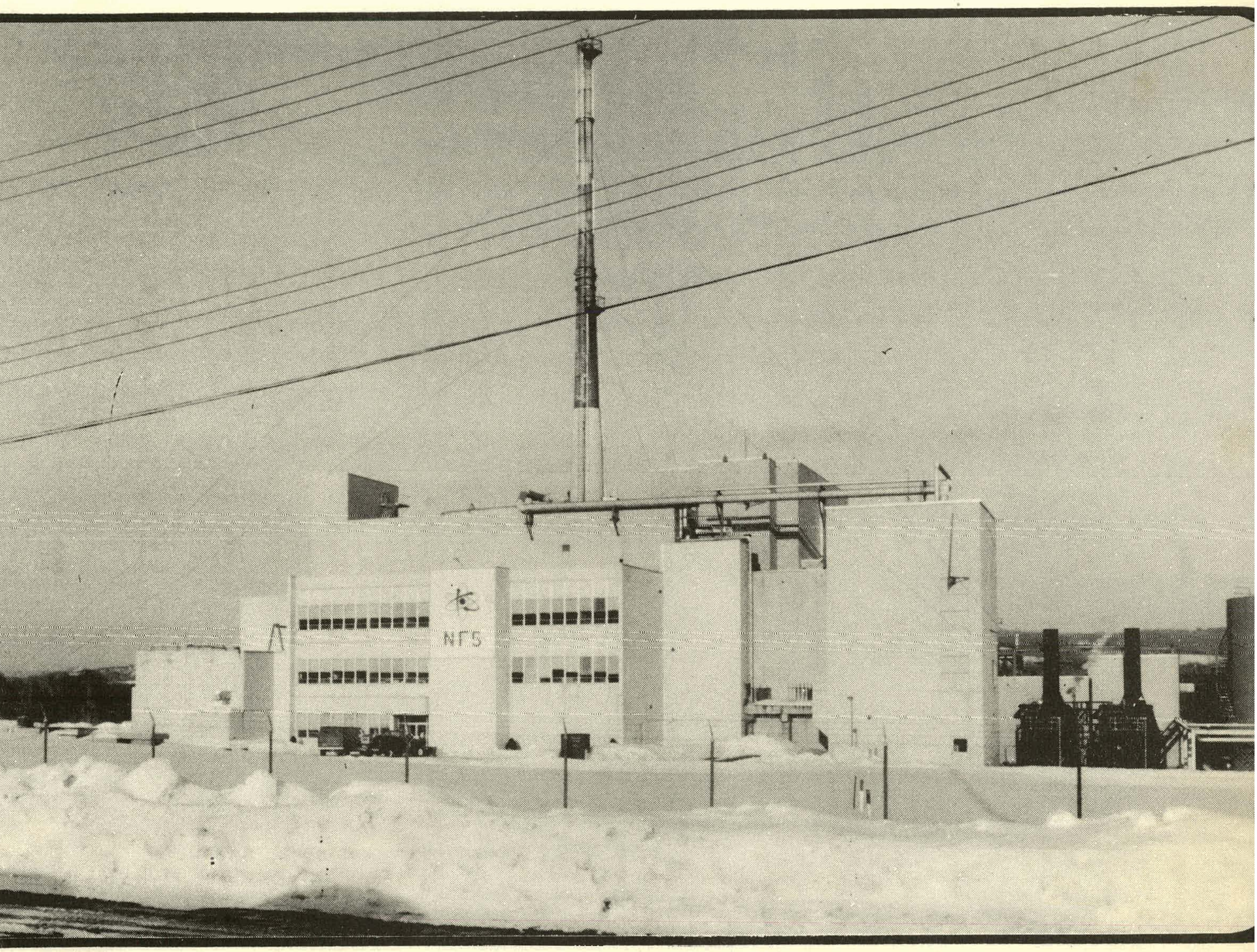
ANL-78-XX-96

DECOMMISSIONING ALTERNATIVES FOR THE WEST VALLEY, NEW YORK, FUEL REPROCESSING PLANT

PREPARED UNDER UNITED STATES DEPARTMENT OF ENERGY CONTRACT FOR ARGONNE NATIONAL LABORATORY



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Contractor's Report No. UNI-1050

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The information in this document, prepared in support of a study concerning the Western New York Nuclear Service Center, does not present all the data from which conclusions were drawn. The report, TID-28905, Vols. 1 & 2, Western New York Nuclear Service Center Study, was prepared after reviewing and evaluating this and other studies.

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FORWARD

"Decommissioning Alternatives for the West Valley, New York Fuel Reprocessing Plant" is a technical assessment of a segment of a technically and politically complex situation. The options and alternatives which we have assessed, for that portion of the total facility we have studied—we believe to be technically sound and politically responsive. However, any alternative is only technically sound when coupled with compatible alternatives for the remainder of the West Valley site.

This document was prepared for the Department of Energy (DOE) under the direction of Argonne National Laboratory, who will combine this information and the work of others into a report on the entire facility. Because of the needs of the Congress which called for the complete study of West Valley within one year, the time allowed for this work was short. Consequently, we have relied heavily on a generic study of reprocessing plants, NUREG 0278, Technology, Safety, and Cost of Decommissioning A Reference Nuclear Fuel Reprocessing Plant. This 1977 document was three years in preparation and represents a comprehensive study of "typical" fuel reprocessing plants. In the time allowed it was impossible to repeat this depth of study for the West Valley Plant. We have relied on NUREG 0278 except where another course was indicated, either by the specific characteristics and operating history of the West Valley Plant or by our own decontamination/decommissioning experience.

As such, we hope this document will be viewed for what it is - a conceptual approach, which will be superseded by subsequent detailed planning.

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ABBREVIATIONS, SYMBOLS, AND DEFINITIONS

ALARA, As-Low-As-Reasonable-Achievable

Alpha Radiation, Charged Particles emitted from radioactive decay which have a man and charge equal in magnitude to a helium nucleous; i.e., two protons and two neutrons.

ANA, Analytical Aisle

ANC, Analytical Cell

ANSI, American National Standards Institute

ARC, Acid Recovery Room

Beta Radiation, Changed Particles emitted from radioactive decay which have a man and charge equal in magnitude to an electron.

CCR, Chemical Crane Room

Ci, Curie

COA, Chemical Operating Aisle

Contamination, Radioactive materials which are not an intrinsic part of a radioactive solid object.

CPC, Chemical Process Cell

CR, Control Room

Criticality, A sustained nuclear chain reaction.

CUP, Cask Unloading Pool

Curie, The special unit of activity. One curie equals 3.700×10^{10} nuclear transformations (disintegrations) per second.

CVA, Chemical Viewing Aisle

DCS, Decontamination Shop

Decay, Radioactive, Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons.

Decontamination Factor, The ratio of the amount of activity prior to decontamination to the amount remaining after decontamination.

Depleated Uranium, Uranium with less of the ^{235}U Isotope than naturally occuring uranium.

DOE, U. S. Department of Energy

Dose, A general form denoting the quantity of radiation or energy absorbed. For special purposes it must be appropriately qualified. If unqualified, it refers to absorbed dose.

Absorbed Dose, The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 100 ergs per gram. (See Rad.)

Dose Equivalent (DE), A quantity used in radiation protection. It expresses all radiations on a common scale for calculating the effective absorbed dose. It is defined as the product of the absorbed dose in rads and certain modifying factors. (The unit of dose equivalent is the rem.)

ABBREVIATIONS, SYMBOLS, AND DEFINITIONS (Cont'd.)

DOT, U. S. Department of Transportation

DPM, Disintegrations Per Minute

EDR, Equipment Decontamination Room

Enriched Uranium, Uranium in which the abundance of the ^{235}U isotope is increased above normal.

Exposure, A measure of the ionization produced in air by x or gamma radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in air, divided by the mass of the air in the volume element. The special unit of exposure is the roentgen.

fCi, Fempto Curie, See Curie and prefixes at the end of this list.

Fixed Contamination, Radioactive material adhered to a surface in such a way that it cannot be readily removed by ordinary mechanical means such as wiping.

FRS, Fuel Receiving and Storage

Fission, Nuclear, A nuclear transformation characterized by the splitting of a nucleus into at least two other nuclei and the release of a relatively large amount of energy.

Fission, Products, Elements or compounds resulting from fission.

Gamma Radiation, Short wavelength electromagnetic radiation (range of energy from 10 keV to 9 MeV) emitted from the nucleus.

GOA, GPC-MC Operating Aisle

GPC, General Purpose Cell

GCR, GPC Crane Room

HAC, Hot Acid Cell

Half-Life Radioactive, Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

HEPA, High Efficiency Particulate Air (Filter). Designed and tested for 99.93% minimum efficiency for 0.3 micron particles.

HEV, Head End Ventilation and Entire Duct System.

Ion Exchange, A chemical process involving the reversible interchange of ions between a solution and a solid ion exchange resin.

LWC, Liquid Waste Cell

LWA, Lower Warm Aisle

LXA, Lower Extraction Aisle

MC, Miniature Cell

MCR, Mechanical Crane Room

MOA, Mechanical Operating Aisle

ABBREVIATIONS, SYMBOLS, AND DEFINITIONS (Cont'd.)

Man-rem, The total dose in Rem received by a population.

mrem, Milli-rem (See Rem and prefixes)

MRR, Manipulator Repair Room

MRS, Master Slave Manipulator Repair Shop

MS, Maintenance Shop

NFS, Nuclear Fuel Services, Inc.

Non-TRU, Nontransuranic

NRC, Nuclear Regulatory Commission

NUREG-0278, NRC Document No. 0278, Technology, Safety, and Costs of Decommissioning a Reference Nuclear Fuel Reprocessing Plant.

OGA, OGC-ARC Aisle

OGC, Off-Gas Cell

PCR, Process Chemical Room

PEA, Pulse Equipment Aisle

PMC, Process Mechanical Cell

Poison, Material of high absorbtion cross section which absorbs neutrons to prevent criticality.

PPC, Product Purification Cell

PPS, Product Packaging and Shipping

Quality Factor, The linear-energy-transfer dependent factor by which absorbed doses are multiplied to obtain (for radiation protection purposes) a quantity that expresses - on a common scale for all ionizing radiations - the effectiveness of the absorbed dose.

R, Roentgen. The special unit of radiation exposure. One roentgen equals 2.58×10^{-4} coulomb per kilogram of air.

rem, Roentgen Equivalent Man. A unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, the distribution factor, and any other necessary modifying factors.

RER, Ram Equipment Room

SC, Sample Cell

SGR, Switch Gear Room

SL, Storage Lagoon

Smearable Contamination, Radioactive contamination which can be removed by ordinary mechanical means such as wiping.

SSC, Sample Storage Cell

SST, Solvent Storage Tanks

TRU, Transuranic

ABBREVIATIONS, SYMBOLS, AND DEFINITIONS (Cont'd.)

UNI, United Nuclear Industries, Inc.

UPC, Uranium Product Cell

UR, Utility Room

UWA, Upper Warm Aisle

UXA, Upper Extraction Aisle

Vacuum Blaster, An abrasive blasting machine equipped with a HEPA filtered vacuum pick up.

VEC, Ventilation Exhaust Cell

VSR, Ventilation Supply Room

VWR, Ventilation Wash Room

WTF, Waste Tank Farm

XC1, Extraction Cell #1

XC2, Extraction Cell #2

XC3, Extraction #3

XCR, Extraction Chemical Room (Extraction Cold Room)

XSA, Extraction Sample Aisle

PREFIXES

d	deci	$(= 10^{-1})$
c	centi	$(= 10^{-2})$
m	milli	$(= 10^{-3})$
μ	micro	$(= 10^{-6})$
n	nano	$(= 10^{-9})$
p	pico	$(= 10^{-12})$
f	femto	$(= 10^{-15})$
a	atto	$(= 10^{-18})$
da	deka	$(= 10)$
h	hecto	$(= 10^{2})$
k	kilo	$(= 10^{3})$
M	mega	$(= 10^{6})$
G	giga	$(= 10^{9})$
T	tera	$(= 10^{12})$

1.0 INTRODUCTION AND SUMMARY

This report was prepared for Argonne National Laboratory by United Nuclear Industries, Inc. (UNI) of Richland, Washington, a prime contractor to the Department of Energy. In this study we have applied the methodology and numerical values of NUREG 0278[1] to four decommissioning alternatives for the West Valley Fuel Reprocessing Plant.

Under the direction of our sponsor, we have assessed the cost and impacts of the following four alternatives for the process building, fuel receiving and storage, waste tank farm, and auxiliary facilities: 1) layaway, 2) protective storage, 3) preparation for alternate nuclear use, and 4) dismantlement. The objectives and end products of each of these alternatives are explained in Section 2, Decommissioning Alternatives.

The regulations impacting disposition are addressed in Section 3. The West Valley site and West Valley Plant are described in Section 4. These descriptions are general in nature and are based on previous documents, but they do provide the basis for our cost, safety, and radiation dose assessment for each alternative, which are presented in Section 6. Disposition criteria for the facility and site are discussed in Section 5.

In this assessment, proposed regulations and guidelines have been adhered to as law. We have assumed that materials or buildings which are surveyed with sensitive portable instruments and found to contain less surface contamination than the levels specified in Regulatory Guide 1.86 could be released for unrestricted use. We have also assumed that all material contaminated above 10 pCi/g with transuranics would require interim

[1] Technology, Safety and Cost of Decommissioning a Reference Nuclear Fuel Reprocessing Plant, Nuclear Regulatory Commission, NUREG 0278, (Washington, D. C.)

retrievable storage (although no such storage site is commercially available at present, and transuranics are already located in the burial grounds onsite in significantly greater quantities than those that would result from any of the facility decommissioning modes). We have further assumed considerable effort to decontaminate equipment in order to reduce the volume of transuranic wastes, and propose that virtually all piping and equipment be disposed of as nontransuranic wastes. In assessing radiation exposure we assume maximum use of remote equipment, decontamination and shielding to reduce radiation exposures. Available remote equipment, much of which is in the experimental or demonstration phase will require adaptation for use in the West Valley Plant.

The future chosen for the West Valley site will depend not only on the data presented here, but upon the results of studies being conducted for Argonne by other parties on the burial grounds, the liquid wastes, the lagoons, and the feasibility of other uses for the site. The possible future of the site will also be affected by release criteria yet to be adopted, and by the actual concentrations of radionuclides existing in the site environs which are not yet fully known.

With a decommissioning mode selected, an end product decided upon, and a more detailed study completed of the conditions present in the facility, specific work procedures and therefore more accurate estimates can be prepared. The estimates presented here, however, do represent the best effort possible within the time allowed. They were compiled by a team of knowledgeable professionals, experienced in nuclear facility decommissioning, nuclear operations, health physics, environmental assessment, and construction.

A summary of preliminary evaluations of cost, safety, and radiation exposure factors for each of the decommissioning alternatives is presented in Table 1-1.

TABLE 1-1

Summary of Factors Affecting Disposition Mode Selection

	Layaway		Protective	Preparation for	
	W/Out Fuel[a]	W/Fuel	Storage[b]	Alternate Use	Dismantlement
DECOMMISSIONING OPERATIONS					
Dollar Cost (millions) - 1000 mile shipment	5.8	5.6	11.3	18.8	31.0
Population dose (man-rem) normal operation	.05	0.05	0.05	0.05	0.05
Worker exposure (man-rem)	141	93	300	410	750
Probable number of loss time injuries	0.67	0.67	1.9	2.3	3.6
Probable number of fatalities	0.005	0.005	0.015	0.018	0.03
Probable number of radiation overexposures	0.236	0.236	0.5	0.68	1.2
INTERIM CARE					
Cost (100 dollars/year)	1,600	1,900	213		0
Population dose (man-rem/year)	0.002	0.002	0		0
Worker dose (man-rem)	20	20	1		0
Relative effect of catastrophic failures	Some risk	Greater risk	Reduced risk		No Effect
TRANSPORTATION - CASE I - ONSITE BURIAL OF NON-TRU—1000 MILE TRANSPORT OF TRU					
Total cost (millions)	5.7	5.5		18.2	30.2
Population dose (man-rem)	0	0.03		2.8	1.3
Transportation worker dose (man-rem)	0.026	0.2		0.64	1.9
Number of vehicle accidents		0.0007		0.0002	0.0006
TRANSPORTATION - CASE II - BURIAL GROUND 1000 MILES					
Total cost (millions)	5.8	5.6		18.8	31.0
Population dose (man-rem)	0.4	0.4		2.8	3.7
Transportation worker dose (man-rem)	2	2.0		14.2	17.9
Number of vehicle accidents	0.009	0.009		0.065	0.085
TRANSPORTATION - CASE III - BURIAL GROUND 3000 MILES					
Total cost (millions)	5.9	5.7		19.3	32.1
Population dose (man-rem) normal operation	1.2	1.2		8.5	10.6
Transportation worker dose (man-rem)	5.9	5.9		42.7	53.1
Number of vehicle accidents	0.027	0.027		0.19	0.25

[a] Does not include cost or radiation exposure to transport fuel.
[b] All wastes are stored within the process building onsite.

Layaway, the first mode examined, is a status very similar to the shut down plant's present condition, except less radioactive contamination would remain in a spreadable form within the process building. Liquid waste would remain in the waste tank. Spent fuel storage operations could continue, if desired, or the storage basin could be shut down.

Of the four modes, layaway requires the smallest initial investment-$5.5 million. But interim care maintenance and security of the plant in layaway would require the equivalent of full time effort by approximately 30 people, at an estimated annual cost of $1.6 million (in 1978 dollars). If fuel storage were to continue, an additional seven people would be required and the cost of interim care would then total $1.9 million; however, revenue from fuel storage fees would more than offset this $300,000 difference. The most significant feature of layaway, when compared to other alternatives, is that a wide range of future options remains.

Protective storage, the second decommissioning alternative, would preclude a relatively simplified restarting or modification of the facility. Protective storage allows all of the radioactive material from the facility to be stored onsite pending a decision on its ultimate placement. Maintenance and surveillance costs would be substantially less than with layaway. The degree of protective storage assessed in this report would provide for double containment of all radioactive materials within the cells inside of the main process building.

The cost to place the facility in protective storage is estimated at $10.7 million, and interim care of the stored facility would require the efforts of only two people at an estimated annual cost of $200,000 (in 1978 dollars.) This reduction in work force assumes that liquid waste has been removed from the site and inspection and maintenance of lagoons and burial grounds requires only a modest effort.

The third mode evaluated here is conversion of the facility to an alternate nuclear use. This alternative was evaluated in a general manner without regard to the possible nature of the new use. It was assumed that all of the process equipment would be removed from the building; however, the cell liners and drain pans, view windows, cranes, ventilation system, and other similar equipment would remain for use in the new process. The cells and other building areas would be decontaminated to reduce working dose rates. Residual contamination would be fixed with paint to minimize the need for stringent contamination control and respiratory protection, particularly during installation of equipment for the new process. The cost of doing this work was estimated to be $18.0 million (in 1978 dollars).

The final disposition alternative assessed is the complete dismantlement of the process building, waste tanks, and auxiliary facilities. All radioactive material would be removed and uncontaminated rubble would be buried onsite. Included in the estimate to perform this work is the cost of surveying the remainder of the site to determine radionuclide concentrations so that all or portions of the area could be released for unrestricted use. Dismantlement would not guaranty unrestricted use since neither site contamination levels or release limits are known with certainty. The cost of dismantlement is estimated to be $31 million (in 1978 dollars).

Each of the above cost figures assumes a base case where both transuranic (TRU) wastes (containing significant quantities of long-lived alpha-emitting radionuclides), and nontransuranic (non-TRU) wastes would be trucked approximately 1000 miles for burial.

Two other methods of waste disoposal are also considered feasible. The West Valley site presently contains a licensed radioactive waste burial ground. If these wastes are to remain, non-TRU decommissioning wastes might be buried onsite without impacting surveillance or long term care requirements. Although TRU wastes have been buried onsite in the past, proposed regulations make continuation of this practice unlikely. The onsite burial option evaluated here presumes TRU waste would be trucked 1000 miles for burial. Other approved burial sites are located 3000 miles from the West Valley Plant; we have also evaluated transporting the wastes to these sites.

Waste transportation and disposal are not factors which affect the protective storage mode, since all wastes would remain within the process building. Waste disposal costs for the other three modes at the three disposal locations (West Valley, 1000 miles distant, 3000 miles distant) are summarized in Table 1-1.

Estimates of radiation exposure to the decommissioning workers were prepared for each disposition alternative by assuming decontamination efficiencies and maximum use of remote operations. Layaway is estimated to have the least amount of worker exposure (141 man-rem), while dismantlement has the highest (642 man-rem). Radiation exposure to the general population from decommissioning work has been estimated and is extremely low, particularly with respect to the population dose from radioactive material in the site environment from previous operations.

In several tables in this report cost are presented to the nearest thousand dollars. This was done to avoid errors due to rounding and to show the relatively small cost differences between certain of the alternatives addressed. The estimates given here are expected to approach the actual cost to an order of magnitude and are more accurately represented by the rounded values given in the text and summary tables. Because of the nature of this study, all cost and radiation exposure estimates include a 25 percent contingency. Once a decommissioning mode has been selected and an end product decided upon, procedures can be developed for each phase of the decommissioning operation, and estimates can be prepared with greater accuracy.

2.0 DECOMMISSIONING ALTERNATIVES

While the alternatives presented do not represent all possible futures for the West Valley site, they do represent four measures which are technically and economically achievable and consistent with the goal of protecting the public from the hazards associated with radioactive materials. Further, none of these decommissioning modes would preclude presently available futures for the site. A description of the end product of each disposition mode and the possible interrelationship of the alternatives follows. End product descriptions are summarized in Table 2-1.

2.1 Layaway

Layaway is the name given to the minimal procedures required to render an inactive facility secure against intruders, and to provide continued operation of the protective systems that assure confinement of hazardous materials. The layaway mode could be employed at the West Valley site to minimize initial cash outlays, to allow time for additional investigation, and to minimize occupational radiation exposure. Layaway would be an appropriate temporary measure if there is a possibility of reopening the plant for some process which would require a substantial quantity of the present equipment and facilities.

The West Valley Plant is presently in a status near that of layaway. The processing operation is shut down; however, the fuel storage basin contains about 160 metric tons of uranium in spent fuel elements from commercial power reactors. In the layaway mode, these fuel elements would be shipped to other offsite storage. The basin would be drained and decontaminated, and any residual contamination would be fixed with paint.

The reprocessing piping and equipment has been internally decontaminated by flushing; however, some additional internal decontamination may be required along with the external decontamination required for layaway purposes. The ventilation system would be kept operational to assure confinement of contamination within the closed areas. The two high level liquid waste

TABLE 2-1

End Product Summary Descriptions

MODE	FACILITY STATUS: Waste Tanks	FACILITY STATUS: Buildings	FACILITY STATUS: FRS	FACILITY STATUS: Site	INTERIM CARE
Layaway	Left as is, liquid in place.	Fixed contamination in accessible areas, some smearable in cells.	Two Options: 1 - Storage basin drained, cleaned. Contamination fixed. Restricted use. 2 - Fuel storage operation continued. Restricted use.	Available for restricted use.[a]	Full time maintenance and security continued.
Protective Storage	Tanks empty. Auxiliary facilities in place. Breathing HEPA filters.	Contamination restricted to cells.	Cleaned for unrestricted use.	Perimeter area available for conditional use.[b]	Observation continued.
Preparation for Alternate Nuclear Use	Tanks filled with dirt.	Fixed contamination only. No process equipment.	Fixed contamination only.	Available for restricted or conditional use as determined by alternate purpose.	Integrated with new use.
Dismantlement	Contamination removed. Clean vault filled with dirt and debris, capped with dirt.	Removed.	Removed.	Surveyed completely to determine conditional and unrestricted[c] use areas.	Not required.

[a]Restricted Use—Radiological controls imposed.

[b]Conditional use—Non-nuclear uses except certain agricultural uses permitted.

[c]Unrestricted use—No restrictions imposed.

storage tanks, presently containing a large quantity of contaminated liquid, would remain "as is" in the layaway mode. Continual monitoring for tank leaks would be provided.

The relatively low initial cost of the layaway alternative is followed by the significant long term costs of maintaining site security, surveillance, and maintenance. For layaway, security forces and electronic surveillance would remain operational. Surveillance devices would monitor for intruders, fires, and variations in radiation levels, and would require periodic inspection and maintenance. Maintenance of the building proper would also be necessary (i.e., entry ways, walls, roof, etc.).

Layaway of the West Valley Plant would be a temporary measure to protect plant life and equipment for an interim period of up to 30 years. It is unlikely that the layaway would suffice beyond this 30-year projection. Public concerns and regulatory requiremnts may also influence the duration of the interim care period.

As a modification of the layaway mode, other alternatives can be considered for the spent fuel storage basin. It could either continue operation in its present passive mode, or receive additional fuel. Reevaluation of and possible minor modification to the ventilation system,[1] and continued high level security would be required. These ventilation and security costs would be more than offset by the revenue from fuel storage fees.

2.2 Protective Storage

The protective storage mode would satisfy the requirements for public safety while minimizing both the initial outlay of capital monies and interim care costs. It is not intended that the facility would be reactivated, but rather that it would be decommissioned (probably dismantled). The objectives of this alternative are to ensure the

[1] Interim Safety Evaluation I, Nuclear Regulatory Commission, NRC Document No. 50-201 (Washington, D. C., 1977).

confinement of radioactivity and enhance the security of the building against intruders. In the protective storage mode, all active plant operational systems would be shut down. Only those passive systems required for safety and surveillance would remain in service.

The cells would be used as a rigid physical barrier against intruders. Loose contamination, such as cladding hulls in the mechanical process cell, would be picked up and packaged. Housekeeping within each cell would be performed to minimize the spread of contamination in the event of loss of contamination control resulting, for example, from a major tornado or earthquake or from sabotage. Those cells which were decontaminated would probably not require significant additional treatment.

