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INTEGRAL MONITORED RETRIEVABLE STORAGE (MRS) FACILITY

CONCEPTUAL DESIGN REPORT

VOLUME I BOOK I — DESIGN DESCRIPTION EXECUTIVE SUMMARY

Prepared for

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Westinghouse Electric Corporation
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INTEGRAL MONITORED RETRIEVABLE STORAGE FACILITY

CONCEPTUAL DESIGN REPORT

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EXECUTIVE SUMMARY

FOREWORD

This report presents a summary design description of the Conceptual Design for an Integral Monitored Retrievable Storage (MRS) Facility, as prepared by The Ralph M. Parsons Company under an A-E services contract with the Richland Operations Office of the Department of Energy. More detailed design requirements and design data are set forth in the Basis for Design and Design Report, bound under separate cover and available for reference by those desiring such information.

The design data provided in this Design Report Executive Summary, the Basis for Design, and the Design Report include contributions by the Waste Technology Services Division of Westinghouse Electric Corporation (WEC), which was responsible for the development of the waste receiving, packaging, and storage systems, and Golder Associates Incorporated (GAI), which supported the design development with program studies. Both WEC and GAI were under subcontract to The Ralph M. Parsons Company.

The MRS Facility design requirements, which formed the basis for the design effort, were prepared by Pacific Northwest Laboratory for the U.S. Department of Energy, Richland Operations Office, in the form of a Functional Design Criteria (FDC) document, Rev. 4, August 1985.

BACKGROUND INFORMATION

The Nuclear Waste Policy Act of 1982 (NWPA) acknowledges that high-level radioactive waste and spent fuel create potential risks, have become major subjects of concern, and require safe and environmentally acceptable methods of disposal. It states that appropriate precautions must be taken to ensure that such waste and spent fuel do not adversely affect the public health and safety or the environment for this and future generations.

The Act provides for the nomination, selection, and recommendation to Congress, for construction authorization, of deep geological repositories according to a specific schedule. It also provides for the development of a limited Federal Interim Storage program, which will accept fuel exclusively from those reactors that cannot reasonably provide adequate storage capability at the sites of such reactors when needed to ensure the continued orderly operation of such reactors.

The Act also instructs DOE to prepare a proposal for a MRS system which, if authorized by Congress and constructed as an integral part of the Federal waste management system, could provide an option for long-term storage of nuclear waste awaiting further processing or disposal.

The Act states that the MRS Facility must be designed to:

(1) Accommodate spent nuclear fuel and high-level waste resulting from civilian nuclear power facilities.

(2) Permit continuous monitoring, management, and maintenance of such fuel and waste for the foreseeable future.

(3) Provide for the ready retrieval of spent fuel and waste for further processing or disposal.

(4) Safely store such spent fuel and waste as long as may be necessary by maintaining such facilities through appropriate means, including any facility replacement.

Previous MRS studies indicate that passive dry storage technologies are preferred for long-term MRS applications because they do not require external power to provide cooling.

After conducting screenings and evaluations of potential storage concepts, DOE has selected the sealed storage cask (concrete cask) and field drywell concepts from a field of eight concepts for the MRS Facility designs. The selection was made after considering the technological maturity of the eight concepts, the extent of operating experience, maturity of available designs, and uncertainties with system performance and cost.

The Conceptual Design work performed by The Ralph M. Parsons Company addressed the DOE MRS proposal requirements to Congress in the form of drawings, design analyses, studies, schedules, and cost data. These appear in this Design Report Executive Summary, the Basis for Design, and the Design Report.

ABBREVIATIONS AND ACRONYMS

A	ampere
AASHTO	American Association of State Highway Transportation Officials
ac	alternating current
ACV	air-control vestibule
A-E	Architect-Engineer
ALARA	As Low As Reasonably Achievable
AMS	Alarm Monitoring Station
ANSI	American National Standards Institute
ANSI NQA-1	American National Standards Institute Nuclear Quality Assurance Requirements for Nuclear Power Plants
API	American Petroleum Institute
ASME	American Society Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
assy	assembly
ASTM	American Society for Testing Material
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
Btu	British thermal unit
BWR	boiling water reactor
CBM	Certified Ballast Manufacturer
CCSA	common control switching arrangement
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CHTRU	contact-handled transuranic waste
CPU	central processing unit
CRT	cathode-ray tube
DB	drybulb
db	decibel
DBE	design basis earthquake
dc	direct current
DCS	Distributed Control System
decon	decontamination
deg	degree (angular)
dia	diameter
DOE	Department of Energy
DOP	dioctyl phthalate
DOT	Department of Transportation
DPDT	double pole/double throw
EA	Environmental Assessment
ECC	Error Correction Code
EIA	Electronic Industries Association
EMT	electrical metallic tubing
EPABX	Electronic Private Automatic Branch Exchange

F	Fahrenheit
FDC	Functional Design Criteria
FID	flame ionization detector
FIS	Federal Interim Storage
FLA	full-load amperes
fpm	feet per minute
fps	feet per second
FS	Federal Specification
F.S.	full scale
ft	foot, feet
ft-c	footcandle
FTS	Federal Telecommunications System
HAW	high-activity waste
HAW/RHTRU	high-specific-activity material that may exceed Class C specifications for low-level waste and may or may not contain some quantity of transuranic material
HC	hydrocarbon
HEPA	high-efficiency particulate air
HID	high-intensity discharge
HLW	high-level waste
HP	health physics
hp	horsepower
HVAC	heating/ventilation/air-conditioning
IES	Illuminating Engineering Society
in.	inch, inches
I/O	Input/Output
ISFSI	Independent Spent Fuel Storage Installation
k	kips (1,000 lb)
kg	kilograms
KSR	keyed/send/receive
kV	kilovolt
kVA	kilovolt-ampere
kV-AR	kilovolt-ampere (reactive)
kW	kilowatt
kWh	kilowatt-hour
lb	pound, pounds
LLLTV	low light level television
LLW	low-level waste
lm	lumen
LPC	Lightning Protection Institute
m	meter, meters
max	maximum
MB	megabytes
MCA	multichannel analyzer
MOS	metal oxide semiconductor

mph	miles per hour
mR/hr	milliroentgen per hour
mrem	milliroentgen equivalent man
mrem/hr	milliroentgen equivalent man per hour
MRS	Monitored Retrievable Storage
MSP	Manufacturers' Standard Practices
MT	metric tons
MTU	metric tons of uranium (based on pre-irradiation)
MWD/MTU	megawatt days per metric ton of uranium
N/A	not applicable
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NIM	Nuclear Instrumentation Module
NPT	National Pipe Thread
NPTF	National Pipe Thread Female
NPTM	National Pipe Thread Male
NRC	Nuclear Regulatory Commission
n/sec	neutrons per second
NWPA	Nuclear Waste Policy Act of 1982
OA/FA	on air/forced air
OBE	operating basis earthquake
OC	on centers
OSHA	Occupational Safety and Health Administration
P&ID	piping and instrumentation diagram
pcf	pounds per cubic foot
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch absolute
PWR	pressurized water reactor
QA	quality assurance
QC	quality control
R/hr	roentgen per hour
R&D	research and development
R&H	receiving and handling
rem/hr	roentgen equivalent man per hour
RHAF	remote handling air filtration
RHTRU	remotely handled transuranic waste
RO	repository overpack
SDBC	solidly drawn bare copper
sec	second
SF	spent fuel
SNM	special nuclear material
SPDT	single pole/double throw
SS	stainless steel
SSE	safe shutdown earthquake
STC	sound transmission coefficient

TBD	to be determined
TEFC	totally enclosed fan cooled
T/G	transfer/generator
TRU	transuranic waste
U	uranium
UBC	Uniform Building Code
UHF	ultra high frequency
UL	Underwriters' Laboratories, Inc.
UPC	Uniform Plumbing Code
UPS	uninterruptible power supply
VHF	very high frequency
wt	weight
WV	West Valley

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EXECUTIVE SUMMARY

1.0 MRS REQUIREMENTS

The Integral MRS Facility, referred to hereafter as the MRS Facility, must include all infrastructure, facilities, and equipment required to routinely receive, unload, prepare for storage, and store spent fuel (SF), high-level waste (HLW), and transuranic waste (TRU), and to decontaminate and return shipping casks received by both rail and truck. The facility is to be complete with all supporting facilities, as described hereafter, to make the MRS Facility a self-sufficient installation. The facility must be licensed by the Nuclear Regulatory Commission (NRC).

The MRS Facility must have the capability to receive for shipment offsite or storage onsite a minimum of 3,600 metric tons of uranium (MTU) per year of spent fuel and a small amount (less than 60 canisters) of HLW. It is to have in-building lag storage capacity for 1,000 metric tons of consolidated spent fuel in canisters plus a field storage capacity of 15,000 MTU of SF and a small amount (less than 300 canisters) of HLW. The design shall assume a spent fuel mix of 60% by weight from pressurized water reactors (PWRs) and 40% by weight from boiling water reactors (BWRs), based on 0.462 MTU per PWR assembly and 0.186 MTU per BWR assembly. It must be capable of retrieval and shipment of at least 3,600 MTU/yr or equivalent of the same spent fuel and waste.

The spent fuel may be received at the MRS Facility fully assembled, either packaged or bare, or disassembled and consolidated in canisters. Fuel rods are to be consolidated in canisters capable of containing all of the fuel rods from whole numbers of either PWR or BWR assemblies. Nonfuel-bearing components of disassembled spent fuel assemblies will require volume reduction and packaging at the MRS Facility in preparation for storage.

The MRS Facility must be capable of receiving shipments by rail and truck, and to receive, unload, load, and ship all standard rail and truck SF, HLW, and RHTRU shipping casks. For design purposes, it may be assumed that the spent fuel will be received 70 wt% by rail and 30 wt% by truck. Nonstandard or off-normal cask shipments are to be routed to a special lag storage area while determination is made of the procedure to follow for routing through the MRS Facility handling and storage process.

Fuel and waste storage facilities shall be capable of attenuating the radiation and passively dissipating the heat generated primarily by 33,000 MWD/MTU spent fuel and/or equivalent HLW and RHTRU out of reactor 10 years. As much as 10% of the spent fuel received shall be considered fuel 5 years out of reactor and/or 10-yr-old spent fuel with burnups as high as 55,000 MWD/MTU. The storage configuration must be capable of maintaining spent fuel cladding surface temperatures below 375°C in an inert-gas environment, and of maintaining HLW container surface temperatures below 375°C in air and borosilicate glass centerline temperature below 500°C.

The design life of the R&H Building shall be 50 years, maintainable or replaceable to extend life to at least 100 years, irrespective of licensing intervals. The design life of the storage facilities shall be 100 years. The design life of supporting facilities shall be 30 years, except for exterior finishes that may require periodic maintenance to satisfy the 30-yr requirement.

The storage facilities shall be capable of confining packages of radioactive material within the storage container (cask/drywell) during the entire storage period, and shall have a monitoring system capable of detecting releases to the environs of radioactive material in excess of 1/10 of that stated in 10 CFR 20, Appendix B, Table II. Stored material shall be protected against likely natural or man-created events, excluding acts of war. In addition, all packages of waste must be retrievable at any time for examination, repair, or shipment offsite.

For receipt and inventory verification, provisions shall be included to account for the quantity, type, and history of the material stored in the facility.

1.1 SITE CHARACTERISTICS AND UTILITIES

Three sites for an MRS Facility were identified, a primary site (Clinch River) and two alternative sites (Hartsville and Oak Ridge), all in Tennessee.

The baseline site conditions established as criteria for site development include the following:

(1) Natural phenomena:

   (a) Seismic: Risk Zone 2 or less.

   (b) Tornado: Maximum wind speed 360 mph; tangential speed of 290 mph; translational speed from 5 to 70 mph.

   (c) Maximum wind: Site dependent.

   (d) Flood: Site above maximum probable flood level.

(2) Annual heating days: An average of 4,000.

(3) Soil characteristics:

   (a) Bearing capacity: Compacted fill or natural soil: 4,000 psf (min.); fresh bedrock: 15,000 psf (min.).

(b) Thermal conductivity: Equal to or greater than 1.2 w/m/°K.

(4) Precipitation: Equal to or less than 9 in. in 24 hr and equal to or less than 3 in. in 1 hr.

Site improvements are to include grading and drainage of the site, roads to the site, a main rail spur from a domestic railroad, internal roads, walks, and rail systems; a heliport for emergency evacuation of injured personnel; and security and site fencing and landscaping, as appropriate.

An onsite treatment and disposal system will be required for sanitary and process water systems. Fuel oil and gasoline storage facilities must also be provided.

1.2 BUILDINGS AND STRUCTURES

The MRS Facility, being a completely independent installation, will require facilities to support the spent-fuel processing and storage operations. These include administrative, maintenance, warehousing, security, fire-protection, and standby power generation facilities.

The Receiving and Handling (R&H) Building is the primary operating building of the MRS Facility. It must be designed to physically contain and control all radioactive or toxic materials being handled or generated by process operations. The systems, equipment, and operations shall be designed to minimize the quantity of radioactive waste generated during operations. It shall include spaces and equipment for receiving, identifying, disassembling, consolidating, and packaging spent fuel; for densifying, packaging, handling of spent-fuel hardware, and site-generated waste; and for receiving and handling canisters of HLW and RHTRU. Spaces and equipment shall also be provided to ship these materials offsite and/or load them out for onsite storage. It shall include mechanized and automated remote-handling equipment, where feasible, to permit rapid and economic handling of wastes. These operations are predicated on spent fuel, HLW, and RHTRU arriving in a dry gaseous environment and shipping casks being unloaded in air.

The R&H Building shall be designed to permit external cleaning, decontamination, and inspection of the transportable metal (dual-purpose) cask. The facility shall have the handling capability to unload this cask from its shipping vehicle and deliver the cask to the storage facility, or to remove the cask contents and return the cask to the transportation system.

Radioactive waste treatment systems shall also be included for treatment, solidification, storage, and shipment of radioactive wastes generated at the MRS Facility. All potentially contaminated effluent streams shall be treated and monitored to meet the environmental requirements of 10 CFR 20, 40 CFR 191 (1983), and DOE Order 5480.1A before release.

The facility shall be designed to limit direct radiation exposure of onsite and offsite personnel within the limits established in 10 CFR 72, 10 CFR 20, DOE Order 5480.1A, and other applicable regulations. The design shall also include the application of As Low As Reasonably Achievable (ALARA) principles to facility design and the operating philosophy. DOE Order 5480.1A requires as a design objective that operating personnel exposure levels shall be less than one-fifth of the permissible dose equivalent limits promulgated by the order.

Two spent-fuel, high-level waste, and remote-handled transuranic waste passive dry storage concepts are to be included in the MRS Facility conceptual designs.

The primary storage concept shall use an array of sealed storage casks (concrete casks) that are placed above grade, upright on support pads. The heat from radioactive decay is conducted through the sealed storage cask, and removed by atmospheric convection and thermal radiation. The walls of the cask and the shielding plug provide the radiation-shielding protection.

The alternative storage concept shall use an array of in-ground, dry, sealed steel caissons. This concept shall use the surrounding soil to attenuate nuclear radiation and to dissipate the heat from the waste while it is in storage.

In addition, space for storage of transportable metal casks must be provided in each of the storage concepts.

A facility is required to store onsite-generated, contact handled transuranic (CHTRU) waste. The initial CHTRU Storage Facility shall be sized to store the CHTRU generated by processing 15,000 MTU of spent fuel and shall be expandable to permit storage of CHTRU wastes generated onsite during subsequent years of operation of the MRS Facility.

The CHTRU will be packaged in 55-gal, stainless steel drums. Containers of CHTRU with surface radiation levels greater than 200 mR/hr shall be processed through hot cells in the R&H Building as RHTRU, and stored in the SF, HLW, and RHTRU Storage Facility.

1.3 SYSTEMS IMPORTANT TO SAFETY

Components, systems, and structures shall be designated Category I if, during or following an extreme environmental load (including Design Basis Earthquake and Design Basis Tornado), they would be required to perform either of the following safety functions:

(1) Prevent or mitigate the consequences of an uncontrolled release of radioactivity with potential radiological consequences in excess of the limits given in 10 CFR 72, 10 CFR 20, or DOE Order 5480.1A.

(2) Maintain nuclear criticality safety.

Non-Category I components, systems, and structures include those necessary for the normal operation of nuclear waste processing and handling facilities.

1.4 OCCUPATIONAL AND ENVIRONMENTAL SAFETY

Occupational and environmental safety considerations for the MRS Facility shall include fire protection, industrial health and safety, and radiological safety.

Fire protection shall include a fire suppression and detection system for all buildings; a site firewater loop with hydrants at each building; central site fire station and equipment; building zoning with fire-separation barriers; and use of noncombustible materials.

The MRS Facility buildings, systems, and equipment shall be designed to comply with all pertinent OSHA standards.

Radiation-protection features shall include the following:

(1) Shielding and facility orientation to reduce radiation dose rates to ALARA and to conform to the applicable portions of 10 CFR 20, 10 CFR 72, 40 CFR 191 (draft), DOE Order 5480.1A, and other applicable federal regulations and NRC regulatory guides.

(2) Filtration of gaseous and airborne particulate effluents from contaminated or potentially contaminated areas before release to the environs to comply with 10 CFR 20, 10 CFR 72, 40 CFR 191, and DOE Order 5480.1A release limits.

(3) Monitoring of liquid effluent streams to ensure that releases to the environs are below those prescribed by 10 CFR 20, 40 CFR 191, and DOE Order 5480.1A, or are detected and corrected.

(4) Monitoring of gamma dose rates in areas where the potential exists for exposure rates above preset thresholds.

