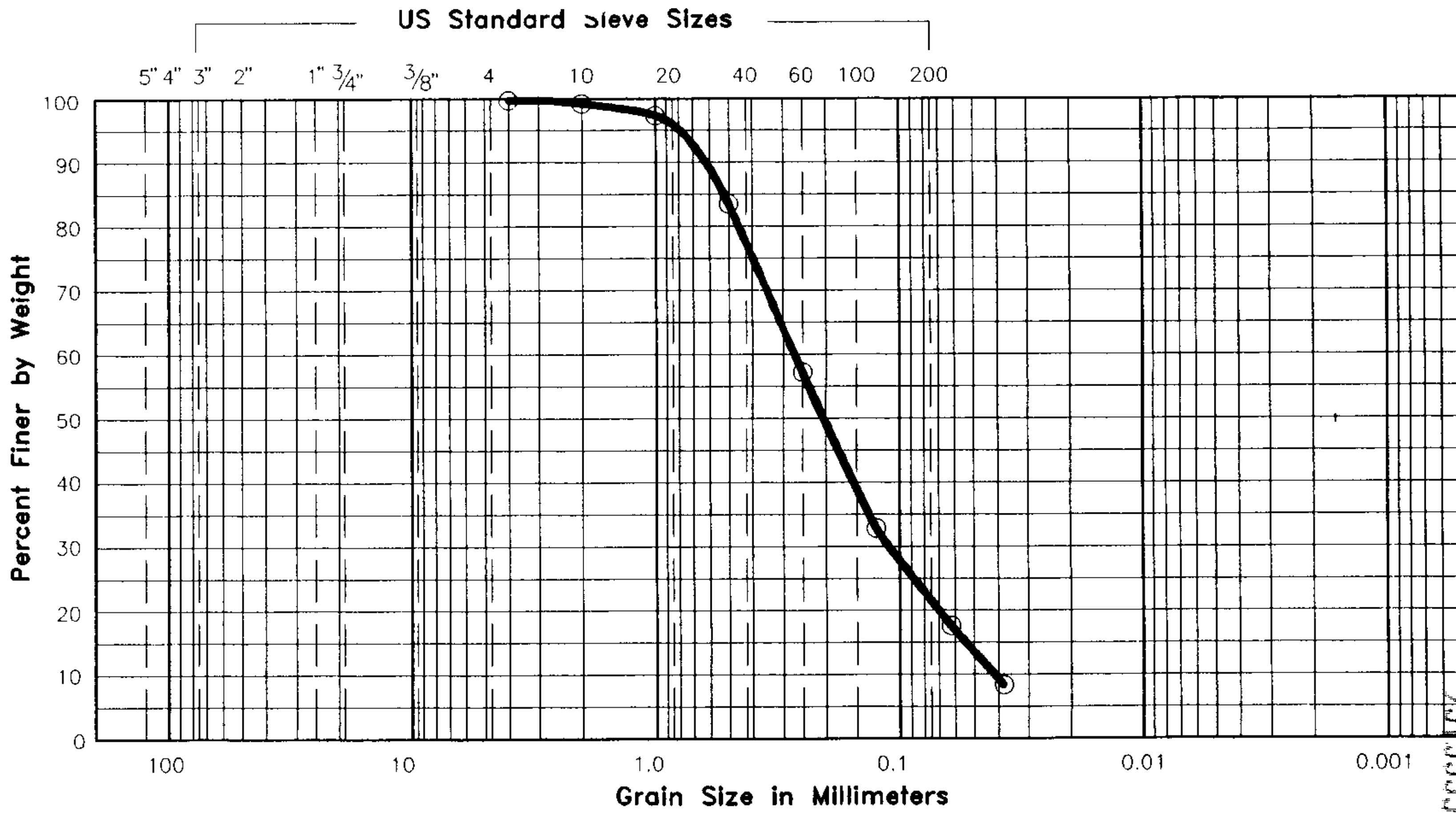

Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
AVERAGE OF Wells 0699-						
032-072	5-35 ft	–	–	–	–	
032-070A	5-35 ft	–	–	–	–	
032-062	5-50 ft	–	–	–	–	
and Sample 4	15 ft	–	–	–	–	

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Figure 6. Composite Sand Grain-Size Distribution

9513333.1791

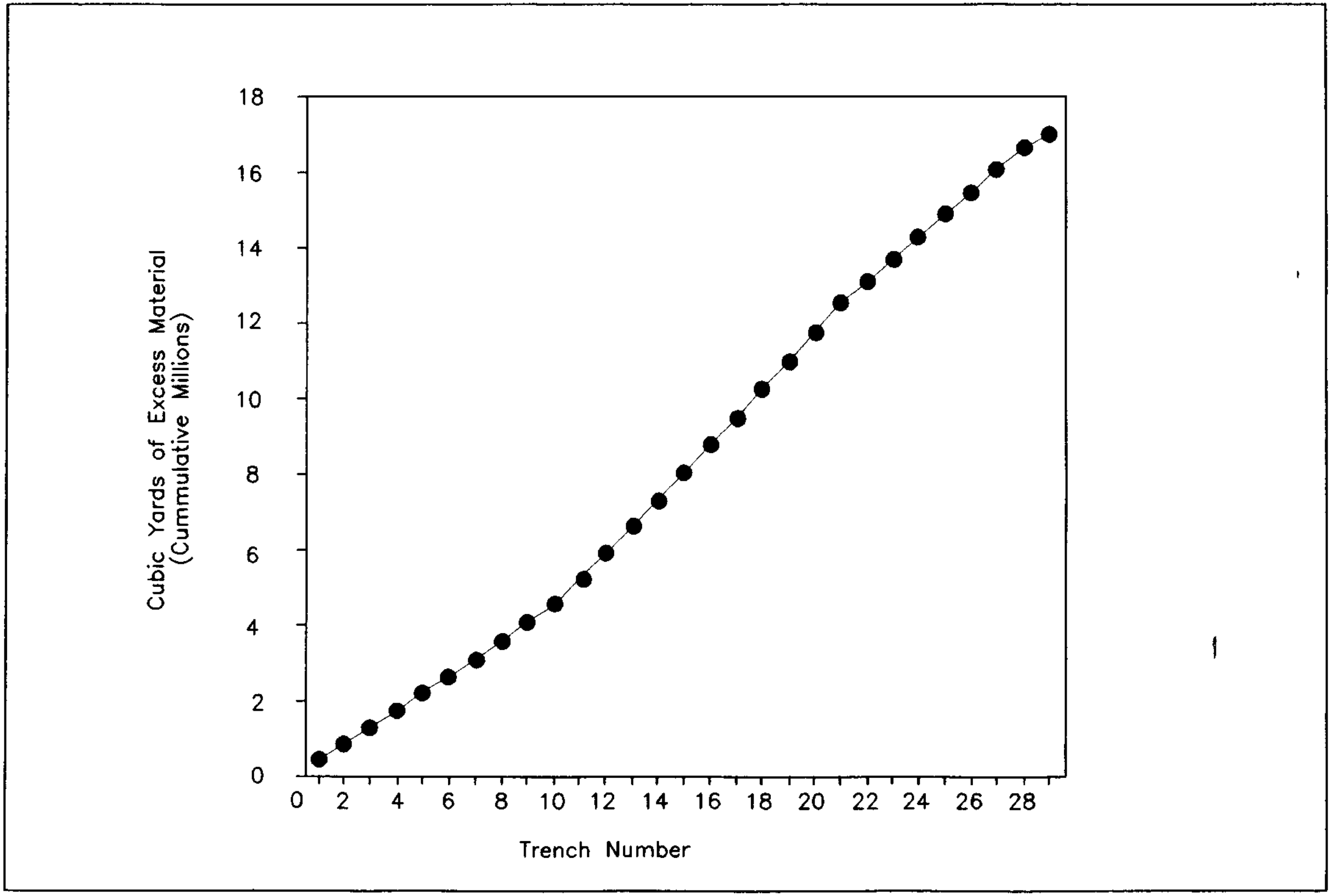

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Figure 7. Excess Material From Trench Excavation

ATTACHMENT E-1

MASS BALANCE CALCULATIONS

9513333.1994

Golder Associates	SUBJECT ERSDF Material Balance		
	Job No. 923-A017	Made by KDL	Date 6-28-93
	Ref.	Checked TCM	Sheet 1 of 20
		Reviewed	

Composite Grainsizes For Gravels at ERSDF

Gravel Pit B, Samples 1, 3, & 5

Sieve size	% Passing 1	3	5			composite
				6"	100%	100%
				5"	87.8	95.9
4"	100	100		—	87.8	95.9
3"	82.4	100			87.8	90.1
2"	79.4	90.4			77.5	82.4
1"	52.8	63.9			66.5	61.1
3/4"	40.0	52.6			57.5	50.0
3/8"	21.7	36.7			36.6	31.7
# 4	10.9	27.5			21.6	20.0
# 10	5.9	17.7			13.7	12.4
# 20	2.9	11.5			8.3	7.6
# 40	1.4	6.7			5.0	4.4
# 60	1.1	3.2			3.2	2.5
# 100	0.9	1.6			2.2	1.6
# 200	0.7	0.9			1.5	1.0