Contaminated process equipment, glove boxes, laboratory equipment and other contaminated equipment outside of the cells would be packaged and placed inside the process cells. The ventilation system would be removed from service; all contaminated ducts and the stack would be removed and placed in the cells. A "breathing" filter would replace the existing ventilation system on the cells. After removing all of the contaminated equipment from the building, the viewing windows and cell access doors would be sealed off. The interior surfaces of the building would then be surveyed and painted as necessary to affix any loose contamination.

The fuel within the storage basin would be removed and the storage basin drained. Gross contamination in the basin would be removed and the residual contamination fixed with paint.

Waste from the storage tank would have been removed and the tank flushed. The vent system would be replaced with a passive "breathing" filter.

The barbed wire-topped chain link fence which surrounds the facility would remain intact. The surrounding buffer zone, approximately 3000 acres, might be released for conditional use (see Section 5) depending on contamination levels and land owners needs.

Periodic maintenance/surveillance would be required to assure confinement integrity. Maintenance of the building's outer surfaces (roof, walls, etc.) and its interior painted surfaces would be necessary, and would be provided by two resident employees with services procured from local contractors as needed. Security surveillance would utilize passive electronic devices operating at all times, and periodic patrol by local law enforcement officials.

2.3 Preparation For Alternate Nuclear Use

Under this alternative, all contaminated systems are decontaminated, disassembled, and removed from the facility for burial either onsite or at another regulated disposal site. The facility itself would be decontaminatd to the extent practicable, and residual contamination fixed in place to minimize security, maintenance, and surveillance costs. The facility would then be available for an alternate nuclear use or future dismantling.

Process equipment and smearable contamination would be removed from the cells and building. Glove boxes would likewise be removed. Highly contaminated sections of the ventilation systems would be decontaminated or replaced. Although contamination would remain in portions of the facility, working dose rates would be low throughout the facility and airborne radioactivity would be minimal. If no alternate nuclear use had been identified for the facility, the shield plugs, viewing windows, and cell doors could be sealed with welded plates or high security locks. The ventilation system could be shut down or reduced to an extremely low place. Fuel would be removed from the storage basin, and the basin would be drained and decontaminated. Any residual contamination would be fixed in place.

The underground tanks, emptied and decontaminated, would be filled with soil to support the tank roof when the walls eventually decay (in several hundred years).

Much of the land surrounding the facility would be available on a temporary basis for conditional use. It would not be released for unrestricted use until a decision on real estate requirements for the planned alternate nuclear use of the facility was received, and then only after appropriate survey.

A combination of passive remote reading alarm systems and onsite surveillance would assure protection of the public during decommissioning operations. Future surveillance would be dictated by the facility's future use. If the facility were placed in interim care following cleanup, it is anticipated that continued surveillance would be required.

2.4 Dismantlement

Dismantlement would remove all radioactive material above uncontrolled release limits from the buildings and tank farm. No structures would remain above grade, although clean concrete and other structural materials would be buried at the building and tank sites. Sufficient soil coverage to support vegetation would be placed over buried debris and the area would be replanted. A survey of the entire 3,345-acre site would be conducted to determine the type of release possible.

No further monitoring or security would be required at the site unless areas which were first released for conditional use (no agriculture) were later surveyed for unrestricted use. (It is presumed that the burial grounds, lagoons, and associated areas were cleaned for unrestricted release.).

2.5 Disposition Sequence

The four disposition alternatives discussed in this plan are related and sequential. Figure 2-1 depicts the sequences in which they could logically occur, with dismantlement or alternate nuclear use as the ultimate end products.

When the facility is operable (see Figure 2-1, step 1), all four decommissioning alternatives are available.

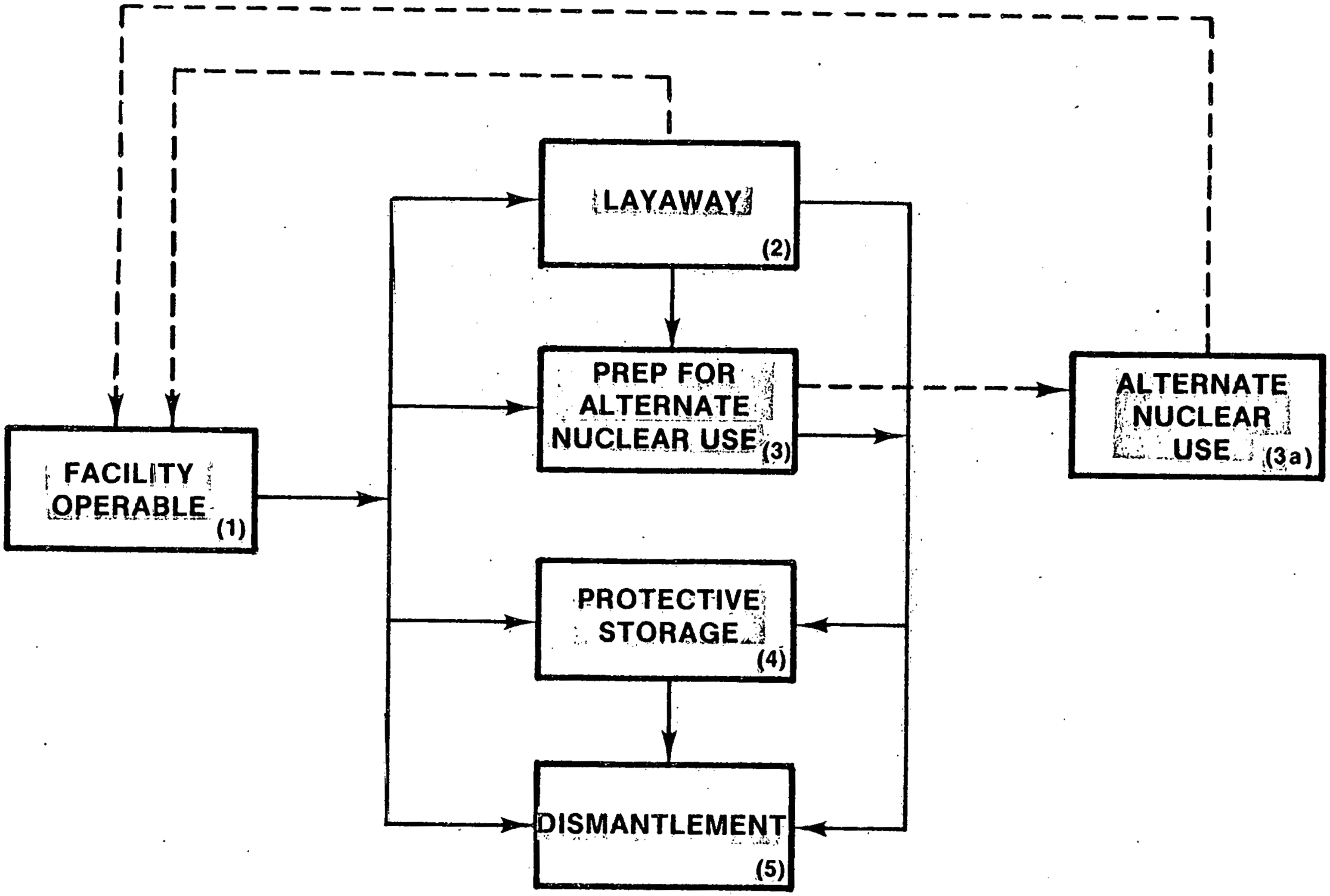


FIGURE 2-1

Interrelationships of Disposition Alternatives

If layaway (step 2) is chosen, the facility is secured and protected against intruders. Confinement of hazardous materials is assured, and al, decommissioning alternatives are still available. This mode of decommissioning does not limit the selection of other options; the facility may be returned to operable conditions, or any of the other disposition alternatives may be selected. The extent of interim care following layaway is greater than that following disposition by any other alternative.

If the facility is prepared for alternate nuclear use (step 3), all contaminated systems are decontaminated, disassembled, and removed from the facility. The building(s) may then be used for other nuclear-related purposes (step 3a). This decommissioning alternative elimates the option of layaway, and greatly reduces the amount of radioactive material which might be placed in protective storage.

If the facility is converted to another nuclear use, it may be considered as an operating nuclear facility for which all decommissioning alternatives would again be available. All decommissioning modes considered lead ultimately to dismantlement (step 5).

If the facility is put into protective storage (step 4), confinement of radioactivity is ensured, all active operational systems are shut down, and only those systems required for safety and surveillance remain operational. Selection of this alternative precludes any other operational use.

If the facility is dismantled (step 5), a variety of restricted, conditional, or unrestricted uses are possible for the site depending on factors discussed in Section 1.0.

3.0 CURRENT REGULATIONS AND GUIDANCE

Federal regulations with regard to decommissioning nuclear facilities are limited. Financial competence for major licensees is treated in 10CFR Part 50, Section 50.33 (f), which requires a determination of the applicant's financial qualifications to operate, shut down, and maintain a production or utilization facility in a safe condition. Section 50.33 (f) does not speak directly to final disposition of the facility, but only of shutting down and maintaining it in a safe condition. Also, Part 50 applies only to production and utilization facilities, not to facilities which operate under Part 30, 40, and 70 material licenses.

Section 50.82 (of 10CFR Part 50) discusses the procedures to be followed when applying for termination of licenses granted for production and utilization facilites. It states:

> "(a) Any licensee may apply to the Commission (NRC) for authority to surrender a license voluntarily and to dismantle the facility and dispose of its component parts. The Commission may require information, including information as to proposed procedures for the disposal of radioactive material, decontamination of the site, and other procedures, to provide reasonable assurance that the dismantling of the facility and disposal of the component parts will be performed in accordance with the regulations in this chapter and will not be inimical to the common defense and security or to the health and safety of the public."

> "(b) If the application demonstrates that the dismantling of the facility and disposal of the component parts will be performed in accordance with the regulations in this chapter and will not be inimical to the common defense and security or to the health and safety of the public, and after notice to interested persons, the Commission may issue an order authorizing such dismantling and disposal, and providing for the termination of the license upon completion of such procedures in accordance with any conditions specified in the order."

Section 50.82 does not require the development of a detailed decommissioning plan until the licensee decides to seek to surrender the license. Section 50.82 only addresses dismantling the facility; however, the procedures outlined are also applicable to other disposition modes where the objective is license conversion (from operating license to possession-only) rather than termination.

Paragraphs 4 and 5 of Appendix F, 10 CFR Part 50, deal with decommissioning of fuel reprocessing plants. This regulation requires that facilitation of decommissioning be a design objective. It also requires that the applicant demonstrate that he has the financial capability to provide for the "removal and disposal of radioactive wastes, during operation and upon decommissioning of the facility." Definitive criteria with respect to the extent of decontamination or viable dispositon alternatives are not provided.

The Nuclear Regulatory Commission (NRC), Division of Fuel Cycle and National Safety, published Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material in November, 1976. These guidelines led to the development of Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors. This latter document defines four methods for retirement of a facility which are acceptable to the regulatory staff: mothballing, in-place entombment, removal and dismantling, and conversion to a new nuclear or fossil fuel system. Guide 1.86 offers detailed advice on how to proceed using either of the first two alternatives to obtain a possession-only license. It also gives guidance on decontamination for unrestricted release, including a table of acceptable surface contamination levels.

In addition to the Federal requirements, the State of New York has regulations covering radiation exposure, decommissioning, and unrestricted release criteria. In general, these do not differ significantly from Federal controls.

The regulations and guides described above provide some insight to the interactions between NRC and the licensees of the West Valley facility. The first action a licensee may take is to request that his operating license be amended to restrict him to possess licensed materials but not process nuclear fuel. Conversion of the operating license to possession-only does not necessarily imply that any decommissioning action is planned. The possession-only license could reduce technical specification surveillance requirements, thus decreasing the licensee's costs.

If subsequent decommissioning is planned, the licensee will submit documentation to NRC describing the proposed actions and measures for protection of public health and safety. The submission will contain estimates of the form and type of radioactive material that will remain after decommissioning has been completed.

Following review of the licensee's submission, NRC will authorize the decommissioning action if it concludes that the proposed actions can be carried out safely. As part of the NRC review, a determination of the environmental impact of the proposed decommissioning operations will be made and documented in either an environmental statement or negative declaration of impact. The licensee will then implement the decommissioning activities with periodic audits and inspection by the NRC staff.

When all decommissioning work has been completed, the licensee will perform a final radiation survey and submit these results along with a final decommissioning report to NRC. The final report may also include recommendations with regard to continued security, maintenance, or surveillance programs.

NRC may inspect the site and verify completion in accordance with the decommissioning plan. If residual radiation levels do not exceed unrestricted release values agreed to by NRC during the planning period, then NRC may terminate the license. If unrestricted release values are exceeded, the licensee will retain a possession-only license and be required to continue surveillance in accordance with agreed upon specifications.

4.0 FACILITY AND SITE DESCRIPTION

This section describes features of the West Valley site and facilities which impact significantly on disposition alternatives. Discussion here is based on published information which was available to UNI and is intended to provide a background against which disposition alternatives can be evaluated. The information presented here is not intended to replace the environmental report or assessment covering the final planned disposition.

4.1 Site Description

This section describes site features which determine the environmental consequence of various disposition modes. Emphasis is given to those features which are used to predict radiation dosage to man, and to determine the probability or consequences of various natural events or accidents which might impact on the human environment.

4.1.1 Site Location and Layout

The 3,345-acre Western New York Nuclear Service Center was established by the State of New York in 1961. Nuclear Fuel Services, Inc. (NFS) leased the reservation and in 1963 began construction of the West Valley Fuel Reprocessing Plant--the world's first commercial nuclear fuel reprocessing plant. The plant operated from 1965 until it was shut down in 1970 for a major expansion program which was begun but never completed. New York State is a co-licensee with NFS and may under certain conditions receive the West Valley Plant. Figure 4-1 shows the site location with respect to population centers and major geographical features. Prominent aspects of the site layout are depicted in Figures 4-2 and 4-3.

The reservation is located about 30 miles south-southeast of Buffalo in Ashford "Town" (township), Cattaraugus County. It is approximately 1400 feet above sea level and lies 20 miles from Lake Erie, which is 780 feet above sea level. A narrow section of the site extends northward along both sides of Buttermilk Creek to its confluence with Cattaraugus Creek at the southern boundary of Erie County.

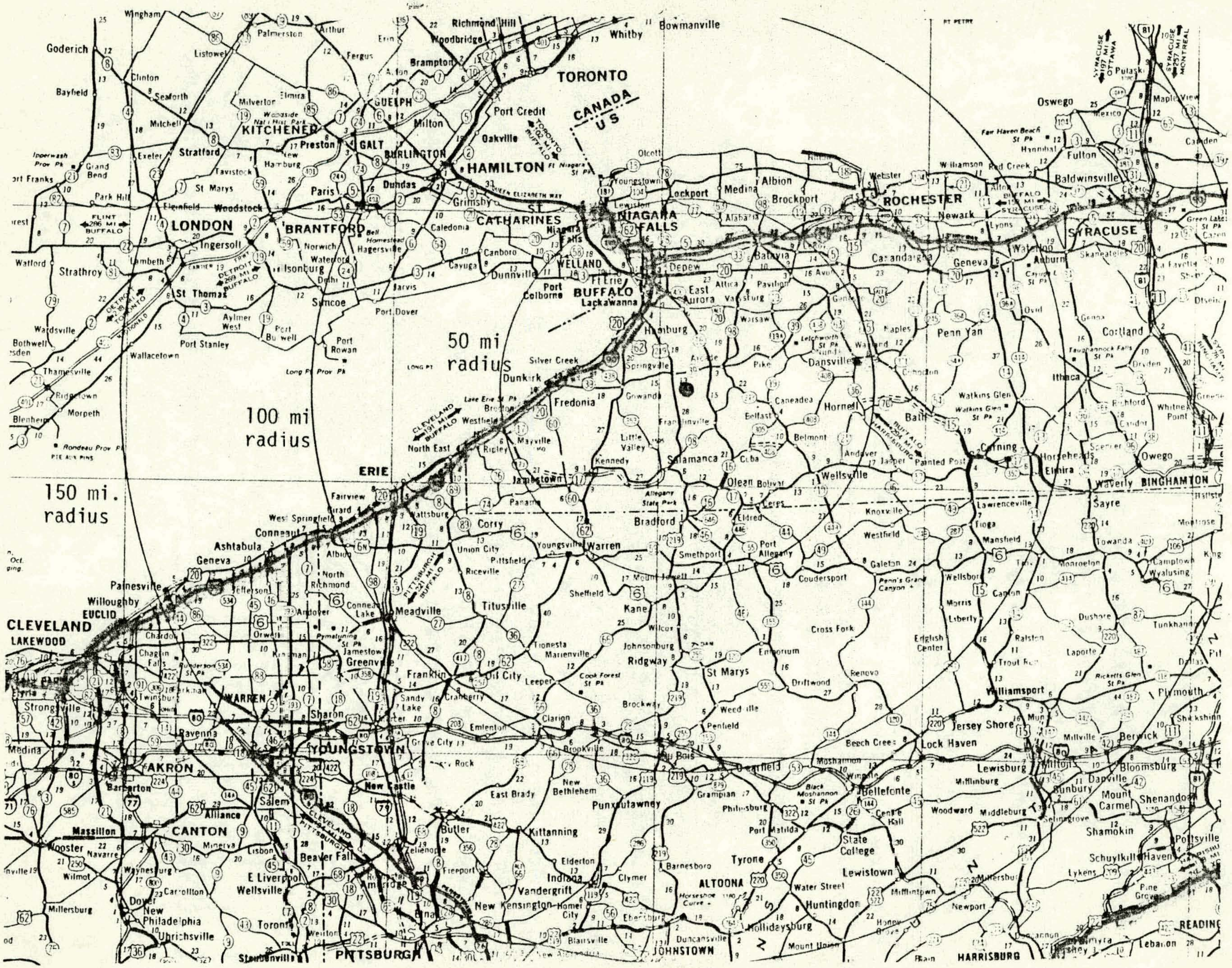


FIGURE 4.1

Western New York Nuclear Service Center, Geographical Location

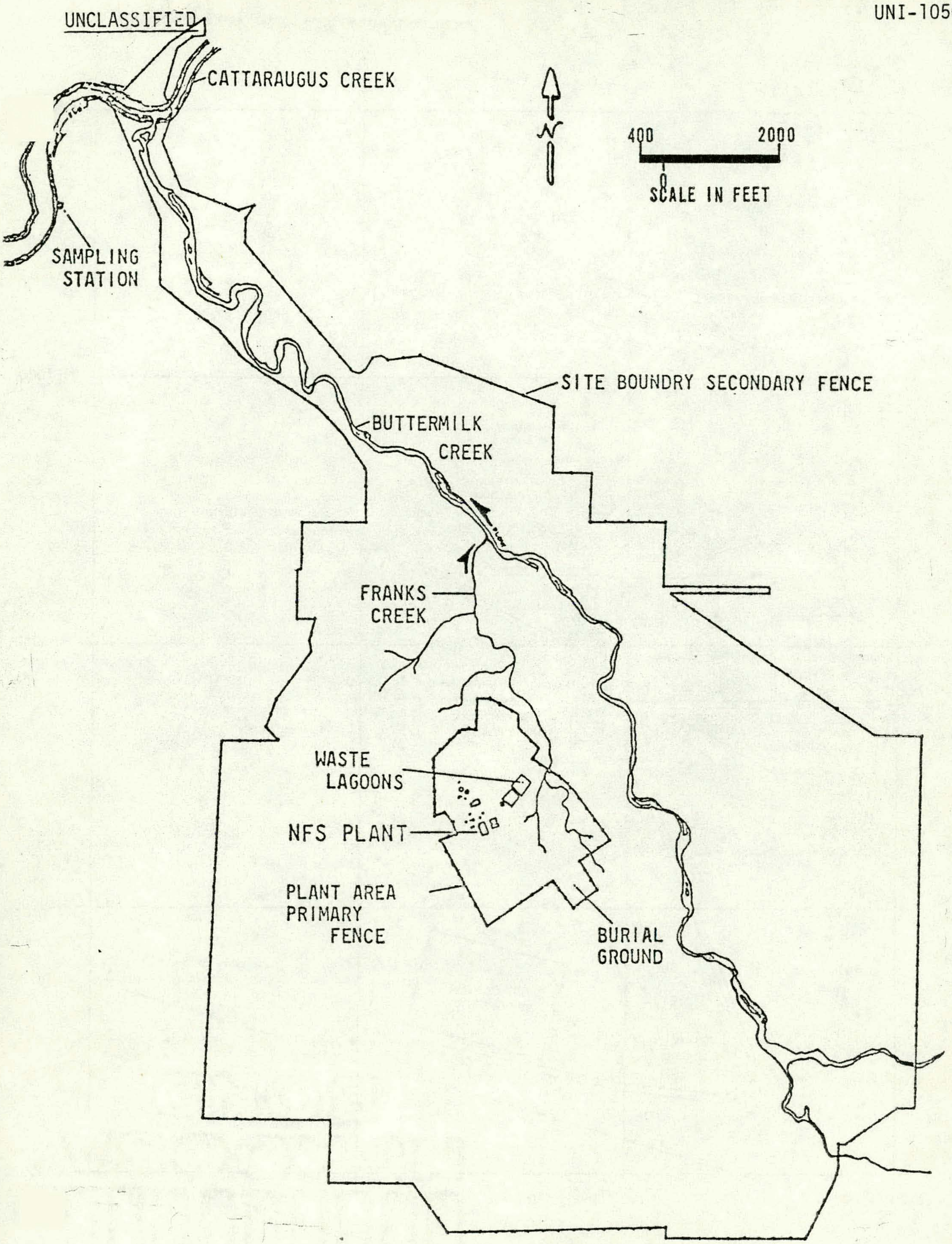


FIGURE 4-2

Western New York Nuclear Service Center—Site Boundaries

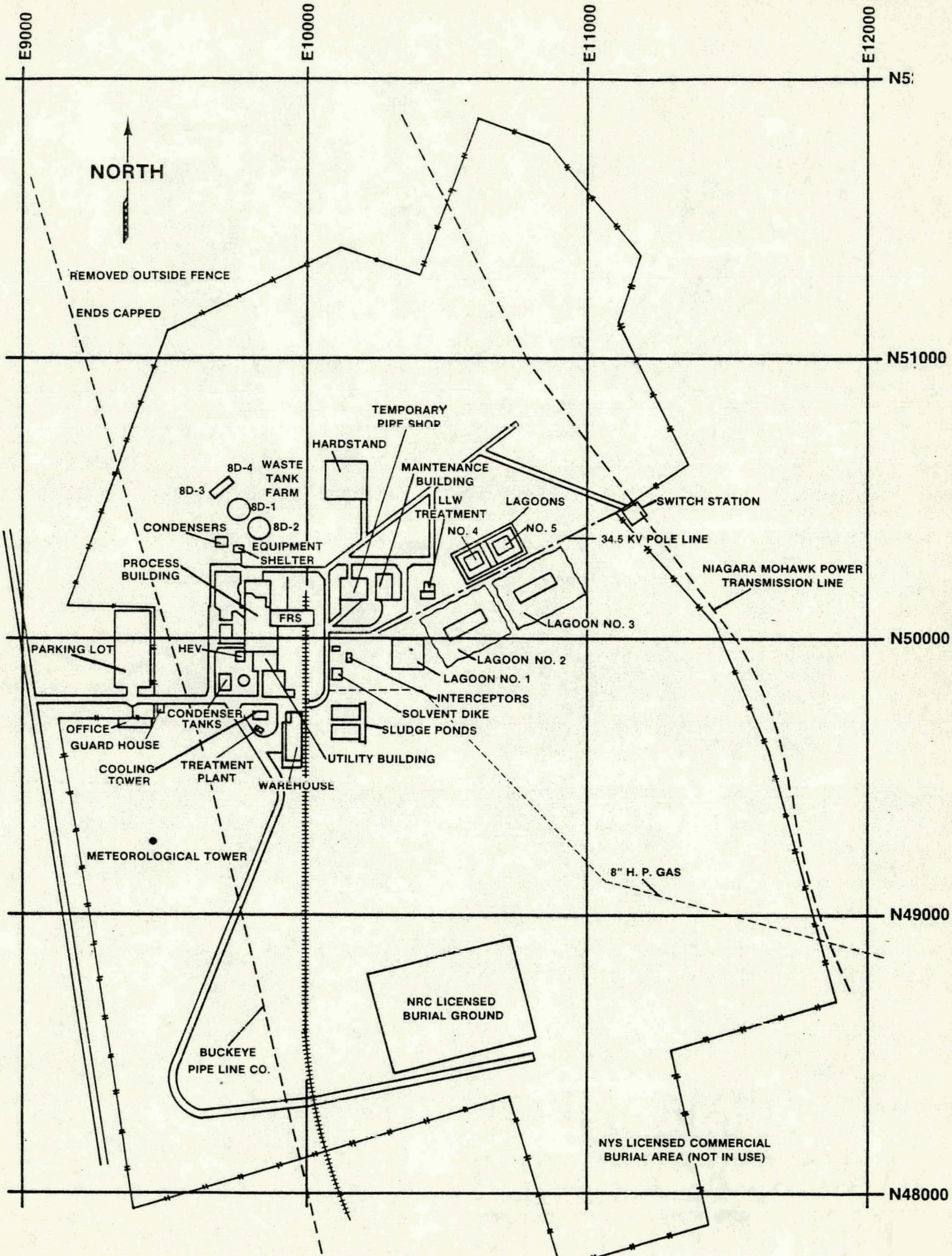


FIGURE 4-3
Site Layout

The reprocessing plant and associated facilities are located near the middle of the reservation within an undeveloped buffer zone. The developed plant area is approximately two miles south of Cattaraugus Creek. The nearest village, Springville (population 4,350), is situated four and one-half miles north of the site.

A portion of four other western New York State counties are within a 25-mile radius of the reservation, with the following approximate air mile distance to the closest point of each: Erie County--two miles, Wyoming County--11 miles, Allegany County--18 miles, and Chatauqua County--22 miles.