(5) Monitoring and sampling of gaseous effluents and storage area atmosphere to ensure that releases to the environs are below 10 CFR 20 and 40 CFR 191 limits.

(6) Monitoring and sampling of the air in potentially contaminated work areas to ensure that operating personnel exposures are below the maximum limits prescribed in 10 CFR 20 or DOE Order 5480.1A for occupied areas.

(7) Personnel survey stations at exits from potentially contaminated areas to detect personnel contamination and provide personnel decontamination facilities.

(8) Criticality alarms and critically safe design parameters.

1.5 SECURITY AND SAFEGUARDS

Site security shall be established to prevent unauthorized access to or removal of items of security interest, and shall provide physical protection and access controls to deter, assess, and respond to the following design basis threats:

(1) Sabotage of the facility or nuclear material, resulting in dispersion of radioactivity into the local environment.

(2) Theft of material for release, or threat to release, into the environment elsewhere.

(3) Theft of material for the purpose of retrieving special nuclear materials.

Barriers, isolation, alarms, lighting, viewing, and manned security checkposts shall be provided in accordance with the requirements of DOE Order 5632, 10 CFR 73, and UL 752 (1981).

1.6 DECOMMISSIONING

The MRS Facility shall be designed to facilitate decommissioning. Provisions shall be made to facilitate decontamination of structures and equipment, and to minimize the quantity of radioactive wastes and contaminated equipment resulting from decommissioning. It shall also be designed to facilitate the removal of radioactive wastes and contaminated equipment and materials at the time of permanent decommissioning. However, complete removal of all structures, particularly the R&H Building, is unwarranted. Following thorough decontamination of the R&H Building, permanent decommissioning will be accomplished by disposal of the major uncontaminated equipment.

1.7 QUALITY ASSURANCE

The MRS Facility must be licensable by NRC to the requirements of 10 CFR 72 or other appropriate regulations. A quality assurance program shall be established in accordance with the requirements of 10 CFR 72.80.

2.0 REFERENCE DOCUMENTS

The Functional Design Criteria and the Basis for Design make reference to specific DOE publications, Federal Regulations, and industrial codes, standards, and specifications that were used in the preparation of the conceptual designs. The major regulations, codes, and standards are identified in the paragraphs that follow. A complete listing can be found in the Basis for Design.

2.1 DOE PUBLICATIONS

The following DOE publications contain general design requirements and apply to the conceptual designs. Portions of some documents apply to certain special-purpose facilities, but do not necessarily apply to the MRS Facility.

(1) DOE 4320.1, Site Development and Facility Utilization Planning, 1983

(2) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations, 1981

(3) DOE 5630.1, Control and Accountability of Nuclear Materials, 1979

(4) DOE 5632.2, Physical Protection of Special Nuclear Materials, 1981

(5) DOE 5700.6, Quality Assurance, 1981

(6) DOE 6430.1, General Design Criteria, 1983

2.2 FEDERAL REGULATIONS AND GUIDES

The MRS Facility must be licensed by the NRC under the appropriate part of Title 10, Code of Federal Regulations (10 CFR). Principal among these is Part 72, which deals specifically with storage of spent nuclear fuel and other radioactive materials in facilities independent of reactors. The parts of 10 CFR applicable to the design, construction, and operation of an MRS facility are:

(1) 10 CFR 20, Standards for Protection Against Radiation, 1984

(2) 10 CFR 50, Appendix B, Quality Assurance, and Appendix E, Emergency Planning, 1984

(3) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation, 1984

(4) 10 CFR 73, Physical Protection of Plants and Materials, 1984

2.3 REGULATORY GUIDES (NRC)

Many Regulatory Guides are applicable to the design of the MRS Facility. A listing of these guides is presented in the Basis for Design.

2.4 CODES, STANDARDS, AND SPECIFICATIONS

Other ANSI and industrial codes, standards, and specifications were included in the Basis for Design for the development of the conceptual designs.

3.0 SUMMARY OF FACILITY DESCRIPTIONS

The conceptual designs of facilities that were developed using the functional requirements and specific design criteria contained in the Basis for Design document, and briefly covered in the previous sections herein, are described in this section. A more comprehensive design description is contained in subsequent volumes.

3.1 IMPROVEMENTS TO LAND AND UTILITIES

The conceptual designs for the MRS Facility site development were developed by using the general site characteristics stated in the Basis for Design

(BFD) and by the use of U.S. Geodetic Survey topographic maps and existing site data for the Clinch River, Hartsville, and Oak Ridge, Tennessee, sites.

3.1.1 Site Development

The overall site plans for the MRS Facility comprise three areas: the limited access and industrial area; the protected area; and the storage area. Six site plans have been developed, two for each proposed site, showing a primary storage concept (sealed storage casks) and an alternate concept (field drywells).

3.1.1.A. Primary Storage Concept - Sealed Storage Casks

The MRS Facility layouts for the sealed storage cask concept are shown on Drawings H-3-56726, H-3-56740, and H-3-56745. The limited access and industrial area is protected with a single fence enclosure and the protected and storage areas with double fences. The relative locations of the limited and protected areas were determined with regard to security, accessibility, and the functional relationships between the areas. The limited access area contains the facilities and services (administration, security, maintenance, utilities, and emergency response) required to support the waste packaging and storage operations. A Main Gate/Badgehouse provides onsite access control for all personnel and nonradioactive shipments. Special-permit vehicles and supply vehicles are allowed onsite after inspection at the Main Gate/Badgehouse. All other vehicles are required to park outside the limited access area. Access to all of the facilities in the limited access area is provided by a network of 24-ft-wide roads and sidewalks.

The industrial area contains the concrete batch plant and cask manufacturing facilities, and is located adjacent to the limited area. Separation of these areas is by a single fence. Access to the industrial area is by a separate road and railspur.

Shipments containing radioactive material will enter the site through an Inspection Gatehouse, and will be transported by onsite vehicles through a fenced corridor to the protected area. Access control for personnel and nonradioactive shipments entering the protected area, from the limited area, is provided at a Protected Area Gatehouse. The Storage Facility is located in the protected area adjacent to the waste handling facilities. Access control to the storage area is provided by a single fence with a keyed gate at the Storage Area Gate Station.

The R&H Building is located so that its receiving areas are in line with the incoming rail spur. Lag storage is provided for both railcars and trucks. A fenced off-normal shipment storage area has also been provided.

The heliport for emergency medical evacuation is located just inside the limited access area.

3.1.1.B. Alternate Storage Concept - Field Drywells

The facility layout of the limited access and the protected areas for the alternate concept (field drywells) is the same as the sealed storage cask concept except that the drywell concept does not require a cask manufacturing and concrete batch plant; therefore, the industrial area is not needed for this concept. The MRS Facility for the drywell concept is shown on Drawings H-3-56733, H-3-56742, and H-3-56747.

3.1.2 Utilities

Utilities such as water, sanitary waste sewer, process waste sewer, and electrical power systems are provided for the MRS Facility and are described in the following paragraphs.

3.1.2.A. Water Distribution System

The primary source of water is from an offsite source. The water will be piped to the MRS Facility storage tank and distributed to all of the facilities onsite. A total of 4 hours of fire-protection water for the highest required flow (480,000 gal for the R&H Building), in addition to normal process and domestic use, will be maintained in the storage tank.

3.1.2.B. Sanitary Sewer System

The MRS sanitary sewer system collects and treats domestic sewage. The system consists of a central sewage treatment plant and a collection system that collects raw sanitary sewage from toilets, showers, lavatories, drinking fountains, and floor drains from uncontaminated areas of the R&H Building and from the support buildings. The system is sized for a flow rate of 25 gal/capita/day times the population needed to support the MRS Facility throughput rate of 3,600 MTU/yr.

3.1.2.C. Process Sewer System

Process waste generated from the MRS Facility that is not contaminated, but contains chemical constituents harmful to the function of the sanitary sewage treatment system, is collected and treated by the process sewer system. Process sewer lines are sized for a facility with a spent fuel/HLW throughput of 3,600 MTU/yr. The sewer lines drain to a lift sump, where the process sewage is neutralized as necessary and pumped to the process sewage treatment plant for clarification and filtration to remove the suspended solids and undesirable chemical constituents before disposal. The dewatered sludge is disposed of at an appropriate waste site, depending upon the chemical content of the sludge.

3.2 RECEIVING AND HANDLING BUILDING

The R&H Building is the primary operating building of the MRS Facility. It has been designed to physically contain and control all radioactive materials received and processed or generated by the spent-fuel process

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operations. The facility includes spaces and equipment for receiving, identifying, disassembling, consolidating, and packaging of spent fuel and processing and packaging of spent-fuel hardware for onsite storage or retrieving from storage and shipping to storage facilities offsite. The facility will include lag storage capability for 1,000 MTU of consolidated spent-fuel waste canisters.

The conceptual design features of the R&H Building are described briefly in the following sections.

3.2.1 Architectural and Structural

The structural designs of the various areas composing the R&H Building are designed in accordance with their importance to safety. Areas requiring confinement of radioactive materials, are designed as Category I structures. Areas that are necessary for normal operation and are not required for confinement of radioactive materials, nor important to radiation safety, are classified and designed as Non-Category I structures. The Category I classification areas are of reinforced concrete design. Non-Category I portions of the facility are of steel frame or reinforced masonry construction. The walls of the steel frame portion are constructed of insulated metal siding. Insulated metal roofs with an elastomeric roof covering are used on all Non-Category I structures.

The major areas of the R&H Building are the administration area, receiving and inspection areas, spent-fuel consolidation and packaging areas, 1,000 MTU lag storage area, transfer/discharge areas for onsite and offsite storage, radwaste processing areas, and building services areas.

The R&H Building is a 709,025-sq-ft, multilevel structure, divided as shown in Table 3-1.

Table 3-1 - R&H Building
Approximate Area Summary
(gross square feet)

Level	Category I	Non-Category I	Total
Basement and Tunnels	4,270	980	5,250
Ground Level	168,280	120,910	289,190
1st Mezzanine	48,330	-	48,330
2nd Level	156,215	9,265	165,480
2nd Mezzanine	91,465	-	91,465
3rd Level	108,430	-	108,430
Roof Penthouse	880	-	880
Total	577,870	131,155	709,025

3.2.1.A. Administration Area (Non-Category I)

The administration area contains offices for management, staff, and operations functions; changerooms; and serves as the control point for personnel entry into the R&H Building.

3.2.1.B. Receiving and Handling Area (Non-Category I)

Two identical receiving and handling areas are provided to serve the process cells and offsite shipping functions. Each receiving and handling area includes an incoming air-control vestibule that includes receipt and vehicle washdown capabilities, a cask receiving and inspection area, and a vehicle exit air-control vestibule. Each is sized for two rail/truck lanes and contains a 150-ton-capacity bridge crane for shipping cask unloading and loading.

3.2.1.C. Remote Handling Area (Category I)

The remote handling area includes cask handling and decontamination rooms, cask unloading rooms, spent-fuel shielded process cells, lag storage compartments, spent-fuel cask loadout rooms, shipping loadout rooms, and maintenance cells for cell equipment and cell cranes. For personnel access to the shielded hot cells, air-control vestibules and health physics storage rooms with keyed doors are provided. Operating galleries around the shielded process cells provide operators with visual control of process operations, and allow use of master/slave manipulators, wall-mounted traveling electromechanical manipulators, and operating consoles for control of remote cell operations.

3.2.1.D. Transfer/Discharge Areas (Ground Level - Non-Category I)

Crawler-type transporters (for sealed storage cask concept) or a shielded transporter (field drywell storage concept) enter and exit the R&H Building through a transfer/discharge corridor.

3.2.1.E. Shipping Loadout Rooms (Ground Level - Category I)

Shipping casks and overpack canisters enter and exit the shipping loadout rooms on electrically powered cask carts traveling on rails.

3.2.1.F. Radwaste Areas (Ground Level - Category I/Non-Category I)

The radwaste areas are designed to contain the equipment used to treat, for recycling or storage, radioactive liquid and solid waste generated onsite as a consequence of processing spent fuels or the handling of HLW canisters and RHTRU canisters or drums. The radwaste areas are separated into a Non-Category I low-level liquid and solid radwaste processing area and a Category I high-activity liquid and solid radwaste processing area.

3.2.1.G. Analytical Laboratory (Ground Level - Non-Category I)

The analytical laboratory is designed to contain equipment, chemical materials, and supplies necessary for the counting of radioactivity levels and analyses of samples of solids, liquids, and gases taken from the various processes in the MRS Facility.

3.2.1.H. Control Room (Second Level - Category I)

The control room is designed to contain control consoles and CCTV monitors for supervisory control and monitoring of the SF, HLW, and RHTRU operations in the process cells; for monitoring and control of HVAC, utilities, and radwaste systems; and for monitoring of radioactive airborne particulates. (A redundant system is located in the Site Services Building control room as a backup in case of failure or sabotage of the control room equipment in the R&H Building.)

3.2.1.I. Health Physics Facility (Ground Level)

A health physics facility is included for the purpose of monitoring personnel for radiation contamination and for decontamination when necessary. The facility is located near the personnel exit from the Category I portion of the R&H Building.

3.2.1.J. Building Services Area

Spaces are also provided for exhaust and supply air equipment, air-filtration systems, comfort heating and cooling equipment, uninterruptible power and electrical equipment, laundry equipment, manipulator storage and maintenance, telephone equipment, and storage.

Those areas that contain systems or components required for confinement of radioactive materials (first-stage HEPA exhaust filters) or required for safe shutdown (UPS system) are located in Category I structures.

3.2.2 Material Handling, Maintenance, and Remote Systems

The receiving and handling areas and the remote handling areas are fully equipped to routinely receive and process casks of SF, HLW, and RHTRU. The equipment in these areas is designed to wash road grime from railcars or trucks and protective covers of storage casks; to prepare casks for unloading from railcars or trucks onto cask transfer carts; to perform inspection, identification, disassembly, consolidation, and canistering of spent fuel; to inspect and overpack, if necessary, the HLW/RHTRU canisters for storage; to compact nonfuel-bearing components generated by the disassembly of spent fuel; and to perform remote maintenance and contact-handled maintenance of equipment.

3.2.2.A. Processing Sequence

Shipping casks arriving at the MRS Facility by railcar or truck are first processed through the Inspection Gatehouse before proceeding to the R&H Building. If necessary, the railcars, truck trailers, or cask protective covers are washed in the receipt and washdown area of the R&H Building and then moved to the receiving inspection area, where the casks are removed from their transport vehicles and loaded onto cask carts. Casks containing HLW or RHTRU are routed to the cask handling and decontamination room located beneath the overpack/weld/discharge area. Casks of spent PWR assemblies are routed to the cask handling and decontamination room located beneath Process Cells 1 and 3. Casks of spent BWR assemblies go to the cask handling and decontamination rooms located beneath Process Cells 2 and 4. Here the casks are prepared for unloading. Preparations for unloading include gas sampling, gas-pressure measurements, removal of the cask outer lid, external surface decontamination (if required), loosening of bolts on the cask's inner lid, and installation of special adapters onto the cask. The cask is then moved into the cask unloading room, mated to a loading port located in the floor of the process cells or overpack/weld/disharge area. The port is opened, the cask inner lid is removed, and the cask is unloaded.

All four process cells can process either PWR or BWR fuel assemblies; however, it is planned for Process Cells 1 and 3 to process PWR fuel, and Process Cells 2 and 4 to process BWR fuel. The disassembly and consolidation equipment contained in these process cells will accommodate any of the various PWR or BWR fuel assemblies. This is accomplished by quick-change modules dedicated to particular fuel assembly configurations. A complement of these modules and tooling is stored in each cell.

Canisters of HLW or RHTRU are inspected; identified; overpacked, if required; and stored in a lag storage pit or offloaded directly into a storage or shipping cask for onsite storage or offsite disposal.

In Process Cells 1, 2, 3, and 4, the spent fuel is inspected, identified, disassembled, consolidated, and packaged in canisters, either consolidated or as intact assemblies. In Process Cells 5 and 6, the fuel canisters are sealed by a welded end closure, leak tested, decontaminated and the weld ultrasonically tested. The canisters are either stored in lag storage or offloaded directly into a storage or shipping cask for onsite storage or offsite disposal.

Process cells 1, 2, 3, and 4 have facilities to compact, by shredding, nonfuel-bearing components, such as grids and skeletons, and to receive clean canisters, lids, and drums. Facilities are also provided to transfer drums full of compacted waste to Cell 5 or 6 for offloading onsite storage or offsite disposal.

3.2.2.B. Spent-Fuel Consolidation

The consolidation equipment is comprised of three basic elements: the laser cutter for severing the nozzle and bottom tie plate, the fuel disassembly system, and the consolidation system.

The consolidation equipment is fitted with the appropriate modules and tooling for a specific PWR or BWR assembly. A power mast transfers three PWR or seven BWR assemblies from the lag storage pit or directly from the shipping cask to a vertically oriented clamping module. The laser cutter is positioned and activated to remove the nozzles of the PWR assemblies by cutting the guide tubes on the inside diameter. For the BWR assemblies, the laser cutter is positioned and activated to remove the nozzles by cutting the tie rods from the outside on the four sides of each assembly. The power mast removes the freed nozzles and transfers them to secondary waste packaging. After nozzle removal, the clamping module is rotated to the horizontal position. The laser cutter is repositioned to cut the lower outer tie rods to remove the lower nozzle. Removal of the center rod requires that it be rotated 45 deg about its axis to disengage its locking detents from the grids. This is done by the dedicated robot. With the nozzles removed, grippers securely grasp each PWR or BWR fuel rod and simultaneously extract all rods through their support grids. During extraction, horizontal and vertical combs support the rods and maintain their arrangement. The extracted fuel rods are reconfigured into a closely packed, circular bundle and pushed into a clean canister. The nonfuel-bearing structure is removed from the clamping module by a dedicated robot and transferred to secondary waste packaging.