ACAD AREAS FOR ERSDF LINER + EXCAVATION

LINER

Admix layer	= 959 ft²
Gravel Drain layers	= 190 ft²
Operations layer	= 1154 ft²

Excavation Areas

Gravel Sequence	
Gravel	5039 ft²
Sand	2365 ft²

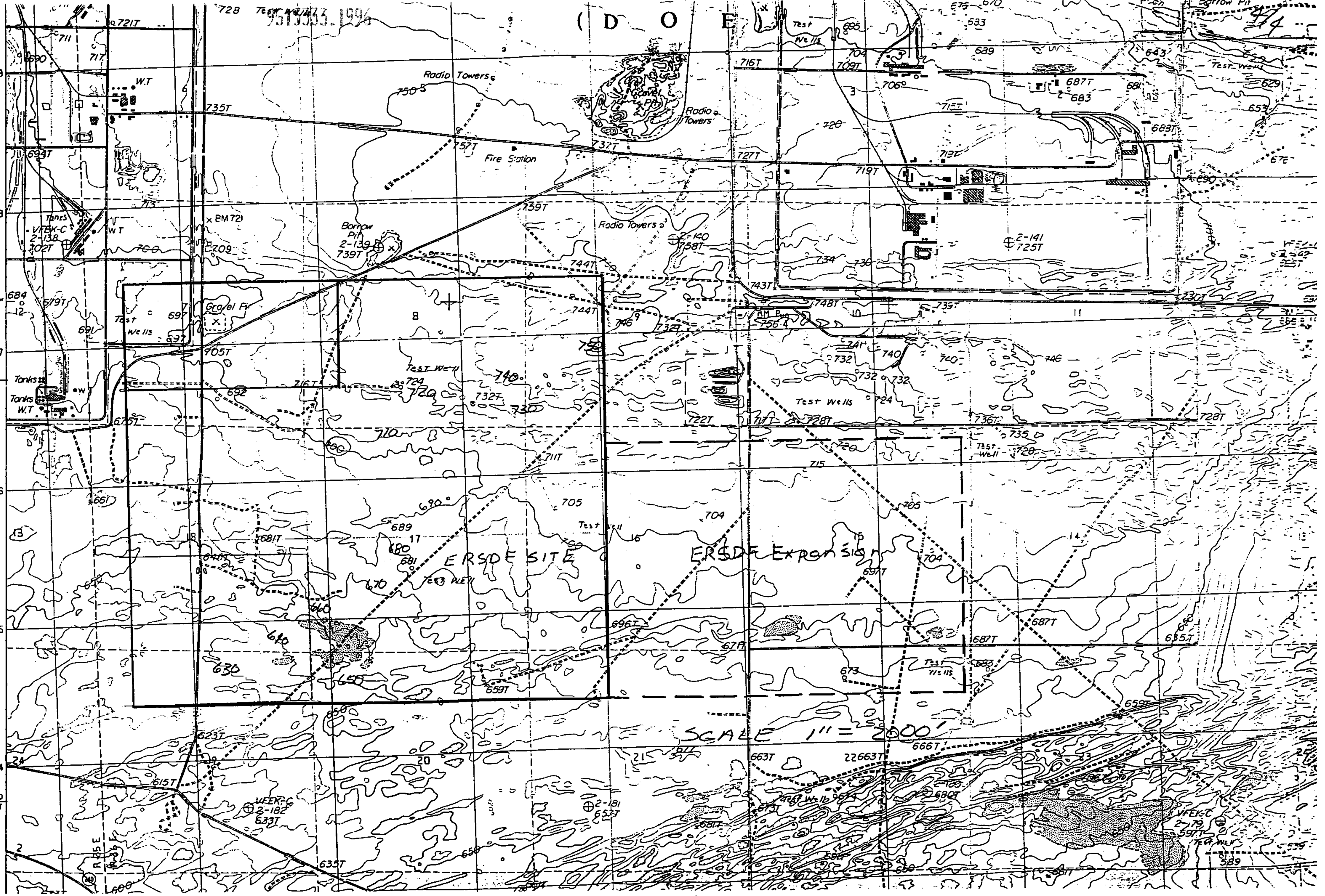
Sand Sequence	
Sand	7,405 ft²

Volume To store waste

$V_w = 6{,}667\ ft^3/LF$

$V_w = 247\ cy/LF$

REF: FIG 1-3, 923-A017 42581



95133.1996
(D O E)
ERSDE SITE
ERSDE Expansion
SCALE 1" = 2000'
Radio Towers
Fire Station
Gravel Pit
Borrow Pit
Test Wells
Test Well
Tanks
W.T
BM 721
VFEK-C 2-138 702T
2-139 739T
2-140 758T
2-141 725T
VFEK-C 2-182 633T
2-181 653T
VFEK-C 2-179 597T
ROSE
32' 30"
430 000 FEET

9513333.1997

Golder Associates

SUBJECT Area of Trench Excavation		
Job No. 923 - A017	Made by RDL	Date 6-29-93
Ref.	Checked TCM	Sheet 4 of 20
	Reviewed	

Volume Per Lineal Foot of Trench

- For Gravel Sequence

V_g = 5039 cf/Lf
V_s = 2365 cf/Lf

- For Sand Sequence
V_s = 7405 cf/Lf

Material Breakdown For Gravel Sequence

- use composite grainsize curve from gravel pit B, samples 1, 3, & 5.

- Break up into
2" +
2" - 1"
1" - #10
< #10

% by weight

2" +	17.6 %
1"-2"	21.3 %
1" - #10	48.7 %
< #10	12.4 %
	100 %

Need in-situ densities, specific gravity of gravel in order to calculate volumes. moisture content?

Table 2-1, Holtz & Kovacs 1981

93.6 - 143.5 pcf

Sands & gravel ρ_d = 1.5 - 2.3 mg/m^3
Silts and Clays ρ_d = 0.6 - 1.8 mg/m^3

37.4 - 112.3 pcf

Project COE/ERDSF DESIGN STUDIES/WA
Project No. 923-A017 Date 7-1-93 Tested By MF Reviewed By DPO

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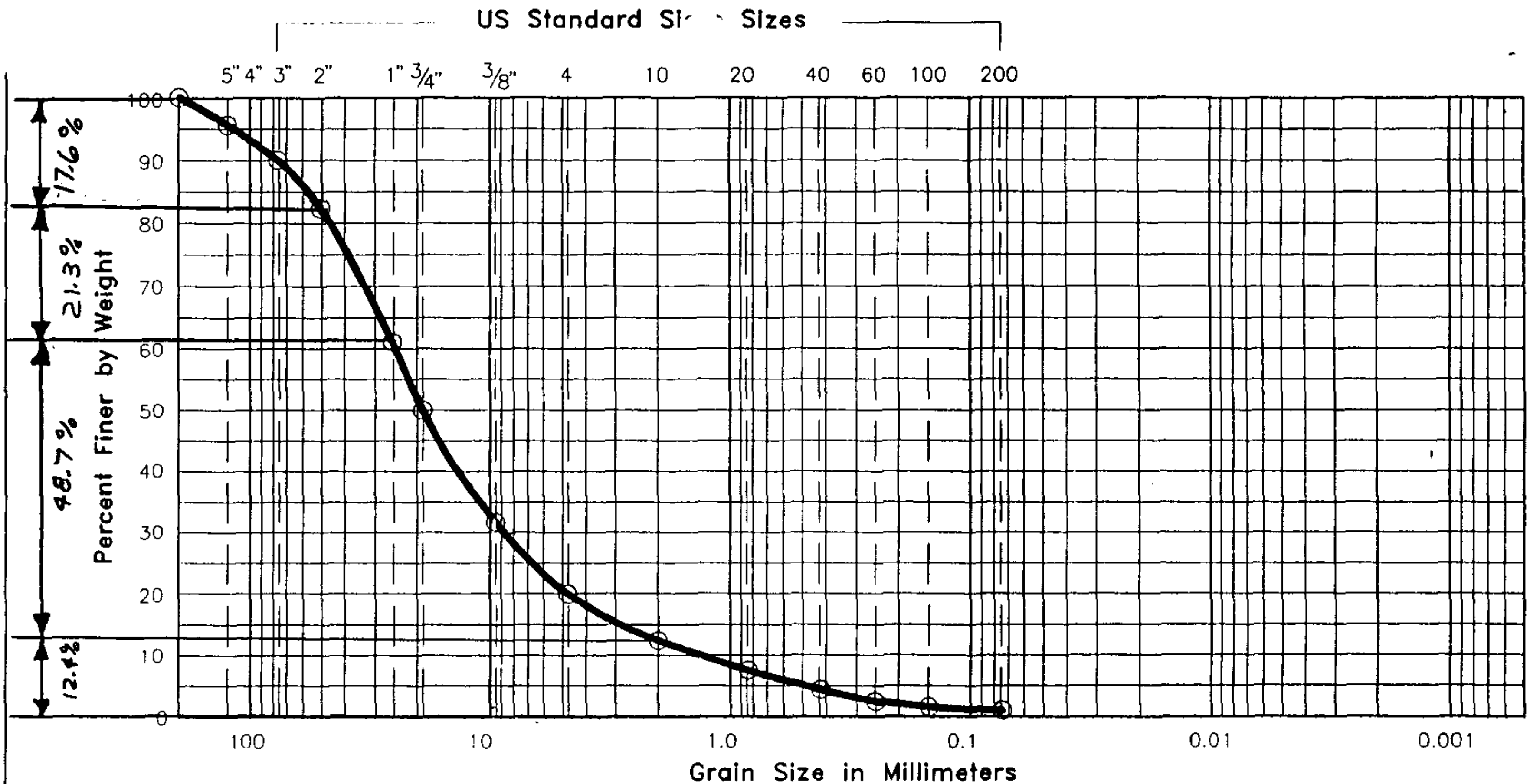
GRAIN SIZE DISTRIBUTION



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
AVERAGE OF GRAVEL SAMPLES						
1	5 FT	0.5	–	–	–	
3	7 FT	0.9	–	–	–	
5	–	0.8	–	–	–	

Figure 3 Composite Gravel Grain Size Distribution For Samples 1, 3, and 5

(Fang, 1991) ρ_0, specific gravity = 2.65 for majority of mechanical analysis is sufficiently accurate