The reservation is served by a country road and by a spur of the Baltimore and Ohio Railroad. This rail line, which is used solely for freight traffic, follows Buttermilk Creek through the reservation.

The entire 3,345-acre reservation is enclosed by a three strand, barbed wire, agriculture-type fence and is posted with signs which warn against trespass.

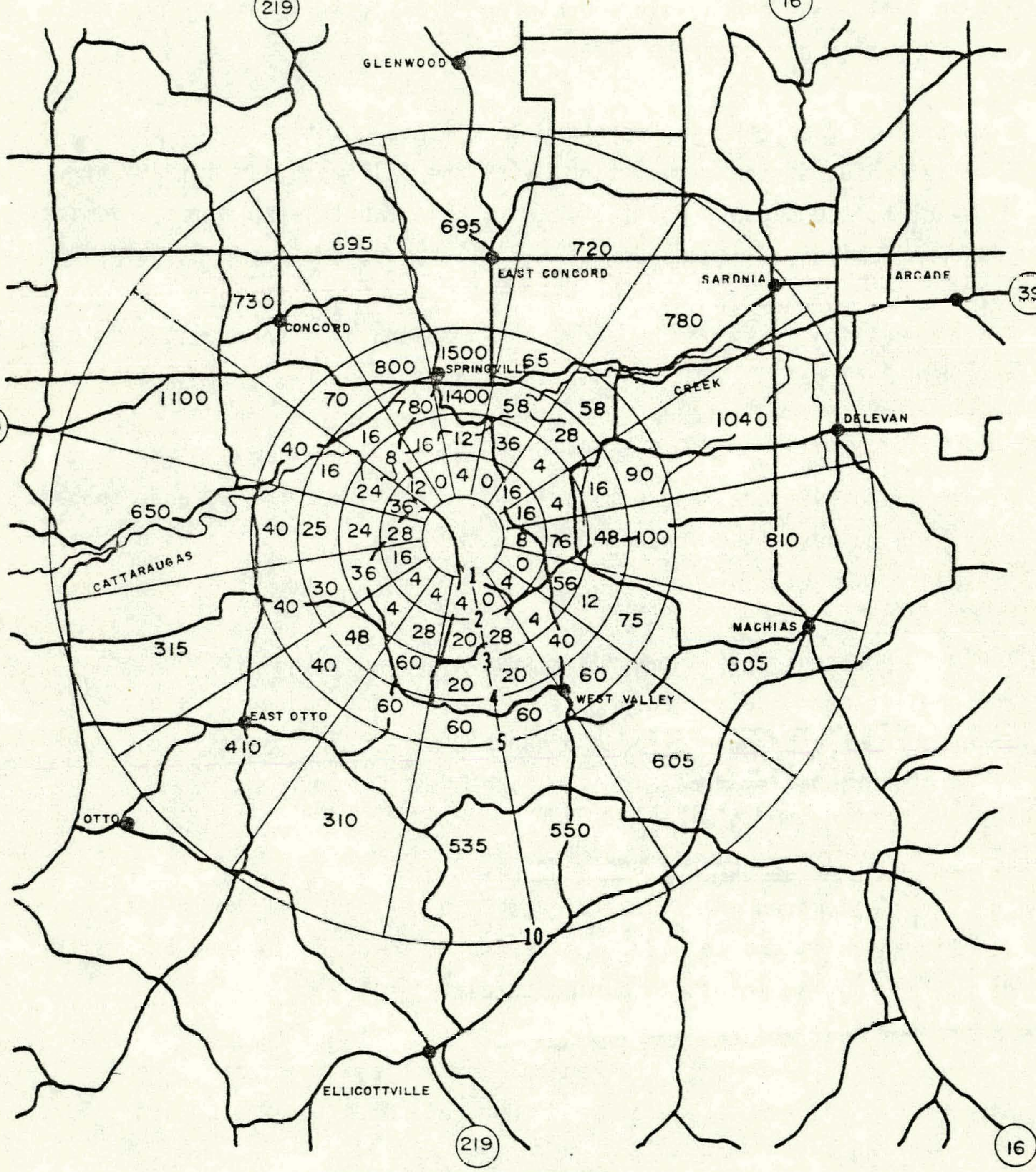
The NFS reprocessing plant complex, which includes the New York State commercial waste burial ground, is completely surrounded by a chain link fence topped with three strands of barbed wire. The overall height of this inner exclusion area fence is over eight feet.

4.1.2 Regional Demography and Land Use

The site is located in a rural area with a relatively low population density and slow growth rate. Agriculture is the prime land use, with dairy farming the principle agricultural activity.

The population density of the region surrounding the plant is depicted in Figures 4-4 and 4-5. Population growth rate data for the period 1960 to 1970 are shown in Table 4-1.

Population projections presented in Tables 4-2, 4-3, and 4-4 covered a proposed expansion of the West Valley facility through the year 2020;



SCALE: 1 INCH = 4 MILES

FIGURE 4-4

Population Distribution—10 Mile Radius

1970 Census Data

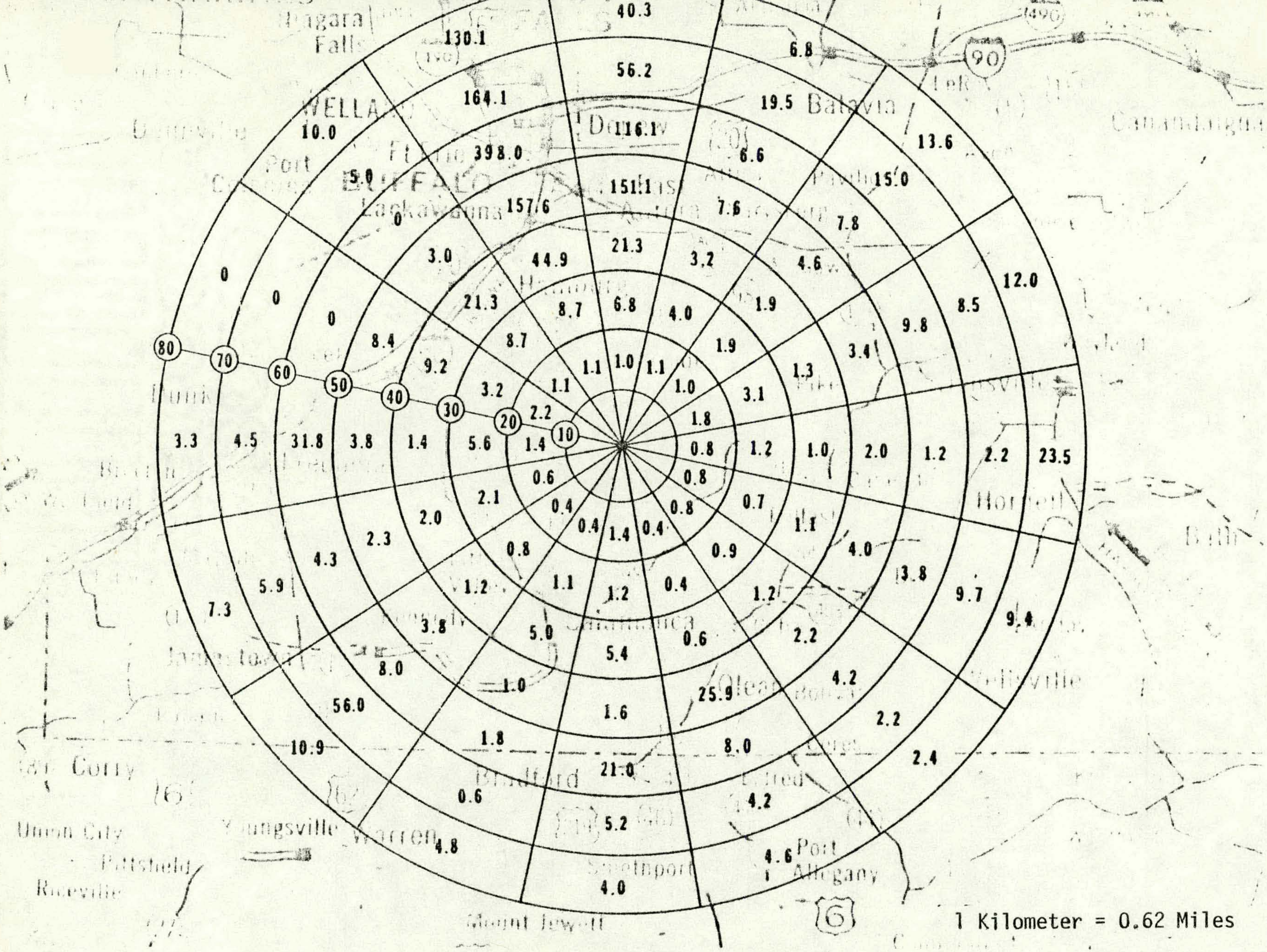


FIGURE 4-5

Population Distribution Map—80 Kilometer (49.6 Mile) Radius

1970 Census Data

TABLE 4-1

Local Population Growth Between 1960 and 1970

"Towns" (Townships) 0-5 Miles from Site	1960	1970	Percent Change
Ashford	1,490	1,577	5.8
Concord	6,452	7,573	17.4
East Otto	701	910	29.8
Ellicottville	1,968	1,779	-9.6
Machias	1,390	1,749	25.8
Yorkshire	2,012	2,627	30.6
Counties			
Cattaraugus	80,187	81,666	1.8
Allegany	43,978	46,458	5.6
Chautaugua	145,377	147,305	1.5
Erie	1,064,688	1,113,491	4.6
Wyoming	34,793	37,688	8.3

TABLE 4-2

Population Projections to Year 2020 for
Five New York Counties and New York State
-1968 Demographic Values[a]
(Thousands of People)

YEAR	ALLEGANY	CATTARAUGUS	CHAUTAUQUA	ERIE	WYOMING	NEW YORK STATE
1950	44	78	135	899	33	14,830
1960	44	80	145	1,065	35	16,782
1965	46	82	151	1,083	36	17,794
1970	47	82	153	1,102	36	18,751
1975	48	82	157	1,150	37	19,666
1980	49	83	162	1,211	37	20,757
1985	51	84	168	1,282	38	22,004
1990	52	85	174	1,353	39	23,355
1995	54	87	180	1,419	41	24,744
2000	56	89	187	1,485	43	26,079
2005	57	91	194	1,550	45	27,402
2010	59	94	202	1,625	47	28,803
2015	62	97	211	1,709	49	30,288
2020	64	100	220	1,794	51	31,784
TOTAL CHANGE	20	22	85	895	18	16,954
PERCENT CHANGE	45%	28%	63%	100%	54%	114%
NET MIGRATION	-20	-23	-13	-156	-7	+3,193
PERCENT MIGRATION	-31%	-23%	-15%	-17%	-14%	+10%

[a] Demographic Projections for New York State Counties to 2020 AD, New York State Office of Planning Coordination - August 1969

TABLE 4-3

Demographic Projections Within 10 Mile Radius

—1970 Census Data

(1980 to 2020 Projection)

Section	Distance (Miles)	1970	1980	1990	2000	2010	2020
N	0-1	0	0	0	0	0	0
	1-2	4	4	4	4	4	4
	2-3	12	12	12	12	12	12
	3-4	1400	1650	1950	2300	2710	3200
	4-5	1500	1770	2090	2460	2900	3430
	5-10	695	820	970	1140	1350	1590
NNE	0-1	0	0	0	0	0	0
	1-2	0	0	0	0	0	0
	2-3	36	37	38	40	42	44
	3-4	58	62	66	70	74	80
	4-5	65	77	90	110	125	150
	5-10	720	850	1000	1180	1400	1650
NE	0-1	0	0	0	0	0	0
	1-2	16	16	16	16	16	16
	2-3	4	4	5	5	6	6
	3-4	28	29	30	31	32	33
	4-5	58	60	62	64	66	68
	5-10	780	920	1090	1280	1510	1780
ENE	0-1	0	0	0	0	0	0
	1-2	16	16	16	16	16	16
	2-3	4	4	5	5	6	6
	3-4	16	16	17	17	18	18
	4-5	90	94	98	102	106	110
	5-10	1040	1120	1210	1310	1410	1530
E	0-1	0	0	0	0	0	0
	1-2	8	8	8	8	8	8
	2-3	76	79	82	85	87	90
	3-4	48	50	52	54	56	58
	4-5	100	108	116	125	135	145
	5-10	810	870	940	1020	1100	1190
ESE	0-1	0	0	0	0	0	0
	1-2	0	0	0	0	0	0
	2-3	56	58	60	62	64	66
	3-4	12	12	13	13	14	14
	4-5	75	80	85	90	95	
	5-10	605	650	710	760	820	

TABLE 4-3 (Cont'd)

Section	Distance (Miles)	1970	1980	1990	2000	2010	2020
SE	0-1	0	0	0	0	0	0
	1-2	4	4	4	4	4	4
	2-3	4	4	5	5	6	6
	3-4	40	42	44	46	48	50
	4-5	60	62	65	68	72	75
	5-10	605	650	705	760	820	890
SSE	0-1	0	0	0	0	0	0
	1-2	0	0	0	0	0	0
	2-3	28	29	30	31	32	33
	3-4	28	29	30	31	32	33
	4-5	60	62	65	68	72	75
	5-10	555	580	600	620	640	660
S	0-1	0	0	0	0	0	0
	1-2	4	4	4	4	4	4
	2-3	20	21	22	23	24	25
	3-4	20	21	22	23	24	25
	4-5	60	62	65	68	72	75
	5-10	535	360	580	600	620	640
SSW	0-1	0	0	0	0	0	0
	1-2	4	4	4	4	4	4
	2-3	28	29	30	31	32	33
	3-4	60	62	65	68	72	75
	4-5	60	62	65	68	72	75
	5-10	310	330	350	370	390	410
SW	0-1	0	0	0	0	0	0
	1-2	4	4	4	4	4	4
	2-3	4	4	5	5	6	6
	3-4	48	50	52	54	56	58
	4-5	40	43	47	50	54	60
	5-10	410	440	480	520	560	600
WSW	0-1	0	0	0	0	0	0
	1-2	16	16	16	16	16	16
	2-3	36	37	39	40	43	44
	3-4	30	32	35	38	41	44
	4-5	40	43	47	50	54	60
	5-10	315	330	360	380	405	425
W	0-1	0	0	0	0	0	0
	1-2	28	28	28	28	28	28
	2-3	24	25	26	27	28	28
	3-4	25	26	28	30	32	34
	4-5	40	43	47	50	54	60
	5-10	650	690	730	770	820	870

TABLE 4-3 (Cont'd)

Section	Distance (Miles)	1970	1980	1990	2000	2010	2020
WNW	0-1	0	0	0	0	0	0
	1-2	36	36	36	36	36	36
	2-3	24	25	26	27	28	29
	3-4	16	17	18	19	20	21
	4-5	40	45	50	55	60	65
	5-10	1100	1210	1340	1490	1650	1840
NW	0-1	0	0	0	0	0	0
	1-2	12	12	12	12	12	12
	2-3	8	8	9	9	9	10
	3-4	16	18	19	21	23	26
	4-5	70	85	100	115	135	160
	5-10	730	860	1020	1200	1410	1670
NNW	0-1	0	0	0	0	0	0
	1-2	0	0	0	0	0	0
	2-3	16	17	17	18	19	19
	3-4	780	920	1090	1280	1510	1780
	4-5	800	940	1110	1310	1550	1825
	5-10	695	820	970	1140	1350	1590

TABLE 4-4

Demographic Projections Within 80-Kilometer (40.6-mile) Radius

—1970 Census Data

(1980 to 2020 Projections)

Sector	Distance (Thousands of Meters)	1970	1980	1990	2000	2010	2020
N	0-10	2.5	3.0	3.5	4.1	4.8	5.7
	10-20	1.0	1.2	1.4	1.6	1.9	2.3
	20-30	6.8	7.6	8.5	9.6	10.7	12.0
	30-40	21.3	23.8	26.7	29.9	33.5	37.5
	40-50	151.1	169.2	189.5	212.2	237.7	266.2
	50-60	116.4	130.4	146.0	163.5	183.1	205.1
	60-70	56.2	62.9	70.5	78.9	88.4	99.0
	70-80	40.3	46.3	53.3	61.3	70.5	81.0
NNE	0-10	0.2	0.2	0.3	0.3	0.3	0.4
	10-20	1.1	1.3	1.5	1.8	2.1	2.5
	20-30	4.0	4.5	5.0	5.6	6.3	7.0
	30-40	3.2	3.5	3.9	4.3	4.7	5.2
	40-50	7.6	8.4	9.2	10.1	11.1	12.2
	50-60	6.6	7.4	8.3	9.3	10.4	11.6
	60-70	19.5	22.2	25.3	28.9	32.9	37.5
	70-80	6.8	7.8	8.8	10.1	11.5	13.1
NE	0-10	0.3	0.3	0.3	0.3	0.4	0.4
	10-20	1.0	1.2	1.4	1.6	1.9	2.3
	20-30	1.9	2.1	2.3	2.5	2.7	2.9
	30-40	1.9	2.1	2.2	2.4	2.6	2.8
	40-50	4.6	5.0	5.4	5.8	6.3	6.8
	50-60	7.8	8.4	9.1	9.8	10.6	11.4
	60-70	15.0	16.7	18.5	20.5	22.8	25.3
	70-80	13.6	15.5	17.7	20.1	23.0	26.2
ENE	0-10	0.2	0.2	0.2	0.2	0.3	0.3
	10-20	1.8	1.9	2.1	2.3	2.4	2.6
	20-30	3.1	3.3	3.5	3.8	4.1	4.4
	30-40	1.3	1.4	1.5	1.6	1.8	1.9
	40-50	3.4	3.7	4.0	4.3	4.6	5.0
	50-60	9.8	10.6	11.4	12.3	13.3	14.4
	60-70	8.5	9.7	11.0	12.6	14.3	16.3
	70-80	12.0	13.9	16.1	18.7	21.7	25.2

TABLE 4-4 (cont'd.)

Sector	Distance (Thousands of Meters)	1970	1980	1990	2000	2010	2020
E	0-10	0.5	0.5	0.6	0.6	0.6	0.7
	10-20	0.8	0.9	0.9	1.0	1.1	1.2
	20-30	1.2	1.2	1.3	1.3	1.4	1.5
	30-40	1.0	1.1	1.1	1.2	1.3	1.4
	40-50	2.0	2.1	2.3	2.4	2.6	2.8
	50-60	1.2	1.3	1.4	1.5	1.6	1.7
	60-70	2.2	2.4	2.5	2.7	2.9	3.1
	70-80	23.5	26.3	29.5	33.0	37.0	41.4
ESE	0-10	0.3	0.3	0.3	0.4	0.4	0.4
	10-20	0.8	0.9	0.9	1.0	1.1	1.2
	20-30	0.7	0.7	0.8	0.8	0.8	0.9
	30-40	1.1	1.2	1.3	1.3	1.4	1.5
	40-50	4.0	4.3	4.6	4.9	5.2	5.6
	50-60	3.8	4.1	4.4	4.7	5.0	5.3
	60-70	9.7	10.4	11.1	11.9	12.7	13.6
	70-80	9.4	10.1	10.8	11.5	12.3	13.2
SE	0-10	0.5	0.5	0.5	0.6	0.6	0.6
	10-20	0.8	0.9	0.9	1.0	1.1	1.2
	20-30	0.9	0.9	1.0	1.0	1.1	1.1
	30-40	1.2	1.2	1.3	1.3	1.4	1.5
	40-50	2.2	2.3	2.5	2.6	2.8	2.9
	50-60	4.2	4.5	4.8	5.1	5.5	5.9
	60-70	2.2	2.3	2.5	2.6	2.8	2.9
	70-80	2.4	2.5	2.7	2.9	3.0	3.2
SSE	0-10	0.3	0.3	0.3	0.4	0.4	0.4
	10-20	0.4	0.4	0.4	0.4	0.5	0.5
	20-30	0.4	0.4	0.4	0.4	0.5	0.5
	30-40	0.6	0.6	0.6	0.7	0.7	0.7
	40-50	25.9	26.9	28.0	29.1	30.3	31.5
	50-60	8.0	8.3	8.7	9.0	9.4	9.7
	60-70	4.2	4.4	4.5	4.7	4.9	5.1
	70-80	4.6	4.8	5.0	5.2	5.4	5.6
S	0-10	0.2	0.2	0.2	0.2	0.2	0.2
	10-20	1.4	1.5	1.5	1.6	1.6	1.7
	20-30	1.2	1.2	1.3	1.4	1.4	1.5
	30-40	5.4	5.6	5.8	6.1	6.3	6.6
	40-50	1.6	1.7	1.9	1.8	1.9	2.0
	50-60	21.0	21.8	22.7	23.6	24.6	25.5
	60-70	5.2	5.4	5.6	5.8	6.1	6.3
	70-80	4.0	4.2	4.3	4.5	4.7	4.9

TABLE 4-4 (cont'd.)

Sector	Distance (Thousands of Meters)	1970	1980	1990	2000	2010	2020
SSW	0-10	0.3	0.3	0.3	0.3	0.4	0.4
	10-20	0.4	0.4	0.4	0.5	0.5	0.5
	20-30	1.1	1.1	1.2	1.2	1.3	1.3
	30-40	5.0	5.2	5.4	5.6	5.8	6.0
	40-50	1.0	1.0	1.1	1.1	1.2	1.2
	50-60	1.8	1.9	1.9	2.0	2.1	2.2
	60-70	0.6	0.6	0.6	0.7	0.7	0.7
	70-80	4.8	5.0	5.2	5.4	5.6	5.8
SW	0-10	0.2	0.2	0.2	0.2	0.3	0.3
	10-20	0.4	0.4	0.4	0.5	0.5	0.5
	20-30	0.8	0.8	0.9	0.9	0.9	1.0
	30-40	1.2	1.2	1.3	1.3	1.4	1.4
	40-50	3.8	4.0	4.2	4.4	4.6	4.8
	50-60	8.0	8.6	9.2	9.8	10.5	11.2
	60-70	56.0	60.0	64.1	68.6	73.4	78.5
	70-80	10.9	11.6	12.2	13.0	13.8	14.6
WSW	0-10	0.2	0.2	0.2	0.2	0.3	0.3
	10-20	0.6	0.6	0.7	0.7	0.8	0.8
	20-30	2.1	2.2	2.3	2.4	2.5	2.6
	30-40	2.0	2.1	2.2	2.3	2.4	2.5
	40-50	2.3	2.5	2.7	2.9	3.1	3.3
	50-60	4.3	4.6	5.0	5.4	5.9	6.3
	60-70	5.9	6.4	6.9	7.4	8.0	8.7
	70-80	7.3	7.9	8.5	9.2	9.9	10.7
W	0-10	0.1	0.1	0.1	0.1	0.1	0.1
	10-20	1.4	1.5	1.6	1.7	1.8	1.9
	20-30	5.6	5.8	6.1	6.3	6.6	6.8
	30-40	1.4	1.5	1.6	1.7	1.8	1.9
	40-50	3.8	4.1	4.4	4.8	5.2	5.6
	50-60	31.8	34.3	37.1	40.1	43.3	46.7
	60-70	4.5	4.9	5.2	5.7	6.1	6.6
	70-80	3.3	3.6	3.8	4.2	4.5	4.8
WNW	0-10	0.5	0.5	0.5	0.6	0.6	0.6
	10-20	2.2	2.3	2.4	2.5	2.6	2.7
	20-30	3.2	3.5	3.7	4.0	4.4	4.7
	30-40	9.2	9.9	10.7	11.6	12.5	13.5
	40-50	8.4	9.1	9.8	10.6	11.4	12.3
	50-60	0	0	0	0	0	0
	60-70	0	0	0	0	0	0
	70-80	0	0	0	0	0	0

TABLE 4-4 (cont'd.)

Sector	Distance (Thousands of Meters)	1970	1980	1990	2000	2010	2020
NW	0-10	0.3	0.4	0.5	0.6	0.7	0.8
	10-20	1.1	1.3	1.5	1.8	2.1	2.5
	20-30	8.7	9.7	10.9	12.2	13.7	15.3
	30-40	21.3	23.9	26.7	29.9	33.5	37.5
	40-50	3.0	3.4	3.8	4.2	4.7	5.3
	50-60	0	0	0	0	0	0
	60-70	5.0	5.2	5.4	5.6	5.8	6.0
	70-80	10.0	10.4	10.8	11.2	11.7	12.2
NNW	0-10	2.4	2.8	3.3	3.9	4.6	5.5
	10-20	1.1	1.3	1.5	1.8	2.1	2.5
	20-30	8.7	9.7	10.9	12.2	13.7	15.3
	30-40	44.9	50.3	56.3	63.1	70.6	79.1
	40-50	157.6	176.5	197.7	221.4	248.0	278.0
	50-60	398.0	446.0	500.0	560.0	627.0	702.0
	60-70	164.1	183.8	206.0	231.0	259.0	290.0
	70-80	130.1	145.7	163.0	183.0	205.0	230.0

these figures were correlated by NFS for their 1973 Environmental and Safety Analysis Reports.

The agricultural potential of a majority of Cattaraugus County is primarily of low viability or of low commercial farming value. A large portion of the land is unused forest.

Dairying is the largest farming activity in the state and also in the five counties surrounding the site. Figure 4-6 shows the cattle density in this region.

Cattaraugus County ranks 24th among the state's 61 counties in farm product value. It generates approximately two percent of the total farm product value of New York State.

Crop production is relatively low in the area. Hay, oats, and corn are raised for animal feed. Snap beans, potatoes, and grapes are raised for human consumption.

Crude oil, natural gas, forest products, sand and gravel are also produced in the neighboring five-county region.

Some of the surrounding land is used for recreational purposes. Allegany State Park is composed of 60,480 acres, situated approximately 25 miles south of the site. Zoar Valley, approximately 10 miles west of the site, is being developed for camping and recreation. Two ski resorts are located within 10 miles of the site, one to the north and one to the south.

Approximately 90 percent of Cattaraugus County is open to hunting; however, hunting is prohibited on Nuclear Service Center land.