3.2.2.C. Spent-Fuel Packaging

Spent-fuel packaging consists of canister inerting, welding, and decontamination, and testing.

The canister upender (located in Process Cells 5 and 6) is a mobile transport and positioning cart for spent-fuel canisters, overpack canisters, or drums. The upender is mounted on rails to position the canister for loading of spent fuel from the consolidation station; to load it into the canister welding system; or to position it at either the cutting or the ultrasonic testing (UT) station.

Spent-fuel packaging begins by aligning an empty clean canister with the axial centerline of the consolidated spent-fuel bundle retained in the spent-fuel consolidation station. With the bundled fuel rods and the clean canister aligned, the push mechanism on the consolidation station loads the rods into the clean storage canister. The loaded canister is transferred and positioned in a canister welding station. With the canister in place, air is evacuated from the canister and welding station, and both are backfilled with an argon-helium gas mixture. The positioned canister lid is welded to the canister by a resistance welding system.

At the end of the welding cycle, the remaining argon-helium mixture is evacuated, a helium-leak-detection test is performed, and the exterior of the canister is decontaminated by a Freon liquid system.

After the canister is removed from the welding station, an ultrasonic test is performed on the canister weld.

3.2.2.D. Secondary Waste Packaging

The nonfuel-bearing components remaining after consolidation are either directly placed into drums or are volume-reduced by shredding and placed into 55-gal drums. The drums are sealed, decontaminated, and transferred through Process Cells 5 and 6 to the overpack/weld/discharge area for shipment to onsite storage or offsite disposal.

3.2.2.E. Packaged Waste Loadout (Onsite Storage)

Although the capacities and functions of the sealed storage cask and the transfer shield (for drywell concept) are different from each other, their preparation and interfacing with the offloading port of the overpack/weld/ discharge area are essentially identical. The empty cask or the transfer shield is moved into a loadout and decontamination room, located beneath the overpack/weld/discharge area, and mated to a loadout port located in the floor of this area. The offloading cell port shield plug is removed, the shield plug of the sealed storage cask is removed or the upper gate of the transport shield is opened, and the packaged waste is loaded into the cask or transfer shield. After loading, the cell and cask shield plug or the transport shield upper gate is closed. The cask is moved to the transfer/ discharge corridor, where a metal lid is welded onto the cask. After the cask metal lid is welded or the transfer shield upper gate is closed, the cask or transfer shield is moved to the storage facility for emplacement.

3.2.2.F. Packaged Waste Loadout (Offsite Disposal)

Packaged waste is also transferred to offsite disposal from the overpack/ weld/discharge area through separate loadout ports located in the floor of this area. Packaged waste, either from lag storage compartments or from the onsite storage facility, may be placed in overpack containers and seal welded. All canisters, with or without overpacks, are placed in shipping casks for shipment offsite.

Retrieval of waste canisters from onsite storage is done in reverse order of that described for packaged waste loadout (onsite storage).

An empty shipping cask is received by railcar in the receiving and inspection area, removed from its carrier, placed on a cask cart, and moved to the shipping cask lidding room. The outer lid is removed and the inner lid bolts are loosened. The cask is moved to the shipping loadout room and mated to a loading port located in the floor of the overpack/weld/discharge area. The cask is loaded, and the lids are replaced; the cask is then replaced onto the railcar, and shipped offsite.

3.2.3 Radioactive Waste (Radwaste) Treatment

Radioactive waste treatment facilities are included in the R&H Building for treatment, solidification, compaction, and storage of radioactive wastes generated at the MRS Facility. Separate treatment systems are provided for low-level (LLW) and/or LLW/CHTRU wastes and high-activity (HAW) and/or

HAW/RHTRU wastes. The LLW wastes are stored temporarily onsite and shipped to an offsite LLW disposal facility. The CHTRU, HAW, and HAW/RHTRU are stored onsite and shipped to a repository.

3.2.4 Mechanical Process Systems

Systems that support the various operations in the R&H Building have been provided and include decontamination solution preparation and distribution, radwaste drain system, washdown water system, steam generation system, welding station cleaning and testing system, deionized water system, vacuum air sampling system, water softener system, and laundry system for contaminated clothing.

3.2.5 Electrical

Electrical power service, distribution, grounding, lighting, communciations, and alarm systems have been provided for the R&H Building.

Building power is obtained from six double 4.16-kV normal primary feeder configuration systems. For each substation, either normal feeder is rated to carry 100% of the substation load. If failure of one of the primary feeders occurs, power is switched to the second feeder automatically with minimum delay in transfer time. If simultaneous failure of both normal primary feeders occurs, power is provided by four 4.16-kV primary feeders from the standby generator system. Standby power is provided to the HVAC filtered exhaust fans, UPS battery chargers, all lighting, and other critical operating systems. The standby power system is provided to permit safe and orderly shutdown of the facility if there is a total failure of the normal power supply sources, but is not intended to permit continuance of all operational functions for extended periods of time. An uninterruptible (battery) power supply (UPS) system is provided for neutron criticality monitoring and alarms, radionuclide monitoring and alarms, air monitoring and sampling systems, fire alarms and supervision circuits, security surveillance system, access control, radio communications, and distributed control instrumentation system.

Lightning protection is provided for the R&H Building in conformance with NFPA 78 Standards, NEC, and LPI-175. The lightning protection system is connected to the building ground loop. All exposed, large metal equipment and materials, as well as metal structural frames, are bonded to the building system ground loop.

The facility is provided with a fire alarm and detection system, public address system, intercom system between the control room and process cell consoles, telephone system, exterior door access control and alarm system, wireless radio paging for selected personnel, building visual and audible alarm systems, and closed-circuit television system.

3.2.6 Instrumentation and Control

The instrumentation and controls for the R&H Building provide for:

(1) Safe and efficient operation of handling and processing equipment throughout the entire facility.

(2) Safe shutdown integrity.

(3) Reliability, redundancy, modularization, and standardization, with components and subassemblies capable of being removed for inspection, maintenance, or replacement.

(4) Remote operation, when required.

(5) Transmission of information to remote locations.

Automatic monitoring and alarming instrumentation, used by health physics specialists and other plant personnel, is designed and used to detect and warn personnel of high radiation levels in controlled work areas, based on the values shown in DOE 5480.1A, Chapter XI, Section 4.a, and the release limits of Table 1 of Attachment XI-1.

Release monitoring, alarming, and surveying instrumentation is designed to detect and warn personnel of high radiation levels in uncontrolled areas, based on the values shown in DOE 5480.1A, Chapter XI, Section 4.b.1, Figure XI-2 (people in uncontrolled areas) and the release limits of Table 2 of Attachment XI-1.

The similar exposure rates and release limits of 10 CFR 20 were conformed to in designing and selecting the radiation monitoring, alarming, and surveying instrumentation for the R&H Building.

Controls for mechanized and automated remote handling and processing equipment allow the equipment to be controlled locally, from gallery-located supervisory control panels, or centrally from the control room.

3.2.7 HVAC

Heating, ventilating, and air-conditioning (HVAC) systems are designed to maintain the required temperatures, ventilation, and contamination-control environments within the R&H Building. Temperatures are controlled as required for the processes performed in the area served, and for the efficient performance of the operating personnel.

In the R&H Building, the ventilation and confinement control provides the essential part of the final and internal confinement systems, and acts as a barrier to minimize the spread of radioactive contamination. The ventilation confinement zones for this facility are described in Table 3-2.

In addition to the listed confinement zones, additional incremental zones are also provided in order to differentiate between hazards within the same zone.

Table 3-2 - Ventilation Confinement Zones

Zone	Definition	Typical Locations
1	Process zone Highly contaminated area, restricted access zones	Shielded hot cells Shielded canyon cells Bare fuel lag storage Drum transfer corridor Glove boxes (including spent-filter processing enclosures within solid radwaste) Remote-handled maintenance equipment room Overpack High-activity waste area
2	Restricted access zones Potentially contaminated areas	Hot-cell service galleries Radwaste treatment facility Shipping cask preparation, decontamination, and unloading rooms Crane maintenance rooms Cask loadout and decontamination Contact-handled maintenance rooms Equipment decontamination rooms Drum/canister transfer rooms Final and remote-handled HEPA filter rooms
3	Operating zones Not normally contaminated	Operating galleries Canistered lag storage vaults Process area corridors Air locks and air-control vestibules Laundry Changerooms Storage rooms Personnel decontamination rooms Filtered exhaust fan rooms Analytical laboratory and health physics area Solid radwaste area (except spent filter processing enclosures, which are considered as large glove boxes) Weld/test and decontamination equipment room

Table 3-2 (Contd)

Zone	Definition	Typical Locations
4	Unrestricted access zones	Administrative areas Lunchrooms Unregulated storage areas Restrooms Electrical equipment rooms Supply air fan room(s) UPS/battery room Chiller room Compressor room Receiving, inspection, and shipping areas Vehicle entry vestibule Vehicle exit vestibule Control room

3.2.8 Fire Protection

Automatic fire-suppression systems are supplied throughout the nonprocess areas of the R&H Building. Nonprocess areas are protected by automatic wet-pipe sprinkler systems; critical areas, such as the control room and electrical equipment room, are provided with Halon 1301 systems. Areas protected by a dry chemical system will be determined during final design of the fire protection system. Fire-suppression systems are not required in the process areas (shielded hot cells), as described in the Basis for Design. Firehose cabinets and manual extinguishers are provided throughout the facility.

3.3 SF, HLW, AND HAW/RHTRU STORAGE FACILITIES

The SF, HLW, and HAW/RHTRU Storage Facilities are designed to store radioactive waste processed through the R&H Building. Two alternate storage concepts were designed: (1) a primary concept using an array of sealed storage casks (concrete casks) containing the canisters of spent fuel or HLW and stored in an open field above ground, and (2) an alternate concept using an array of in-ground drywells containing canisters. In the concrete cask concept, the concrete cask and steel liner are designed for radiation shielding and to remove the heat by convection and thermal radiation. The drywell concept is designed to use the surrounding soil to attenuate nuclear radiation and to dissipate the heat from the waste while in storage.

Two site development concepts, for each of the three sites, were designed for the SF, HLW, and HAW/RHTRU Storage Facilities, a primary concept (sealed storage casks) and an alternate concept (field drywells). Site characteristics described in the Basis for Design were considered in the design.

The storage capacity design for either concept is 15,000 MTU of spent fuel and related waste plus a small amount (less than 300 canisters) of HLW.

3.3.1 Sealed Storage Casks (Concrete Storage Casks)

The concrete storage casks provide a sealed, self-shielded, dry storage container for intact spent-fuel assembly canisters, consolidated fuel rod canisters, drums of nonfuel-bearing components, HLW canisters, and drums and canisters of RHTRU and high-activity waste, as shown in Table 3-3. The storage casks are cylindrical, reinforced concrete structures with a stepped, carbon-steel-lined cavity for storing waste canisters and drums. A cylindrical concrete shield plug fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask. For purposes of conceptual design, all casks have been designed with the same height and exterior configuration. The casks are 22 ft high by 12 ft dia (outside diameter). The cask and the enclosed canisters provide double containment to withstand credible natural phenomena and man-induced events.

Monitoring of the concrete cask liner and cover integrity is performed on a periodic basis. Sampling of a cask internal atmosphere is performed by removing an access cover bolted to the gas sampling port housing. An evacuated bottle with a valve is attached to the quick-disconnect fitting on the end of the assembly of compression fittings located inside the port housing. Gas samples are collected for analysis to determine the presence of any gaseous fission products or canister tag gas in the cask interior. Gas analysis results obtained from cask samples indicate whether canisters or canisters and fuel rods have lost their integrity. Cask liner/cover integrity is tested by using a pressure-decay check.

Monitoring will also include temperature surveillance of the casks. Temperature measurement is accomplished by using thermocouples installed in tubes, extending from the cask exterior to the liners of spent fuel and commercial high-level waste casks. The thermocouple/tube design allows for replacement operations in the storage facility if failure occurs.

Table 3-3 - Concrete Cask Contents

Waste Type	Container Type and Number	Liner OD (in.)
Spent fuel	Twelve 12.75-in. canisters	72.0
Nonfuel-bearing components and high-activity waste	Three 28.5-in. storage cages, each with five 55-gal drums	60.0
RHTRU (50 to 1,000 R/hr)	Seven 24.00-in. canisters	84.0
RHTRU (< 50 R/hr)	Nine 24.00-in. canisters	102.0

Table 3-3 (Contd)

Waste Type	Container Type and Number	Liner OD (in.)
HLW	Nine 12.75-in. by 10-ft canisters	60.0
	Eight 12.75-in. by 15-ft canisters	60.0
	One 30.00-in. canister	60.0
	Five 24.00-in. canisters	78.0

3.3.2 Open Field Drywells (Alternate Concept)

Drywells provide a passive method of safely storing spent-fuel assemblies, drums of compacted nonfuel-bearing components and high-activity waste, HLW canisters, and drums and canisters of RHTRU, as shown in Table 3-4. Four drywell sizes have been designed to accommodate the variations in waste container configurations. Each drywell holds a single canister of waste. Each different waste type is stored in a unique array of drywells, sized according to the containers they must hold, and spaced according to the amount of waste heat that must be dissipated and the thermal conductivity of the soil at the proposed sites. Sufficient heat must be passively transferred from the drywell interior to maintain fuel cladding and canister temperatures below specified limits.

The drywell spacings for spent fuel and for HLW, defined in Table 3-5, were based on maintaining peak fuel rod cladding temperatures (for spent fuel) and peak HLW canister temperature below 375°C. Parametric studies were performed to determine the effect of the soil thermal-conductivity values on drywell spacing and the emplaced decay heat loads for the Clinch River, Hartsville, and Oak Ridge sites.

Monitoring of the drywell liner and cover integrity is performed on a periodic basis. Sampling of drywell internal atmosphere is performed by removing the gas sampling port access lid bolted to the drywell cover plate. An evacuated bottle with a valve is attached to the quick-disconnect fitting on the end of the assembly of compression fittings located underneath the lid. Gas samples are collected, and can then be analyzed for the presence of gaseous fission products or canister tag gas in the drywell atmosphere. Gas analysis results obtained from drywell samples indicate whether canisters or canister and fuel rods have lost their integrity. Drywell liner/cover integrity is tested by using the pressure decay check previously mentioned for concrete casks, and by visual inspections of drywell covers, welds, and liner flanges.

Monitoring also includes temperature surveillance of the drywells. Temperature measurement is accomplished via thermocouples on the exterior of spent-fuel or commercial high-level waste drywell liners.

3.4 CHTRU FACILITY

The CHTRU Facility is designed to provide storage for CHTRU wastes generated onsite while processing the first 15,000 MTU of spent fuel. The waste stored in this facility arrives in drums from the solid low-level radwaste treating and packaging system in the R&H Building.

The facility is designed as an underground box structure containing twenty-four 8 ft-8-in. square compartments, approximately 17 ft deep, formed by 8-in. interior and 12-in. exterior, reinforced concrete block walls. The roof consists of removable concrete plugs of sufficient weight to prevent removal by tornado action.

Table 3-4 - Drywell Dimensions and Contents

Liner Diameter (in.)	Liner Length (in.)	Contents	Container OD (in.)	Container Length (in.)
16.0	247.0	Spent-fuel canister	12.75	192.0
18.0	235.88	HLW canister	12.75	180.0
	181.88	HLW canister	12.75	120.0
30.0	247.	Nonfuel-bearing components		
		Drum (five per package)	28.50	186.5
		HLW canister		
		RHTRU canister or drum	28.50	186.5
		High-activity waste		
36.0	247.0	HLW canister	30.00	
		Overpacked 55-gal drum (five per package)	31.50	202.5

Table 3-5 - Drywell Spacing

Drywell Size (in. dia)	Waste Type	Reference Site Conditions	Drywell Spacing (ft-in.)
16.0	Spent-fuel canisters	Clinch River	16-0 x 16-0
		Hartsville	16-0 x 16-0
		Oak Ridge	16-0 x 16-0
18.0	HLW canisters	Clinch River	20-0 x 20-0
		Hartsville	20-0 x 20-0
		Oak Ridge	20-0 x 20-0

Table 3-5 (contd)

Drywell Size (in. dia)	Waste Type	Reference Site Conditions	Drywell Spacing (ft-in.)
30.0	Nonfuel-bearing component drums, HLW canisters, RHTRU canisters or drums, high-activity waste drums	Clinch River Hartsville Oak Ridge	10-0 x 5-6 10-0 x 5-6 10-0 x 5-6
36.0	Overpacked drums	Clinch River Hartsville Oak Ridge	10-0 x 5-6 10-0 x 5-6 10-0 x 5-6
36.0	HLW canisters	Clinch River Hartsville Oak Ridge	40-0 x 40-0 40-0 x 40-0 40-0 x 40-0

Each storage compartment is equipped with provisions for manually sampling the air and monitoring the interior for temperature and radiation level. The temperatures of the multidrum enclosures are measured manually by means of access ports through the roof plug. Air samples are also taken at these same ports, and are analyzed at the analytical laboratory in the R&H Building.

The facility contains a gravity-drain system which conveys any liquids from the compartments to two main drain sumps. Each sump is provided with a fixed beta and gamma radiation monitor and a level meter for monitoring the sump liquid. Both of these variables are indicated, recorded, and alarmed by the DCS in the R&H Building. If required, collected liquid is removed by vacuum truck.

3.5 SUPPORT FACILITIES

The design descriptions of the support facilities housing the functions that assist in maintaining a self-sufficient MRS Facility are given in the paragraphs that follow.