Average of D_{10}, D_{30}, D_{60}, Cu, Cz For Gravel samples 1, 3, and 5

Sample	1	3	5	Avg
D_{10}	4.0	0.70	1.1	1.9
D_{30}	13	5.9	7.0	8.6
D_{60}	30	23	20	24
Cu	7.5	32.9	18.2	19.5
Cz	1.4	2.2	2.2	1.9

Classification

Sample	
1	GW
3	GW
5	GW

(Fang, 1991) Table 8.3

- For a GW, 3"-, w/ D_{10} = 2, Cu = 14 and Cc = 2.6

γ_{min} = 109 pcf
γ_{max} = 137 pcf

- For a GW, 3"-, w/ D_{10} = 2, Cu = 12, and Cc = 1.3

γ_{min} = 112 pcf
γ_{max} = 138 pcf

Assume material has a in-place relative density of Dr = 0.70 ~~no~~

Based on that for a medium compact sand 1/3 < Dr < 2/3

Assume gravel is med. to dense

9513333.2000

7/20

where

γd_{max} = dry density of the soil in its densest state
γd_{min} = dry density of the soil in its loosest state
γd = dry density of the soil being tested

Relative density can also be expressed in terms of porosity:

$$D_r = \frac{(n_{max} - n)(1 - n_{min})}{(n_{max} - n_{min})(1 - n)} \tag{8.5}$$

where

n_{max} = maximum porosity (loosest state)
n_{min} = minimum porosity (densest state)
n = porosity of the soil being tested

Terzaghi (1925) and Bjerrum et al. (1960) considered it possible to judge whether a sand is deposited in a loose or dense state only on the basis of its relative density and its compactibility. Terzaghi defined the ranges of relative denseness

TABLE 8.3 COMPACTIBILITY (F) OF COHESIONLESS SOILS (where $F = (e_{max} - e_{min})/e_{min}$).

Unified Classification	γ_{min}	γ_{max}	e_{min}	e_{max}	Max. size	D_{10}	C_u	C_c	F
SP-SM	90	108	0.54	0.84	#16	0.058	6.0	2.2	0.555
SM	75	97	0.83	1.36	¾"	0.0065	31	5.5	0.638
SP	92	112	0.48	0.80	#4	0.15	3.0	0.93	0.667
SP	93	113	0.46	0.77	1½"	0.16	2.4	0.92	0.674
SP	95	116	0.43	0.74	#4	0.30	3.7	1.0	0.721
SP-SM	92	113	0.46	0.80	¾"	0.08	3.0	0.88	0.739
SP	85	107	0.54	0.94	#30	0.10	2.3	1.3	0.740
SP	97	118	0.40	0.70	1½"	0.11	3.2	1.2	0.750
SP	99	120	0.38	0.67	1½"	1.8	4.4	0.76	0.763
SM-ML	83	108	0.62	1.11	#4	0.012	8.3	1.5	0.790
SP-SM	79	103	0.60	1.08	#30	0.09	2.4	1.5	0.800
SP	103	124	0.33	0.60	⅜"	0.17	5.0	0.75	0.818
SM	105	126	0.31	0.57	5"	0.02	350	0.30	0.838
SP-SM	87	112	0.48	0.90	#4	0.08	3.0	1.3	0.875
SM	82	108	0.54	1.02	#16	0.023	6.5	1.4	0.889
SW-SM	95	119	0.39	0.74	3"	0.05	10	1.4	0.897
SP	98	122	0.36	0.69	#4	0.37	5.1	1.2	0.917
SW-SM	98	125	0.34	0.71	3"	0.07	6.8	1.0	1.088
SP-SM	97	124	0.33	0.70	¾"	0.10	5.0	1.4	1.121
SP-SM	84	115	0.44	0.97	1½"	0.085	4.7	1.4	1.205
SP-SM	94	123	0.34	0.76	1½"	0.12	4.4	1.3	1.235
SM	99	128	0.31	0.70	3"	0.02	240	1.8	1.258
SP-SM	80	114	0.44	1.06	#16	0.07	3.7	1.6	1.409
SW-SM	80	116	0.42	1.07	1½"	0.074	6.6	2.4	1.547
SM	83	120	0.38	0.99	#4	0.015	26	6.1	1.605
SM	102	134	0.23	0.62	¾"	0.01	120	1.9	1.695
GN-GM	113	127	0.31	0.47	3"	0.14	86	1.2	0.517
GP-GM	112	129	0.32	0.52	3"	0.03	200	0.50	0.625
GW-GM	116	133	0.26	0.44	5"	0.17	171	2.2	0.692
GP-GM	110	128	0.30	0.51	3"	0.11	191	15	0.700
GP-GM	117	133	0.24	0.41	5"	0.125	160	4.0	0.708
GW-GP	111	130	0.27	0.49	3"	0.20	105	7.5	0.815
GP	116	134	0.23	0.43	5"	0.27	111	6.2	0.870
GW	119	139	0.24	0.45	3"	0.51	45	2.2	0.875
GW	120	139	0.20	0.39	3"	0.45	51	1.6	0.950
GW	119	139	0.21	0.41	3"	0.18	94	1.1	0.952
GW	111	132	0.25	0.49	3"	2.9	9.7	1.8	0.960
GP	115	136	0.22	0.44	5"	0.38	29	0.61	1.000
GP	114	135	0.22	0.45	3"	2.0	11	0.77	1.045
GW-GM	121	141	0.19	0.39	3"	0.30	77	2.3	1.052
GM	122	141	0.17	0.36	1½"	0.025	381	3.0	1.118
GW-GM	114	137	0.21	0.45	3"	0.60	16	1.2	1.143
GW	112	138	0.20	0.48	3"	2.0	12	1.3	1.400
GW	109	137	0.21	0.52	3"	2.0	14	2.6	1.476
GP	114	140	0.18	0.45	3"	1.7	10	0.76	1.500
GM	101	132	0.25	0.64	1½"	0.03	260	12	1.560
GW-GM	111	139	0.19	0.49	3"	1.8	13	2.3	1.578
GP	115	142	0.17	0.44	3"	0.31	87	8.2	1.588
GW	123	146	0.13	0.34	3"	0.21	124	1.1	1.615
GW-GM	110	139	0.19	0.50	5"	0.42	43	2.1	1.631
GW-GM	115	142	0.17	0.45	3"	0.15	133	1.1	1.647
GP-GM	112	140	0.18	0.48	3"	0.42	26	4.2	1.667
GW-GM	112	140	0.18	0.48	5"	0.25	56	1.0	1.667
GW-GM	114	142	0.16	0.45	3"	1.2	15	1.7	1.812
GP	112	141	0.17	0.48	3"	1.4	7.1	0.73	1.823
GW-GM	118	147	0.12	0.40	3"	1.3	19	1.1	2.333

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(Fang, 1991) Pp. 261

$$D_r = \frac{\gamma_{dmax}(\gamma_d - \gamma_{dmin})}{\gamma_d(\gamma_{dmax} - \gamma_{dmin})}$$

D_r = Relative Density

$$D_r = \frac{(\gamma_{dmax})\gamma_d - (\gamma_{dmax})(\gamma_{dmin})}{(\gamma_d)(\gamma_{dmax}) - (\gamma_d)(\gamma_{dmin})}$$

$$\gamma_d D_r = \frac{(\gamma_{dmax})\gamma_d - (\gamma_{dmax})(\gamma_{dmin})}{\gamma_{dmax} - \gamma_{dmin}}$$

$$\gamma_d = \frac{(\gamma_{dmax})(\gamma_d) - (\gamma_{dmax})(\gamma_{dmin})}{D_r(\gamma_{dmax} - \gamma_{dmin})}$$

∴ use $\gamma_{min} = 109$ pcf

$\gamma_{max} = 137$ pcf

$D_r = 0.7$

$$\gamma_d = \frac{(137)(\gamma_d) - (137)(109)}{0.7(137-109)}$$

$$\gamma_d = \frac{137\gamma_d - 14,933}{19.6}$$

$$(19.6)\gamma_d - 137\gamma_d = -14,933$$

$$(117.4)\gamma_d = 14,933$$

$$\gamma_d = 127.2 \text{ pcf} \checkmark$$ For GW w/ $D_r = 0.7$

use $\gamma_{min} = 112$ pcf

$\gamma_{max} = 138$ pcf

$$\gamma_d = \frac{(138)\gamma_d - (138)(112)}{(0.7)(138-112)}$$

$$\gamma_d = \frac{138\gamma_d - 15,456}{18.2}$$

$$138\gamma_d - 18.2(\gamma_d) = 15,456$$

$$\gamma_d = 129 \text{ pcf} \checkmark$$

Average the two dry densities

$$Ad_{Avg} = \frac{127.2 + 128}{2}$$

Ad_{Avg} = 128 pcf for GW @ 70% Relative Density

Now estimate void ratio / in-place dry densities for various processed materials from Gravels.