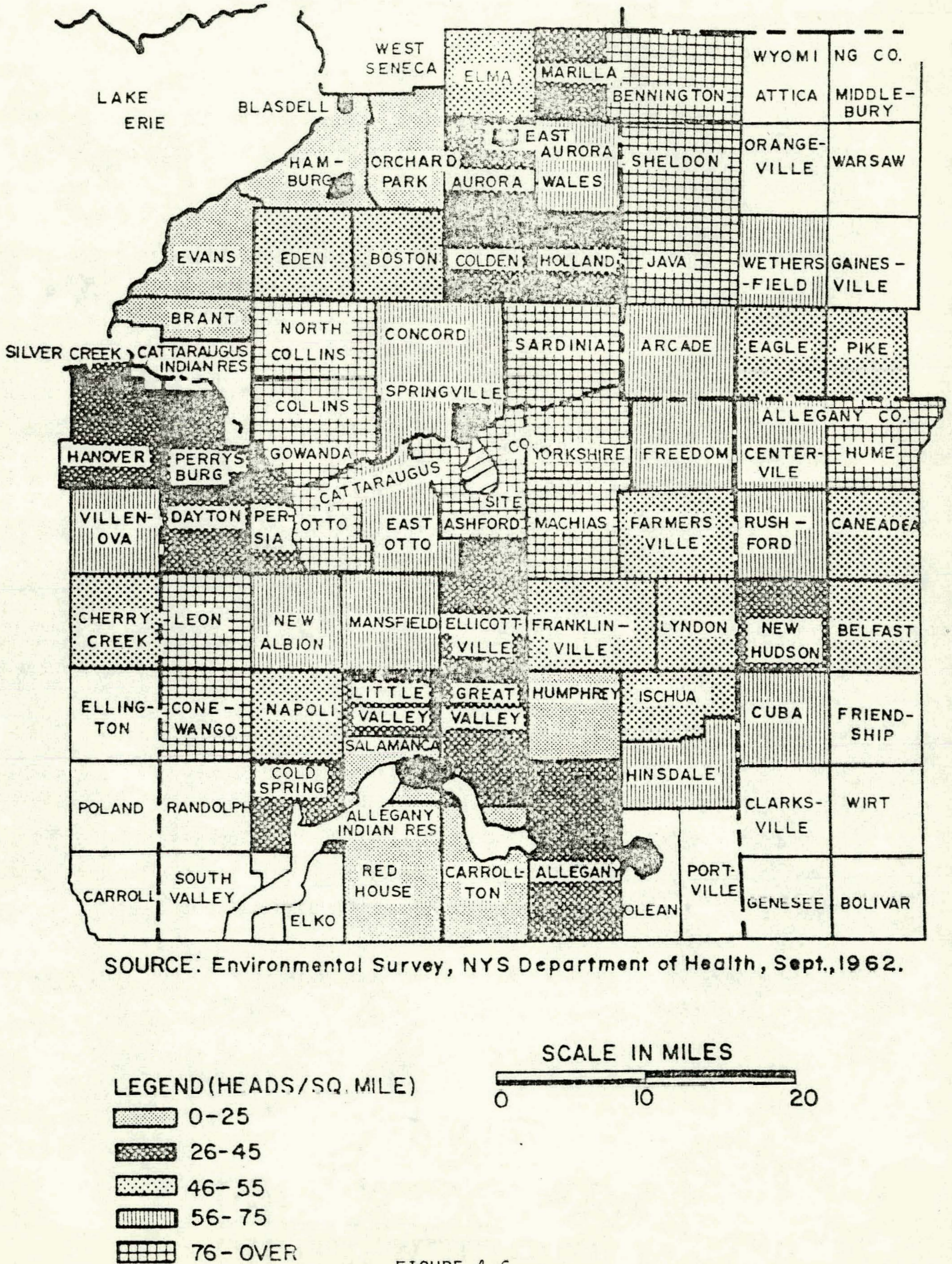


FIGURE 4-6

Milk and Beef Herd Population Density

4.1.3 Geology and Seismology

Western New York, from just south of Buffalo's latitude, lies in the glaciated Alleghany Section of the Appalachian Plateau Physiographic Province. Along the meridian of the Western New York Nuclear Service Center, the land surface rises from approximately 250 feet above sea level at the Lake Ontario shoreline to about 2,250 feet at the Pennsylvania line.

The regional topographic slope is underlain by a thick series of flat-lying sedimentary rocks (shales, sandstones, and limestones). The rock strata dip gently to the south at 20 to 40 feet per mile. The result is that, as one goes from north to south, the sedimentary rock sections progressively increase in thickness and younger formations appear at the surface. The depth to crystalline "basement" rocks at the Center is estimated at about 7,000 feet.

All of western New York, with the exception of the area generally encompassed by Allegany State Park, is overlain by a veneer of glacial deposits. Most of this consists of till (ground clay rock fragments containing cobbles and pebbles) and thick deposits of sand, gravel, and clay.

The preglacial erosion surface in this area was a maturely dissected upland with deeply incised valleys. Many of these valleys have been deeply buried by glacial deposits and much of the present drainage is on glacial deposits in bedrock valleys. Some of the streams presently flow on valley fill that is as much as 600 feet above the bedrock floor.

The site is underlain by a thick series of flat-lying gray and black impervious shales down to the top of the Onondaga limestone at an estimated depth of 2,000 feet. Several layers of limey shales and limestones lie beneath the Onondaga limestone, and still deeper is the Syracuse salt member of the Salina formation at a depth of approximately 2,700 feet.

The only significant structural feature in the region is the north-south trending Clarendon-Linden structure some 20 miles to the east. The structure appears to pass from a fault at the northern end to a monoclinical flexure as it trends southward. A north-northeast trend o. major fractures is associated with the fault in the Batavia-Attica area.

Western New York is an area of low seismicity. Although northern New York and New England are subject to frequent minor earth shocks, this frequency does not extend to northwestern New York.

There have been 13 reported earthquakes with maximum intensities of V or greater on the modified Mercalli Scale, and with epicenters within 100 miles of the site. Of these shocks, one was of intensity VII to VIII, four were intensity VI, and eight were of intensity V. The closest shocks to the site have been at Attica, about 35 miles northeast of the Nuclear Service Center. The Attica earthquake of August 12, 1929 had an intensity between a VII and a low VIII and was felt over an area of 50,000 square miles. The shock was felt most strongly in the eastern part of Attica and further eastward, which would place the epicenter at or near the western edge of the triangular block outlined by the Clarendon-Linden structure.

4.1.4 Surface and Ground Water Hydrology

4.1.4.1 Surface Water

The area lying within the Western New York Nuclear Service Center's boundaries is drained by two creeks. Cattaraugus Creek passes through the northern end of the site in a general westerly direction and empties into Lake Erie about 30 miles downstream. Buttermilk Creek flows through the site in a general northwesterly direction and joins Cattaraugus Creek at the north end of the site. Site boundaries extend on either side of Buttermilk Creek from its confluence with Cattaraugus Creek to Riceville Station, about four miles to the southeast.

Buttermilk Creek has eroded a narrow, deep defile into the glacial deposits in the valley in which the site is located. The elevation of Buttermilk Creek where it enters the site is 1,315 feet above sea level, and the creek falls to an elevation of slightly over 1,100 feet at its confluence wi

Cattaraugus Creek. The reprocessing plant is located on a bench-like plateau to the west of Buttermilk Creek at an elevation of about 1,415 feet.

The U.S. Geological Survey maintained a gaging station on Buttermilk Creek from October, 1961 to September, 1968. The gage was located one and one-quarter miles upstream from the mouth of the creek. The drainage area above the station is 29.4 square miles. Summarized flow data for the recording period are as follows:

Buttermilk Creek Flow Data

Flow Parameter	Flow (CFS)
Average Discharge	46.5
Maximum Discharge Rate	3,910
Minimum Discharge Rate	2.1

The flow rates in Buttermilk Creek are about ten percent of those in Cattaraugus Creek.

The data on water flows in Buttermilk Creek indicates maximum gage height of eight and one-half feet. This level would cause only local flooding on the flood plain well below plant elevation. Before the creek could rise to plant site flood stage, it would spill over the divide on the west bank and flow down another valley.

4.1.4.2 Ground Water

In preglacial times there was a fairly deep valley extending through the site along an axis of about north 20^o west which had been eroded in the underlying Devonian shales and siltstones. As the glaciers advanced and retreated over the area, the underlying valley was filled with a very fine-grained silty clay interspersed with intermittent lenses of sand and gravel. A layer of dense till approximately 20 feet thick generally overlies the area. Below this, a series of till layers and deposits of thinly bedded fine sandy silts and clays, formed in melt water lakes between the ice front and higher ground, are common. Outwash deposits of well sorted sand and gravels from lenses that cut through the till and lake deposits also occur.

Usable quantities of ground water occur in three aquifers on the site. uppermost aquifer occurs in the coarse granular deposits at the surface. This aquifer probably results from surface infiltration which is prevented from further downward migration by the underlying impermeable silty till. Many farms in the area use this nonartesian aquifer for domestic and livestock uses. It outcrops in marshy areas south of the reprocessing plant and at the edges of the steep defiles eroded by local streams within the site; thus, ground water from this aquifer on the site is discharged to surface drainage within the site.

The silty till sheet immediately beneath the surface aquifer, while saturated with water, is not an aquifer. The pore spaces in the till are small and poorly interconnected so that water movement through the till is very slow and almost entirely capillary in nature.

The thin sand layer, at an elevation of about 3,160 feet, beneath the uppermost till sheet constitutes the second aquifer. Known as the shallow artesian aquifer, it is found in most of the area on the peninsula between Buttermilk Creek, Franks Creek, and Erdman Brook. This aquifer is confined above and below by impermeable till sheets. The water level stands five to 17 feet above the level of the aquifer and about eight to 22 feet below the land surface.

The third aquifer is a weathered and fractured zone at the top of the shale bedrock. Although the underlying shales are low in permeability, approximately of the same order of magnitude as the overlying silty till, bore hole data indicate that the uppermost layer of shales may be fractured sufficiently to permit the passage of usable quantities of water. Deeper saline aquifers have been noted in deep drilling for oil and gas in the region, but these are below a series of over 2,000 feet of impervious shales extending down to the Onondaga limestone.

4.1.5 Meteorology

The general climate in the West Valley area may be classified as a cool, moist, mid-continent variety somewhat modified by the adjacent Lake Er and the upslope terrain from the lake towards the south and southeast.

The latitude of the area is about 43° north and the climate is typical of northern mid-continent sites such as Buffalo, Detroit, and Chicago, all of which are on or near the same latitude. West Valley's annual rainfall is typical for the eastern U.S.--about 40 inches per year. Precipitation occurs rather evenly throughout the year, and with an average temperature of 45° F much of it falls in the form of snow. Annual snowfall at the site is about 150 inches. Tables 4-5 and 4-6 show mean precipitation and mean temperature for communities in the vicinity of the site. Meteorological data are available from Buffalo Airport, from stations in smaller communities in the vicinity, and from meteorological equipment at the West Vally site. Wind roses for Buffalo Airport and for the site are presented in Figures 4-7 and 4-8. Stability information has also been obtained for onsite conditions for the period November 1, 1974 to September 18, 1975. Class A conditions, highly unstable, occurred 2.36 percent of the time; Class B conditions, moderately unstable, 3.58 percent of the time; Class C, slightly stable, 5.99 percent; Class D neutral, 45.66 percent; Class E, slightly stable 28.56 percent; Class F and G, highly stable 13.85 percent.

The frequency of severe weather in the West Valley area is low compared to the U.S. average. This is probably due to the low average temperature in the area which effectively reduces the driving force for the generation of thunderstorms (the basis for most severe weather). Another factor is the topographical effect of the Appalachian Mountains, which cause hurricanes moving westward from the Atlantic coast to lose much of their energy by the time they reach the area. Lake Erie may also have a modifying effect by cooling lower levels of the atmosphere that might otherwise be heated sufficiently to set off instability, thereby giving rise to thunderstorms.

The NRC staff[1] has assessed the probability of a tornado at the West Valley site. The recurrance interval is estimated to 3,400 years for a tornado of any size, and 10 million years for a design basis tornado.

Interim Safety Evaluation I, Nuclear Regulatory Commission, NRC Document 50-201 (Washington, D.C., 1977).

TABLE 4-5

Mean Precipitation in Western New York

Month	Arcade[a]	Franklinville[b]	Little Valley[c]	Gowanda[d]	Derby[e]
January	3.05	2.71	3.74	2.89	3.06
February	2.37	2.68	3.86	2.34	2.77
March	3.25	2.89	4.87	2.63	2.99
April	3.21	3.17	4.53	3.10	3.21
May	3.96	3.55	4.77	3.62	3.86
June	4.05	3.93	4.32	3.50	3.20
July	3.19	3.70	4.95	4.00	3.05
August	3.09	3.12	3.48	2.47	2.65
September	3.89	3.26	4.13	3.37	4.10
October	3.26	3.04	3.45	2.49	3.03
November	3.61	3.00	4.70	3.77	4.47
December	2.86	2.83	4.25	2.36	2.90
Annual	39.79	37.88	51.05	36.54	39.35

a 8 to 10 years record. 13.2 miles N.E., elevation 1,480 feet.

b 13 to 17 years record. 12.3 miles S.E., elevation 1,590 feet.

c 11 to 12 years record. 15.7 miles S.W., elevation 1,600 feet.

d 7 to 8 years record. 15.0 miles W., elevation 865 feet.

e 7 to 8 years record. 23.8 miles N.W., elevation 640 feet.

Site elevation is ~1,400 feet.

TABLE 4-6

Mean Temperatures in Western New York

Franklinville, N. Y. 1931-1952

(12 miles S.E. of Western New York Nuclear Service Center)

Month	Minimum	Maximum	Mean Temperature Over 13-Year Period, F	Highest[a]	Lowest[b]
January	15.9	32.8	24.3	71	-28
February	12.0	31.6	21.8	65	-45
March	20.5	39.1	29.6	77	-16
April	30.7	52.6	41.7	82	3
May	41.6	66.9	54.2	89	20
June	51.1	76.8	63.9	97	30
July	54.1	80.4	67.3	99	36
August	52.3	78.8	65.6	94	26
September	45.8	71.9	58.9	93	21
October	36.9	60.7	48.8	86	10
November	28.7	45.7	37.2	80	-24
December	18.8	34.8	26.8	63	-27
Annual	34	56	45.0		

a 13-Year Period.

b 14-Year Period.

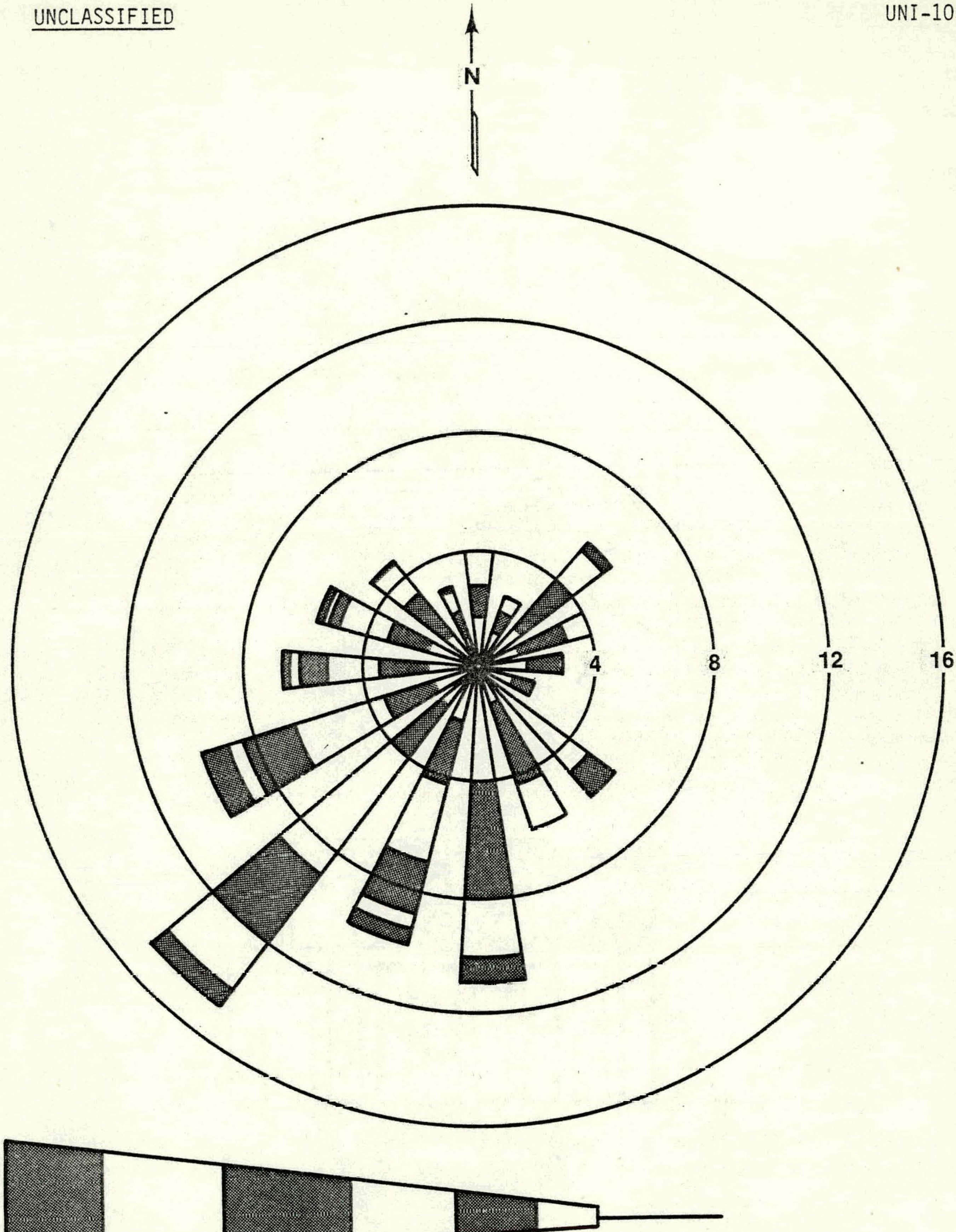


FIGURE 4-7

Buffalo Airport Wind Rose

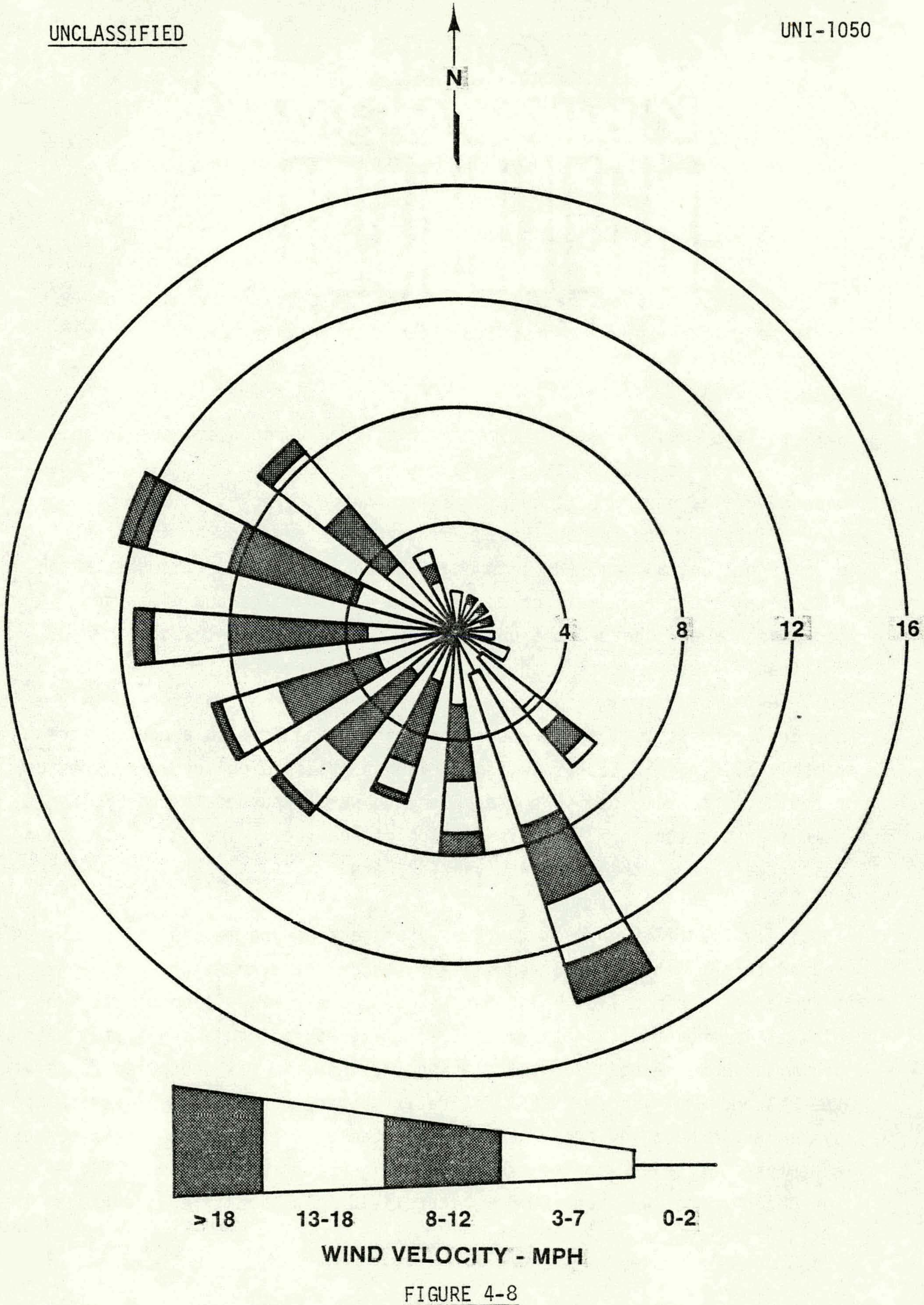


FIGURE 4-8

West Valley Wind Rose

4.2 Process Description

This section describes the physical and mechanical processes which were performed in the West Valley Plant, thereby indicating the nature of radionuclides, chemicals, and equipment present in the facility. Figure 4-9 outlines these processes. (Table 6.4-31 provides a ready reference list of plant facilities and their abbreviations which are also included in the Abbreviations, Symbols and Definitions Section of this report.)

West Valley received several types of fuel from various sources in shielded casks. These were submerged in the fuel storage basin and the fuel then unloaded. The basin has a considerable storage capacity which provided flexibility in processing. Fuel from the basin was brought into the process mechanical cell (PMC) through a fuel transfer port. Once in the PMC, metal end pieces were sawed from the fuel bundles and discarded. A mechanical shear chopped the bundles and dropped the pieces into criticality-safe baskets with consumable iron liners in the general purpose cell (GPC) for interim storage. Baskets of fuel were transferred to the chemical process cell (CPC) where the uranium and fission products were dissolved in nitric acid solutions. The stainless steel or zirconium fuel cladding hulls remained in the baskets and were returned to the GPC for sampling to insure complete dissolution of the fuel. The hulls were then discarded through the scrap removal (SR) area.

Initially, ventilation from the fuel storage area and mechanical cells was routed through the general ventilation system; however, ventilation in these areas was modified. The fuel storage basin was placed on its own high efficiency particulate air (HEPA) filtered recirculating system with dehumidifiers. A head end ventilation (HEV) system was installed to serve the PMC and GPC with dual HEPA filtration bypassing the general ventilation system and exhausting from the building stack. The HEV system also serves other process cells, the master slave manipulator repair shop (MRS), and the decontamination shop (DCS). Figure 4-10 is a simplified diagram of the ventilation system.