3.5.1 Administration Building

The Administration Building is designed to accommodate such functions as accountability, plant management, plant operations, finance and administration, health and safety, quality assurance, personnel, and public relations. To house these functions, the building has offices, a conference room, a computer room, a lunchroom, a multipurpose room, storage rooms, a mail room, restrooms, and building equipment rooms. Dedicated office space has been provided for DOE, NRC, and State of Tennessee personnel.

3.5.2 Security-Related Buildings

Site security functions are housed in various buildings in strategic locations on the MRS Facility site. The purpose of these facilities is to prevent unauthorized access to or removal of items of security interest, and to provide physical protection and access controls to deter attempts at sabotage and theft of nuclear materials.

The security-related buildings are described below.

3.5.2.A. Security Building

The Security Building serves as security headquarters and provides facilities for the safeguards and security systems. It provides for the security personnel, with their administrative offices, and support facilities, as well as the Alarm Monitoring Station (AMS) and the radio communication system. The building has a lobby/waiting area, offices, multipurpose room, showers, restrooms, exercise room, building equipment rooms, and a hardened, bullet-resistant area that houses the MRS site secondary AMS. As part of the building, a security patrol vehicle parking enclosure, with three parking spaces, is provided.

3.5.2.B. Main Gate/Badgehouse

The Main Gate/Badgehouse is located at the main entrance, and is designed to serve as the initial observation and inspection point for all nonwaste transport vehicles entering the site, as well as security clearance and badge control for all visitors and employees. The building has a badge/clearance processing room, guardroom, passage room, waiting room, vestibules, restrooms, and equipment room.

3.5.2.C. Inspection Gatehouse

The Inspection Gatehouse provides for initial observation, inspection, and entrance clearance for all rail and transport vehicles delivering radioactive shipments to the facility. The building has a guard/inspector room, a restroom, and a storage room.

3.5.2.D. Protected Area Gatehouse

The Protected Area Gatehouse is located at the entrance to the MRS Facility protected area. It serves as a badge checkpoint for monitoring and inspecting all employees entering and leaving the protected area. It has an inspection area for nontransport vehicles, such as delivery vehicles, maintenance vehicles, or any other vehicle authorized to enter the protected area. The building has an access control room, detection monitoring room, mechanical and electrical equipment rooms, and a hardened area containing the primary control alarm and remote surveillance room with its associated UPS system.

This gatehouse is equipped with a hardened, primary AMS system; detection devices for metal, explosives, and radiation; and an X-ray inspection unit.

3.5.2.E. Storage Area Gate Station

The Storage Area Gate Station is located at the entrance to the SF, HLW, and HAW/RHTRU Storage Facilities. It provides hand-held radiation detection and monitoring for all employees leaving the storage facilities.

3.5.3 Site Services Building

The Site Services Building is a multifunction building. It provides shops for cold maintenance and fabrication, a process cell mockup area, offices for shop management, and other support areas. The shops included are machine, millwright, pipefitting, welding, sheetmetal, carpentry, plastics/glass/ceramic, electrical, instrument, paint, and a steam-cleaning area. The office area includes offices for shop management, physical plant operations personnel, and engineering personnel. Support functions include first aid, warehousing, mail, and reproduction. It also includes a computer room, a lunchroom, training and conference rooms, locker rooms, restrooms, and mechanical equipment rooms. This building also contains a control room for the redundant MRS centralized process and utility monitoring control and alarm system (DCS), which acts as a backup for that contained in the R&H Building. Parking is provided adjacent to the building for onsite service vehicles.

3.5.4 Warehouse

The Warehouse serves as the main storage location in support of operations for the MRS support facilities. It is located near the Site Services Building, and is provided with both truck and rail access. Besides the large warehouse area, the building has a waiting area, receiving room, restrooms, and an electrical equipment room. Employee parking is provided outside the Main Gate/Badgehouse and onsite vehicle parking is provided adjacent to the Warehouse.

3.5.5 Vehicle Maintenance Building

The Vehicle Maintenance Building provides routine maintenance and service for all vehicles dedicated for use at the MRS Facility, including railroad yard engines and shielded transporters. A service station is located adjacent to the building. This building contains a locker room, restroom, lunchroom, railcar service area, semi-truck repair area, onsite vehicle overhaul and lubrication bays, paint shop, and supporting electrical and mechanical rooms.

3.5.6 Fire Station

The Fire Station provides complete facilities to house firefighting equipment, paramedical ambulance personnel and equipment, fire-protection personnel (full-time and on-call), and limited combined cooking, dining, exercise, and training facilities. The building is divided into three major functional areas: (1) firefighting apparatus and equipment, (2) personnel facilities, and (3) building services. The building contains a lunchroom, nurse's station with an examination room, offices, restrooms, fire alarm and dispatch center, main apparatus room, breathing air cylinder and fire extinguisher charging rooms, and electrical and mechanical equipment rooms.

3.5.7 Standby Generator Building

The Standby Generator Building contains the equipment that provides electrical power upon loss of normal power. The building contains five main generator rooms; a sixth room houses all electrical switchgear.

The Standby Generator Building is a Category I structure, designed to withstand Design Basis Earthquakes and Tornadoes. The construction is of reinforced concrete throughout. All removable equipment, access openings, and exterior door assemblies are designed to withstand a DBE or DBT event.

3.5.8 Cask Manufacturing Facility

The facility provides space to fabricate, form, pour, and cure sealed storage casks (concrete casks). The major areas consist of unloading facilities for raw materials arriving by railcar, raw material storage area, steel liner storage area, and an enclosed manufacturing area.

The enclosed manufacturing area consists of an office area, fabrication area, material laboratory, and building services. The fabrication area is designed to accommodate the concrete batch plant, forming and casting area, and the curing area.

Based on a 3-shift, 5-day workweek, the facility is designed to produce 10 casks per week.

3.5.9 Steam Generator Building

The Steam Generator Building contains the steam boilers and associated equipment for the process and heating requirements of the R&H Building.

4.0 SECURITY AND SAFEGUARDS

4.1 INTRODUCTION

Physical security is established to provide protection and access controls to deter and assess unauthorized access to or removal of items of security interest and to respond to the following design basis threats:

(1) Sabotage of the facility or nuclear material, resulting in dispersion of radioactivity into the local environment.

(2) Theft of material for release, or threat to release, into the environment elsewhere.

(3) Theft of material for the purpose of retrieving special nuclear materials.

4.2 SITE SECURITY

A security fence is provided around the entire developed area of the MRS Facility. The fence provides the boundary to the Limited Area as described in DOE Order 5632, Chapter III (draft) for DOE facilities and the boundary to the Protected Area in accordance with DOE Order 5632.2 and 10 CFR 73.2.g. The Limited Area contains nonprocess structures and the Protected Area contains the structures or facilities that contain nuclear materials and are considered vital to safe operation of the MRS Facility. All Vital Areas (10 CFR 73.2.h) and Material Access Areas (10 CFR 73.2.j) for the MRS Facility are located within the Protected Area. Security-related facilities are located adjacent to the Limited Area and Protected Area access points, except for the main Security Building, which is in the Limited Area.

The Limited Area is enclosed within a single physical barrier (steel wire-fabric fence), 8 ft in height, topped with brackets for multistrand barbed wire. Except for security-related facilities, buildings are located a minimum of 30 ft from the fence. Protective lighting is provided to permit 24-hr surveillance of the barrier.

The Protected Area is enclosed within two fences (10 CFR 73.2.f) separated by an alarm zone 100 ft in width. An Isolation Zone (10 CFR 73.2.k) is established around the buildings or facilities within the Protected Area and adjacent to the Protected Area fences. Protective lighting and a closed-circuit television system are provided to permit 24-hr surveillance of the barriers. A patrol road around the perimeter of the Protected Area facilitates routine surveillance and alarm response.

Access to the Protected Area is by controlled, manned security points containing explosives, metal and radiation detectors or by an access control system. All exterior doors and interior doors into Vital Areas or Material Access Areas are locked and monitored by an alarm system during unoccupied periods.

Uninterruptible power supply (UPS) system(s) furnish power supply to alarms, essential surveillance and access-control instrumentation and equipment, and emergency lighting systems in case of power loss (commercial and standby). All security alarms, fire alarms, evacuation alarms, or any other alarm requiring a security force response are annunciated at the Protected Area Gatehouse and at the Security Building. These stations are hardened, controlled access buildings with capabilities to communicate to all security personnel and offsite law enforcement agencies. The design of all security areas and devices complies with NFPA 101 Life Safety Code, Section 5, "Means of Egress."

4.3 SPECIAL NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY

The MRS Facility is designed to accommodate the physical inventory procedures required for special nuclear material (SNM) in accordance with 10 CFR 70 (1984), Domestic Licensing of Special Nuclear Material, and 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent

Spent Fuel Storage Installation (ISFSI). An item control system for SNM inventory provisions is provided, based on state-of-the-art techniques and current regulations.

Provisions are made for recording of data; record retention for all spent fuel, HLW, and TRU wastes; and for periodically performing physical inventories to confirm the presence of accountable material. Material inventory is recorded, printed daily, and stored in two separated onsite locations. Physical inventory can be achieved by removing the cask or by removing the canister from the drywell, and by transferring the canister to a shielded process cell for physical inspection and verification.

The requirement for the capability to control and inventory special nuclear materials is an integral feature of the MRS design. In order to incorporate proper SNM inventory systems into the MRS Facility, Item Control Areas (ICAs) and Unit Process Areas (UPAs) for control and inventory of SNM are established.

5.0 OCCUPATIONAL AND ENVIRONMENTAL SAFETY

The MRS Facility has been designed in accordance with the safety standards of applicable codes, standards, DOE Orders, Federal Regulations, and Guides for the occupational and environmental safety of plant personnel and the public.

The occupational and environmental considerations include seismic category designations and ventilation confinement zoning; safety evaluations; industrial health and safety; nuclear criticality and safety; radiation protection and shielding; contamination control; decontamination and decommissioning; and environmental assessments.

5.1 SEISMIC CATEGORY DESIGNATIONS AND VENTILATION CONFINEMENT ZONES

Structures, systems, and components whose survival is essential in controlling the release of radionuclides, prevent criticality, and provide safe shutdown were designated Category I and quality assurance Level I. Those items so designated were designed for the effects of natural phenomena and specified to ensure that the quality of the item will meet the design requirements. The structures, systems, and components so designated included the structures providing the confinement barriers affording protection from external events of the waste forms, maintaining geometrically safe fuel storage configuration and protection for the systems and components important to safety. The systems so designated were those that are required to maintain the confinement barriers, protect the waste forms, and provide for safe shutdown. The components so designated included those that are required for safe operability of the designated systems and those whose functions are required for safe shutdown.

The R&H Building ventilation system is a once-through system designed to remain operational or fail-safe during all operational modes or credible accident conditions. The volume of air supplied or exhausted was based on that required for comfort and contamination control. Ventilation confinement zones were established based on the relative potential for exposure of personnel to airborne radionuclides and a potential release to the environment. Pressure differentials were established and maintained by the design to ensure air flow from less to more hazardous areas, and to ensure confinement of contamination within the appropriate area.

Supply air is provided to the R&H Building contaminated areas to maintain an air velocity of 150 $\pm$ 25 ft/min across all openings when the penetrations are open. When closed, air is supplied in sufficient quantity to maintain the zone pressure differential and less than the exhaust rate. All supply air penetrations into contaminated areas are provided with HEPA filters and fail-safe backdraft dampers to prevent backflow during an off-normal event. In addition, the supply system is provided with tornado valves to preclude pressure excursions during an event.

The R&H Building exhaust system is provided with multiple, testable, redundant HEPA filters, redundant exhaust fans, temperature protection, and a standby power supply. Exhaust air from the contaminated areas passes through a remotely maintained roughing filter and a remotely testable HEPA filter. The air is then routed through two contact-maintained, testable HEPA filters before release to the environment. The exhaust system is provided with test ports for sampling the exhaust air particulate distribution in size and content before and after the remotely handled first-stage HEPA filter and each subsequent stage of HEPA filtration. In addition, the HEPA filters are monitored for radiological activity and the final exhaust effluent is sampled and monitored. Air is monitored for temperature ahead of the second-stage HEPA filter and, if required, is cooled by a heat-suppression system. Backdraft dampers are provided to preclude backflow of air between zones. Redundant exhaust fans with standby power service have been provided to ensure the capability of this system to maintain the desired pressure zone differentials.

5.2 SAFETY EVALUATION

A safety evaluation of the proposed MRS Facility was developed to provide assurance that the design meets the requirements of 10 CFR 72 and will not cause an undue risk to the health and safety of the public during normal or off-normal operations.

Various off-normal events and design basis accidents for the MRS Facility were evaluated and their potential consequence(s) to both operating personnel and the general public were determined.

The accident analysis events are grouped in accordance with the event definitions of ANSI/ANS 57.9, referenced in Regulatory Guide 3.48 (1981), Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage).

Calculations were performed on selected events from categories III and IV to ensure that the current design does not exceed acceptable limits at the site boundary as defined in 10 CFR 72.68. The events that were calculated are believed to present the worst-case exposure for operating personnel and/or the general public.

5.3 INDUSTRIAL HEALTH AND SAFETY

All buildings, systems, and equipment in the MRS Facility are designed to comply with all pertinent OSHA standards and comply with the intent of state and local safety standards.

Safety showers and eyewash stations are provided in areas where personnel are exposed to chemicals, radiation, and other industrial hazards. They are connected to the potable water system. Drainage for these facilities is connected to the sanitary waste system or radioactive waste system, depending on the potential hazard of the waste solution.

Curtains are provided around welding stations for eye protection from ultraviolet rays and dust-collection systems are provided for the plastics, glass, and carpentry shops. Noise levels are limited to less than 70 db in areas of continuous occupancy and to 80 db in other personnel access areas. Floors subject to wetting are treated with nonskid materials or otherwise constructed with nonskid materials. Emergency lighting is provided to illuminate exitways from facilities in case of electric power outage.

Facilities are provided for plant emergency and industrial first aid. Space has been provided for a heliport for emergency medical air evacuation from the facility. Process reagents and decontamination solutions (such as acids and caustics, metal salt solutions, oxidizing solutions and gases, and others) are stored and handled in accordance with Federal, State, and local standards.

The Fire Station provides complete facilities to house firefighting equipment, paramedic/ambulance personnel and equipment, and on-call fire-protection personnel.

A local fire alarm system is provided for all site buildings. An alarm annunciator panel is located in each building. The system includes smoke detectors, fire sensors, manual fire alarm stations, and a local and audible alarm.

The dispatch room in the Fire Station also contains the central fire alarm computer and event/recorder/printer for the plantwide fire alarm system. The fire alarm computer is UL-listed, and is connected to equipment in the redundant alarm-monitoring stations. A repeater system is located in the Security Building. All fire alarm systems are connected to the radio dispatch room at the Fire Station and at the Security Building.

Treated water is supplied from an offsite source in sufficient quantity to satisfy the MRS demands. Piping is extended from the source to a storage tank located at the MRS Facility. The water system is looped and sectioned with valves, provided at appropriate locations, to provide system reliability and flexibility. The water distribution pressure provided is a minimum of 100 psi. Fire hydrants are located throughout the MRS Facility site.

An automatic wet-pipe sprinkler system is provided in buildings throughout the facility, except in electrical equipment rooms and process cells. Areas of high value or of high program importance (e.g., computer areas/control room, electrical equipment rooms, and remote surveillance room) are provided with a total-flooding Halon 1301 system. In addition, dry chemical systems are provided in areas subject to flammable-liquid fires, and portable extinguishers are installed throughout the facility.

5.4 NUCLEAR CRITICALITY AND SAFETY

Criticality is a potential problem in the R&H Building because of the fissionable material in the spent fuel rods. The spent fuel handling in the R&H Building is confined to the hot cells. The chance of a criticality event is minimized by using criticality safe design. No moderator is present in the hot cells during normal operation. This is facilitated by using spool pieces in the decon solution lines penetrating the cells to avoid the inadvertent introduction of decon liquid into the hot cell.

The nominal configuration of spent fuel in the lag storage pits is significantly subcritical. This reactivity margin would be reduced, but would remain subcritical, if fuel with lower than expected burnup is stored in the pits. However, administrative control of the acceptance of low-burnup fuel is expected.

During consolidation, the fuel rod array is reconfigured from an open, square pitch to a close-packed triangular pitch. During reconfiguration, there is a change in the k_{eff} of the array; however, the nominal configurations are subcritical.

The canisters containing the consolidated fuel rods are designed to maintain the consolidated fuel geometry during and after a seismic event, so the reactivity will remain low. Once the canisters are sealed, in the welding station, there will be no chance for moderator to enter the canister, although neutron reflection may be a problem. However, with no water present in the lag storage vault or in the storage cask/drywell during normal or abnormal operations, there is little chance for significant reflection and no criticality event is expected.

Although the hot cells will contain spent-fuel particulate contamination, the amount is small and the processing is in a dilute form. The high-activity decontamination liquids from the process cell drains will be piped to the high-activity liquid radwaste treatment system. The solids in the liquid streams will be concentrated by an evaporator and pumped to a slurry tank located in the solid radwaste treatment area. The evaporator bottoms slurry will be placed in a cement grout mix to solidify the contaminants. A criticality analysis was made of the most reactive component configuration: a 55-gal drum filled with water and decontaminant filter burden. This proved to be safely subcritical even with highly conservative model assumptions. Thus, there is no chance for a criticality event in the high-activity radwaste treatment system.

5.5 RADIATION PROTECTION AND SHIELDING

The R&H Building design provides radiation protection shielding for its operating personnel by using As Low As Reasonably Achievable (ALARA) principles in the facility design.