2" + — Hanford Barrier Cap. break material

2" - 1" — Road surfacing

1" - #10 — Liner System drainage gravel
— Hanford Filter barrier + drain rock
— Operations layer

< #10 — Liner admix (w) 10% bentonite by weight
— operations layer
— Interim layer (1 @ 6" thick ½-way and top
— Hanford Barrier filter sand

2" + — classify as a poorly graded gravel (GP)

Fang - Table 8.3

	γmin	γmax
GP —	116	134
	115	136
	114	135
	114	140
	115	142
	112	141
avg	114	138 ✓

Assume $D_r = 0.5$ for cap. break material

$$\gamma_d = \frac{(138)\gamma_d - (138)(114)}{0.5(138-114)}$$

$$\gamma_d = \frac{138\gamma_d - 15{,}732}{12}$$

$$138\gamma_d - 12\gamma_d = 15{,}732$$
$$126\gamma_d = 15{,}732$$
$$\gamma_d = 124.9 \text{ pcf}$$

$$\gamma_d \approx 125 \text{ pcf}$$

2" - 1" ~ assume same dry density as 2"+

$$\gamma_d = 125 \text{ pcf}$$

1" - #10 material Classify as a clean poorly graded gravel w/ max. 1" particle size < 1" ∴ GP, 1" -

Fang - Table 8.3 lists no GP w/ max. particle size < 1" ∴ estimate inplace dry density of 120 pcf (D_r = 30%)

#10 - material Classify as a well & poorly graded sand, ~~sand some~~ silt, SW-SM/ SP-SM

Fang - Table 8.3 SP-

	γ_{min}	γ_{max}	max.
SP-SM	87	112	#4
SP-SM	80	114	#16
SP-SM	90	108	#16
avg	86	111	

10 sieve minus, Estimate Dr = 50% compacted in-place.

$$\gamma_d = \frac{(113)\gamma_d - (113)(86)}{0.5(111 - 86)}$$

$$\gamma_d = \frac{113\gamma_d - 9,546}{12.5}$$

$$98.5\gamma_d = 9,546$$

$$\gamma_d = 96.9$$

$$\gamma \cong 97 \text{ pcf} \checkmark$$

Summary of Dry Densities (Est) For Processed Gravels

In-Place, unprocessed Gravel

GW = 128 pcf

2" + = 126 pcf
1"-2" = 126 pcf
1"-#10 = 120 pcf
#10 < = 98 pcf

Breakdown for Each Lineal Foot of Excavation For Trench in the gravel sequence

- Total volume of Gravel per lineal foot

V_g = 5039 cf @ 128 pcf

Total Weight = (5039)(128 pcf)
= 644,992 lbs / LF ✓

Breakdown into the various Screened sizes

2" +	(644,992)	(17.6%)	=	113,519 lbs
1-2"	(644,992)	(21.3%)	=	137,383 lbs
1" - #10	(644,992)	(48.7%)	=	314,111 lbs
< #10	(644,992)	(12.4%)	=	79,979 lbs
				644,992 lbs OK ✓

Convert into Cubic Ft

2" +	113,519 / 125	=	908
1-2"	137,383 / 125	=	1099
1" - #10	314,111 / 120	=	2618
< #10	79,979 / 97	=	825
			5450 CF

Bulk Factor due to redistribution of Grain sizes

$$\text{Bulk F} = \frac{5450}{5039} = 1.08$$

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Now Calculate Materials Required for Liner + Hanford Barrier Construction

Liner – Admix layer = 959 ft³/LF *

Gravel Drain layers = 190 ft³/LF *

Operations layer 1154 ft³/LF *

* ACAD Areas off of Fig. 1-3
923-A017 #2581

Interm layers –

1 @ .5' thick ½ way up, 200 ft² of surface area per LF
= 100 ft³/LF

1 @ top 0.5' thick, 300 ft² surface per LF = 150 ft³/LF

Hanford Barrier – assume 400' wide

– 12" Drainage rock
(400)(1) = 400 ft³/LF ✓

– Capillary break material (crushed basalt?) 5' thick
(400)(5) = 2000 ft³/LF ✓

– Gravel Filter, 12" thick
(400)(1) = 400 ft³/LF ✓

– Sand Filter, 6" thick
(400)(0.5) = 200 ft³/LF ✓

– Silt, 3.3' thick
(400)(3.3) = 1,320 ft³/LF

– Silt and Gravel Admix, 3.3' thick
(400)(3.3) = 1,320 ft³/LF

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Summary of Soil/Gravel Materials Required For Construction of Liner + Hanford Barrier For ERSDF Per Lineal Foot

Given: Hanford Barrier 400' wide
Liner As Per Fig. 1-3

Liner: 3' compacted Admix
2 X 1' gravel drainage layer, full width of bottom (100')
3' operations layer

LINER

Component	Material	Vol. Per L.F. (ft^3)
Admix	< #10 sand	959
Gravel drain	1" – #10	190
operations layer	1" – #10 sand	1154
Total =		2,303 ft^3/LF

Interm layer: 1@ 0.5' thick ½ way up, 200 ft wide

1@ top, 0.5' thick, 300 ft wide

Interm layer (cover)

Component	Material	Vol. Per L.F. (ft^3)
Layer 1	< #10 sand	100
Layer 2	< #10 sand	150
Total =		250 ft^3/LF

Golder Associates	SUBJECT Material Balance ERSDF		
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Hanford Barrier:

1' Drainage rock
5' Capillary break
1' Gravel Filter
6" Sand Filter
3.3' silt
3.3' Silt/Gravel Admix
14.1' x 400' = 5,640 ft³/LF

Hanford Barrier

Component	Material	Vol. Per L.F. (ft³)
1' Drain Rock	1" - #10	400
5' Capillary break	2" + Crushed Rock	2,000
6" Sand Filter	SAND	200
1' Gravel Filter	1" - #10	400
3.3' silt	silt	1,320
3.3' silt/Pea Gravel Admix	Silt + 15% Pea Gravel	1,320
Total =		5,640 ft³/LF

Total Material Required

Liner	2303
Interm Layer	250
Hanford Barrier	5640
Total =	8,193 cf/LF. 303 cy/LF

Note: In-place/compacted yards used for all calculations.

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Material Balance

Gravel Series Trench Per LF (from Page 9)

2" +	901	CF
1-2" +	1090	CF
1"-#10	2618	CF
< #10	816	CF
Total =	5,425	

unscreened Sand = 2,365 CF

Total from X = 7,790 FT³/LF

Priority - 1st - use material in Liners system
2nd - use material in barrier
3rd - use in operations layer / interm cover

Material balance Per LF For Gravel

Material	Quantity (ft³)	Use	Need	excess /	deficit	Excess (cf)
2"+	908	Hanford barrier	2000		-1092	
1"-2"	1,099	cap, break Road Resurfacing	unknown	1090	0	1099
1" - #10	2618	Liner drainage Layer	190 ✓	2428	0	0
		Hanford Barrier Filter + drain rock	800	1628	0	0
		operations layer	1154	474	0	0
		Interm Layers	250	224	0	224
< #10	825	Liner admix / fill	959		-134	
Unscreened sand	2,365	Liner admix	134	2231		
		Sand Filter	200	2031		2031
SILT	0	H.B.	1320	0	-1320	
Silt/gravel Admix	0	H.B.	1320	0	-1320	
					3,732	3,354

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SUBJECT Material Balance ERSDF		
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Summary of Material Balance For Gravel Sequence

	CF/LF	
Import	1,092	H.B. Cap Break
	1,320	H.B. silt layer
	1,320	H.B. Silt/Gravel Admix
total =	3,732	

Export	1099	1-2"
	224	1"-#10
	2036	SAND
total	3,354	

Balance Check For Gravel Sequence

		CF/LF
Material Excavated:	Processed Gravel	5450
	Sand	2365
Material Exported:	1"-2" Gravel	-1099
	1"-#10	-224
	Sand	-2031
Material Imported:	H.B. Cap Break	+1092
	Silt layer	+1320
	Silt/Gravel Admix	1320
		8,193

SEE ATTACHED SPREAD SHEET FOR DETAILED OUTPUT

NOTE: Due to rounding in the hand calculations, the spread sheet varies slightly (±1 CF/LF)

MATERIAL BALANCE FOR ERSDF TRENCH 33.3 FT DEEP WITH 3H:1V SIDE SLOPES AND 100 FT WIDE TRENCH BOTTOM (GRAVEL SEQUENCE)

MATBAL.XLS

GRAIN SIZE DIST. FOR GRAVEL (AVG)	%
2"+	17.6
1"-2"	21.3
1"-#10	48.7
#10<	12.4

DRY DENSITIES OF GRAVEL AND SREENED MATERIAL

MAT.	DENSITY (PCF)	
IN-SITU	128	(GW)
IN-SITU	115	SAND
2"+	125	
1"-2"	125	
1"-#10	120	
#10<	97	

VOLUME AND WEIGHT OF MATERIAL EXCAVATED PER LF OF TRENCH

	CF/LF	LBS
GRAVEL	5039	644992
SAND	2365	271975
TOTAL	7404	916967

BREAK INTO VARIOUS SCREENED SIZES

	CF/LF	LBS
2"+	908	113519
1"-2"	1099	137383
1"-#10	2618	314111
#10<	825	79979
TOTAL	5449	644992
SAND	2365	

MATERIAL BALANCE

MATERIAL EXCAVATED		MATERIAL NEEDED FOR CONSTRUCTION PER LF OF EXCAVATION (CF/LF)																						
MAT.	QUANT.	H.B CAP BREAK		ROAD SURFACING		LINER DRAINAGE		HB FILTER + DR		OPERATIONS LAYER		INTERM COVERS		LINER ADMIX		HB SAND FILTER		SILT LAYER FOR HB		SILT/GRAVEL ADMIX		MATERIAL
	(CF)	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	EXCESS(CF)
2"+	908	2000	-1092																			0
1"-2"	1099			0	1099																	1099
1"-#10	2618					190	2428	800	1628	1154	474	250	224									224
#10<	825													959	-134							0
SAND	2365													134	2231	200	2031					2031
SILT	0																	1320	-1320			0
SILT + GRAVEL	0																			1320	-1320	0

TOTAL MAT. AVAILALBE FROM EXCAVATION =	7814	CF/LF
TOTAL EXCESS FROM ECAVATON =	3353	CF/LF
TOTAL USED FROM ECAVATON =	4461	CF/LF
TOTAL NEEDED FOR LINER AND HB CONST. =	8193	CF/LF
TOTAL TO BE IMPORTED FOR CONST. =	3732	CF/LF