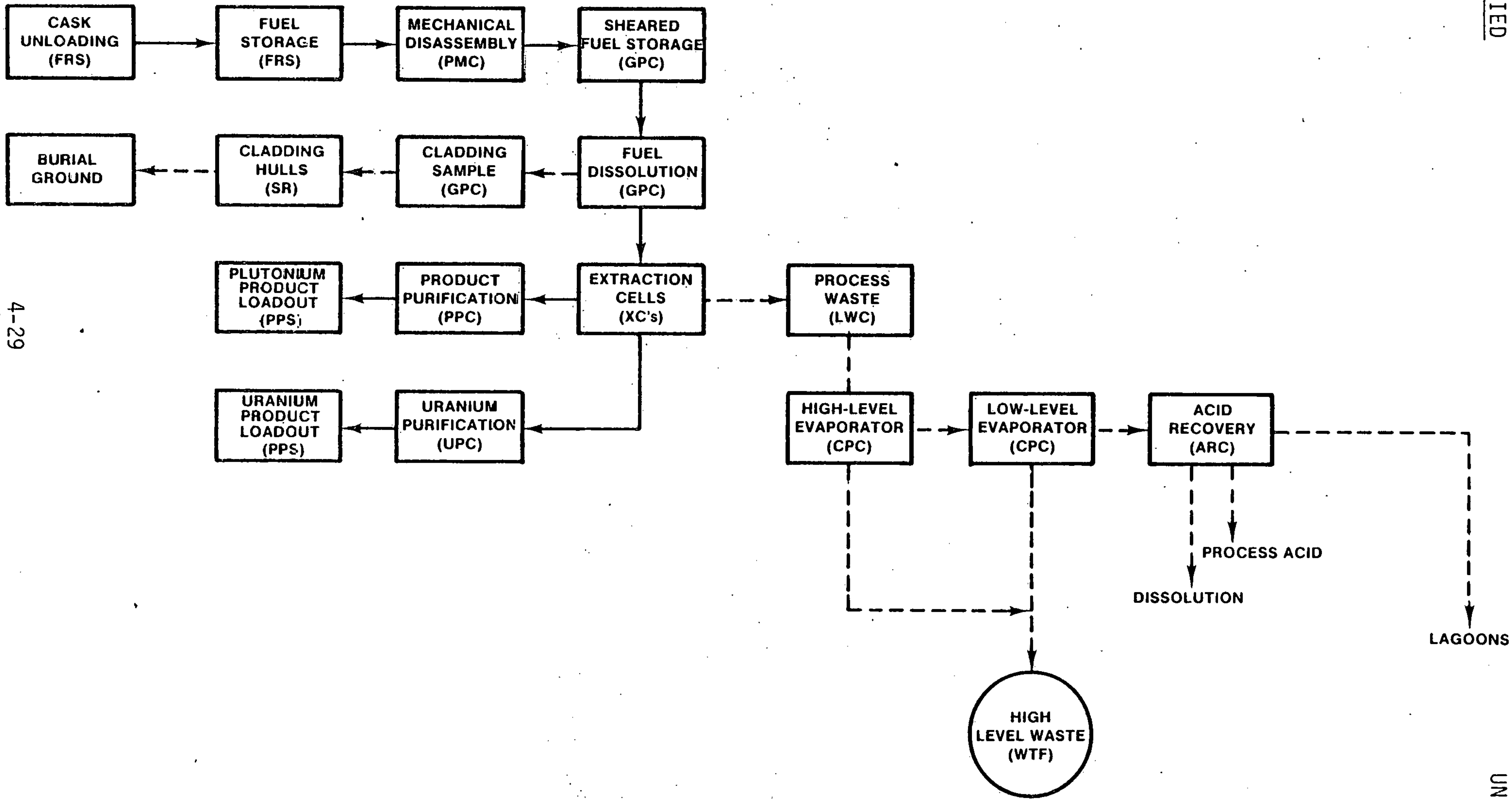


FIGURE 4-9

Process Diagram—West Valley Plant

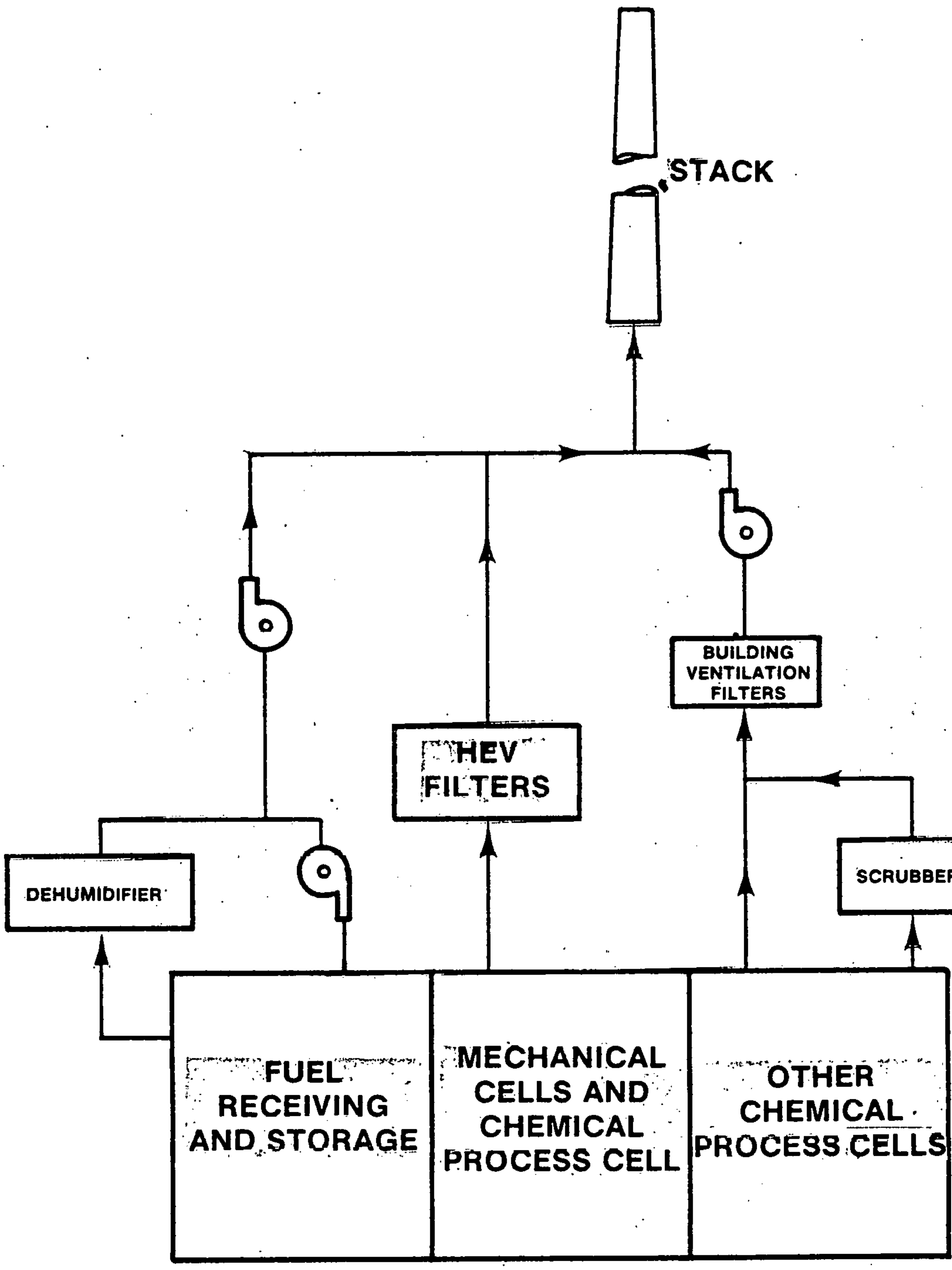


FIGURE 4-10

Simplified Ventilation Diagram

Off-gas from the dissolution process in the CPC was put through a scrubber, heated, passed through dual HEPA filters, and exhausted from the stack.

The uranium, plutonium and fission product solution from the dissolver was sampled for materials accountability and transferred to extraction cell number one (XC1) where the initial separation of uranium, plutonium, and fission products took place by solvent extraction in pulsed columns. Tributyl phosphate (TBP) dissolved in dodecane was used in the organic phase, and nitric acid solutions of varying concentrations in the aqeous phases.

Fission product solutions were sampled for uranium and plutonium. If significant quantities were found, they were reworked; if not, they were sent to the CPC for waste evaporation and neutralization.

The uranium was further purified by solvent extraction in XCs 2 and 3. Extraction solutions from this process were purified and recycled in the cells, and waste solutions were sent to the liquid waste cell (LWC). Uranium product solutions were evaporated and further purified on a silica gel column prior to storage in the uranium product cell (UPC) for offsite shipment. The silica gel column was regenerated with an oxalic solution which was sent to waste treatment.

The plutonium product stream was further purified by solvent extraction in XC2 and concentrated by anion exchange in the Product Purification Cell (PPC). The product was then concentrated by evaporation and transferred to product packaging and shipping (PPS). Plutonium processing equipment was designed to maintain critically safe geometry under all credible conditions.

High level aqueous waste solutions were transferred to the waste evaporators in the CPC. The evaporator bottoms were neutralized and placed in the CPC. The evaporator overheads were collected along with other low level wastes in tanks in the LWC. Low level wastes were evaporated in another evaporator in the CPC. Bottoms from this evaporator were likewise neutralized and transferred to the underground high level liquid waste tank. Overheads from the low level liquid evaporator were treated in an acid fractionator where acid was reclaimed and stored in the hot acid c (HAC) for reuse in the dissolvers. The low level, acid free liquid was routed to the general purpose evaporator or to the lagoon through a stainless steel lined "interceptor" pit.

After the close of operation, the solvent was discarded, process liquids were disposed of, and the system was flushed and in many cases chemically cleaned.

4.3 Plant Description

The major facilities included in this study are: 1) the fuel receiving and storage area, 2) the main process building, 3) the liquid waste storage area, and 4) the auxiliary process systems and service areas. A brief description of each of these facilities is given in this section, following a discussion of design criteria.

4.3.1 General Plant Design Base

The fuel reprocessing plant was designed and constructed to minimize the release of radioactive materials both during routine operation and under accident conditions. At least two physical barriers contain significant quantities of radioactive materials within the facility during operation. These barriers are typically the process equipment (vessels, pipes, etc.) and the building around the process equipment. In most cases the building itself provides two barriers: the cell or room where the process equipment is located, and the outer building shell.

All process and waste storage vessels were vented through appropriate treatment systems for primary confinement of airborne radioactive materials. All building spaces subject to potentital radioactive contamination from a breach of the primary confinement system were equipped with ventilation systems capable of controlling flow and maintaining the release of airborne radioactive effluents within the applicable limits during normal, abnormal, and accident conditions.

Most of the equipment used in the process was designed specifically for use in the facility. Most of the equipment is stainless steel, although other corrosion resistant materials such as titanium and Carpenter 20 were also used to limit corrosion. Where failure of process equipment could result in major releases of radionuclides, the equipment and process building were designed to building code specifications to protect against earthquakes, storms of tornado intensity, and other credible natural events and accidents. Structural barriers were designed to contain process materials if primary equipment barriers were breached. The principal structural barriers were constructed of heavily reinforced concrete, normally at least partially lined with stainless steel to facilitate decontamination.

The process structural barriers, generally termed radioactive process cells, are in most cases surrounded by operating and service areas. Heavily reinforced concrete walls were constructed not only as structural barriers to prevent the spread of radioactive contamination, but to provide shielding from high radiation levels in the fuel. The PMC, GPC, CPC, and analytical cells (ANC) are all equipped with protective viewing windows (constructed of several thicknesses of lead glass, filled with an oil between sheets) which permitted remote operation and/or maintenance using master slave manipulators and remotely operated cranes. All but the GPC were designed for remote equipment removal or contact maintenance.

XCs 1 and 2 have thick concrete walls for shielding in the unlikely event of criticality. Entry to these is provided through doors or overhead hatches.

4.3.2 Fuel Receiving and Storage Area

The fuel receiving and storage area (FRS) was designed to receive and store irradiated fuel elements. Irradiated fuel was received at FRS in heavily shielded casks transported on either truck or railroad vehicles. Facilities were provided inside the FRS building for the inspection, monitoring, and preparation of each cask for unloading. The fuel was unloaded underwater to provide both cooling and radiation shielding, and the removed fuel was transferred underwater to storage canisters. The storage canisters were then transferred to predetermined locations in the fuel storage pool where they were stored in racks until processing. For processing, the canisters were taken from storage and transferred under water via a special conveyor to a port in the PMC where a crane removed the assembly from the canister. The unloaded casks were moved from the pool to a cask decontamination area where the empty cask was prepared for shipment offsite. The four main sections of the FRS are discussed below.

4.3.2.1 Cask Decontamination Area

The cask decontamination area is an enclosed, curbed stall within the FRS. The casks were removed here from the transport vehicle using a 100-ton capacity crane and set within the stall. The area was serviced by an elevator-type platform to facilitate preparation for underwater unloading, and also by travelling high-pressure water sprays used for decontamination, if necessary.

4.3.2.2 Cask Unloading Pool

The cask unloading pool (CUP) was used for removing fuel assemblies from the shipping casks and placing them in the fuel storage canisters. The CUP measures about 24 by 26 feet, and is for the most part 29 feet deep but has a section 44 feet deep that provides a minimum of 11 feet of water shielding over the fuel during removal of irradiated fuel assemblies from the casks. The shelf area--29 feet deep--was used for temporary placement of the casks into the shroud to minimize contact between the casks' outer surface and the pool water, and for the storage of cask lids during unloading operations.

The entire CUP was lined with stainless steel. A watertight gate was available to isolate the CUP from the storage pool in the event that casks containing highly contamination coolant had to be unloaded.

4.3.2.3 Fuel Storage Pool

The fuel storage pool measures 75 by 40 feet and is 29 feet deep. It is filled with demineralized water to 29 feet and contains storage racks for the fuel cannisters.

4.3.2.4 FRS Water Treatment System

The FRS water treatment system consists of a 500 gpm filter which utilized replaceable media, and a 100 gpm non-regenerable ion exchanger. Both units are housed in the water treatment area.

4.3.3 Main Process Building

The main process building is the functional center of the fuel reprocessing plant. Uranium and plutonium were chemically separated from the spent fuel in this building. Processing was carried out in a series of process cells that occupy a major portion of the building. The main process building also contains a wide variety of facilities and equipment that were used to monitor and control the process, maintain the equipment, carry out auxiliary operations, and treat gaseous and liquid effluents from the processes.

The major features of the main process building are shown in Figure 4-11. The primary functions of the main process cells are listed in Table 4-7. Most of the building is constructed of reinforced concrete. Process cell walls are three to six feet thick to provide personnel shielding from radioactivity. Other main process building features of interest are discussed below:

- Control Room

  The control room (CR) housed the process control and safety-related instrumentation for the plant. It served as the communications center from which operators were directed to perform manual functions. The CR area is not expected to be contaminated, since the only process connections are electrical.

- Analytical Cells

  The ANC is a shielded facility designed to provide radiochemical analyses for samples from the more highly radioactive portions of

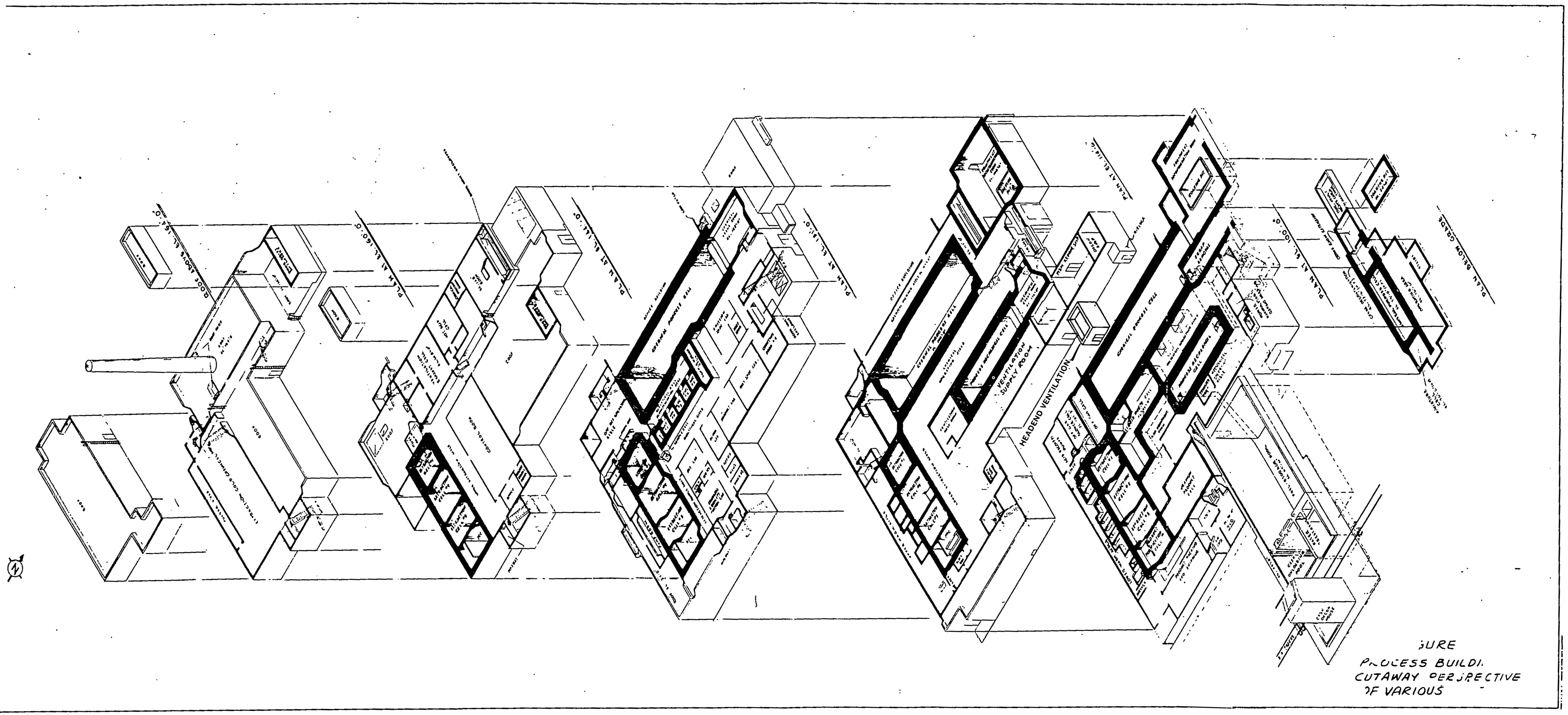


FIGURE 4-11
Main Process Building

TABLE 4-7

Primary Functions of Main Process Cells

Cell	Primary Process Functions	Remarks
PMC	Shear fuel bundles	Remote maintenance stainless steel lined
GPC	Handle sheared fuel; store sheared fuel; package leached hulls	Remote maintenance; stainless steel lined
CPC	Dissolve sheared fuel; prepare feed; evaporate waste	Remote maintenance; stainless steel lined
XC-1,-2,-3	Solvent extraction	Contact maintenance; stainless steel floor[a]
PPC	Concentrate U and Pu; purify U and Pu stream; package	Contact maintenance; stainless steel floor[a]
UPC	Store Uranyl Nitrate	Contact maintenance; stainless steel floor[a]
PPS	Package product and loadout	Normal access area; equipped with glove boxes

[a] Cells with stainless steel floors have stainless steel 18 inches up the wall.

the process. The cells provided a shielded area for remote sampling and analysis of these materials, and for preparation of samples to be analyzed in the plant laboratories. Operations were conducted through protective viewing windows with manipulators.

- Decontamination and Maintenance Areas
  Adjacent to the PMC, GPC, and CPC are crane rooms where decontamination and maintenance of cranes and certain other equipment could be performed. An equipment decontamination room (EDR) with a soaking pit serviced major pieces of equipment from the CPC. A power manipulator repair room (MRR)--later replaced by the Master Slave Manipulator (MSM) repair shop--and a contamination equipment repair shop were also provided.

- Operating Aisles
  The various operating aisles of the plant allowed for manual control of process streams, stream flow and water flow, and also provided access for maintenance of automatic equipment. Nearly all of the utility piping to the cells is exposed in the operating aisles.

- Acid Recovery and Off-Gas Cells
  Acid recovery and treatment of process off-gases were carried out in cells located at the south end of the CPC. The acid recovery cell (ARC) contains evaporators, coolers, and condensers used for the recovery of acid from the process. The off-gas cell (OGC) houses filters, blowers, heaters, tanks, and other process off-gas treatment equipment.

- Ventilation Systems
  The ventilation system consists primarily of supply and exhaust subsystems. It was designed to provide once-through air flow by a combination of flow and pressure controls from noncontaminated areas, through potentially contaminated or low contaminated areas, to contaminated areas, then through the filtering system before release from the stack.

The air supply subsystem is powered by conventional electrically driven fans which are connected to emergency power sources. The exhaust (and filter) subsystem is powered by an electrically driven exhaust fan to blow the ventilation air out the building stack, and is backed up by a diesel-driven exhaust fan.

All ventilation air in the sytem is routed to the ventilation exhaust cell (VEC) for filtration before exiting through the stack.

4.3.4 Liquid Waste Storage Area - Waste Tank Farm

The waste tank farm (WTF) is located north of the reprocessing plant. Four underground storage tanks, two of carbon steel and two of stainless steel (see Sections 4.3.4.1 and 4.3.4.2, respectively), and the necessary auxiliaries were installed here for the storage of high level liquid wastes generated from fuel reprocessing. Only one tank of each type is in use; a spare of each type is maintained in standby status.

4.3.4.1 High Level Liquid Waste Storage (Neutralized)

The carbon steel waste storage tank system was designed to maintain the waste in a neutralized, self-boiling condition; however, radioactive decay heat has never been sufficient to boil the solution. In addition to the tank now in use, a full capacity spare tank is provided. Each tank is situated over a steel pan within a concrete vault buried underground in the naturally impermeable site soil.

The carbon steel storage tanks are 70 feet in diameter and 27 feet in height, with a nominal capacity of 750,000 gallons. One tank presently contains 550,000 gallons of waste. The spare tank contains condensate from the tank in use. The tank sides and bottoms have a minimum thickness of 1/2-inch; roofs are at least 7/16-inch thick. This provides a 1/4-inch allowance for corrosion. The circular pan under each tank is 75 feet in diameter, 5 feet 3 inches in height, with a wall thickness of 3/8-inch. The tank and pan are instrumented for leak detection and temperature control and are equipped with corrosion coupons. If a leak should develop, facilities are provided for pumping from one tank to the other. Each tank and pan are inside a separate waterproof, reinforced concrete vault. The vaults, each 78 feet in diameter, sit on a gravel bed and have side wall and roof thicknesses of two feet. In addition to the tanks, pan, and vault, the facility includes air cooled condensers and a building that houses the instrumentation and ventilation equipment.

4.3.4.2 Thorium Bearing Liquid Waste Storage

The stainless steel tank maintains the thorium-bearing wastes in an acidic media to minimize thorium precipitation. In addition to the one tank now in use, a full capacity spare tank is provided and both tanks are situated in a single stainless steel pan within a concrete vault.

The tanks are 12 feet in diameter and 15 feet 9 inches high, with a nominal capacity of 15,000 gallons. One tank presently contains 10,000 gallons of waste. The tanks are inside a one foot-thick reinforced concrete vault which measures 32 by 19 feet and is 25-1/3 feet high outside. The vault walls are lined with 1/8-inch type 304L stainless steel sheet to a height of 18 inches. The thorium waste storage facility also includes a building to house the instrumentation and controls.

4.3.5 Auxiliary Process Systems and Service Areas

4.3.5.1 Auxiliary Process Systems

The auxiliary systems provide the essential services of electricity, water, air, fuel, steam, fire protection, drainage, sewage, and communications. The principal auxiliary systems of the reprocessing plant are located in the utility room (UR). Other auxiliary systems or parts of systems, such as cooling towers, water storage and treatment, transformers, and fuel supply, are located in the yard area surrounding the reprocessing plant and inside the security area fence. Outside of the security area, but within the site exclusion area, is the guard house, switching station, environmental laboratory and farm.

The major areas of interest in this study are described briefly below:

- Electrical Power

  Normal electrical power is supplied by a 34.5 kV commercial loop system that can furnish power from either of two stations located 25 and 10 miles from the reprocessing plant. A switching station provides automatic selection of power from whichever end of the loop it is available. A feeder line from the switching station on the 34.5 kV line transmits power to the reprocessing plant substation where it is stepped down to 480 V. The lake pumps, which supply water to the reprocessing plant, obtain power from a separate 2300 V 480 V rural system of the commercial supplier. Emergency power is available at 480 V from a 625 kVA diesel-driven generator located in the UR.

- Fire Control and Protection

  Fire detection and protection systems at the facility were designed to provide early detection and rapid control of fire. Fire detectors and/or alarms were provided at the PMC and GPC, with alarm signals in the mechanical operating aisles (MOA), the extraction chemical room (XCR), cooling tower, warehouse, and the office building.

  Filtered water is stored in a 475,000-gallon tank (300,000 gallons of which is physically restricted for fire use) and distributed throughout the plant through an underground system to hydrants, and through a wet stand pipe system to hose stations in the process building. The three XCs, the PPC, and the CPC are equipped with numerous two-phase fog nozzles which can be fed from hose connections outside the cells. Dry chemical and CO_2 systems were installed to extinguish metal fires in the GPC and PMC. The dry chemical is propelled with bottled nitrogen and piped to in-cell hose stations.

4.3.5.2 Auxiliary Facilities and Service Areas

Auxiliary facilities outside of the security fence include the administration building guard house, electrical sub-station, environmental laboratory and farm. These are expected to be uncontaminated and except for requiring survey will have very little impact on site disposition. Auxiliary facilities inside the security fence include the warehouse, cooling tower, maintenance shop, utility room, temporary pipe shop, meteorology station and laundry building. Only the laundry building is expected to be contaminated. These facilities are discussed below:

- Warehouse, Maintenance Shop and temporary Pipe Shop

  These are steel frame buildings. The Warehouse is located south of the main process building. The Maintenance Shop and temporary Pipe Shop are located together, east of the main process building.

  The Maintenance Shop has a machine bay equipped with a five-ton hoist, locker room, an electrical shop, tool crib, storage yard, and two offices.

- Utility Room and Switch Gear Room

  The UR is a 90- by 79-foot concrete block structure adjacent to the south side of the process building. Housed in or adjacent to this building are the boilers, air compressors, water pumps, and water purification equipment to provide the utility services for the plant. External structures integrated with the utilities systems are as follows:

  a) A two-cell induced draft cooling tower located south of the UR. (The cooling tower is a wood frame structure with a concrete water collection reservoir at its base.)

  b) A 475,000-gallon storage tank for plant water and fire water located near the southwest corner of the UR.

  c) Four 17,500-gallon condensate storage tanks situated on the west side of the UR.

  d) A water treatment flocculator/clarifier located at the south side of the UR.

  e) Two 44,000 pound-per-hour boilers adjacent to the west wall of the UR.

The SGR, located adjacent to the northeast corner of the UR, is a 39- by 20-foot concrete block structure which houses the electrical switching components and breakers for the plant. A transformer station outside the east wall of the SGR steps down the incoming voltage for plant use. Motor control centers for process pumps and other equipment, and the emergency motor control center which provides for special breaker changes in the event of a power outage are also housed here.

Fire hydrants in the plant yard and hose stations throughout the plant are pressurized. About 300,000 gallons of water is available to fire stations at all times from the plant water storage tank next to the pump house.

- Meteorology Station
  The meteorology station consists of an instrument tower and portable shed housing printout instrumentation which are required to collect onsite data.

- Laundry Building
  The laundry building is a single story 25- by 55-foot concrete structure located near the southeast corner of the UR. The south half of the building houses the laundry facility, and the north half an additional locker room with showers and clothing storage for construction personnel.

  Included in the laundry facility are two heavy duty laundry machines, two clothes dryers, and an inspection area equipped with a ventilation hood. The laundry room is vented through absolute filters and exhausted air is discharged via the roof stack.

4.4 Radiological Conditions

This section discusses the radiological conditions present in the fuel reprocessing plant and surrounding site.