The dominant radiation sources in the R&H Building are the spent fuel assemblies, the high-level waste (HLW), and the remote handled transuranic waste (RHTRU). Contamination sources will originate in the process cells from the activated crud on the fuel assemblies, activated fuel assembly structural metal from the laser cutting operations, and particulate spent fuel from failed fuel rods. There will also be trace amounts of radioactive contamination in the spent fuel transport casks.

The spent-fuel assemblies, HLW, and RHTRU will be handled in the process cells. The sources in these materials determine the shielding for the process cells; the cask loading and unloading equipment and compartments; and the storage casks and drywells. The nominal spent fuel burnup is 33,000 megawatt days per metric ton of uranium (MWD/MTU) with 10 years' decay time. However, the facility is designed to handle spent fuel with a burnup of 55,000 MWD/MTU and 10 years' decay time. The gamma source terms for this fuel (55,000 MWD/MTU) and for the activated structural fuel assembly metal parts were calculated with the ORIGEN-II computer program.

The contamination sources in the process cells will be significant as they are deposited on the in-cell equipment, in the HVAC filters and in the facility decontamination (decon) systems and components.

The incoming spent-fuel assemblies will have surface deposits of crud that will be abraded from the fuel assemblies during the handling and consolidation operations. It is estimated that these operations will produce 196 grams of crud per day per cell for PWR assemblies and 210 grams/day per cell for BWR assemblies as a fine particulate powder.

The fuel-assembly thimbles will be cut with a laser beam to facilitate the disassembly before the fuel rod consolidation. It is estimated that, for PWR fuel assemblies, this operation will produce 12 grams/day per cell of vaporized metal in each of the four process cells. For BWR assemblies, the estimated vaporized metal production rate is 140 grams/day per cell.

It is expected that there will be failed fuel rods in the incoming spent fuel assemblies with some additional fuel-rod cladding breakage during the handling and fuel-rod consolidation operations. The total failed fuel is estimated as 1% with 0.1% of that amount deposited in the process cell, equipment, and HVAC systems. This amounts to 30 grams/day per cell for PWR fuel and 20 grams/day per cell for BWR fuel.

The average exterior contamination on a spent-fuel transport cask is 9 microcuries. This contamination will be removed in the cask decon station and will be included in the liquid radwaste systems radiation sources.

Reduction of radiation exposure is one of the major design objectives of the MRS Facility design. As such, the facility design and equipment layout have included the design considerations for operation, maintenance, and replacement to meet the intent of the ALARA principle for radiation exposure. Sufficient shielding is provided to permit operation without exposing personnel to unacceptable radiation levels. Remote maintenance is used as needed to reduce personnel exposure and minimize facility downtime. The spent fuel handling consolidation and packaging are conducted in heavily shielded process cells while the equipment maintenance and decon are done in adjacent, heavily shielded compartments.

The gamma radiation shielding analyses were done by using the QAD-P5A point kernel radiation analysis program. The ANISN-ORNL one-dimensional radiation transport program was used for the neutron shielding analysis, primarily in the hot cell.

In these analyses, the geometries were simplified whenever possible with compensating conservatism. This approach was used only where the simplification did not have an adverse impact on the results.

The radiation zoning followed the suggested zoning in the ALARA reduction document DOE/EV 1830-T5, 1980.

The health physics functions in the MRS Facility include monitoring and recording personnel radiation exposure; monitoring for personnel radioactive contamination; routine monitoring of facilities radiation levels and level trends; and routine monitoring for the spread of radioactive contamination in the facility. The duties of health physics personnel include applying correcting actions to maintain personnel exposure to or below acceptable levels and overseeing both personnel and facilities decontamination processes.

Area radiation monitors will track radiation levels in the facility; process samples will provide information on radiation sources in the system. Swipes will be used to determine area contamination, and personnel radiation badges will record personnel radiation exposure.

5.6 CONTAMINATION CONTROL

The waste storage and handling facilities are capable of containing radioactive material during the entire operating period, and have a monitoring system capable of detecting releases of radioactive material greater than 0.1 of 10 CFR 20, Appendix B, Table II. Operating personnel and the public are protected from release of radioactive particulate material and gases that would cause exposure of operating personnel and the public (as measured at the site boundary) to doses greater than those defined in 10 CFR 20, 10 CFR 72, and other federal regulations and guides.

The dominant sources of contamination in the MRS Facility are the spent fuel disassembly/consolidation operation and the fuel assembly skeleton shredding operation in the R&H Building.

The waste-handling inlet and discharge ports are provided with contamination barriers to prevent the spread of contamination during cask unloading/loading. These contamination barriers mate with shipping cask adapters or the sealed storage cask or the transfer shield. The shielded process cells have been separated from the canister welding operations by a contamination barrier wall. This design minimizes carryover of contaminants from the disassembly/consolidation/shredding operations area to the welding/lag storage/loadout operations area. Therefore, the exterior of the canisters should not be grossly contaminated during the consolidated fuel loading and the canister closure weld operations. After the welding operation, the canister is decontaminated, checked for surface contamination, and released to storage when the surface contamination is reduced to acceptable levels.

The disassembly/consolidation operations generate a large volume of loose crud. This crud will be scraped from the fuel assemblies during disassembly and consolidation. An HVAC duct will draw air flow downward around the disassembly/consolidation station to draw the loosened crud down, away from the disassembly station and through roughing filters. This duct discharges into the cell HVAC duct and filter system.

All areas containing radioactive materials are equipped with a ventilation system designed to maintain internal air pressure negative with respect to atmospheric pressure. These systems are equipped with high-efficiency particulate air (HEPA) filters. Release of contaminants to the environment at the point of release is maintained within the constraints of DOE Order 5480-1A, Chapter XI, Change 6, for environmental standards for exposure to the general public or as depicted in 10 CFR 20. Building areas are divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. To limit contamination spread, air-control vestibules, backdraft dampers, and other barriers are provided to separate ventilation control zones from one another.

Drains from the shielded process cell sumps and other radioactive waste streams are routed through doubly encased lines (original line inside a secondary encasing line) to the radwaste facilities for processing and disposition. Telltale sample drains are installed in the secondary encasing pipe to monitor leaks in the effluent-carrying pipe. Effluent from personnel decontamination sinks and showers, and other, similar streams are connected to the radwaste system.

Area radiation monitors are located appropriately throughout the MRS Facility to alert operations personnel to unusual radiation levels. An audible and visual alarm will be activated at the storage site and the R&H Building control room. Air monitors and samples are provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from leaking storage receptacles. In addition, all potentially contaminated work areas are provided with personnel monitoring equipment to be used in checking all personnel for contamination upon leaving the work areas.

5.7 DECONTAMINATION AND DECOMMISSIONING

In accordance with 10 CFR 72.76, the MRS Facility is designed to facilitate decommissioning at the end of its useful life. Provision is made to

(1) Facilitate decontamination of structures and equipment.

(2) Minimize the quantity of radioactive wastes and contaminated equipment.

(3) Facilitate the removal of radioactive wastes and contaminated materials at the time the facility is being permanently decommissioned.

To provide reasonable assurance that the decontamination and decommissioning can be accomplished, a decommissioning plan was prepared. This plan contains sufficient information for the proposed practices and procedures for decontamination of the site and facilities and for the disposal of residual radioactive materials in such a way that the decommissioned facility will not jeopardize the safety of the public.

5.7.1 Decontamination

The conceptual design philosophy and rationale for equipment and utility arrangements for decontamination are based upon operational experience and procedures used for other existing radioactive material-handling facilities. Therefore, to maintain good housekeeping practices, the capability has been provided to decontaminate all potentially contaminated facility surfaces and equipment components and to decontaminate the onsite-generated waste packages to minimize the contamination levels during operations. These same capabilities will be used to support the final facility and site decontamination before decommissioning the MRS Facility.

The design rationale is to provide single and multiple decontamination stations and agents in the areas where the highest level of contamination will occur. In addition, the design has provided the following features to facilitate decontamination activities:

(1) Expendable vacuum cleaners and portable decontamination carts with high-pressure (10,000-psi) spray wands.

(2) Stainless steel liner plate on floor and walls, up to the crane rails, of all shielded process cells, shielded canyon cells, remote handled equipment maintenance rooms, decontamination rooms, high-activity radwaste treatment cell; on the floor of the low-level liquid radwaste slurry pump and evaporator areas; and in the process

cell crane maintenance area. All other areas within the R&H Building, where the potential of the spread of contamination exists, have all surfaces covered with protective coatings.

(3) All areas that contain tankage or equipment containing contaminated liquids are curbed to limit the spread of the liquids.

(4) All spent decontamination solutions generated in the potentially contaminated areas are collected in sumps and jetted to either the low-level or high-activity liquid radwaste system for processing.

(5) Personnel entry into the areas of potentially high contamination for the purpose of expediting decontamination or emergency maintenance is through air locks and changerooms adjacent to the contaminated areas.

(6) Adequate maintenance space or remote designs or handling equipment has been provided to minimize time to replace or repair equipment or components.

(7) Personnel decontamination facilities are provided in the health physics treatment room.

5.7.2 Decommissioning

The basic philosophy for decommissioning the MRS Facility is to restore it to unrestricted use as soon as possible and at the lowest cost. Therefore, the decommissioning method selected consisted of (1) decontaminating all facilities and equipment to a level acceptable for unrestricted use and storage onsite, or (2) packaging and shipment to offsite disposal of the facility items or equipment whose contamination levels remain unacceptable for unrestricted use.

A basic approach in this philosophy is to use the capabilities of the R&H Building to aid in decommissioning other parts of the MRS Facility. The MRS Facility decommissioning plan has been sequenced in four phases. Phase I includes the decommissioning of the CHTRU Storage Facility, the sealed storage cask or drywell, transportable metal casks, onsite transporters, and the R&H Building shielded process cells, concurrently with the stored waste package loadout. The R&H Building would be used to directly support these decommissioning activities by providing utility, monitoring, and laboratory support.

Phase II includes the decommissioning of the SF, HLW, and HAW/RHTRU storage area site and all other areas, except the low-level waste treatment system and the laboratory of the R&H Building. The low-level waste treatment system and laboratory will be used to support this decommissioning phase.

Phase III includes the decommissioning of the facility protected area site, using the R&H Building low-level waste treatment system and laboratory to support this effort. After completion of the site decommissioning, the decommissioning of the R&H Building low-level radwaste system and laboratory will be completed.

During all of the above decommissioning phases, the MRS support buildings and limited area are required. Upon final decommissioning of the R&H Building, all areas and facilities of the MRS Facility will be released for unrestricted use (Phase IV).

In accordance with 10 CFR 72.18, the decommissioning plan must include financial arrangements made by the applicant to reasonably assure that the decontamination and decommissioning will be carried out.

The planned decommissioning operations and their estimated duration have been estimated. As noted herein, the sealed storage cask, drywell, CHTRU Storage Facility, and initial R&H Building decommissioning will be accomplished concurrently with the waste loadout and shipping phase, which has been estimated to be approximately 4 years.

The final decommissioning, after waste loadout, of the R&H Building will require approximately 5 years to accomplish after all stored waste has been shipped from the site.

Under the current decontamination and decommissioning philosophy, the volume of radioactive wastes resulting from decommissioning activities is minimized by disposing only those components surveyed as contaminated above acceptable limits. The related environmental impacts are addressed in the Environmental Assessment.

5.8 ENVIRONMENTAL ASSESSMENT

The Environmental Assessment (EA) for the MRS Facility was conducted by Pacific Northwest Laboratory (PNL).

The EA document includes a discussion of the purpose and need for MRS facilities, a description of the two selected concepts, a description of the three proposed sites, a discussion of the impacts associated with each site/concept combination, and a comparison of the impacts from the six site/concept combinations. The potential environmental consequences associated with the six site/concept combinations described in the EA include:

(1) Radiological
(2) Air quality
(3) Water quality and use
(4) Land use
(5) Biological
(6) Socioeconomic
(7) Resource requirements and costs

This information is based on estimates of the consequences or impacts and for environmental dose calculation for activities such as construction, operation (normal and accident), decommissioning, and transportation.

6.0 ENERGY CONSERVATION

Several energy conservation features have been incorporated into the conceptual design of the MRS Facility to minimize energy usage and cost.

The construction system and materials used that affect the energy consumption of buildings for the MRS Facility will form an envelope of insulation assemblies that will provide "U" values of 0.07 for walls and 0.05 for roof/ceiling combinations for all buildings except those that are unoccupied and whose interior design temperatures need not be maintained above 55°F during winter.

In the area of HVAC, energy conservation features include variable air volume design, economizer control to minimize energy consumption and optimize equipment usage, controls with night setback features, energy-efficient equipment and design, and use of fuel oil in lieu of electricity whenever practicable. In the R&H Building, where constant air volume and 100% outside air are required, a runaround heat recovery system is provided to recapture heat from the building exhaust. The recaptured heat is then used for heating of the incoming air.

To minimize electrical power usage, all 480-volt motors are of the premium efficiency type, with motors 5 hp and larger having a minimum power factor of 0.85. Fluorescent lighting fixtures, with high-power factor and energy-saving ballasts, are used in all office areas and rooms with low ceilings. High-pressure sodium (HPS) fixtures are used for all other areas, as well as for the illumination of building exteriors, parking lots, roadways, and railroad sidings.

In addition to the above, several other energy-conservation features (such as use of process waste heat, use of solar energy, use of absorption chillers for building cooling, and use of centralized vs. localized heating system) have been considered. Some of these features have proven to be impractical or economically unfeasible, whereas the economic feasibility of others can only be determined during the final design phase.

7.0 PROJECT SCHEDULES

Two schedule options, I and II, have been developed for the site characterization, design, licensing, and construction of the MRS Facility. These schedules indicate that the total time to field an MRS Facility varies from 9 to 11 years, depending upon the construction planning. The schedule options to deploy an MRS Facility are the same for each of the three identified sites.

The schedule for licensing has been established from discussions with personnel from Pacific Northwest Laboratories (PNL), Richland Operations Office (RL), and the Nuclear Regulatory Commission (NRC). The construction schedule was derived from the material takeoff and labor estimates developed during the Conceptual Design engineering.

7.1 SCHEDULE I

This 10-year-4-month schedule (Figure 1) is based upon (1) the Definitive Design configuration being the same as that developed for the Conceptual Design; (2) construction activities being performed on a 40-hr week; (3) adequate construction personnel being available at the jobsite; (4) labor contracts being in place for the duration of the job; (5) no major delays being encountered because of weather; and (6) sufficient specific site data being available for initiation of design and licensing activities upon notice to proceed.

7.2 SCHEDULE II

This 8-year-7-month schedule (Figure 2) is based upon (1) the Definitive Design configuration being the same as that developed for the Conceptual Design; (2) sufficient specific site data being available for initiating design and licensing activities upon notice to proceed; (3) construction activities for the critical elements being performed on a double-shift basis (R&H work performed on a 2-shift/5-day week); (4) adequate construction personnel being available at the jobsite; (5) labor contracts being in place for the duration of the job; and (6) no major delays being encountered because of weather.

8.0 COST ESTIMATE

This section presents the total project estimate for engineering and construction of the standard site and primary storage concept, as determined by the Conceptual Design engineering and construction schedule.

The Total Estimated Cost (TEC) (for construction-related costs) consists of direct and indirect construction costs, engineering (excluding site characterization), construction inspection, project administration, and contingency. No allocation was made for operating contractor, purchase of land, financial assistance, or DOE/NRC licensing activities. The total construction-related estimated cost for Schedule I is shown in Figure 3 and the total estimated cost for Schedule II is shown in Figure 4. The cost penalty for schedule acceleration is $5 million.

As shown in Table 8-1, the cost of the Alternate Storage Concept varies between +13% to +9% of the Primary Storage Concept. These cost variances result from the geotechnical differences and the storage area development included in the initial construction phase. The Primary Storage Concept cost includes all site development costs for 15,000 MTU storage, cask foundations for 5,000 MTU storage, and no cost for the Cask Manufacturing Facility. The Alternate Storage Concept cost includes all site development for 15,000 MTU storage and drywells for 5,000 MTU storage. The costs associated with all casks, additional drywells or cask foundations for 10,000 MTU storage, and the Cask Manufacturing Facility are considered as capital costs incurred during operations.

Table 8-1 - Concept/Site Cost Comparison
($ 000)

Site	Primary Concept	Alternate Concept
Clinch River	701,410	796,440
Oak Ridge	690,200	781,860
Hartsville	708,370	772,840

9.0 MAINTENANCE

Depending upon the potential contamination level and ALARA considerations, the R&H Building equipment and associated components have been designed for both contact and remote maintenance techniques. Items located within the highly contaminated areas (shielded process cells and remote handled equipment maintenance rooms) have been designed and arranged for remote removal and replacement. They are of modular design, provided with remote connections/disconnects, and sized for transfer through access openings and the capacity of remotely operated handling equipment. Equipment and associated components in all other areas of the R&H Building have been designed for contact removal/replacement or maintenance. However, equipment that can become contaminated has been provided with shielded separations and the capability for remote decontamination to achieve ALARA exposure for maintenance personnel.