2/18

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Golder Associates	SUBJECT ERSDF Material Mass Balance		
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Material Balance For The Sand Sequence

Import:

CF/LF	
2000	H.B. Cap. Break
190	Liner Drainage
1320	Silt/Gravel Admix
1320	Silt Layer
5630	

Used:

1154	Operations Layer
250	Interim Covers
959	Liner Admix
200	H.B. Sand Filter
2563	

Excavated: 7404 (Sand)

Exported: 4841 (Sand)

Balance Check For Sand Sequence

		CF/LF
material Excavated:	Sand	7404
material Exported:	Sand	-4841
Material Imported:	Cap. Break	2000
	Drainage layer	190
	H.B. Filter + D.R.	800
	Silt Layer	1320
	Silt/Pea Gravel	1320
	Total =	8,193 *

OK

* 8,193 CF/LF of materials are required to construct the Landfill

MATERIAL BALANCE FOR ERSDF TRENCH 33.3 FT DEEP WITH 3H:1V SIDE SLOPES AND 100 FT WIDE TRENCH BOTTOM (SAND SEQUENCE)

MATBAL.XLS

GRAIN SIZE DIST. FOR GRAVEL (AVG)	%
2" +	17.6
1"-2"	21.3
1"-#10	48.7
#10<	12.4

DRY DENSITIES OF GRAVEL AND SREENED MATERIAL

MAT.	DENSITY (PCF)	
IN-SITU	128	(GW)
IN-SITU	115	SAND
2" +	125	
1"-2"	125	
1"-#10	120	
#10<	97	

VOLUME AND WEIGHT OF MATERIAL EXCAVATED PER LF OF TRENCH

	CF/LF	LBS
GRAVEL	0	0
SAND	7404	851460
TOTAL	7404	851460

BREAK INTO VARIOUS SCREENED SIZES

	CF/LF	LBS
2" +	0	0
1"-2"	0	0
1"-#10	0	0
#10<	0	0
TOTAL	0	0
SAND	7404	

MATERIAL BALANCE

MATERIAL EXCAVATED		MATERIAL NEEDED FOR CONSTRUCTION PER LF OF EXCAVATION																				
MAT.	QUANT.	H.B CAP BREAK		ROAD SURFACING		LINER DRAINAGE		HB FILTER + DR		OPERATIONS LAYER		INTERIM COVERS		LINER ADMIX		HB SAND FILTER		SILT LAYER FOR HB		SILT/GRAVEL ADMIX		MATERIAL
	(CF)	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	EXCESS(CF)
2" +	0	2000	-2000																			0
1"-2"	0			0	0																	0
1"-#10	0					190	-190	800	-990	0	-990	0	-990									0
#10<	0													0	0							0
SAND	7404									1154	6250	250	6000	959	5041	200	4841					4841
SILT	0																	1320	-1320			0
SILT + GRAVEL	0																			1320	-1320	0

TOTAL MAT. AVAILABLE FROM EXCAVATION =	7404	CF/LF
TOTAL EXCESS FROM ECAVATON =	4841	CF/LF
TOTAL USED FROM ECAVATON =	2563	CF/LF
TOTAL NEEDED FOR LINER AND HB CONST. =	8193	CF/LF
TOTAL TO BE IMPORTED FOR CONST. =	5630	CF/LF

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Golder Associates	SUBJECT "Fluff Factor" ERSDF		
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Calculated "Fluff" factor for sand and Gravel.

Fang, page 263, Fig. 8.19

For 80% Gravel w/ 3" + SAND

$\gamma_{min} = 115$

$\gamma_{max} = 138$

For SAND w/ 0% Gravel

$\gamma_{min} = 91$

$\gamma_{max} = 120$

For Gravel, Assume $D_r = 0.7$ (inplace)
For SAND, Assume $D_r = 0.5$ (inplace)

$$\gamma_d = \frac{(\gamma_{dmax})(\gamma_d) - (\gamma_{dmax})(\gamma_{dmin})}{D_r(\gamma_{dmax} - \gamma_{dmin})}$$

Assume $D_r = 0.3$ For loose gravel
Assume $D_r = 0.2$ For loose sand

GRAVEL

$$\gamma_d = \frac{(138)\gamma_d - (138)(115)}{0.7(138-115)}$$

$$\gamma_d = \frac{138\gamma_d - 15{,}870}{16.10}$$

$121.9\,\gamma_d = 15{,}870$

$\gamma_d = 130$ pcf

GRAVEL (cont'd)

For $D_r = 0.3$

$$\gamma_d = \frac{(138)(\gamma_d) - (138)(115)}{0.3(138-115)}$$

$$\gamma_d = \frac{138\gamma_d - 15{,}870}{11.5}$$

$$131.1\gamma_d = 15{,}870$$

$$\gamma_d = 121 \text{ pcf}$$ ✓

$$\text{"Fluff"} = \frac{130}{121} = 1.07 \quad (D_r = 0.3)$$

For $D_r = 0.20$

$$\gamma_d = \frac{(138)(\gamma_d) - (138)(115)}{0.2(138-115)}$$

$$133.4(\gamma_d) = 15{,}870$$

$$\gamma_d = 119 \text{ pcf}$$ ✓ $D_r = 0.2$

$$\text{"Fluff" Factor} = \frac{130}{119} = 1.09$$

→ Estimate 10% Fluff Factor For Gravel

For $D_r = 0$

$$\text{"Fluff" Factor} = \frac{130}{115} = 1.13$$ ✓

Golder Associates

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SAND

For $D_r = 0.5$

$$\gamma_d = \frac{(120)\gamma_d - (120)(91)}{0.5(120-91)}$$

$$105.5\,\gamma_d = 10,920$$

$$\gamma_d = 103.5 \text{ pcf}$$

For $D_r = 0.15$

$$\gamma_d = \frac{(120)(\gamma_d) - (120)(91)}{0.15(120-91)}$$

$$115.65\,\gamma_d = 10,920$$

$$\gamma_d = 94.4 \text{ pcf}$$

"Fluff" Factor $= \frac{103.5}{94.4} = 1.10$

For $D_r = 0$ $\gamma_d = 91$

"Fluff" Factor $= \frac{103.5}{91} = 1.14$

Estimate "Fluff" Factor = 15% For the SAND of sand as follows

$0 < D_r < \frac{1}{3}$ Loose sand
$\frac{1}{3} < D_r < \frac{2}{3}$ Medium compact sand
$\frac{2}{3} < D_r < 1$ Dense sand

He defined compactibility as

$$F = \frac{e_{max} - e_{min}}{e_{min}} \tag{8.6}$$

In well-graded cohesionless soils such as SW or GW, $e_{max} - e_{min}$ is large and e_{min} is small; hence F is large. These soils are easily compacted.

In uniform soils such as certain types of SP and GP, $e_{max} - e_{min}$ is small and e_{min} is large; hence F is small and the soil more difficult to compact. Table 8.3 lists compactibilities for a variety of soils.

Burmister (1948) showed that the relative density of non-cohesive soils was a more significant parameter than dry density alone insofar as engineering properties of the soil are concerned. His work has been verified and extended by other investigators (D'Appolonia, 1970).

As indicated in Equations 8.3 and 8.4, determination of the relative density of a soil requires measuring its dry density in place, its dry density in the loosest state, and its dry density in the densest state (or the three corresponding void ratios). The density in place and minimum density (loosest state) present no particular difficulty, but a generally accepted method of determining the maximum density (densest state) of all cohesionless soils has not yet been found (see Section 8.4).

Zolkov and Wiseman (1965) studied uniform, fine subangular quartz beach sands. They used ASTM D 1557-58T (10-lb hammer) to obtain maximum density, frequently at 0 percent compaction moisture. They point out that a percentage of maximum density can be very misleading, for if $\gamma_{max}/\gamma_{min} = 1.25$, 80 percent $\gamma_{max} = \gamma_{min}$. The quantity $\gamma_{max}/\gamma_{min}$ varied from 1.17 to 1.35. For uniform spheres, $\gamma_{max}/\gamma_{min} = 1.4$. Figure 8.18 shows the relationship between percentage of maximum density to relative density D_r for various ratios of maximum to minimum densities.

Figure 8.19 from the Bureau of Reclamation *Earth Manual* (1968b) shows maximum and minimum densities of typical sand and gravel soils.