4.4.1 Radiological Conditions - Fuel Reprocessing Plant

The dose rates, airborne concentration, and contamination levels preser the facility determine to a large extent the methods employed, the cost involved, and the volume and nature of waste generated. One of the initial steps in disposition planning will be to further characterize the radiation and contamination levels present, particularly with respect to effectiveness of decontamination methods.

Following suspension of operation in 1972, extensive flushing and internal decontamination was performed, both for material accountability and to facilitate plant modifications. Some equipment, such as the PMC saw, and process materials such as extraction solvents and resin, were removed. The modification program, however, was not completed.

The facility was designed with considerable forethought to the radiological conditions which would be encountered. Shielding thickness in the cell walls appears adequate. Considerable forethought was given to airlocks for preventing the spread of contamination, and to cranes and manipulators for remote dismantling and removal of eqipment.

Facilities were not provided for the external decontamination of equipment in cells. Likewise, the buildup of gamma-emitting radionuclides in the ventilation ductwork between the ventilation wash room (VWR), and the filters was not adequately planned for.

Contamination characterization and control during operation was designed for personnel protection and material accountability. It was not designed to provide a data base for decommissioning or to facilitate decontamination.

Survey programs of occupied areas define contamination levels on floors, equipment, and walls to about seven feet above floor level. Additional special surveys were also conducted. Contamination may be fixed in place with paint as long as smearable contamination is less than 2,000 d/m per 100 cm^2 gross beta. Zones within the building are characterized as to smearable contamination levels. The available information concerning dose rates, contamination levels, and airborne activity is presented in Table 4-8. The zone classification system supplied by NFS for Table 4-8 is presented in Table 4-9.

Additional information on radiological conditions in the reprocessing plant may be derived from the material unaccounted for (MUF) records from the operating history. These figures accumulate not only material which may be held up in the process system, but also inaccuracies in volume and concentration measurement. MUF records indicate 9.6 Kg plutonium and 2.2 metric tons of uranium are unaccounted for.[1]

NFS estimates of radionuclide quantities, based on its accumulated radiological data, are given in Table 4-10.

4.4.2 Radiological Conditions - The Site

Accumulations of radionuclides occur on the West Valley site in the following locations:

- Fuel reprocessing plant--Discussed in Section 4.4.1.
- Liquid waste tanks--Liquid waste is addressed elsewhere in Argonne's studies. Conditions in the tank after the waste has been removed are discussed in connection with various alternatives.
- Burial grounds, ponds, and streambed--Adressed elsewhere in Argonne's studies.
- The site in general from deposition of material released in gaseous effluents--Available data on radionuclide concentrations in site soil are presented in this section (4.4.2).

[1] Oral communication from NFS.

TABLE 4-8

Present Radiological Condition

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Process Mechanical Cell (PMC)	Possibly fuel and cladding particles.	Some fuel or cladding pieces present. External water flush. Some equipment removed.	142 R/hr[a]; Northport-210 R/hr[c]; Southport - 300 R/hr[c]	Estimated extremely high, Zone 4[b] 1.5 MPCa beta[c] 35 MPCa alpha[c]	Designed for a decontamination and remote removal of equipment. Viewing windows and manipulators provided. Stainless steel walls and floor.
Mechanical Crane Room (MCR)	Material from PMC mixed fission products.	Occasionally decontaminated for crane maintenance.	0.3-1.2R/hr[a] 0.8-1.2R/hr[a]	Zone 4 10^6 dpm/100cm^2 beta[d] 10^4 dpm/100cm^2 alpha[d]	Entered periodically during operation.
General Purpose Cell (GPC)	Fuel cladding hulls.	Some loose material present.	700-1800 R/hr[a]	Zone 4 28 MPCa beta[c] 122 MPCa alpha[c]	Manipulators and viewing windows provided. Equipment permanently installed. Stainless steel walls and floor.
GPC Crane Room (GCR)	Material from GPC. Mixed fission products.	Occasionally decontaminated for crane maintenance.	100-150 mR/hr[a]	Zone 4	Entered periodically during operation.
Miniature Cell (MC)	Some contamination from ventilation system. Cell never used.	None	Assume only a few mR/hr	10^5 dpm/100cm^2 beta[d] 10^3 dpm/100cm^2 alpha[d]	Cell never used. Stainless steel lined. Equipped for access or manipulator installation. No equipment.
Scrap Removal (SR)	Fuel cladding hulls in drums transferred here.	Area routinely decontaminated.	20 mR/hr[a] 1-20 mR/hr[c]	Zone 3 10^3 dpm/100cm^2 beta[d] 10^3 dpm/100cm^2 alpha[d]	Used for loading cladding hulls etc., to be taken to the burial ground. Trucks, shielded casks, etc., decontaminated here. Remote crane & viewing window provided.

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Fuel Receiving and Storage (FRS)	Primarily Cs-137. Some mixed fission products.	Drained, sludge removed, and cleaned in 1972.	Walkway 0.5-20 mR/hr	10^2 dpm/100cm^2 beta 1.0 dpm/100cm^2 alpha (Waste Treatment Area:) 10^5 dpm/100cm^2 beta 10 dpm/100cm^2 alpha	In operation has its own recirculating HEPA filtered ventilation system. 305 carboline basin coating was found breached in one place during 1972 cleaning. Basin was recoated. Cask receiving portion is stainless steel lined.
Chemical Process Cell (CPC)	Mixed fission product solutions. Some "fines" of cladding material held up in system.	Internal flush.	12-32 R/hr[a] Northport-16 R/hr[c] Southport-55 R/hr[c]	8 MPCa beta[c] 65 MPCa alpha[c]	Designed for remote operation and equipment removal. Windows. Stainless steel lined floor and 18" inches up walls. "Hanford Type" connectors.
Equipment Decontamination Room (EDR)	Contamination brought from CPC on cranes, etc. Mixed fission products.	Area used to decontaminate process equipment for maintenance	30-200 mR/hr[a]	Zone 4 10^4 dpm/cm^2 beta[d] 10^2 dpm/cm^2 alpha[d]	Stainless steel floor and soaking pit. Coated concrete on walls. Some breach of coating evident near ceiling.
Chemical Crane Room (CCR)	Mixed fission products from CPC.	Routinely decontaminated for crane maintenance. Has been cleaned and painted.	50-100 mR/hr[a]	Zone 4 10^3 dpm/100cm^2 beta[d] 10^1 dpm/100cm^2 alpha[d]	Coated concrete, airlock access.
Extraction Cell 1 (XC1)	Mixed fission products. Plutonium and uranium products in various sections.	Has had internal decontamination. Some external decontamination.	2-25 R/hr[a] Level From Penetration — Reading 20 feet — 57.R/hr 30 feet — 19.R/hr 40 feet — 9.R/hr 50 feet — 14.2R/hr 55 feet — 4.R/hr	Zone 4 1 MPCa beta[c] 20 MPCa alpha[c]	∿7000 feet of welded stainless steel and vessels. Stainless steel floor and coated walls. Access through top.

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Extraction Cell 2 (XC2)	Plutonium and mixed fission products.	Extensive internal decontamination since last operation. Some external decontamination.	32-140 mR/hr[a]	Zone 4 1 MPCa beta[c] 1 MPCa alpha[c]	12,000 feet of welded stainless steel pipe and vessels. Stainless steel floor, coated walls. Access through top or floor level air lock.
Extraction Cell 3 (XC3)	Uranium, degree of enrichment variable. Mixed fission products.	Extensive internal decontamination since last operation. Some external decontamination.	3-17 mR/hr[a]	Zone 4 1 MPCa beta[c] 45 MPCa alpha[c]	10,000 feet of welded stainless steel pipe and vessels. Stainless steel floor. Coated walls. Access through top or floor. level air lock.
Product Purification Cell (PPC)	Plutonium and uranium.	Flushed	.5 mR/hr[d]	Zone 4 32 MPCa beta[c] 4 MPCa alpha[c]	Stainless steel floor. Coated walls. Access through top or floor level air lock.
Product Packaging and Shipping (Plutonium Loadout)	Plutonium	Glove box interior cleaned for housekeeping and accountability.	Less than 0.5 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Glove box removable.
Uranium Product Cell (UPC)	Uranium (degree of enrichment varies).		0.5 mR/hr	Zone 4	Two tanks contain depleted Uranium.
Uranium Loadout	Uranium (degree of enrichment varies).		1.0 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	
Liquid Waste Cell (LWC)	Fission products.	Equipment flushed internally.	0.5 to 1 R/hr[c]	Zone 4 130 MPCa beta[e] 80 MPCa alpha[e]	No flow-through ventilation.
Acid Recovery Cell (ARC)	Fission products.	Equipment flushed internally.	1-3 R/hr[c]	Zone 4 10^4 dpm/100cm^2 beta[c] 10^2 dpm/100cm^2 alpha[c]	

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Acid Recovery Pump Room	Fission products.	Major decontamination performed.	.5 to 1 R/hr[c]	Zone 4 10^5 dpm/100cm^2 beta[d] 10^3 dpm/100cm^2 alpha[d]	Reported to have concrete contaminated from leak. New floor poured over old.
Hot Acid Cell (HAC)	Ru, Zr-Nb	Equipment flushed.	20 mR/hr[d]	Zone 4 10^3 dpm/100cm^2 beta 10^2 dpm/100cm^2 alpha	Coated concrete, contact-maintained.
Lower Warm Aisle (LWA)	From XCs.	Equipment decontaminated.	Generally 0.5 to 2.5mR/hr spots 20-30 mR/hr[b]. Pump niches may be to 30R[d].	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Pumps and equipment located in shielded enclosures with removable concrete plug tops. Access via air lock.
Upper Warm Aisle (UWA)	From XCs.	Cleaned for routine entry.	Generally 0.5 to 2.5 mR/hr. Spots to 50 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Same as for LWA.
Solvent Storage Tanks (SST)		Internal Decontamination	General 10-100 mR/hr[c] Tank 200-500 mR/hr[c]	10^3 dpm/100cm^2 beta 1 dpm/100cm^2 alpha	Painted concrete.
Manipulator Repair Room (MRR)		Decontaminated routinely during operation.	200 mR/hr to 2 R/hr[a] 100-200 mR/hr[c]	10^6 dpm/100cm^2 beta[d] 10^4 dpm/100cm^2 alpha[d]	Carbolene-covered concrete, contact-maintained.
Analytical Cells and Sample Storage Cell (ANC)	Variable.	Decontaminated routinely during operation.		Zone 4	Designed for routine entry. Stainless steel tray, coated walls.
Off-Gas Cell (OGC)	Dissolver off-gas.	Equipment flushed internally.	1-3 R/hr[c]	Zone 4	Walls and floor coated concrete.

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TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Off-Gas Blower Room	Vessel off-gas.	Major decontamination completed.	0.3 to 1.0 R/hr[a] 100-300 mR/hr[c]	Zone 4 10^4 dpm/100cm^2 beta[d] 10^2 dpm/100cm^2 alpha[d]	Coated concrete.
Head End Vent (HEV)	Fission products.		Generally 20-90 mR/hr[c] Filters 1-20 R/hr[c]	Zone 4 10^4 dpm/100cm^2 beta[d] 10^2 dpm/100cm^2 alpha[c]	In operation. Served PMC, GPC, and CPC.
Ventilation Supply Room (VSR)	Background from ventilation exhaust duct.		1-15 mR from ventilation system.	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	In operation.
Ventilation Wash Room (VWR)			1-2 R/hr[a] 1-3 R/hr[c]	Zone 4 10^5 dpm/100cm^2 beta[d] 10^2 dpm/100cm^2 alpha[d]	In operation.
Ventilation Exhaust Cell	Filter area is cause of radiation readings.		1-2 R/hr 10-100 mR/hr[c]	Zone 3 10^3 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	In operation.
Ventilation Duct Work	Mixed fission products.	Flushed with water.	10-400 mR/hr	Variable	Stainless steel welded, except in some laboratories where plastic was used.
Analytical Cell Decontamination Aisle		Decontaminated routinely during operation.		Zone 3	
Chemical Operating Aisle (COA)			Less than 1 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Normal access area.

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Analytical Aisle (ANA)	Background from ventilation duct.	Kept free of smearable contamination.	1-15 mR/hr from ventilation system.	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Normal access area.
Control Room (CR)	Background from ductwork.		2.5 mR/hr[a] 1-6 mR/hr from vent duct[c]	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Normal access area.
Chemical Viewing Aisle (CVA)			Less than 1.0 mR/hr[c]	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Normal acess area.
Decontamination Shop (DCS)			1.5-2 mR/hr		
GPC-MC Operting Aisle (GPA)			1.0-10 mR/hr[c] vent duct 100-300 mR/hr[c]	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	
Lower Extraction Aisle (LXA)			1-40 mR/hr generally; pump niche 100 mR/hr[d]; vent duct 200-400 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	
Mechanical Operating Aisles			0.5-5.0 mR/hr	10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	
Hot Lab	Background from ventilation duct.		1-10 mR/hr[c]	Hoods 10^5 dpm/100cm^2 beta[c] 10^4 dpm/100cm^2 alpha[c] General 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	Four large hoods.

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TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Standards and Quality Control Lab	Analytical standards Plutonium - only 1 gram present in liquid form.	Recently repainted	0.5-2.5 mR/hr spots to 5 mR/hr	Hoods 10^5 dpm/cm^2 beta[c] 10^4 dpm/cm^2 alpha General 10^2 dpm/cm^2 beta 10 dpm/cm^2 alpha	Removable hoods. Some with only fixed contamination.
Alpha Lab	Plutonium and background from ventilation duct.	Hoods have been decontaminated.	3-10 mR/hr from ductwork	Possible fixed contamination on floors.	Removable hoods.
Product Lab	Plutonium and background from ventilation system.		1-50 mR/hr from ductwork	Hoods 10^4 dpm/cm^2 beta[c] 10^2 dpm/cm^2 alpha General 10^2 dpm/100cm^2 beta 1 dpm/100cm^2 alpha	Removable hoods. Some with only fixed contamination.
Mass Spec Lab		Kept as contamination free as possible.	Less than 0.5 mR/hr	10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha	Removable hoods.
Emission Spec Lab	Three segregated sample heads, hot materials, plutonium and uranium - all somewhat segregated.	Two hoods cleaned of all smearable contamination.	0.5-1. mRh/hr	General area 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha	Plutonium primarily confined to large glove box.
Dark Room		Has been kept relatively free of contamination.	∿ less than 0.5 to 1 mR/hr.	Zone 2	
Counting Room	Background from PMC hoist.	Kept as contamination free as possible.	0.5-1 mR/hr from PMC hoist	10^2 dpm/cm^2 beta[c] 1 dpm/cm^2 alpha	

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Old Instrument Shop	Background from ductwork.		25-100 mR/hr	Zone 2 10^2 dpm/cm^2 beta[c] 1 dpm/cm^2 alpha	
Waste Tank Farm (WTF)	Primarily Cs and Sr neutralized liquid high level waste.	Contains liquid waste.		Zone 2 in support buildings	
Low Level Waste Treatment Plant (LLWT)	Low level process waste solution and waste from these solutions		0.5-15 mR/hr generally 0.5-1 mR/hr[c] Loadout 1-5 mR/hr	Operating & Equipment Aisles - Stairwell Zone 2 Centrifuge Zone 3 Drum Filling Station-Zone 4 10^3 dpm/100cm^2 beta 1 dpm/100cm^2 alpha	Facility in use.
Master Slave Manipulator Repair Room (MSM)			10.-10 mR/hr	Zone 3 10^3 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	In operation.
OGC-ARC Aisle (OGA)			0.5-2.0 mR/hr	Zone 2 10^2 dpm/cm^2 beta[c] 1 dpm/cm^2 alpha[c]	Normal access area.
Process Chemical Room (PCR)		Decontaminated.	1-2 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 10 dpm/100cm^2 alpha[c]	
Pulse Equipment Aisle (PEA)		Some decontamination performed	0.5-20 mR/hr[a] 5-20 mR/hr[c] valve niche 100 mR/hr[c]	Zone 3 10^3 dpm/cm^2 beta[c] 10 dpm/cm^2 alpha[c]	
Ram Equipment Room (RER)	Background from PMC cell penetration.		Generally 5 mR/hr spots 80 mR/hr[c] 30 mR/hr[a]	Zone 2 10^2 dpm/cm^2 beta[c] 1 dpm/cm2 alphac	

TABLE 4-8 (Cont'd)

Building Section	Nature of Material	Extent of Decontamination Performed	Dose Rate	Contamination Levels & Airborne Activity	Comments
Upper Extraction Cell (UEA)	Concrete contaminated by pipe break.		1-30 mR/hr[c] spots at ~30 mR/hr	Zone 2 10^2 dpm/cm^2 beta[c] 1 dpm/cm^2 alpha[c]	Area 20 feet by 20 feet involved in spill decontaminated and painted.
Extraction Chemical Room (XCR) (Also called extraction cold chemical		Decontaminated.	Generally less than .5 mR/hr spots to 5 mR/hr	Zone 2 10^2 dpm/100cm^2 beta[c] 1 dpm/100cm^2 alpha[c]	
Extraction Sample Aisle (XSA)			0.5 to 2 mR/hr	Zone 3 10^2 dpm/cm^2 beta[c] 1 dpm/cm^2 alpha[c]	Airlock entrance. Glove box removable.
South Stairwell	Contaminated concrete	Surface decontaminated.	Generally less than 0.5 mR/hr spots to 5-10 mR/hr[a]	Zone 2	Concrete contaminated by pipe break.
Other Stairwells				Zone 2	
Uranium Product Sample Station	Uranium - various degrees of enrichment.	Area decontaminated since last use.	1-10 mR/hr	Contamination fixed or confined to glove box.	
Plutonium Product Sample Station	Plutonium	Area decontaminated since last use.	Less than 0.5 mR/hr	Contamination fixed or confined to glove box.	

[a]Data from Nuclear Regulatory Staff -Interim Safety Evaluation I, August 1977, Docket 50-201

[b]Zone system defined in Table 5.4-2

[c]Data from NFS surveys, March 1978

[d]NFS estimate, March 1978

[e]NFS data, April 1977

TABLE 4-9

Contamination Zone Defintions

Zone Category	Smearable Contamination (dpm/100cm²) Alpha	Beta	Posting and Barriers
Zone 1	≤10	≤100	Clean area outside security fence; not posted
Zone 2	10 to 50	100 to 500	Clean area inside security fence; not posted
Zone 3	50 to 500	500 to 50,000	Posted, rope barrier
Zone 4	≥500	≥50,000	Posted, barrier, and airlock

TABLE 4-10

NFS Estimates of Radionuclide Quantities[a]

Location	Curies Alpha	Curies Beta, Gamma
Reprocessing Plant	125	12,000
Waste Tank		40,000,000
Waste Tank Heel (after removing liquid)	66	50,000
NRC Licensed Burial Ground[b]	530	39,000 Sr 90 + Cs 13[illegible] 500,000 Co-60

a Oral communication from NFS

b Burial ground is not part of the scope of this work, but is included here for perspective

Some onsite soil samples were taken by the New York Department of Conservation (DOC) and are summarized in Table 4-11. The New York DOC concluded from their 1971 samples that "a pattern of local deposition extended in the northwest direction for approximately one and one-half miles."[1] From their 1972 data, DOC detected no Cesium-134 or -137 typical of nuclear fuel processing, but did find evidences of Ruthenium 106 and other radionuclides which may have been deposited from the reprocessing plant's airborne effluents or from worldwide fallout.[2]

The State of New York did not perform soil sampling for Iodine 129, which, as discussed in Section 5, is the principal contributor to dose-to-man from the shut down facility.

Soil samples were taken from the area surrounding the 3,345-acre site and analyzed for Iodine-129 by Battelle Pacific Northwest Laboratories. The results of these samples are summarized in Table 4-12. Other samples were taken of terrestrial and aquatic vegetation, and biota to determine bioaccumulation of Iodine 129.

The Environmental Protection Agency (EPA) also measured Iodine-129 in biota on and around the West Valley site.[3] The agency determined an average ratio of 0.2 μCi Iodine-129 per gram of total iodine in the site vicinity. It has been suggested that 1.4 μCi Iodine-129 per gram of iodine in the human thyroid would yield 500 mrem/year. The dose to an individual whose sole source of iodine was the site vicinity would then be 36 mrem/year to the thyroid. Implications of the iodine dose is discussed further in Section 5.

1 Annual Report of Environmental Radiation to New York State, New York Department of Conservation (New York, 1971).

2 Annual Report of Environmental Radiation to New York State, New York Department of Conservation (New York, 1972).

3 Magno, Reavey, and Apidianakis, Iodine 129 in the Environment Around a Nuclear Fuel Reprocessing Plant, U.S. Environmental Protection Agency (Washington, D.C., 1972).

TABLE 4-11

New York Department of Conservation Soil Samples[a]

Direction & Distance From NFS	Date	Cs-137	Co-60	Cs-134	Sr-90	Remarks
		pCi/kg (wet)				
1250' NW	4/29/71	27,790	N.D.	1,920	3,900	Near Fence
2000' NW	4/29/71	43,200	154	2,520	3,671	Field N. Quarry Creek
2250' NW	4/28/71	1,420	N.D.	168	578	Field
2700' NW	4/29/71	18,150	N.D.	1,127	-	Field S. of Ravine
4750' NW	4/28/71	753	N.D.	125	-	Field
4900' NW	4/29/71	34,410	N.D.	2,027	2,002	Field W. Rock Spring Rd.
5000' SE	4/28/71	1,075	N.D.	172	-	Field
5750' E	4/28/71	993	N.D.	213	-	Field W. Heinz Rd.
7750' N	4/28/71	945	N.D.	267	-	Field S. Bond Rd.
8300' NNW	4/29/71	412	N.D.	118	-	Old Gravel Pit
		pCi/kg (dry)				
1250' NW	4/29/71	66,900	+	3,760	-	
2000' NW	4/29/71	88,200	+	5,240	-	
2250' NW	4/28/71	6,360	+	N.D.	-	
4900' NW	4/29/71	58,500	+	3,520	-	

(Results in pCi/kg)

Station	Date Collected	CS-137	Co-60	Ru-106
Ashford fields east of Buttermilk Creek	5/12/72	3,958	57	8,347

(Results in pCi/kg)

Station	Date Collected	Sb-125	Ru-106	Cs-134
Ashford 100' NW of Old Lagoon for Burial Site	6/14/72	8,500±300	23,700±500	3,390±130
		Cs-137	ZrNb-95	Co-60
		5,370±150	3,800±200	2,600±40(

[a]Data from "Annual Report of Environmental Radiation in New York State," 1971, 1972, and 1973.

TABLE 4-12

Iodine-129 in Soil Surrounding the West Valley Site

(Concentrations ± SE of ^{129}I in Forest and Grass Communitites at West Valley, New York[a]

	(fCi/g dry wt.)
	Forest Communities
Litter	110 ± 48
Surface Soil	97 ± 46
Subsurface Soil	1.1 ± 0.32
	Grass Communities
Litter	5.7 ± 4.3
Surface Soil	9.2 ± 0.30
Subsurface Soil	.35 ± 0.01

[a]BNWL - 195-PT2, UC-48 -- Pacific Northwest Laboratory Annual Report for 1974 to the USAEC Division of Biomedical and Environmental Research.

4.5 Chemical Inventories

Numerous chemicals were used during facility operations. Among those u___ were ion exchange resins, organic solvents, mild oxidizing and reducing agents, and acids and bases.

Some nitric acid, sodium hydroxide, and fuel oil remain onsite in storage tanks. (Some of these chemicals could be used for chemical decontamination and to neutralize residues from decontamination; fuel oil is used in the boilers). Lesser amounts of other chemicals are also present.

Residual quantities of some chemicals may remain in process vessels. these vessels have been flushed and drained so that only small quantities of chemicals are expected.

.0 DISPOSITION CRITERIA

The choice of possible future uses of the West Valley site and fuel reprocessing facility depends upon the degree to which it can be demonstrated to be free of contamination.

This section discusses disposition criteria in conjunction with expected residual radioactive contamination levels, and resultant doses from these levels. The technical approach and assumptions used in determining residual contamination levels and doses are also discussed.

5.1 Existing Guidance

There are no unique regulations or specific guidelines on acceptable maximum annual dose to individuals living on or near a decommissioned site. Guidance that could be interpreted as dose limit recommendations specifically for the cases of interest here include:

- Recommendations of the International Committee on Radiation Protection (ICRP), Publication 9
- Surgeon General's Guidelines (DHEW)
- Appendix I of 10 CFR 50, Guides for Design Objectives for Light Water-Cooled Nuclear Power Reactors (NRC)
- Federal Guidance for the Environmental Limits of Plutonium Contamination in Soil, DRAFT (EPA)
- 40 CFR 190 Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle (EPA)

Each of the above references suggests different maximum dose rate limits. These limits generally range from maximum total body dose rates of 3 to 500 mrem/yr. It is reasonable to expect that if dose limits are promulgated uniquely for the control of public exposure from decommissioned nuclear facilities, that they will probably fall in the range of the lower values, i.e., 1 to 25 mrem/yr.

5.2 Use Categories

Use categories for sites and facilities can be broadly classified as restricted, conditional, or unrestricted. These categories are defined in a manner which offers options for the level of residual contamination that can be left in a facility or at a site.

5.2.1 Restricted Use

The restricted use category permits reuse of facilities and land for nuclear activities only. It is expected that the radioactive contamination levels at the facility and its site will be similar to the levels normally found at operating nuclear facilities. Therefore, the controls imposed for classification in this use category should be consistent with licensing requirements for nuclear facilities. The alternative of placing the facility in layaway or preparing the facility for an alternate nuclear use would employ restricted use limits.

5.2.2 Condition Use

Conditional use is an interim category which permits limited use of a facility or site until unconditional release. Use restrictions include physical barriers, where necessary, to avoid exposure of the members of the public to radiation levels in excess of those permitted in the unrestricted use category. Conditonal release of facilities for uses other than nuclear would most likely require a possession only license from NRC or the State of New York.