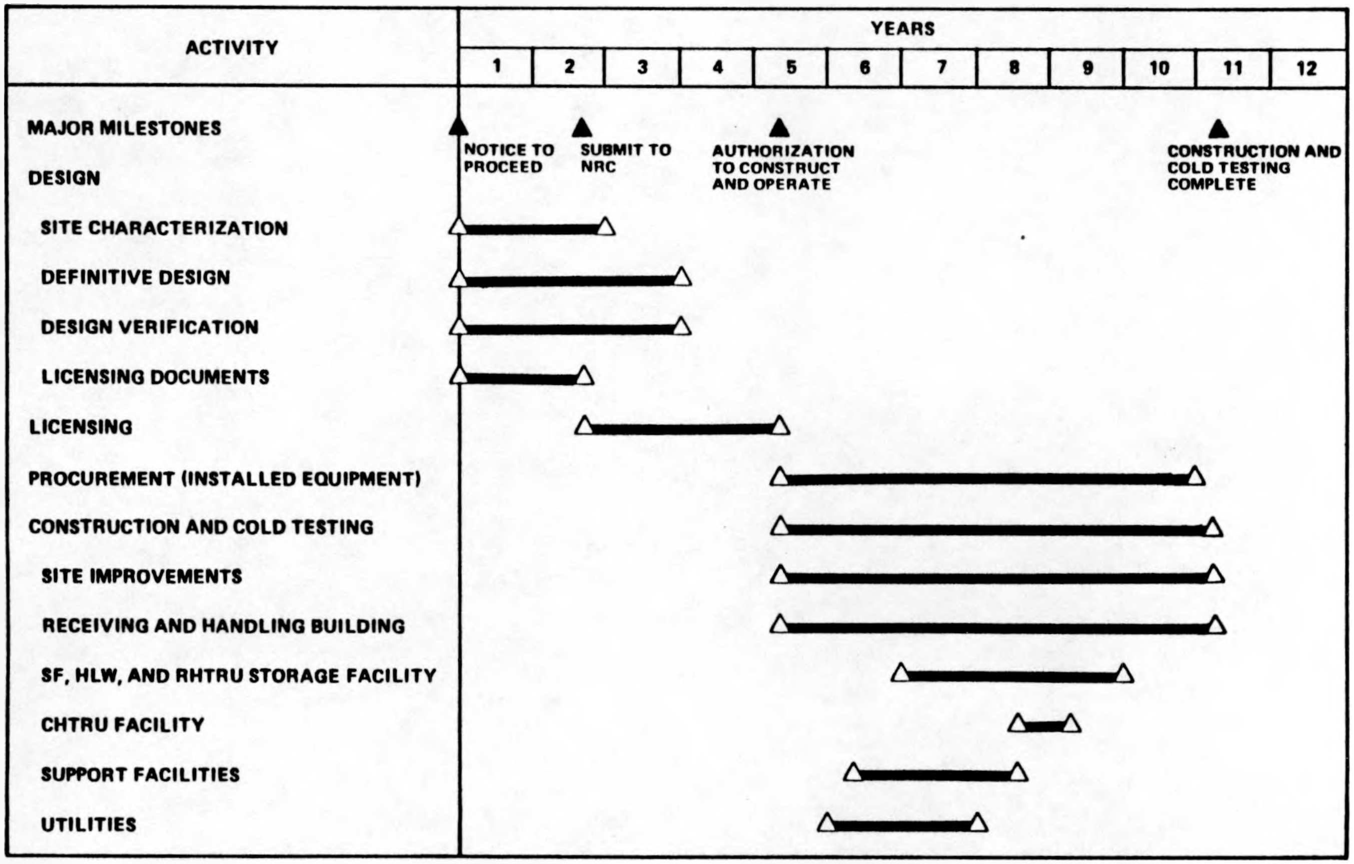


Figure 1 - Schedule I

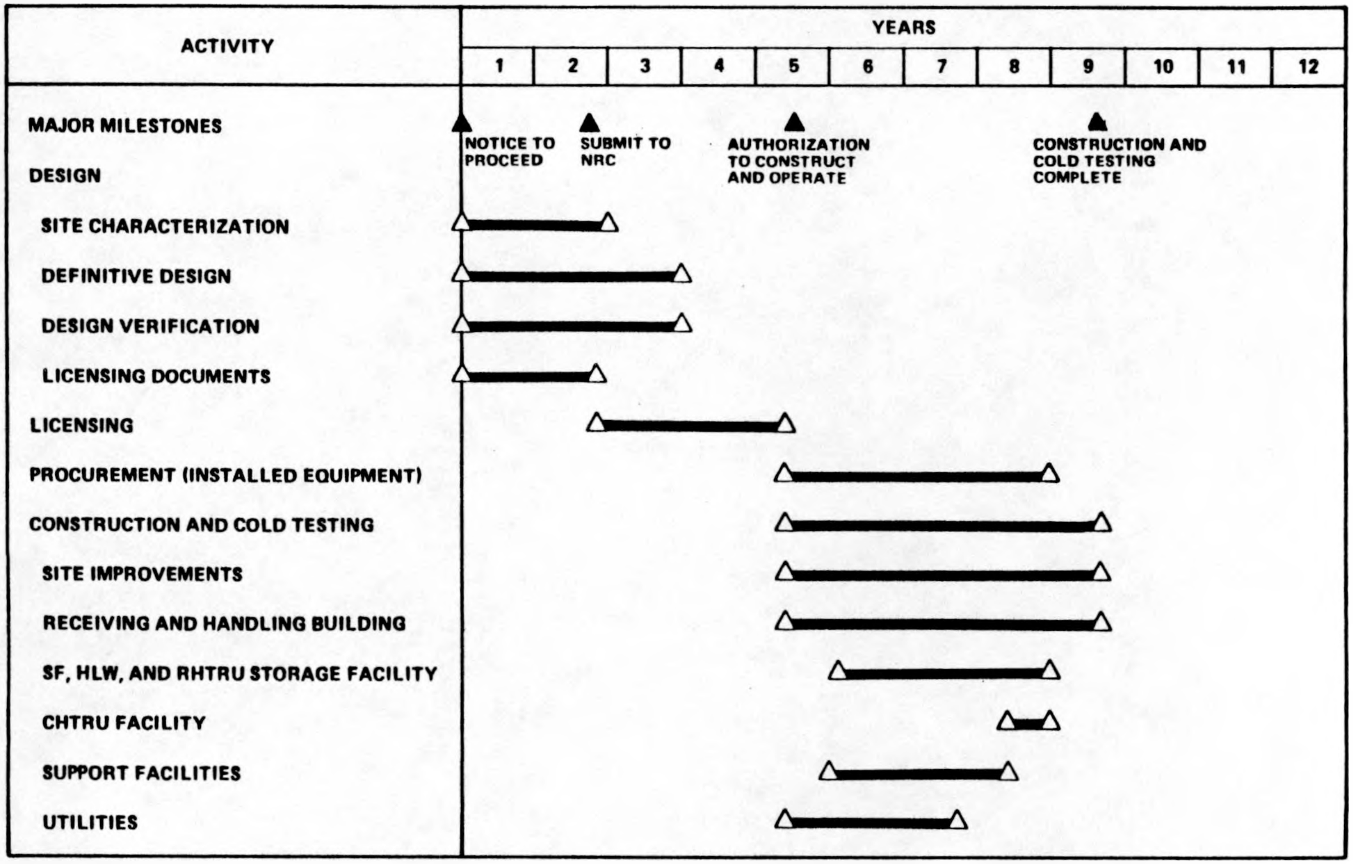


Figure 2 - Schedule II

BB-1(1-79)

PREPARED BY:

MRS Facility Clinch River Site - Primary (Casks) Schedule I

PROJECT COST ESTIMATE SUMMARY

TITLE	PREPARED FOR	PREPARED BY	CHECKED BY	PROJECT NO.	DATE
Project Cost Estimate (Cask Storage)	PNL/DOE	V. Mesec	CCE	6440-11	August 85

		TITLE I	TITLE II	TITLE III	($ TOTAL X 1000)
A. ENGINEERING					
ARCHITECT - ENGINEER		NA	49,500	23,600	73,100
OTHER ENGINEERING - SPECIFY		NA	4,800	0	4,800
SUBTOTAL	I / II / III	NA	54,300	23,600	77,900
ESCALATION	NA % / NA % / NA %	NA	0	0	0
CONTINGENCY	NA % / 20 % / 20 %	NA	10,700	4,400	15,100
SUBTOTAL ENGINEERING		NA	65,000	28,000	93,000
OPERATING CONTRACTOR					0
TOTAL A					93,000
B. CONSTRUCTION					
(1) IMPROVEMENTS TO LAND					53,068
(2) BUILDINGS					0
BUILDING NO. R&H Bldg 709,025 SQ. FT.					333,265
BUILDING NO. Suppt. Bldgs SQ. FT.					35,266
(3) OTHER (DETACHED) STRUCTURES	CHTRU Bldg.				1,163
(4) SPECIAL FACILITIES AND INSTAL.	Storage Area				27,313
(5) UTILITIES					4,453
(6) OPERATING EXPENSE CHARGES	NA				0
(7) CONTRACT ADMINISTRATION	NA				0
(8)	Construction Management				45,240
SUBTOTAL					499,768
ESCALATION NA % @ NA YEARS					0
CONTINGENCY Varies %					103,573
TOTAL B					603,341
C. STANDARD EQUIPMENT					0
TOTAL C					0
D. TRANSFERRED CAPITAL PROP. OR EQUIPMENT	NA				0

CURRENT ENG. COST INDEX BUILDING ______ CONSTRUCTION ______

TOTAL PROJECT ESTIMATE $ 696,341

PROPOSED FUNDS ALLOCATION

FUNDS PURPOSE	OPER. CONTR.	DOE-RL
ENGINEERING		
PROCUREMENT		
CONSTRUCTION		
ESCALATION		
CONTINGENCY		
TCP/TCE		
WASH. STATE TAX		
TOTAL		

TYPE OF ESTIMATE:

APPROVALS	DATE
ESTIMATING	
PROJECT MANAGER	
CLIENT ENGINEER	

REMARKS:
(1) All cost 2nd quarter 1985.
(2) 85% productivity on labor is included in the estimate. Productivity factor furnished by DOE Oak Ridge.
(3) Escalation not included in estimate.
(4) NA = not applicable

ESTIMATE SHEET ___ OF ___

PARSONS

Figure 3 - Estimated Cost for Schedule I

EB-1(1-79)

PREPARED BY:

MRS Facility Clinch River Site - Primary (Cask) - Schedule II

PROJECT COST ESTIMATE SUMMARY

TITLE	PREPARED FOR	PREPARED BY	CHECKED BY	PROJECT NO.	DATE
Project Cost Estimate (Cask Storage)	PNL/DOE	V. Mesec	CCE	6440-11	August 85

		TITLE I	TITLE II	TITLE III	($ TOTAL X 1000)
A. ENGINEERING					
ARCHITECT - ENGINEER		NA	49,500	23,600	73,100
OTHER ENGINEERING - SPECIFY		NA	4,800	0	4,800
SUBTOTAL	I / II / III	NA	54,300	23,600	77,900
ESCALATION	NA % NA % NA %	NA	0	0	0
CONTINGENCY	NA % 20 % 20 %	NA	10,700	4,400	15,100
SUBTOTAL ENGINEERING		NA	65,000	28,000	93,000
OPERATING CONTRACTOR					0
TOTAL A					93,000
B. CONSTRUCTION					
(1) IMPROVEMENTS TO LAND					53,068
(2) BUILDINGS					0
BUILDING NO.	R&H Bldg 709,025 SQ. FT.				337,300
BUILDING NO.	Suppt. Bldgs SQ. FT.				35,266
(3) OTHER (DETACHED) STRUCTURES	CHTRU Bldg.				1,163
(4) SPECIAL FACILITIES AND INSTAL.	Storage Area				27,313
(5) UTILITIES					4,453
(6) OPERATING EXPENSE CHARGES	NA				0
(7) CONTRACT ADMINISTRATION	NA				0
(8)	Construction Management				45,240
SUBTOTAL					503,803
ESCALATION	NA % @ NA YEARS				0
CONTINGENCY	Varies %				104,607
TOTAL B					608,410
C. STANDARD EQUIPMENT					0
TOTAL C					0
D. TRANSFERRED CAPITAL PROP. OR EQUIPMENT	NA				0

CURRENT ENR. COST INDEX BUILDING ______ CONSTRUCTION ______

TOTAL PROJECT ESTIMATE $ 701,410

PROPOSED FUNDS ALLOCATION

FUNDS PURPOSE	OPER. CONTR.	DOE-RL
ENGINEERING		
PROCUREMENT		
CONSTRUCTION		
ESCALATION		
CONTINGENCY		
TCP/TCE		
WASH. STATE TAX		
TOTAL		

TYPE OF ESTIMATE:

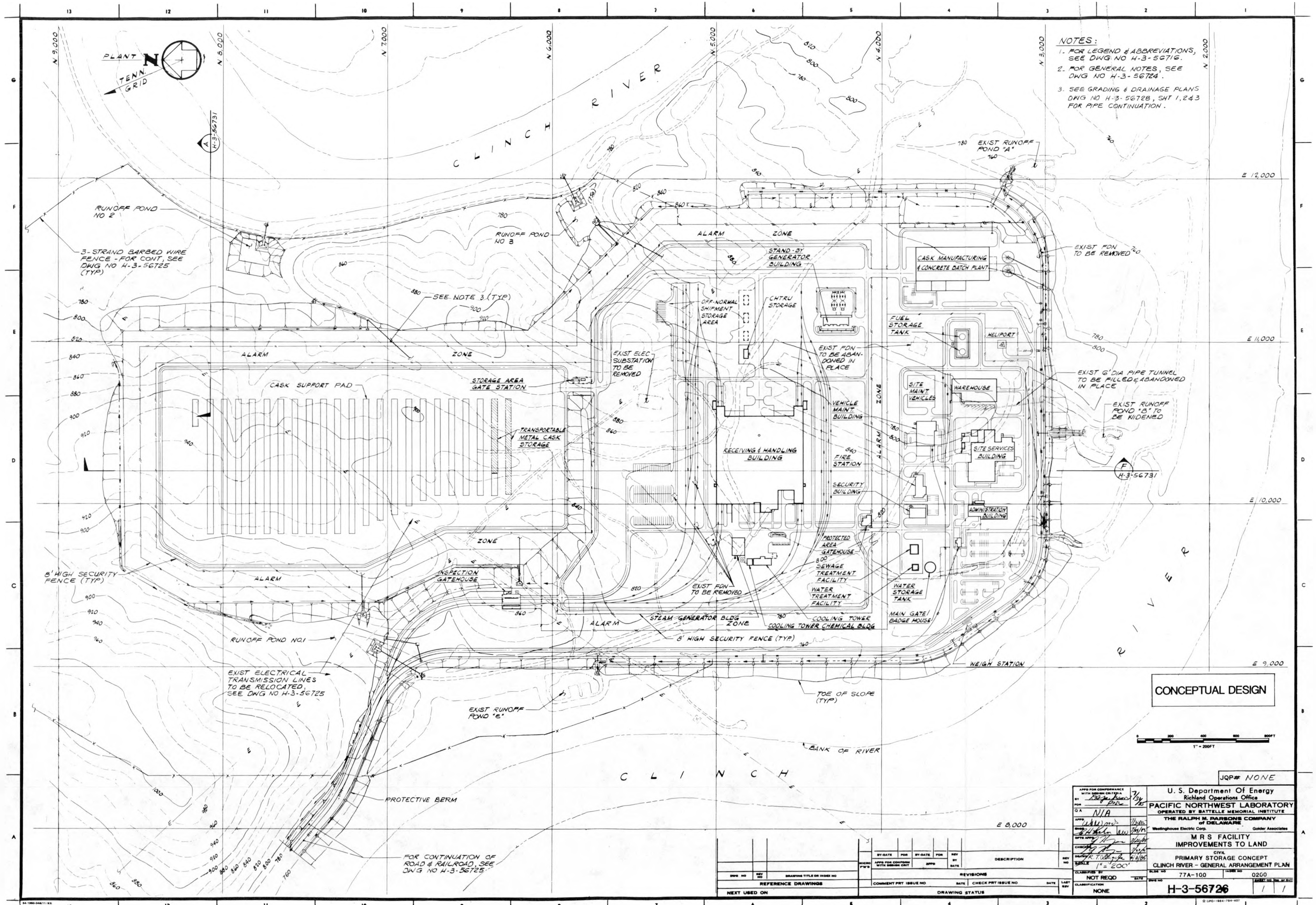
APPROVALS	DATE
ESTIMATING	
PROJECT MANAGER	
CLIENT ENGINEER	

REMARKS:
(1) All cost 2nd quarter 1985.
(2) 85% productivity on labor is included in the estimate. Productivity factor furnished by DOE Oak Ridge.
(3) Escalation not included in estimate.
(4) NA = Not applicable