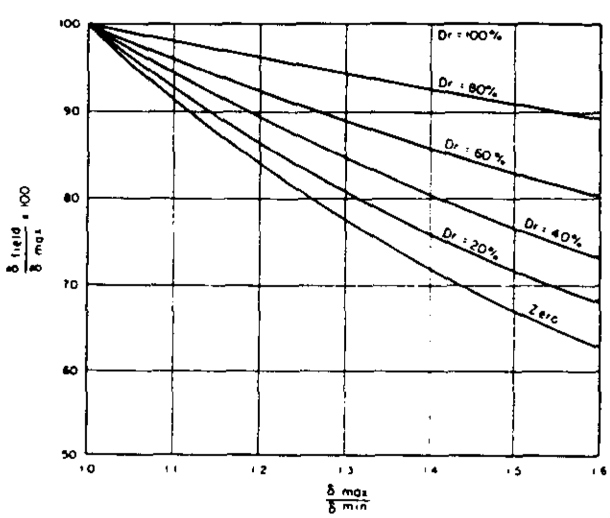

Fig. 8.18 Relative density, maximum and minimum density relationships. (*After Zolkov and Wiseman, 1965.*)

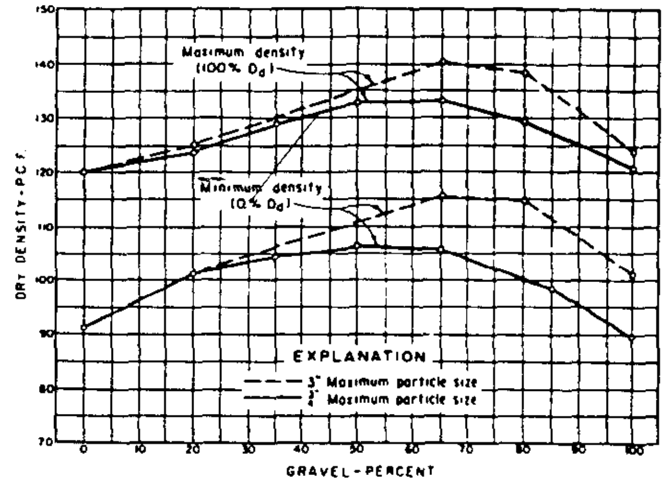

Fig. 8.19 Maximum and minimum densities of typical sands and gravel soils (101-D-173). (*After Bureau of Reclamation* Earth Manual, *1968b.*)

Compressibility of Compacted Sands and Gravels Under Static Loads

The relationship between relative density and volume change under load is illustrated in Figure 8.20 for a Platte River medium to coarse clean sand (SW). The sand had a maximum density of 124.0 pcf, a minimum density of 92.5 pcf, and a specific gravity of 2.63.

Tests were made in 1956 by the Bureau of Reclamation in the one-dimensional consolidation apparatus with the sand in a wet condition. These confined compression tests show that this sand is more than twice as compressible at a relative density of about 40 percent than it is at a relative density of 70 percent.

The effect of relative density on compressibility is accentuated at higher loads; for example, under a 25-psi load the consolidation (volume change) is 0.86 percent for a relative density of 73.1 percent and 1.86 percent for a relative density of 39.4 percent, but under a load of 200 psi, the consolidations are 1.7 and 5.1, respectively, for those relative densities.

Terzaghi and Peck (1967) reported similar results for compressibility of confined layers of loose and dense sand and showed that the shape of the particles affect volume change under load; sands with flat particles (sand–mica mixtures) are more compressible than sand alone. Crushing of the sand grains appeared to occur at pressures of about 100 kg/cm². Roberts and DeSouza (1959) made high-pressure (up to 14 000 psi) confined compression tests on well-rounded uniform quartz sand. They concluded that at sufficiently high pressures, sand may be more compressible than clay, primarily owing to crushing and fracturing of individual sand grains. The pressure at which breakdown occurs depends on the angularity and initial void ratio of the sand.

The foregoing results were for confined compression in which volume change is due to vertical movement only. The results of these studies show that sand is relatively incompressible at low pressures, that at high pressures there can be considerable volume change due to crushing of grains, and that compression can continue for a considerable period of time.

Lee and Seed (1967a) reported on tests on saturated washed Sacramento River sand (0.297 in to 0.149 in, subangular to subrounded, $G = 2.68$, $e_{min} = 0.61$, $e_{max} = 1.03$) in triaxial compression. Samples (1.4-in diameter, 3.4-in high) were prepared at different initial void ratios and confined under a seating load of 0.7 psi, after which volume changes were

Golder Associates	SUBJECT ERSDF/ Trench Length		
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Total Length of Trench needed @ 247 cy/LF

L_T = 30,000,000 CY / 247
L_T = 121,458 LF

29 Trenches are required as layed out per Fig. XX

To account for reduced volume of waste at the ends of each trench (247 CY/LF tapering to 0 CY/LF) must add additional trench length.

- Add 119' per trench to account for end areas.*

Effective total Length of Trenches

L_{TE} = (29)(119') + 121,458'
L_{TE} = 124,908 LF

Summary

Total Length Required w/ 29 trenches

L = 124,908 LF

* Note: Approximation only, does not account for 3-D geometry of trench.

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SUBJECT ERSDF / Trench Length		
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Measure Linear Ft of Gravel Excavation

- Starting at NW corner (top), numbering 1-29. Measurement by ACAD off Fig. XX)

Trench #	Gravel Length (FT)	SAND Length (FT)	Total (FT)
1	1,665	1,737	3402
2	1,595	1,807	3402
3	1,496	1,906	3402
4	1,454	1,948	3402
5	1,372	2,030	3402
6	1,276	2,126	3402
7	1,226	2,176	3402
8	1,150	2,252	3402
9	1,056	2,346	3402
10	1,018 ok	2,384	3402
11	3,443	2,459	5,902
12	3,361	2,541	5,902
13	3,290	2,612	5,902
14	3,209	2,693	5,902
15	3,153	2,749	5,902
16	3,068	2,834	5,902
17	2,985	2,917	5,902
18	2,916	2,986	5,902
19	2,839	3,063	5,902
20	2,770	3,132	5,902
21	2,699	3,203	5,902
22	—	3,402	3,402
23	—	3,402	3,402
24	—	3,402	3,402
25	—	3,402	3,402
26	—	3,402	3,402
27	—	3,402	3,402
28	—	3,402	3,402
29	—	2,146	2,146
Total =	47,041* +	77,861* =	124,902*

* Note - Due to Rounding During Conversion From meters to FT., Total Footage is 6' less than total length previously calculated. Layout on Fig. XX is in meters.

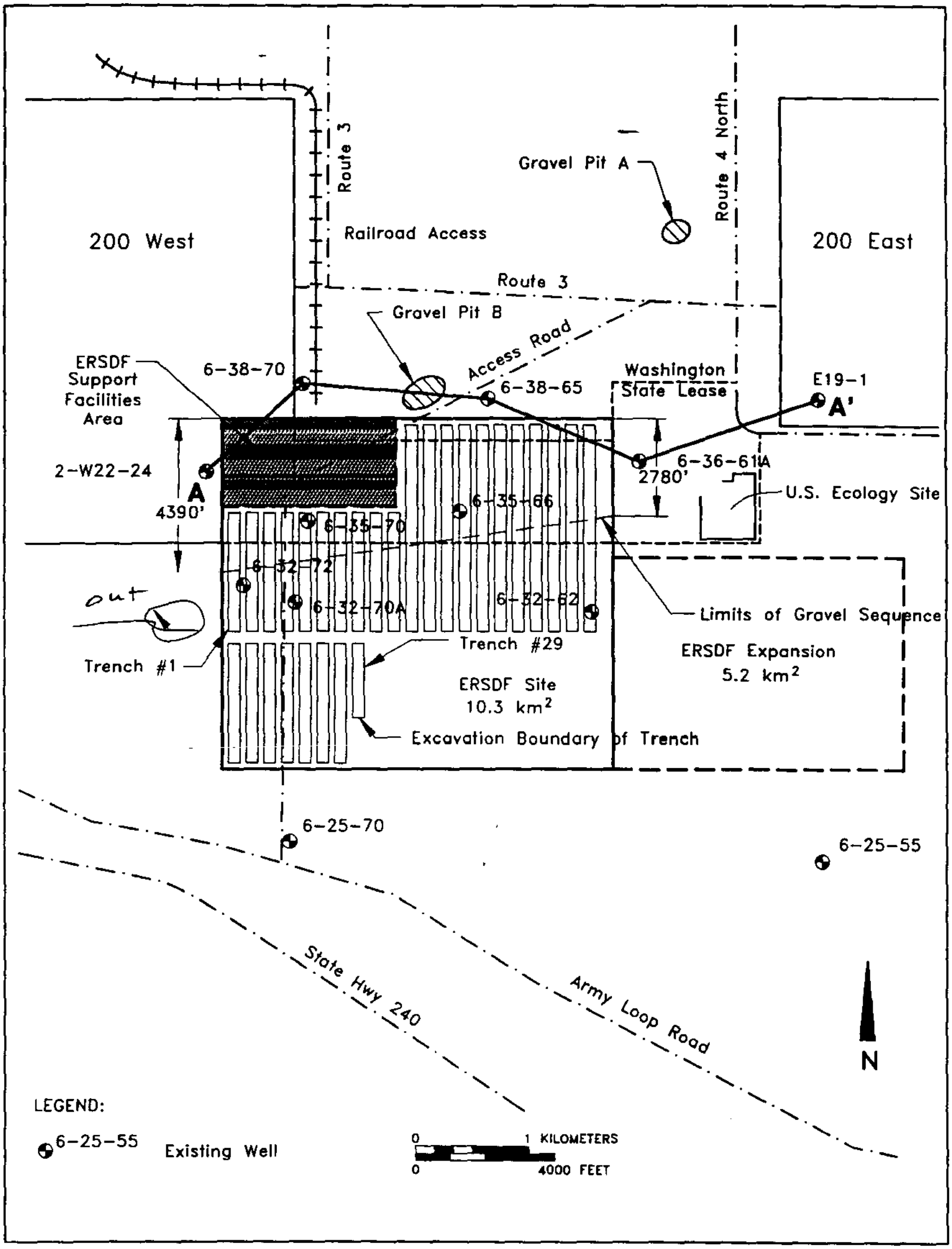

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Figure 5 Trench Layout at ERSDF Site

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SUBJECT TOTAL MASS BALANCE		
Job No. 923-A017 Ref.	Made by RDL Checked TCM Reviewed	Date 7-14-93 Sheet 1 of 4

Mass Balance For Effective Trench Length

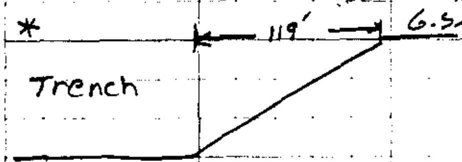
Given: Total trench Length as per Fig-5

- Gravel Sequence = 47,042'
- Sand Sequence = 77,867'

total = 124,909 LF

Calc - Effective Length @ 247 CY/LF*

*Ref. Fig 1-3 From Mat. Balance Calc's



- Gravel Sequence = 47,042 − (21)(119/2)
  = 45,792'
- Sand Sequence = 77,867 − [(8)(119) + 2(119/2)]
  = 75,666'