Conditional use categories do not exist in regulations, but have been considered in NUREG 0278 and other documents dealing with decommissioning. With the West Valley plant in layaway or protective storage, part of the site (including perhaps the surrounding land or office space) might be released for some non-nuclear use, conditioned upon adequate protection of the public from any radioactivity remaining in the facility, tanks, and burial grounds. Protecting the public would restrict entrance to the facility and possibly prohibit certain agricultural activities (see below). In short, the conditional use category permits higher residual contamination levels than the unrestricted use category, providing that physical barriers and administrative controls will limit potential doses to members of the public to no greater than those established for the unrestricted use category.

5.2.3 Unrestricted Use

Unrestricted release of facilities and/or land necessarily means that the potential dose rate to users of the property, from all possible exposure pathways, will not exceed appropriate limits. Since no constraints are placed upon the use of property in this category, all potential exposure pathways for members of the general public must be considered in establishing the allowable levels of residual radioactive contamination. For land, considerations should be given to people living directly on previously contaminated areas, excavating, growing crops, grazing food animals, and using well water. If the potential dose to any member of the public demonstrated by the analysis of all these pathways is less than the dose limits, then an unrestricted release can be justified.

5.3 Technical Approach

The basic premise for proposed disposition criteria in this study is no member of the general public will receive a dose at a rate in excess of the maximum annual dose (1-25 mrem), and that all doses will be as low as is reasonably achievable. Under no foreseeable circumstance will the predicted dose rate to any member of the general public be permitted to exceed the limits specified for the unrestricted use category.

5.3.1 Facility Contamination

Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, specifies average and maximum levels of fixed surface contamination and acceptable levels of removable contamination. Guidelines from this document, summarized in Table 5-1, have been used in arriving at the procedures, manpower estimates, and waste volume estimates in this study. Similar guidance is presented in the proposed American National Standards Institute (ANSI) Standard N328, summarized in Table 5-2. The New York State sanitary and industrial codes also specify contamination levels which are summarized in Table 5-3.

TABLE 5-1

Regulatory Guide 1.86 Acceptable Surface Contamination Levels

Nuclide[a]	Average[b,c]	Maximum[b,d]	Removable[b,e]
U-nat, ^{235}U, ^{238}U and associated decay products	5,000 dpm /100 cm^2	15,000 dpm /100 cm^2	1,000 dmp /100 cm^2
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above	5,000 dpm /100 cm^2	15,000 dpm /100 cm^2	1,000 dpm /100 cm^2

---

a Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

b As used in this table, dmp (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such subject.

d The maximum contamination level applies to an area of not more than 100 cm^2.

e The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the ...nt of radioactive material on the wipe with an appropriate instrument of known efficiency. When ...vable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

TABLE 5-2

ANSI N328 Surface Contamination Limits (Proposed)

Nuclide	Limit (Activity)[a] dpm/100 cm^2 Total	Removable
Group 1:		
Nuclides for which the nonoccupational MPC[(b)] is 2×10^{-13} Ci/m^3 or less or for which the nonoccupational MPC_W(c) is 2×10^{-7} Ci/m^3 or less[(d)]	100	20
Group 2:		
Those nuclides not in Group 1 for which the nonoccupational MPC_a[(b)] is 1×10^{-12} Ci/m^3 or less or for which the nonoccupational MPC_W[(c)] is 1×10^{-6} Ci/m^3 or less[(d)]	1,000	200
Group 3:		
Those nuclides not in Group 1 or Group 2	5,000	1,000

a The levels may be averaged over one square meter, provided the maximum activity in any area of 100 cm^2 is less than 3 times the limit value.

b Maximum permissible concentration in air applicable to continuous exposure of members of the public as published by or derived from an authoritative source such as NCRP, ICRP or NRC (10 CFR Part 20, Appendix B, Table 2, Column 1).

c Maximum permissible concentration in water applicable to members of the public.

d Values presented here are obtained from 10 CFR Part 20. The most limiting of all given MPC values (e.g., soluble vs. insoluble) are to be used. In the event of the occurrence of mixtures of radionuclides, the fraction contributed by each constituent of its own limit shall be determined and the sum of the fractions must be less than 1.

TABLE 5-3

New York State Contamination Limits
for Uncontrolled Areas

Parameter	State Sanitary Code Part 16 Table 7 Limit	New York State Industrial Code Rule No. 38 Table 5 Limit
Removable alpha	100 dpm/100cm^2	100 dpm/100cm^2 (max) 33 dpm/100cm^2 (avg)
Total (fixed) alpha	2,500 dpm/100cm^2 (max) 500 dpm/100cm^2 (avg)	5,000 dpm/100cm^2 (max) 1,000 dpm/100cm^2 (avg)
Removable beta gamma	1,000 dpm/100cm^2	All except H-3 500 pCi/100cm^2 (max) 100 pCi/100cm^2 (avg) For H-3 5,000 pCi/100cm^2 (max) 1,000 pCi/100cm^2 (avg)
Fixed beta-gamma	0.2 mR/hr at 1cm from surface	.25 mrem/hr at 1 cm from surface
Soil contamination	--	Limits are specified in Table 2 Column 2 of Code Rule No. 38

The facility is currently divided into four zones based on loose surface contamination levels. (See Table 4-9)

In general, Zone 1 conditions exist only in office spaces outside the process building, and Zone 4 conditions exist only inside the process cells. Airborne survey data indicates that maximum loose surface contamination levels inside the cells could exceed 2×10^4 $\mu Ci/m^2$. Fixed contamination levels have not been measured because of the high background. Fixed contamination could be as much as 10 times unrestricted release levels.

Zone 2 and Zone 3 gamma levels range from 1 to 10 mrem/hr. A significant portion of this gamma field is from internally contaminated ductwork that is located in Zones 2 and 3. Gamma levels inside some cells are quite high, with dose rates in excess of 1000 R/hr in some areas.

Decontamination of surfaces, and removal and/or internal decontamination of process equipment, piping, and ductwork is expected to result in the residual contamination levels presented in Table 5-4, based on the assumptions of NUREG 0278.

Release of the facility for unrestricted use following decontamination to Table 5-4 values would not be possible due to residual contamination. However, conditional use of the site might be possible. The conditions imposed would require that entry into Zone 4 be prevented, and that proper surveillance and maintenance be performed to assure that fixed contamination remains fixed. Doses to people working in areas with these contamination levels are presented in Table 5-5 and 5-6. It must be noted that these doses are based on all of the contamination being loose. This assumption is very conservative since most of the contamination is fixed, and actual doses should be much lower than the values shown in these tables.

Restricted use of the facility is feasible. The occupational doses resulting from residual contamination would not interfere with other nuclear work, and the surveillance/maintenance requirements due to the residual contamination would not be a significant burden for the licensee.

TABLE 5-4

Expected Facility Contamination Levels Following General Decontamination $\mu Ci/m^2$

	Zone 1	Zone 2	Zone 3	Zone 4
Sr 90[a]	ND[b]	1.4 E-2	3.5 E-2	3.5 E-1
Y 90	ND	1.4 E-2	3.5 E-2	3.5 E-1
Ru 106+daughters	ND	7.4 E-6	1.8 E-5	1.8 E-4
Sb 125+daughters	ND	2.4 E-5	6 E-5	6 E-4
Te 125^m	ND	--[c]	--[d]	--[e]
Cs 134	ND	1.7 E-4	4.2 E-4	4.2 E-3
Cs 137+daughters	ND	2.2 E-2	5.5 E-2	5.5 E-1
Pm 147	ND	2.6 E-4	6.5 E-4	6.5 E-3
Sm 151	ND	3.9 E-4	9.7 E-4	9.7 E-3
Eu 154	ND	6.6 E-4	1.6 E-3	1.6 E-2
Eu 155	ND	9.2 E-6	2.3 E-5	2.3 E-4
Pu 238	ND	4 E-4	1 E-3	1 E-2
Pu 239	ND	5.5 E-5	1.4 E-4	1.4 E-3
Pu 240	ND	1.6 E-4	4 E-4	4 E-3
Pu 241	ND	9.2 E-3	2.3 E-2	2.3 E-1
Pu 242	ND	5.3 E-7	1.3 E-6	1.3 E-5
Am 241	ND	1.3 E-3	3.2 E-3	3.2 E-4
Am 212M	ND	4.6 E-5	1.1 E-4	1.1 E-3
Am 243	ND	5.5 E-5	1.4 E-4	1.4 E-3
Cm 242	ND	--	--	--
Cm 244	ND	1.1 E-3	2.7 E-3	2.7 E-2
TOTAL	ND	9.2 E-2	2.3 E-1	2.3 E-0

a - Based on isotope composition given on Table D.2-1 Nureg 0278

b - Not detectable above background levels

c - Less 10^{-7}

d - Less 3 E^{-7}

e - Less 3 E^{-6}

TABLE 5-5

Maximum Annual Worker Dose[a] From Expected Residual Facility Contamination (mrem/year)

	Zone 1	Zone 2		Zone 3		Zone 4	
Whole Body[b]	0	2	E-1	5	E-1	5	E-0
Thyroid	0	5.4	E-2	1.3	E-1	1.3	E-0
Bone	0	4.6	E-0	1.2	E+1	1.2	E+2
Lung	0	6.1	E-0	1.5	E+1	1.5	E+2

[a] 40 hour Working Week - No Food Crops

[b] Dose Conversion Factors (mrem/ μCi m^{-2}) from Table 6, NUREG 0278

TABLE 5-6

Population Dose Equivalent from Expected Residual Facility Contamination (Man-rem/year)[a,b]

Whole Body[c]	0.0026
Thyroid	0.0026
Lung	0.020
Bone	0.013

[a] One years exposure. Integrated for 50 years.

[b] Does not include materials depositied prior to shutdown, which are accounted for in population dose from site contamination.

[c] Dose Conversion Factor (Man-rem/Pico-Ci inhaled) from Reg. Guide 1.109.

5.3.2 Site Contamination

There are several approaches to assessing radiation dosage from unrestricted or proposed conditional uses of the West Valley site. Existing data on site contamination levels are incomplete, however, possible doses from unrestricted use have been assessed from limited sampling by two methods. NUREG 0278 reports population dose from depositions of 1 pCi/m^2 from a "reference fuel reprocessing plant". This dose was calculated by assuming a ratio of radionuclides typical of reprocessing commercial reactor fuel using present state-of-the-art methods. Some data on Cesium 137 in soil are available (see Section 4). Assuming depositions are in the ratio predicted in NUREG 0278, site contamination levels have been calculated and are presented in Table 5-7. The resulting dose to the maximum individual and to the general population were determined by applying appropriate scaling factors to the NUREG 0278 dose. The maximum individual and general population doses are presented in Tables 5-8 and 5-9, respectively.

The calculated dose to the maximum individual living onsite and consuming agricultural products from the 3,345 acre site (but not within the facility) is 7.0 mrem per year to the thyroid. If a conditional use which excludes agricultural uses was adopted, this dose would drop to 0.089 mrem per year. Dose to the thyroid from Iodine-129 is the controlling isotope for both these doses.

Using a different dose calculation method, Magno, Reavey and Apidianakis measured the specific activity of Iodine 129 (μCi I^{129} /grams Iodine) in biota onsite. They found an I^{129} to total Iodine ratio which, if present in the human thyroid, would give a thyroid dose of 37 mrem/yr.[1]

While it is unlikely that (even with unrestricted use of the site) an individual might receive his entire iodine burden from site sources, the

[1]Magno, Reavey and Apidianakis, Iodine-129 in the Environment Around a Nuclear Fuel Reprocessing Plant, U.S. Environmental Protection Agency (Washington, D.C., 1972).

TABLE 5-7

Presumed Site Contamination Levels μCi/m²

	Maximum	Average
89 Sr	--	--
90 Sr	3.3 E-3	8.7 E-4
90 Y	3.3 E-3	8.7 E-4
91 Y	--	--
95 Zr	--	--
95 Nb	--	--
103 Ru	--	--
106 Ru	8.5 E-6	2.2 E-6
110 Ag	2.9 E-10	7.6 E-11
125 Sb	6.8 E-6	1.79 E-6
127 Te	--	--
129 Te	--	--
129 I	2.1 E-2	5.5 E-3
131 I	--	--
134 Cs	6.2 E-5	1.6 E-5
137 Cs	5.2 E-3	1.4 E-3
141 Ce	--	--
144 Ce	3.2 E-7	8.4 E-8
147 Pm	7.2 E-5	1.9 E-5
154 Eu	9.8 E-5	2.6 E-5
155 Eu	2.8 E-5	7.4 E-6
234 U	6.5 E-7	1.7 E-7
235 U	1.4 E-8	3.7 E-9
236 U	2.4 E-7	6.3 E-8
236 U	2.6 E-7	6.8 E-8
238 Pu	4.9 E-4	1.3 E-4
239 Pu	6.5 E-5	1.7 E-5
240 Pu	1 E-4	2.6 E-5
241 Pu	4.2 E-3	1.1 E-3
242 Pu	2.8 E-7	7.4 E-8
241 Am	4.9 E-4	1.3 E-4
243 Am	1.5 E-6	3.9 E-7
242 Cm	5.5 E-12	1.5 E-12
244 Cm	7.8 E-5	2.1 E-5
TOTAL	3.9 E-2	1.0 E-2

TABLE 5-8

Maximum Individual Annual Dose from Presumed Site Contamination

(mrem/year)

	Unrestricted[a]	Conditional[b]
Whole Body[c]	1.5 E-1	7.4 E-2
Lung[c]	1.7 E-2	1.3 E-2
Bone[c]	5.2 E-1	7.4 E-2
Thyroid[c]	7 E-0	8.9 E-1

[a] All pathways

[b] No crops

[c] Dose Conversion Factors (mrem/ $\mu Ci \cdot m^{-2}$) from Table 6.4-1, NUREG 0278.

TABLE 5-9

Population Annual Dose from Presumed Site Contamination

(Man-rem/year)

	Unrestricted[a]	Conditional[b]
Whole Body[c]	5 E-2	2 E-2
Lung	5 E-3	1 E-3
Bone	1.6 E-1	2 E-2
Thyroid	2.2 E-0	2.8 E-1

a All pathways
b No crops
c Dose Conversion Factors (mrem/ μCi m^{-2}) from Table 6.4-1, NUREG 0278.

dose from this pathway could exceed established or proposed guidelines. The only certain conclusion that may be drawn from these assessments is that further data collection and dose assessment are required prior to unrestricted use of the site.

5.4 Disposition Criteria for Equipment and Material

The standards presented in Tables 5-1, 5-2 and 5-3 are applicable for decommissioning equipment and materials at the West Valley Fuel Reprocessing Plant. However, the complexities of decontaminating equipment and measuring internal contamination levels are great. Each piece of equipment will have to be dealt with as an individual case. Many pieces of equipment tend to have inaccessible areas, making the measurement required for unrestricted release difficult. Useable pieces of equipment and materials will probably be released for restricted or conditional use. Some of the remaining materials which are amenable to contamination survey might be destructively decontaminated and disposed of by unrestricted burial, while the remaining portion would be disposed of as contaminated waste. It is planned that virtually all equipment and materials would be decontaminated to the extent that contamination levels would allow nonretrievable disposal. Regulatory Guide 1.86, ANSI N328, and New York State limits are given in Tables 5-1 through 5-3.

5.5 Measurement Methods

The surface contamination levels given in Tables 5-1 through 5-3 for direct measurements can for the most part be detected by commercially available portable instrumentation, at least in low background locations. Table 5-10 shows nominal detection levels for several typical used instruments. However, minimum detection levels for direct surveys with such instrumentation are generally limited to the equivalent of the background reading at the survey location (i.e., a detection level of 100 d/m per detector area above a background level of 100 d/m per detector area).

Inside generally contaminated spaces, in the presence of large contaminated equipment items, or over large generally contaminated surfaces, it may be necessary to resort to indirect survey methods to measure required release

TABLE 5-10

Detection Capabilities for Direct Surveys With Portable Instruments

Beta-Gamma Emitters	Nominal Detection Level $\mu Ci/m^2$
Count-rate meters with thin window GM probe	0.1-1[a]
Alpha Emitters	
Count-rate meter with alpha-scintillator probe	0.02
Portable dual-channel analyzer with x-ray scintillator probe	0.02[b]

[a]Highly dependent on beta energy and total nuclide spectrum.

[b]Plutonium in soil.

levels. Smears or samples may be taken and removed to a lower background location or to a counting laboratory.

The limits shown in the tables of this section imply that something is known about the history of the material or the mixture of radionuclides being measured. Although this is generally the case at West Valley, sampling for laboratory identification and the establishment of relationships between portable instrument measurements and specific nuclide contamination levels are highly desirable.

Sampling of bulk materials such as soils has nearly as many variations as practitioners. Practicality limits the fraction of any large area that can be sampled and analyzed. Some uniform system is needed for selecting sampling stations and the number, size, and spacing of sample aliquots at each location, not only for appropriate statistical inferences but for reproducibility and comparability. For soil the problem is further compounded by the variability of overlying vegetation and of included rock and gravel. Regulatory Guide 4.5 provides one commonly used scheme which is generally applicable for soil sampling. Adequate sampling of bulk materials required sampling in depth, 30 to 100 cm in soil depending on climate and history. Sampling depths should be determined impirically for the West Valley site. Soluble radionuclides may show considerable migration, while plutonium normally concentrates in the upper portions of most soil columns.

There is no commonly accepted procedure for translation of surface contamination limits to mass contamination limits or vice versa. However, with reasonable assumptions as to soil bulk density and the volume of soil seen by portable alpha probe, the value of 0.02 $\mu Ci/m^2$ shown in Table 5-10 translates to approximately 0.01 $\mu Ci/kg$, or $\sim 10^4$ times the lower level of detection for laboratory analyses shown in Table 5-11. For all nuclides in environmental media, sample radioanalysis can prove far more sensitivity than is required by any of the proposed limits. Portable instrumentation and some limited radioanalytical capability is available onsite for most analyses. Some samples may be sent to an independent laboratory for quality control purposes.

TABLE 5-11

Detection Capabilities for Environmental Sample Analysis[a]

Analysis	Lower Limit of Detection (LLD)[b] Water (pCi/ℓ)	Vegetation (pCi/kg, Wet)	Soil (pCi/kg, Dry)
^{3}H (HTO)	300	300[c]	---
^{54}Mn	15	150	50
^{59}Fe	30	300	100
$^{58,60}Co$	15	150	50
^{65}Zn	30	300	100
^{89}Sr [c]	10	10	150
^{90}Sr [c]	2	2	30
^{95}Zr-Nb	10	150	100
^{106}Ru-Rh	10	150	100
^{129}I [c]	2	10	---
^{131}I [c]	0.4	2	---
$^{134,137}Cs$	15	150	100
^{140}Ba-La	15	150	100
U [c]	2	50	30
Pu-Alpha [c]	0.01	5	1

[a] This table is based on similar values given in Regulatory Guide 4.8,(22) with adjustments and additions reflecting current experience at a commercial radioanalytical laboratory.

[b] The normal Lower Limit of Detection is defined in HASL 300, Appendix D (Rev. 8/74), (23) at the 95% confidence level. The LLD for radionuclides analyzed by gamma spectrometry will vary according to the number of radionuclides encountered in environmental samples.

[c] After chemical extraction.

Table 5-12 summarizes relative advantages and disadvantages for common methods for determining surface contamination levels. Further discussion of instrument capabilities may be found in LBL-1[1], and of environmental survey techniques in ERDA-77-24[2], and NCRP Report No. 50[3], as well as in the health physics literature.

The recommended procedure for most release surveys consists of initial qualatative survey with portable instruments (aerial survey for large ground surface areas) in conjunction with quantative sampling for nuclide identification, or verification.

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1 Environmental Instrumentation Group, Instrumentation for Environmental Monitoring, LBL-1, Vol. 3 - Radiation, University of California, Lawrence Berkeley Laboratory, Berkeley, CA, 1972.

2 J. P. Corley, et al., A Guide for Environmental Radiological Surveillance at ERDA Installations, ERDA-77-24, U. S. Energy Research and Development Administration, Washington, DC, March 1977.

3 National Council on Radiation Protection and Measurement, Environmental Radiation Measurements, NCRP Report No. 50, NCRP, Washington, DC, 1976.

TABLE 5-12

Comparison of Measurement Methods for Release Surveys

Direct	Advantages	Disadvantages
Portable Instruments[a]	Relatively fast; Relatively inexpensive; Readily available; Able to delineate "hot spots";	Limited sensitivity; Not nuclide-specific; Subject to interferences from high background and surface conditions; For alpha and beta emitters, useful for exposed surfaces only;
Aerial Survey	Extremely fast;	Useful in general for gamma emitters only[b]; Insensitive to small areas;
Indirect		
Smears, scraping	Avoidance of high background interference;	Not indicative of total activity present; Highly variable results; Incomplete coverage of large surfaces; Not applicable to loose or confined materials;
-with direct field	Relatively fast; Relatively inexpensive;	Not nuclide-specific;
-with laboratory counting	Nuclide identification possible (but more expensive); Greater sensitivity than direct field count;	Relatively slow;
Sampling and Laboratory Analysis	Nuclide-specific; Highly sensitive;	Relatively slow; Relatively expensive; Applicable only when sample of material can be taken to laboratory; Provides data for only small part of total surface;

[a] See Table 5-1 for typical examples and detection levels.

[b] With special calibrations, aerial surveys may be useful for large area fo TRU , but not to release levels specified

.0 DECOMMISSIONING METHODS AND COST

Four decommissioning modes are considered in this study--layaway, protective storage, preparation for alternate nuclear use, and dismantlement. The activities associated with each of these modes can be divided into three phases:

- Planning and Preparation—During this period, the decommissioning plan is prepared, necessary documents are submitted to regulatory agencies for review and licensing action, the decommissioning personnel are assembled, procedures are prepared, and any required special tooling is researched and developed or procured. Planning is expected to require one to two years.

- Decommissioning Operations—Activities which implement the decommissioning plan range from minimal cleanup and equipment deactivation for layaway to removal of all equipment and buildings for dismantlement. Decommissioning operations range from six months for layaway to four years for dismantlement.

- Interim Care—After the basic decommissioning operations have been completed, continuing maintenance and surveillance may be required until the facility is reactivated, dismantled, or converted to alternate use. (Interim care is considered only for layaway and protective storage.)

Conceptual decommissioning procedures for each of the four modes were developed using presently available decommissioning techniques. Techniques selected for application to various portions of the facility are based on engineering judgement of a reasonable balance between safety and costs.

In this section, estimated quantities of wastes generated, and methods for packaging and transporting the wastes are discussed as applicable under each of the four modes. Also presented for each mode are the manpower requirements for carrying out decommissioning procedures, total decommissioning costs, occupational radiation exposure anticipated, and an assessment of public worker safety. (These data are summarized in Section 1.0)

(NOTE: West Valley Plant facilities are predominantly referred to in Section 6.1 through 6.4 by abbreviations. For reader convenience, a reference foldout of these abbreviations and their meanings is provided as Table 6.4-31. They are also listed alphabetically in the Abbreviations, Symbols, and Definitions section of this report.)

6.1 Layaway

Layaway is designed to place the facility in a condition that provides protection to the public and the environment from residual radioactivity, while requiring a minimum initial expenditure. A minimal amount of activity is required to place the facility in layaway. Tasking consists of overall facility cleanup and deactivation of equipment not required for interim care.

Once layaway status has been achieved, activities at the site during the interim care period are limited to inspection and maintenance of safety and security systems, and facility and environmental radiation surveillance. The facility is manned on a continuous basis during interim care in order to operate and maintain safety-related systems. The chain link perimeter fence is maintained and guarded, and no unauthorized entry is permitted.

6.1.1 End Product Description

The West Valley Plant is presently in a status near that of layaway. The processing operation is shut down; however, the fuel storage basin contains about 160 metric tons of uranium in spent fuel elements. In the layaway mode, these fuel elements would be shipped to other offsite storage. The basin would be drained and decontaminated, and any residual contamination would be fixed with paint.

The reprocessing piping and equipment has been internally decontaminated by flushing; additional internal decontamination of it would be minimal. The ventilation system would be kept operational to assure confinement of contamination within the closed areas. The two high level liquid waste storage tanks, presently containing a large quantity of contaminated liquid, would remain "as is" in the layaway mode. Continual monitoring for tank leaks would be provided.

NOTE: A reference list of plant facilities is provided as Table 6.4-31.

6.1.2 Planning and Preparation

Planning and preparation activities required for layaway are minim Most layaway activities could be conducted under the present operating license; however, it is most likely that a document would be submitted to NRC to amend the facility license from an operating to a possession-only license. This submittal may include a master decommissioning plan and safety analysis, a set of revised technical specifications that will govern the interim care period after layaway activities are completed, and an environmental report or environmental assessment.

The master decommissioning plan would include layaway objectives for the facility and site, a description of layaway activities including a schedule of events, an analysis of the significant safety issues associated with layaway activities, and an overview of the layaway Quality Assurance (QA) plan. Acceptable contamination levels for unrestricted use of auxiliary facilities and excess equipment would be established. The safety analysis requirements have not been fully identified by NRC, but are expected to include an estimate of radioactive inventories in the facility, as well as reviews of public health and safety, and industrial and radiological safety programs covering decommissioning activities and the interim care period. Unrestricted release criteria would be identified along with acceptable survey methods.

A set of revised technical specifications is required because plant conditions will have changed following layaway activities. Layaway activities might be conducted under the existing specifications, possibly with some minor revisions.

The QA program would not require extensive effort since the existing program can be adapted to layaway and submitted as part of the document to NRC. Planned layaway activities will follow plant maintenance and operating procedures whenever possible.

The environmental report provides NRC with the basic information necessary to assess the environmental impact of the layaway activities.

For estimating decommissioning costs in this study, the environmental report required for layaway is expected to require only a modest effort.