ESTIMATE SHEET ___ OF ___

Figure 4 - Estimated Cost for Schedule II

PARSONS



NOTES:
1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.
3. SEE GRADING & DRAINAGE PLANS DWG NO H-3-56728, SHT 1,2&3 FOR PIPE CONTINUATION.
PLANT N
TENN. GRID
CLINCH RIVER
RUNOFF POND NO 2
3-STRAND BARBED WIRE FENCE - FOR CONT, SEE DWG NO H-3-56725 (TYP)
RUNOFF POND NO 3
SEE NOTE 3 (TYP)
EXIST RUNOFF POND "A"
ALARM ZONE
STAND-BY GENERATOR BUILDING
CASK MANUFACTURING & CONCRETE BATCH PLANT
EXIST FDN TO BE REMOVED
OFF-NORMAL SHIPMENT STORAGE AREA
CHTRU STORAGE
FUEL STORAGE TANK
HELIPORT
EXIST FDN TO BE ABANDONED IN PLACE
EXIST ELEC SUBSTATION TO BE REMOVED
STORAGE AREA GATE STATION
CASK SUPPORT PAD
EXIST 6' DIA PIPE TUNNEL TO BE FILLED & ABANDONED IN PLACE
SITE MAINT VEHICLES
WAREHOUSE
EXIST RUNOFF POND "B" TO BE WIDENED
VEHICLE MAINT BUILDING
TRANSPORTABLE METAL CASK STORAGE
RECEIVING & HANDLING BUILDING
FIRE STATION
SITE SERVICES BUILDING
SECURITY BUILDING
ADMINISTRATION BUILDING
PROTECTED AREA GATEHOUSE
SEWAGE TREATMENT FACILITY
WATER TREATMENT FACILITY
WATER STORAGE TANK
MAIN GATE/BADGE HOUSE
8' HIGH SECURITY FENCE (TYP)
INSPECTION GATEHOUSE
EXIST FDN TO BE REMOVED
STEAM GENERATOR BLDG
COOLING TOWER
COOLING TOWER CHEMICAL BLDG
RUNOFF POND NO.1
8' HIGH SECURITY FENCE (TYP)
WEIGH STATION
EXIST ELECTRICAL TRANSMISSION LINES TO BE RELOCATED, SEE DWG NO H-3-56725
EXIST RUNOFF POND "E"
TOE OF SLOPE (TYP)
BANK OF RIVER
PROTECTIVE BERM
FOR CONTINUATION OF ROAD & RAILROAD, SEE DWG NO H-3-56725
CONCEPTUAL DESIGN
1" = 200FT
JQP# NONE
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Richland Operations Office
PACIFIC NORTHWEST LABORATORY
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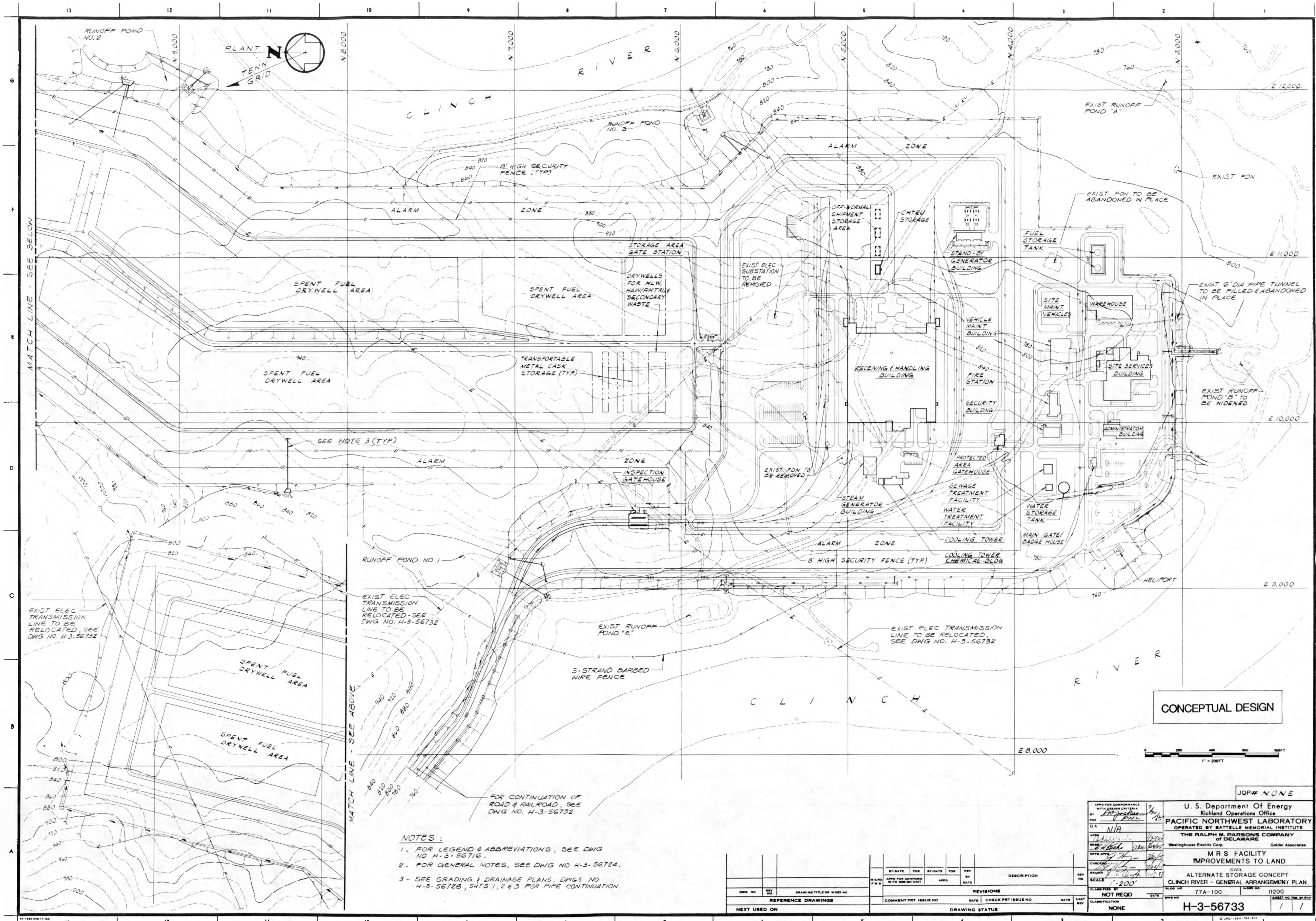
THE RALPH M. PARSONS COMPANY of DELAWARE
Westinghouse Electric Corp.
Golder Associates
M R S FACILITY
IMPROVEMENTS TO LAND
CIVIL
PRIMARY STORAGE CONCEPT
CLINCH RIVER - GENERAL ARRANGEMENT PLAN
BLDG NO 77A-100
INDEX NO 0200
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
SCALE 1" = 200'
DWG NO H-3-56726
SHEET NO 1 NO OF SHTS 1
GPO-1984-794-407



PLANT N
TENN GRID
RUNOFF POND NO. 2
RUNOFF POND NO. 3
RUNOFF POND NO. 1
CLINCH RIVER
N 9,000
N 8,000
N 7,000
N 6,000
N 5,000
N 4,000
N 3,000
E 12,000
E 11,000
E 10,000
E 9,000
E 8,000
EXIST RUNOFF POND "A"
EXIST FDN
EXIST FDN TO BE ABANDONED IN PLACE
ALARM ZONE
8' HIGH SECURITY FENCE (TYP)
STORAGE AREA GATE STATION
DRYWELLS FOR HLW, HAW/RHTRU & SECONDARY WASTE
SPENT FUEL DRYWELL AREA
TRANSPORTABLE METAL CASK STORAGE (TYP)
SEE NOTE 3 (TYP)
INSPECTION GATEHOUSE
OFF-NORMAL SHIPMENT STORAGE AREA
CHTRU STORAGE
STAND-BY GENERATOR BUILDING
FUEL STORAGE TANK
EXIST ELEC SUBSTATION TO BE REMOVED
EXIST 6' DIA PIPE TUNNEL TO BE FILLED & ABANDONED IN PLACE
SITE MAINT VEHICLES
WAREHOUSE
VEHICLE MAINT BUILDING
RECEIVING & HANDLING BUILDING
FIRE STATION
SECURITY BUILDING
SITE SERVICES BUILDING
EXIST RUNOFF POND "B" TO BE WIDENED
ADMINISTRATION BUILDING
EXIST FDN TO BE REMOVED
PROTECTED AREA GATEHOUSE
SEWAGE TREATMENT FACILITY
WATER TREATMENT FACILITY
STEAM GENERATOR BUILDING
WATER STORAGE TANK
MAIN GATE/BADGE HOUSE
COOLING TOWER
COOLING TOWER CHEMICAL BLDG
HELIPORT
EXIST ELEC TRANSMISSION LINE TO BE RELOCATED, SEE DWG NO. H-3-56732
EXIST ELEC TRANSMISSION LINE TO BE RELOCATED - SEE DWG NO. H-3-56732
EXIST ELEC TRANSMISSION LINE TO BE RELOCATED, SEE DWG NO. H-3-56732
EXIST RUNOFF POND "E"
3-STRAND BARBED WIRE FENCE
MATCH LINE - SEE BELOW
MATCH LINE - SEE ABOVE
FOR CONTINUATION OF ROAD & RAILROAD, SEE DWG NO. H-3-56732
CONCEPTUAL DESIGN
0 200 400 800 900FT
1" = 200FT
NOTES:
1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.
3 - SEE GRADING & DRAINAGE PLANS, DWGS NO H-3-56728, SHTS 1, 2 & 3 FOR PIPE CONTINUATION.
JQP# NONE
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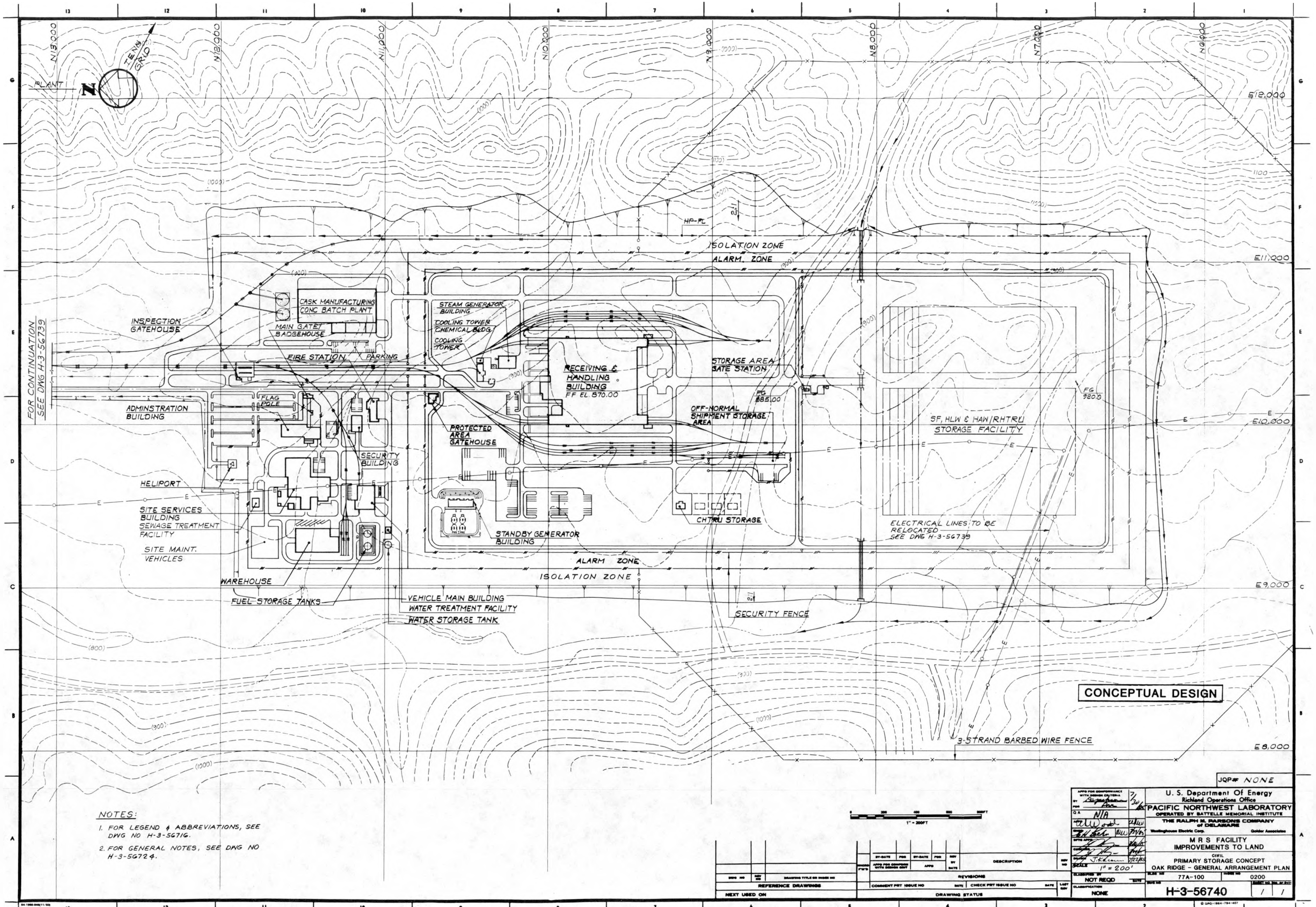
Westinghouse Electric Corp.
Golder Associates
M R S FACILITY
IMPROVEMENTS TO LAND
CIVIL
ALTERNATE STORAGE CONCEPT
CLINCH RIVER - GENERAL ARRANGEMENT PLAN
APPD FOR CONFORMANCE WITH DESIGN CRITERIA
BY
FOR PNL
QA N/A
SCALE 1" = 200'
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
BLDG NO 77A-100
INDEX NO 0200
DWG NO H-3-56733
SHEET NO 1
NO OF SHTS 1
REFERENCE DRAWINGS
DRAWING STATUS
REVISIONS
NEXT USED ON
GPO-1984-794-407



PLANT
N
TENN GRID
N13,000
N12,000
N11,000
N10,000
N9,000
N8,000
N7,000
N6,000
E12,000
E11,000
E10,000
E9,000
E8,000
FOR CONTINUATION SEE DWG H-3-56739
ISOLATION ZONE
ALARM ZONE
HP-FL
INSPECTION GATEHOUSE
CASK MANUFACTURING CONC BATCH PLANT
MAIN GATE/ BADGEHOUSE
FIRE STATION
PARKING
STEAM GENERATOR BUILDING
COOLING TOWER CHEMICAL BLDG
COOLING TOWER
RECEIVING & HANDLING BUILDING FF EL 870.00
STORAGE AREA GATE STATION
FG 885.00
FG 920.0
OFF-NORMAL SHIPMENT STORAGE AREA
SF, HLW & HAW/RHTRU STORAGE FACILITY
ADMINSTRATION BUILDING
FLAG POLE
PROTECTED AREA GATEHOUSE
SECURITY BUILDING
HELIPORT
SITE SERVICES BUILDING
SEWAGE TREATMENT FACILITY
SITE MAINT. VEHICLES
WAREHOUSE
FUEL STORAGE TANKS
STANDBY GENERATOR BUILDING
CHTRU STORAGE
ELECTRICAL LINES TO BE RELOCATED SEE DWG H-3-56739
VEHICLE MAIN BUILDING
WATER TREATMENT FACILITY
WATER STORAGE TANK
SECURITY FENCE
3-STRAND BARBED WIRE FENCE
CONCEPTUAL DESIGN
1" = 200FT
NOTES:
1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.
REFERENCE DRAWINGS
NEXT USED ON
REVISIONS
DRAWING STATUS
JQP# NONE
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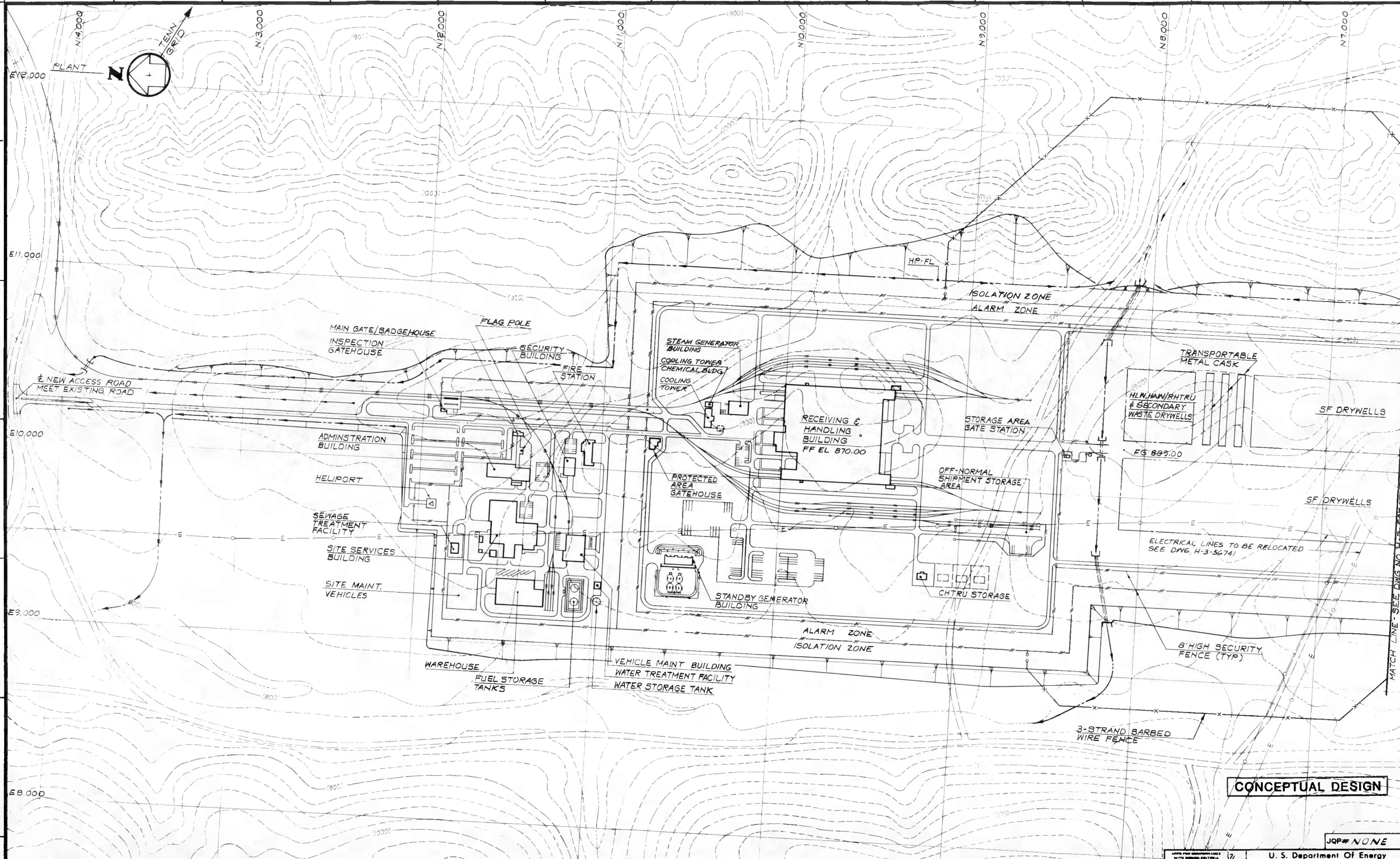
Westinghouse Electric Corp.
Golder Associates
M R S FACILITY
IMPROVEMENTS TO LAND
CIVIL
PRIMARY STORAGE CONCEPT
OAK RIDGE - GENERAL ARRANGEMENT PLAN
SCALE 1" = 200'
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
77A-100
0200
H-3-56740
1 / 1
GPO-1984-794-407



NOTES:

1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.