Total = 121,458 LF

Given: CF/LF Excavation as per Spread Sheet

- Gravel Sequence

Excess Material Volume

V_{EG} = (45,792)(3353)
= 153,540,576 CF
= 5,686,688 CY

Imported Material Volume

V_{IG} = (45,792)(3732)
= 170,895,744 CF
= 6,329,472 CY

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SUBJECT Total Mass Balance		
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- Sand Sequence

Excess Material

$V_{ES} = (75,666)(4841)$
$= 366,299,106$ CF
$= 13,566,634$ CY

Imported material

$V_{IS} = (75,666)(5630)$
$= 425,999,580$ CF
$= 15,777,762$ CY

Summary of Mass Balance

Trench Location	Excess Mat. (CY)	Import For Const (CY)
Gravel Sequence	5,686,688	6,329,472
Sand Sequence	13,566,634	15,777,762
Total	19,253,322	22,107,234 ✓

MATERIAL BALANCE FOR ERSDF TRENCH 33.3 FT DEEP WITH 3H:1V SIDE SLOPES AND 100 FT WIDE TRENCH BOTTOM (SAND SEQUENCE)

MATBAL.XLS

GRAIN SIZE DIST. FOR GRAVEL (AVG)

	%
2"+	17.6
1"-2"	21.3
1"-#10	48.7
#10<	12.4

DRY DENSITIES OF GRAVEL AND SREENED MATERIAL

MAT.	DENSITY (PCF)	
IN-SITU	128	(GW)
IN-SITU	115	SAND
2"+	125	
1"-2"	125	
1"-#10	120	
#10<	97	

VOLUME AND WEIGHT OF MATERIAL EXCAVATED PER LF OF TRENCH

	CF/LF	LBS
GRAVEL	0	0
SAND	7404	851460
TOTAL	7404	851460

BREAK INTO VARIOUS SCREENED SIZES

	CF/LF	LBS
2"+	0	0
1"-2"	0	0
1"-#10	0	0
#10<	0	0
TOTAL	0	0
SAND	7404	

MATERIAL BALANCE

MATERIAL EXCAVATED		MATERIAL NEEDED FOR CONSTRUCTION PER LF OF EXCAVATION																				
MAT.	QUANT.	H.B CAP BREAK		ROAD SURFACING		LINER DRAINAGE		HB FILTER + DR		OPERATIONS LAYER		INTERM COVERS		LINER ADMIX		HB SAND FILTER		SILT LAYER FOR HB		SILT/GRAVEL ADMIX		MATERIAL
	(CF)	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	EXCESS(CF)
2"+	0	2000	-2000																			0
1"-2"	0			0	0																	0
1"-#10	0					190	-190	800	-990	0	-990	0	-990									0
#10<	0													0	0							0
SAND	7404									1154	6250	250	6000	959	5041	200	4841					4841
SILT	0																	1320	-1320			0
SILT + GRAVEL	0																			1320	-1320	0

TOTAL MAT. AVAILALBE FROM EXCAVATION =	7404	CF/LF
TOTAL EXCESS FROM ECAVATON =	4841	CF/LF
TOTAL USED FROM ECAVATON =	2563	CF/LF
TOTAL NEEDED FOR LINER AND HB CONST. =	8193	CF/LF
TOTAL TO BE IMPORTED FOR CONST. =	5630	CF/LF

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MATERIAL B[illegible]CE FOR ERSDF TRENCH 33.3 FT DEEP WITH 3H:1V SIDE SLOPES AND 100 FT WIDE TRENCH BOTTOM (GRAVEL SEQUENCE)

MATBAL.XLS

GRAIN SIZE DIST. FOR GRAVEL (AVG)	%
2" +	17.6
1"-2"	21.3
1"-#10	48.7
#10<	12.4

DRY DENSITIES OF GRAVEL AND SCREENED MATERIAL

MAT.	DENSITY (PCF)	
IN-SITU	128	(GW)
IN-SITU	115	SAND
2" +	125	
1"-2"	125	
1"-#10	120	
#10<	97	

VOLUME AND WEIGHT OF MATERIAL EXCAVATED PER LF OF TRENCH

	CF/LF	LBS
GRAVEL	5039	644992
SAND	2365	271975
TOTAL	7404	916967

BREAK INTO VARIOUS SCREENED SIZES

	CF/LF	LBS
2" +	908	113519
1"-2"	1099	137383
1"-#10	2618	314111
#10<	825	79979
TOTAL	5449	644992
SAND	2365	

MATERIAL BALANCE

MATERIAL EXCAVATED / MATERIAL NEEDED FOR CONSTRUCTION PER LF OF EXCAVATION (CF/LF)

MAT.	QUANT.	H.B CAP BREAK		ROAD SURFACING		LINER DRAINAGE		HB FILTER + DR		OPERATIONS LAYER		INTERIM COVERS	
	(CF)	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT	NEED	DEFICIT
2" +	908	2000	-1092										
1"-2"	1099			0	1099								
1"-#10	2618					190	2428	800	1628	1154	474	250	224
#10<	825												
SAND	2365												
SILT	0												
SILT + GRAVEL	0												

MAT.	LINER ADMIX		HB SAND FILTER		SILT LAYER FOR HB		SILT/GRAVEL ADMIX		MATERIAL
	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	NEED	DEFICT	EXCESS(CF)
2" +									0
1"-2"									1099
1"-#10									224
#10<	959	-134							0
SAND	134	2231	200	2031					2031
SILT					1320	-1320			0
SILT + GRAVEL							1320	-1320	0

TOTAL MAT. AVAILAUBLE FROM EXCAVATION =	7814	CF/LF
TOTAL EXCESS FROM ECAVATON =	3353	CF/LF
TOTAL USED FROM ECAVATON =	4461	CF/LF
TOTAL NEEDED FOR LINER AND HB CONST. =	8193	CF/LF
TOTAL TO BE IMPORTED FOR CONST. =	3732	CF/LF

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SUBJECT Rate of Excess Mat. From Trench X		
Job No. 923-A017	Made by RDL	Date 7-14-93
Ref.	Checked TRM	Sheet 1 of 3
	Reviewed	

Given: A) 29 trenches + length in gravel + length in sand

B) Excess Sand Generated per Lineal foot of excavation

— 2031 CF/LF in Gravel Sequence

— 4841 CF/LF in Sand Sequence

Assumptions:

A) Trenches are excavated from # 1 (NW corner) to # 29 (SE area).

B) All of the assumptions for the material balance

Calculations: See attached spread-sheet.

Note: Material Balance is based on effective length of trench that is, 119' is subtracted off of each trench (to account for reduced end volume)

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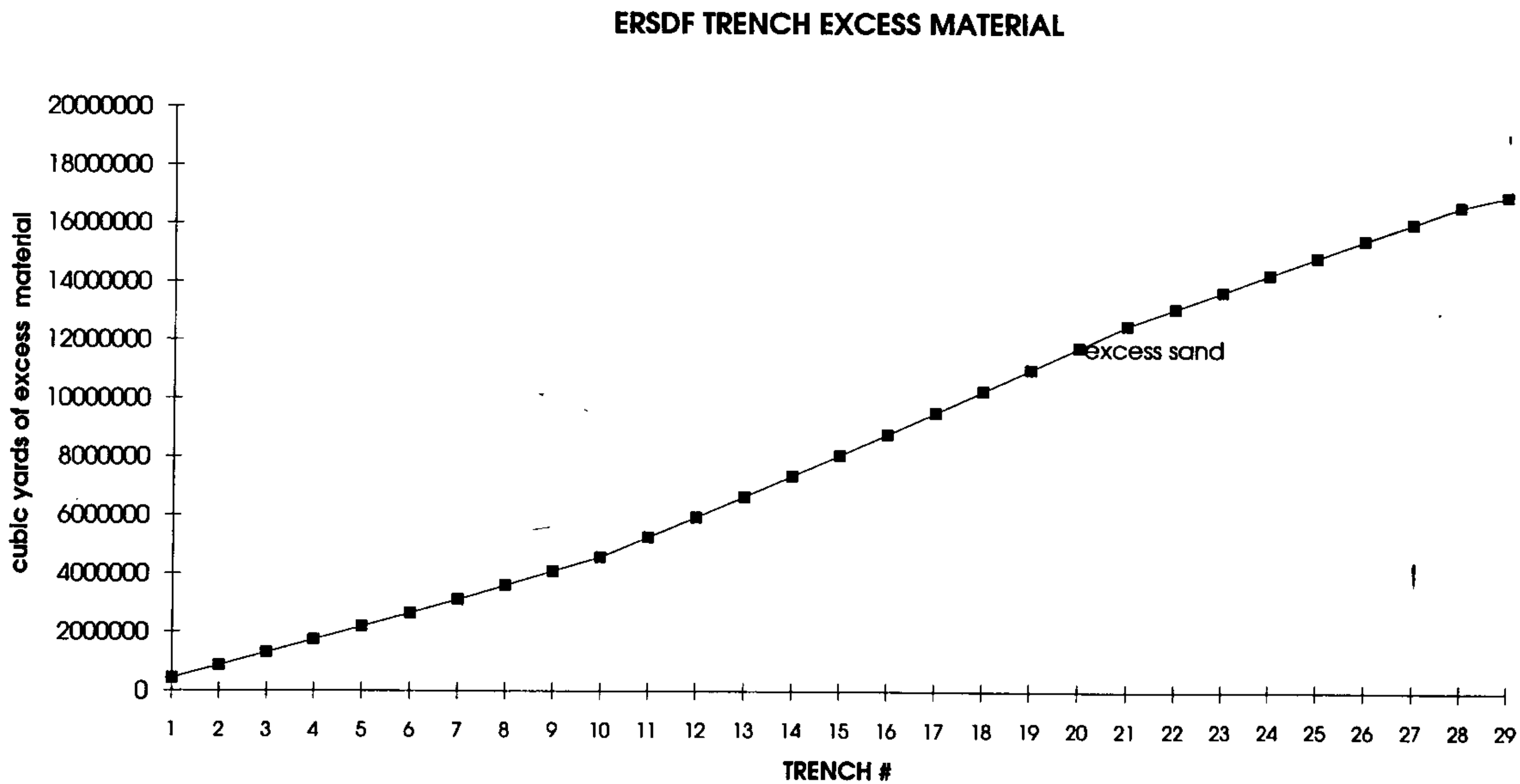
EXCESS MATERIAL FROM TRENCH EXCAVATION FOR ERSDF DESIGN STUDIES