JQP# NONE

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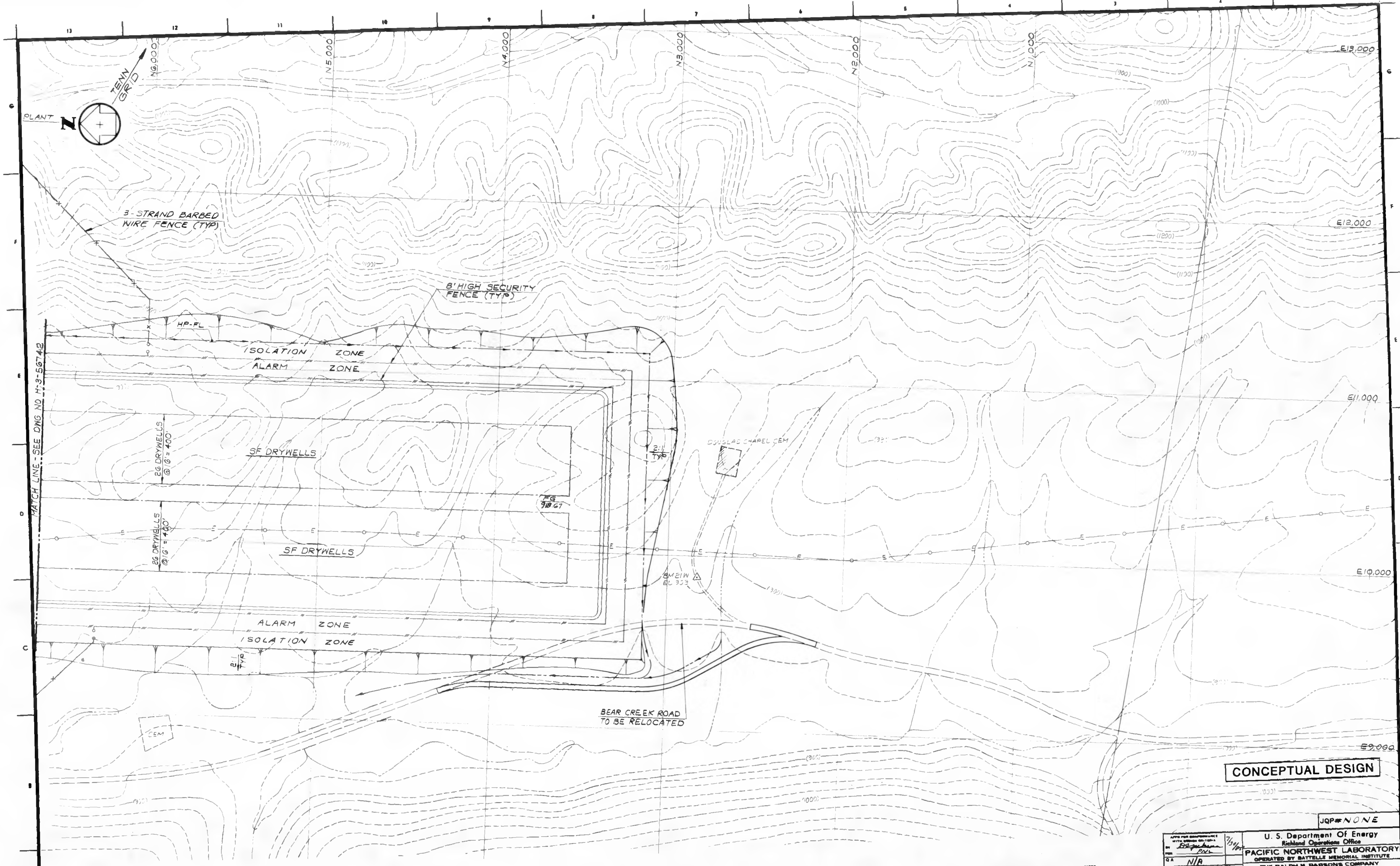
IMPROVEMENTS TO LAND

CIVIL
ALTERNATE STORAGE CONCEPT
OAK RIDGE - GENERAL ARRANGEMENT PLAN, SHT 1

Q A N/A
SCALE 1" = 200'
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
77A-100 0200
H-3-56742 1 2

REFERENCE DRAWINGS
REVISIONS
DRAWING STATUS
NEXT USED ON



NOTES :

1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.

1" = 200 FT

JQP# NONE

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M R S FACILITY
IMPROVEMENTS TO LAND

CIVIL
ALTERNATE STORAGE CONCEPT
OAK RIDGE - GENERAL ARRANGEMENT PLAN, SHT 2

QA N/A

SCALE 1" = 200'

77A-100 0200

NOT REQD

CLASSIFICATION NONE

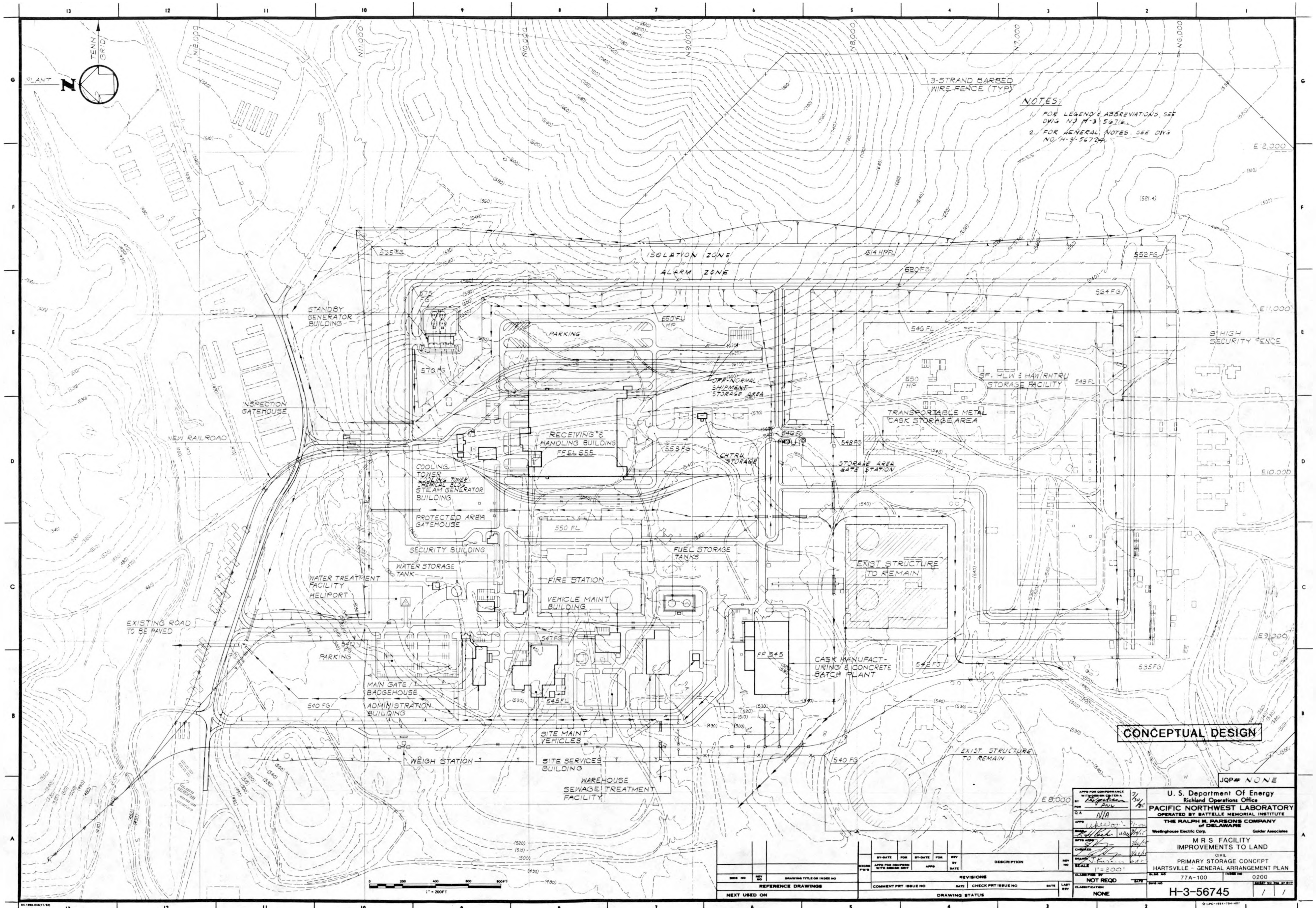
H-3-56742 2 2

REFERENCE DRAWINGS

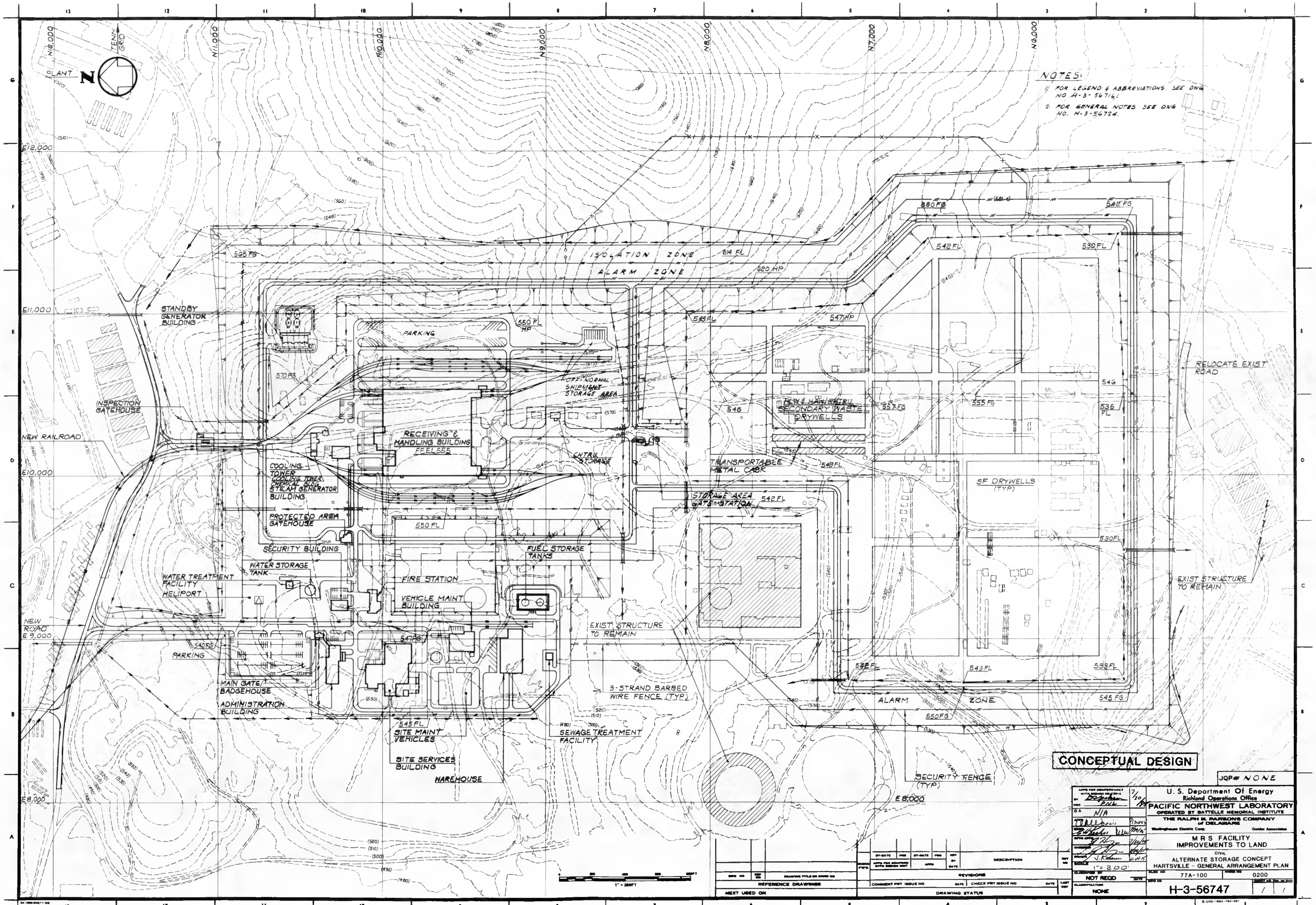
NEXT USED ON

REVISIONS

DRAWING STATUS



TENN GRID
PLANT
N
NOTES:
1. FOR LEGEND & ABBREVIATIONS SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES, SEE DWG NO H-3-56724.
3-STRAND BARBED WIRE FENCE (TYP)
ISOLATION ZONE
ALARM ZONE
8' HIGH SECURITY FENCE
STANDBY GENERATOR BUILDING
INSPECTION GATEHOUSE
NEW RAILROAD
PARKING
OFF-NORMAL SHIPMENT STORAGE AREA
RECEIVING & HANDLING BUILDING FFEL 555
COOLING TOWER
STEAM GENERATOR BUILDING
CHTRU STORAGE
STORAGE AREA GATE STATION
SF, HLW & HAW/RHTRU STORAGE FACILITY
TRANSPORTABLE METAL CASK STORAGE AREA
PROTECTED AREA GATEHOUSE
SECURITY BUILDING
550 FL
FUEL STORAGE TANKS
WATER STORAGE TANK
WATER TREATMENT FACILITY
HELIPORT
FIRE STATION
VEHICLE MAINT BUILDING
EXIST STRUCTURE TO REMAIN
EXISTING ROAD TO BE PAVED
PARKING
MAIN GATE BADGEHOUSE
ADMINISTRATION BUILDING
FF 545
CASK MANUFACTURING & CONCRETE BATCH PLANT
SITE MAINT VEHICLES
WEIGH STATION
SITE SERVICES BUILDING
WAREHOUSE
SEWAGE TREATMENT FACILITY
EXIST. STRUCTURE TO REMAIN
CONCEPTUAL DESIGN
JQP# NONE
U. S. Department Of Energy
Richland Operations Office
PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE
THE RALPH M. PARSONS COMPANY of DELAWARE
Westinghouse Electric Corp.
Golder Associates
APPD FOR CONFORMANCE WITH DESIGN CRITERIA
7/30/85
Q A N/A
SCALE 1" = 200'
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
M R S FACILITY
IMPROVEMENTS TO LAND
CIVIL
PRIMARY STORAGE CONCEPT
HARTSVILLE - GENERAL ARRANGEMENT PLAN
BLDG NO 77A-100
INDEX NO 0200
DWG NO H-3-56745
SHEET NO 1
NO OF SHT 1
REFERENCE DRAWINGS
NEXT USED ON
REVISIONS
DRAWING STATUS
1" = 200FT
GPO-1984-794-407



PLANT
TENN GRID
N
N18,000
N11,000
N10,000
N9,000
N8,000
N7,000
N6,000
E12,000
E11,000
E10,000
E 9,000
E8,000
E 8,000
NOTES:
1. FOR LEGEND & ABBREVIATIONS, SEE DWG NO H-3-56716.
2. FOR GENERAL NOTES SEE DWG NO. H-3-56724.
ISOLATION ZONE
ALARM ZONE
STANDBY GENERATOR BUILDING
PARKING
OFF-NORMAL SHIPMENT STORAGE AREA
INSPECTION GATEHOUSE
NEW RAILROAD
RECEIVING & HANDLING BUILDING
F.F.EL.555
CNTRL STORAGE
COOLING TOWER
COOLING TOWER CHEMICAL FEED STEAM GENERATOR BUILDING
PROTECTED AREA GATEHOUSE
SECURITY BUILDING
WATER STORAGE TANK
WATER TREATMENT FACILITY
HELIPORT
FIRE STATION
VEHICLE MAINT BUILDING
FUEL STORAGE TANKS
NEW ROAD
PARKING
MAIN GATE/ BADGEHOUSE
ADMINISTRATION BUILDING
SITE MAINT VEHICLES
SITE SERVICES BUILDING
WAREHOUSE
SEWAGE TREATMENT FACILITY
3-STRAND BARBED WIRE FENCE (TYP)
EXIST STRUCTURE TO REMAIN
TRANSPORTABLE METAL CASK
STORAGE AREA GATE STATION
HLW & HAW & RU SECONDARY WASTE DRYWELLS
SF DRYWELLS (TYP)
RELOCATE EXIST ROAD
EXIST STRUCTURE TO REMAIN
ALARM ZONE
SECURITY FENCE (TYP)
CONCEPTUAL DESIGN
JQP# NONE
U. S. Department Of Energy
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THE RALPH M. PARSONS COMPANY of DELAWARE
Westinghouse Electric Corp.
Golder Associates
M R S FACILITY
IMPROVEMENTS TO LAND
CIVIL
ALTERNATE STORAGE CONCEPT
HARTSVILLE - GENERAL ARRANGEMENT PLAN
1"= 200'
NOT REQD
NONE
77A-100
0200
H-3-56747
REFERENCE DRAWINGS
NEXT USED ON
REVISIONS
DRAWING STATUS