GRAVEL SEQ.			SAND SEQUENCE	
EXCESS	CF/LF		EXCESS	CF/LF
SAND	2031		SAND	4841
1"-2"	1090		1"-2"	0
1"- #10	224		1"- #10	0
TOTAL	3345		TOTAL	4841

Trench #	Gravel Sequence		Sand Sequence		Total (CY)	Running Total	Depth/5 km
	LF	Sand (CY)	LF	Sand (CY)		(CY)	(ft)
1	1665	120769	1737	300811	421580	421580	0.211497
2	1595	115490	1807	313394	428884	850464	0.426658
3	1496	108061	1906	331101	439162	1289626	0.646975
4	1454	104878	1948	338689	443567	1733193	0.869502
5	1372	98708	2031	353395	452103	2185296	1.096311
6	1276	91527	2126	370512	462039	2647335	1.328105
7	1226	87726	2177	379572	467298	3114633	1.562538
8	1150	82025	2252	393161	475185	3589818	1.800927
9	1056	74991	2346	409925	484916	4074734	2.044198
10	1018	72128	2384	416749	488877	4563612	2.289456
11	3443	254532	2459	430220	684752	5248364	2.63298
12	3361	248363	2541	444926	693288	5941652	2.980787
13	3290	243032	2612	457632	700664	6642316	3.332293
14	3209	236912	2693	472220	709131	7351448	3.688048
15	3153	232692	2749	482278	714970	8066418	4.046732
16	3068	226299	2834	497515	723814	8790232	4.409852
17	2985	220056	2917	512397	732452	9522684	4.777306
18	2916	214848	2987	524809	739657	10262342	5.148375
19	2839	209098	3063	538515	747613	11009955	5.523435
20	2770	203891	3132	550927	754818	11764773	5.902109
21	2699	198560	3203	563632	762193	12526965	6.284483
22	0	0	3402	588671	588671	13115636	6.579805
23	0	0	3402	588671	588671	13704307	6.875128
24	0	0	3402	588671	588671	14292978	7.17045
25	0	0	3402	588671	588671	14881649	7.465772
26	0	0	3402	588671	588671	15470320	7.761095
27	0	0	3402	588671	588671	16058991	8.056417
28	0	0	3402	588671	588671	16647662	8.351739
29	0	0	2146	363434	363434	17011096	8.534065
TOTAL	47042	3444586	77867	13566510	17011096		



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SUBJECT ERSDF Onsite Disposal For Excess Fill		
Job No. 923-A017	Made by RDL	Date 7-14-93
Ref.	Checked TCM	Sheet 1 of 4
	Reviewed	

Topogranic Notes For ERSDF site

- site slopes to the SW
- Overall topographic relief is on the order 100' across the entire site
- Average slope of ERSDF site

$$\text{Slope} = \frac{730' - 630'}{9000'} = 0.011$$

Avg. Slope = 1%

Reference: 7.5 minute series Gable Butt Quadrangle Topo map, USGS.

- Layout attached

Placing Excess Material Onsite

Assumptions: Material can be placed across the southern portion of the site. Divide site in half, N-S.

Only ½% slope is needed to maintain positive drainage for surface H_2O.

Given: Approximately 17 million Yards of Sand well be available for on-site disposal

Golder Associates	SUBJECT ERSDF Onsite Disposal for Excess Fill		
	Job No. 923-A017	Made by RDL	Date 7-14-93
	Ref.	Checked TCM	Sheet 2 of 4
		Reviewed	

Calculations:

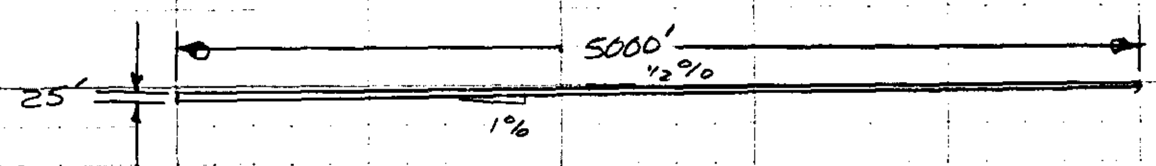
- Dimensions of S. portion of ERSDF Site = 5,000' x 10,000'

  A = 55,000,000 sf

  A = 6,111,111 sy

- total Excess = 17 M CY

Reduce slope from 1% to ½% over southern portion of site



Area available for Fill

$A = \frac{1}{2}(5000)(25)$

$A_{FILL} = 62,500$ sf

Volume for Southern Portion of Site

V = (62,500 SF)(11,000')

V = 687,500,000 CF

V = 25,462,963 CY

Conclusions

By raising grade across the South half of the ERSDF site, by decreasing the slope from 1% to ½%, a total of 25 million yards of material can be placed. The estimated excess sand from trench construction is 17 m cubic yards

∴ Placing Excess Material Onsite is Feasible

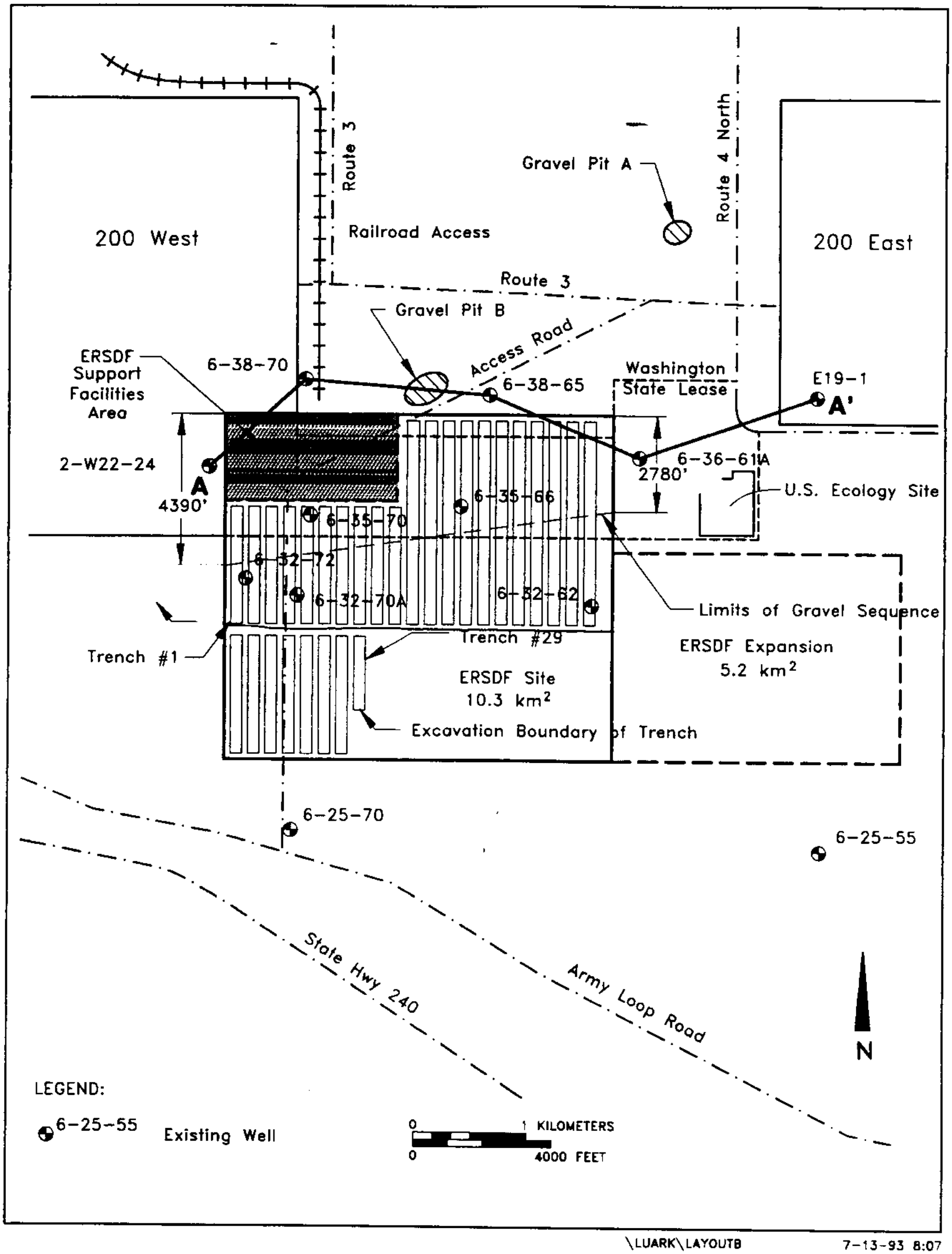


Figure 5 Trench Layout at ERSDF Site