Following submittal of the license modification package to NRC for review, the decommissioning staff would respond to questions from the Commission and/or requests to furnish additional information. Modifications to the decommissioning plan, environmental report, and technical specifications may result from the NRC reviews. Public hearings on the environmental impacts of the decommissioning plan may be required before NRC issues an Environmental Impact Statement or a Negative Declaration of Environmental Impact. When the review process has been completed and all safety-related issues resolved, the modified license will be issued.

Major layaway planning activities, along with the approximate time period over which they should take place, are presented in Figure 6.1-1.

6.1.3 Methods

These activities begin with cleanup/housekeeping of the cells, particularly the PMC and GPC. Next, radioactive surface contamination in accessible areas of the plant will be removed. Contamination that cannot be readily removed will be fixed in place with paint. Remaining fuel in the FRS basin will be removed, and the basin drained. Any residual contamination will be removed or affixed with paint. An alternate to this is to continue operating the FRS. This may be required if an acceptable alternate storage location cannot be found.

All systems and equipment not required for interim care will be deactivated. All safety-related systems such as building ventilation, fire protection, and radiation monitoring equipment will be inspected for maximum reliability during the interim care period. Additional safety devices required for facility surveillance and security, such as high security locks, barricades, and intrusion alarms, will be installed.

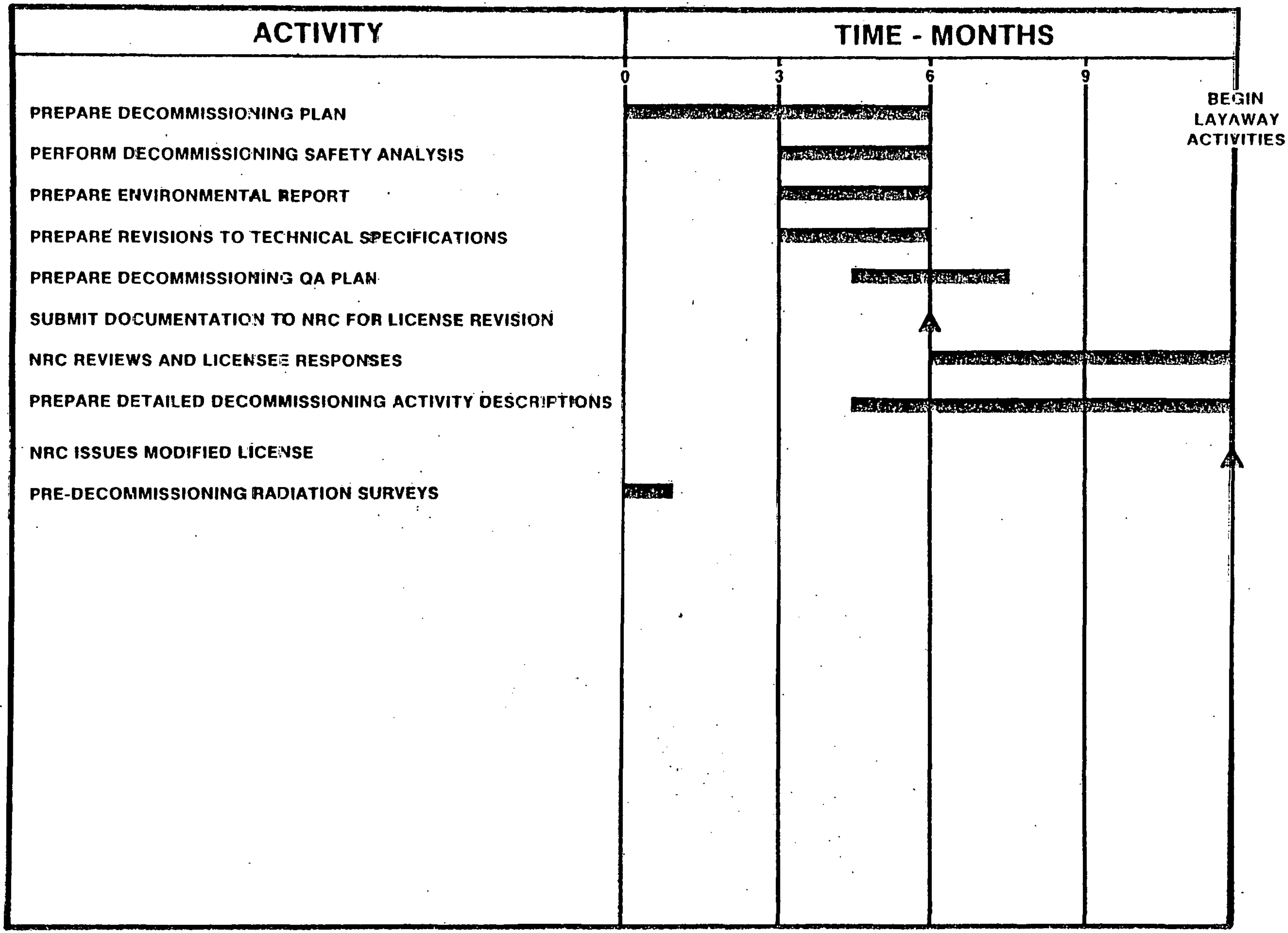

FIGURE 6.1-1

Approximate Schedule of Events for Layaway Planning and Preparation

The high level liquid waste stored in the tanks will remain, and surveillance and security in this area will continue as it did during operation. Layaway activities will include inspection and survey of the tank farm shelters as well as other auxiliary facilities.

For the purposes of this report, the West Valley Plant was divided into four major sections: main process building, fuel receiving and storage area, waste tank farm, and auxiliary facilities. The activities to be performed in each of these facility sections are outlined in Table 6.1-1, and a tentative schedule is presented in Figure 6.1-2.

6.1.3.1 Main Process Building

Tasks begin with the removal of loose contamination in the PMC and GPC. Decontamination methods to be used include vacuuming and washdown with high pressure decontamination sprayers. Internal chemical decontamination of the PPC and XCs was performed at shutdown in 1972 and further flushes may not be required in these areas. Decontamination solutions will be sent to the evaporators in the CPC. Overheads will go to LLWT. Concentrated waste will be added to the WTF wastes.

Internal and external decontamination solutions may contain detergents, wetting agents, chealating agents (such as EDTA), and mild acids and bases (such as dilute nitric acid or bicarbonate solutions). Reviews of operational records and empirical test conducted during planning will be used to select chemicals.

The exhaust ductwork connecting the VWR with the HEPA filters represents the most highly accessible contamination and will require internal decontamination or replacement. Conventional decontamination solutions will probably be effective. All other ductwork is to remain in "as is" condition, with HEPA filters changed as necessary.

The glove boxes in the laboratories and plutonium loadout station will be sealed. Gloves will be removed and rigid plastic covers will be placed over the ports.

Accessible areas of the facility such as the corridors, laboratories, and other areas where smearable contamination could exist will be surveyed and painted as necessary. The painting (using a distinctively

TABLE 6.1-1

Outline of Layaway Activities

Main Process Building

1. Chemically decontaminate internals of process equipment and piping.
2. Vacuum loose materials from PMC and GPC.
3. Chemically decontaminate cell walls and equipment externals.
4. Decontaminate glove boxes and hoods.
5. Decontaminate ventilation system; change out filters as necessary.
6. Survey and fix residual contamination in accessible areas.
7. Deactivate systems and utilities not required for interim care.
8. Perform final radiation survey of the facility.

Fuel Receiving and Storage (Layaway Condition)

1. Remove stored spent fuel from basin.
2. Drain storage basin and remove solids.
3. Decontaminate basin, CUP and storage racks.
4. Seal access hatch between PMC and FRS basin.
5. Remove and/or fix smearable contamination in basin area.
6. Remove and/or fix smearable contamination in other areas and deactivate cranes.
7. Decontaminate ventilation system; change out filters as necessary.
8. Deactivate systems and utilities not required for interim care.
9. Perform final radiation survey of FRS.

Fuel Receiving and Storage (Continued Operation)

1. Perform radiation survey only.

Waste Tank Farm (Shelters Only)

1. Survey and decontaminate support systems as required.
2. Perform final radiation survey of WTF.

Auxiliary Facilities

1. Install small package boiler system to replace existing system.
2. Survey facilities outside of the exclusion area to unrestricted release levels.

TABLE 6.1-1 (Cont'd)

Auxiliary Facilities (Cont'd)

3. Survey, decontaminate and/or fix contamination in facilities within the secured area.
4. Deactivate systems and utilities not required for interim care.
5. Perform final radiation survey of auxiliary facilities.

ACTIVITY	TIME - WEEKS
MAIN PROCESS BUILDING	
INTERNAL DECONTAMINATION OF PROCESS EQUIPMENT	6
EXTERNAL DECONTAMINATION OF CELLS AND EQUIPMENT	8
DECONTAMINATE GLOVE BOXES AND HOODS	4
DECONTAMINATE VENTILATION SYSTEM	3
SURVEY AND FIX RESIDUAL CONTAMINATION IN ACCESSIBLE AREAS	7
DEACTIVATE SYSTEM AND UTILITIES NOT REQUIRED	2
FUEL RECEIVING AND STORAGE (IF PLACED IN LAYAWAY)	
REMOVE STORES SPENT FUEL	15
DRAIN STORAGE BASIN	10
DECONTAMINATE BASIN AND STORAGE RACKS	4
REMOVE AND/OR FIX RESIDUAL CONTAMINATION	2
DECONTAMINATE VENTILATION SYSTEM	1
DEACTIVATE SYSTEM AND UTILITIES NOT REQUIRED	1
WASTE TANK FARM (SHELTERS ONLY)	
SURVEY AND DECONTAMINATE SUPPORT SYSTEMS	4
AUXILIARY FACILITIES	
INSTALL PACKAGE BOILER	3
SURVEY, DECONTAMINATE, AND FIX CONTAMINATION AS NECESSARY	5
DEACTIVATE SYSTEM AND UTILITIES NOT REQUIRED	1
BEGIN INTERIM CARE	▲

FIGURE 6.1-2

Schedule of Major Layaway Activities

color that identifies level of contamination) is done to prevent contamination from becoming airborne. The location and characteristics of each such area will be noted in the permanent records of the layaway operation.

Equipment and systems are not necessary to maintain the facility in a safe condition will be deactivated. All process equipment, valves, circuit breakers, etc., will be tagged and deactivated. The tag will identify the piece of equipment, the system to which it belongs, and its layaway condition.

The systems that are to remain in operation throughout the interim care period will provide a means for minimizing environmental releases. The equipment in these systems will be inspected and modified as appropriate to reduce interim care costs.

- Ventilation
  Most of the ventilation system's equipment will remain intact and in operation. Normal ventilation pathways will be maintained. Ventilation flow rates will be reduced to levels that will prevent the spread of contamination. Filters will be replaced unless replacement is determined to be unwarranted. Heating and cooling systems will operate at reduced levels (cooling is used primarily for humidity control, and heating is used only to prevent freezing or other equipment damage).

- Fire Protection
  All firefighting and fire detection systems will remain operational.

- Radiation Monitors
  Radiation monitors and alarms will remain in operation at strategic locations throughout the main process building. The location of some devices may be changed and some additional devices may be installed to assure that all areas are adequately covered. Effluent and environmental monitoring systems will also be maintained in operation.

- Backup Power

  The emergency electrical system will be maintained to run the radiation monitoring and alarm, and fire protection systems in the event of the loss of normal electrical power. Steam is also required for a backup power system and will be supplied by a small "package" boiler installed as part of the modifications to the auxiliary facilities.

6.1.3.2 Fuel Receiving and Storage Area

If the FRS is placed in layaway, operations begin with the removal of the spent fuel assemblies using existing methods and procedures. The fuel will be sent to an approved offsite fuel storage facility. (One has not been identified with capacity for this fuel, and the cost of fuel transportation and storage has not been included.) Draining and decontamination of the pool follows. The water will be treated at the low level waste treatment facility and discharged to the onsite lagoons for sampling prior to discharge to Buttermilk Creek. Any heel or sludge remaining will be removed with an underwater vacuum cleaner. Solids will be collected on filters placed in the vacuum discharge. A high pressure water sprayer will be used to wash down contaminated equipment, walls, and floors. Any residual contamination will be fixed with paint.

The FRS cranes and other equipment not required during the interim care phase will be deactivated. Radiation monitoring, fire alarm, and ventilation systems will remain in operation. Ventilation flow rates will be reduced to levels that will maintain slight air flow. High security locks will be installed on all exterior doors, and remote reading intrusion alarms will be installed at selected locations to notify the security force of unauthorized entry.

6.1.3.3 Waste Tank Farm

There are no major activities involved in placing the WTF in layaway; it will be left in its existing condition. Present technical specifications delineate allowable operating conditions of the WTF. The area will be surveyed and maintenance/surveillance will be conducted during the interim care period to keep the system in compliance with current specifications.

6.1.3.4 Auxiliary Facilities

Auxiliary facilities outside of the security fence include the administration building, guard house, electrical sub-station, environmental laboratory, and farm. These are expected to be uncontaminated, but will be surveyed for unrestricted release. Auxiliary facilities inside the security fence include the warehouse, cooling tower, maintenance shop, utility room, temporary pipe shop, meteorology station, and laundry building. Only the laundry building is expected to be contaminated, and only slightly so. The laundry facility will be needed during the interim care period following layaway, so will remain operational.

The utility room, adjacent to the main process building, contains a large boiler which will be deactivated and replaced by a small package boiler to supply steam for required backup power systems. This measure will both conserve energy and reduce interim care costs.

6.1.4 Wastes and Waste Disposal

A minimal quantity of waste will be generated in the layaway mode. These wastes will include the contaminated wash down solutions and combustible and noncombustible trash (protective clothing, contaminated tools, paper, plastic, metal scrap, filter medias, basin solids, etc.).

Decommissioning wastes will be segregated and categorized as transuranic (TRU) and nontransuranic (non-TRU) for disposal purposes. TRU wastes will be shipped to interim storage or to a federal repository; non-TRU wastes will be disposed of either in the onsite burial ground, or at a commercial site either 1000 or 3000 miles from West Valley.

Volumes of waste are UNI estimates based on a study of the West Valley facility. Volume and packaging information for wastes generated in layaway are presented in Table 6.1-2.

6.1.5 Manpower

Estimates of the work force required to place the West Valley Reprocessing Plant in layaway are presented in this section. This work force would also provide security and maintenance of the facility during planning and work performance. The project organization for planning and performing the work to place the facility in layaway status is presented in Figure 6.1-3. The organization which would function to provide interim care for the facility in layaway is presented in Figure 6.1-4.

Requisite support staff and craftsman labor is summarized in Tables 6.1-3 and Table 6.1-4 respectively. Craft labor for interim care is included with the support staff in Table 6.1-3.

Tables 6.1-5 through 6.1-8 provide the manweek estimates for work on each portion of the facility: the main process building, FRS, WTF, and auxiliary facilities, respectively. If continued operation of the fuel storage basin is required, then no manpower or cost would be required for decommissioning it; however, the size of the security force would be greater.

The manpower to transport and dispose of the waste is not estimated here, but is considered in developing the waste disposal cost estimate presented in Section 6.1.6.

The estimated 67.4 manyears required to place the facility in layaway includes 53.7 manyears of management and support staff, and 13.7 manyears of craft labor. This estimate assumes that the storage basin is also placed in layaway.

TABLE 6.1-2

Volume and Packaging Data for Wastes Generated in

Placing the Facility in Layaway

Waste Category	Shipping Volume (ft^3)	Weight (Tons)	Container Type	Number of Containers	Number of Shipments
Non-TRU - From Treatment of Low Level Liquid Waste	270	9.5	55-gal Drums	36	1
Non-TRU - Filters	1,100	5.5	Plywood Box	46	1
Non-TRU - Trash	5,000	75.0	55-gal Drums	680	10
TRU Wastes	100	3.5	Steel Canister	1	1
TOTALS	6,470	93.5	---	---	13

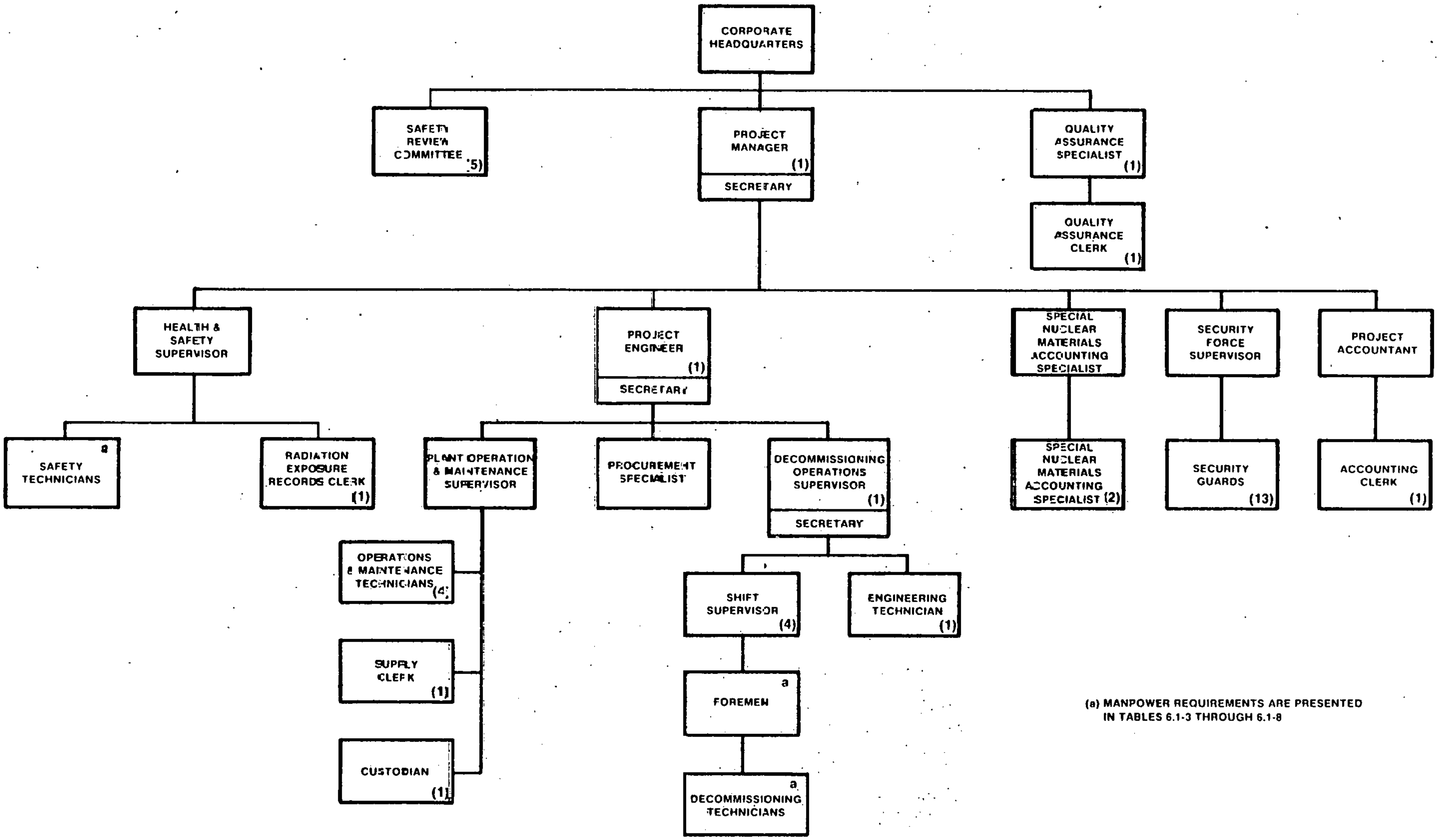

FIGURE 6.1-3

Staff Organization for Layaway Activities

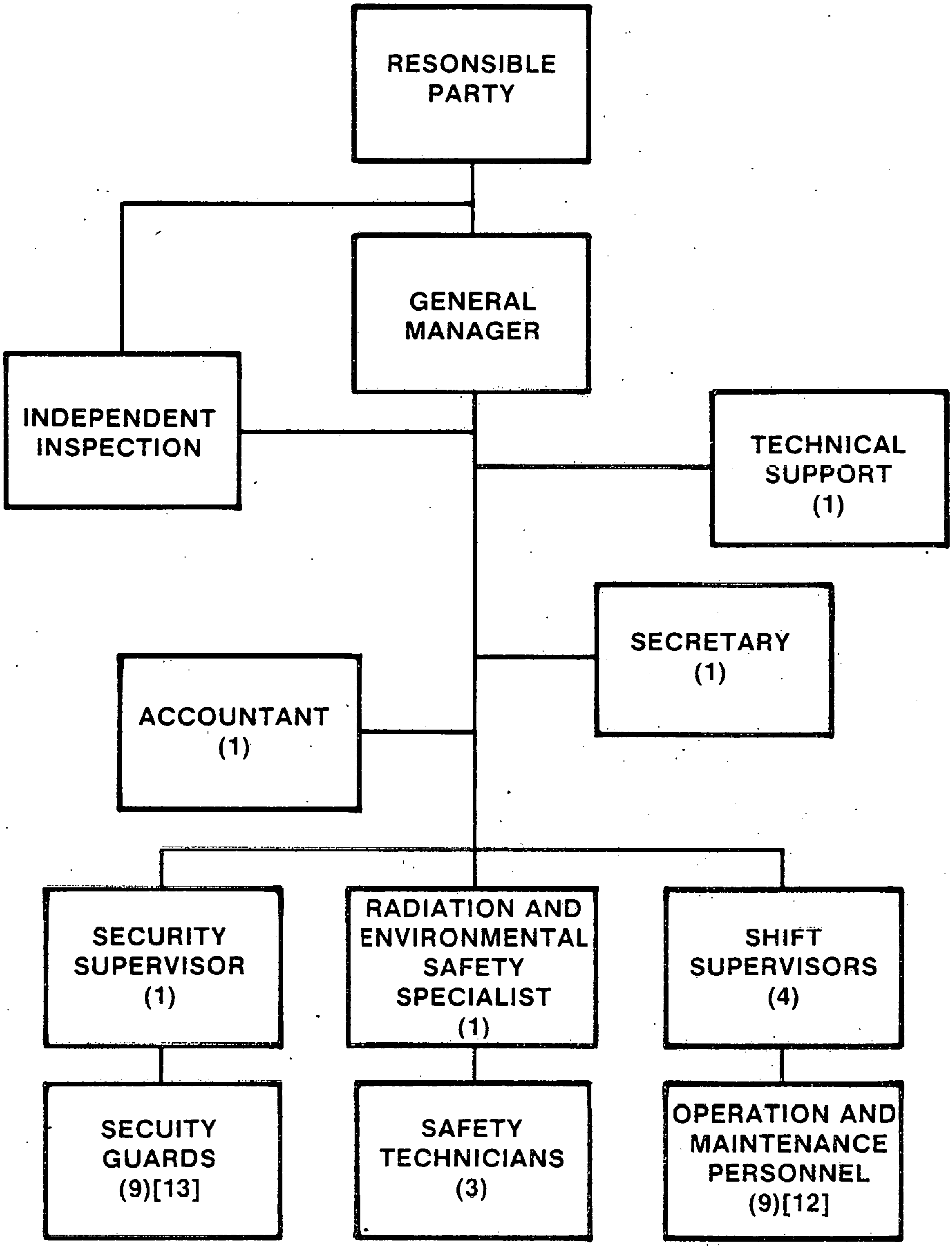

FIGURE 6.1-4

Organization for Interim Care—Layaway

TABLE 6.1-3

Summary of Estimated Support Staff Labor Requirements
—Layaway

Employees (No.)	Manyears of Labor: Planning Phase	Manyears of Labor: Decommissioning Operations	Annual Interim Care Labor[a]
Project Manager Personnel			
Project Manager	1	0.8	1
Quality Assurance Personnel			
Quality Assurance Specialist	1	0.8	
Quality Assurance Clerk	0.1	0.6	
Decommissioning Operations Personnel			
Project Engineer	1	0.8	
Decommissioning Operations Supervisor	1	0.8	
Operations and Maintenance Supervisor	1	0.5	
Engineering Technician	1	0.5	
Operation and Maintenance Technicians (4)	4	2	9 [12]
Shift Supervisor (4)	4	2	4
Health and Safety Protection Personnel			
Safety Review Committee (5)	--[b]	--[b]	
Health and Safety Supervisor	1	0.8	1
Safety Technicians	0.1	--	3
Radiation Exposure Records Technician	0.1	0.6	
Safeguards and Security Personnel			
SNM Accounting Specialist	0.3	0.6	
SNM Accounting Technicians (2)	0.1	1	
Security Force Supervisor	1	0.6	1
Security Guards (9)	9 [13]	4.5 [6.5]	9 [13]
Support Services Personnel			
Procurement Specialist	0.5	0.5	
Supply Clerk	0.5	0.5	
Custodian	1	0.6	
Accountant	1	0.8	1
Accounting Clerk	0.3	0.6	
Secretaries (3)	3	1.8	1
TOTALS	32 [36]	21.7 [23.7]	30 [37]

[a]Interim care includes the equivalent of one person furnished full time by the responsible party to provide technical support.
[b]Committee consists of 5 members meeting 1 day per month.

[ ] Values in brackets are manpower figures with fuel in storage.

TABLE 6.1-4

Summary of Estimated Craftsmen Labor Requirements — Layaway (with No Future Spent Fuel Storage[a])

(In Manyears)

Activity		Foreman	Safety Technician	Decommis-sioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building	1.3	1.7	4.8	1.3	0.1	--	0.1	0.1	1.2	10.5
B.0	FRS	0.2	0.2	1.0	--	0.2	--	--	--	0.2	1.8
C.0	Tank Farm (Shelter only)	--	0.2	--	--	--	--	--	--	--	0.2
D.0	Auxiliary Facilities	0.1	0.3	0.2	--	0.1	0.1	0.1	0.3	--	1.2
	TOTAL Manyears	1.6	2.3	6.0	1.3	0.4	0.1	0.2	0.4	1.4	13.7

[a] If spent fuel storage is to be continued, delete item B.0.

TABLE 6.1-5

Craftsmen Labor Requirements to Place Process Building in Layaway

(In Manweeks)

Activity		Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building										
A.1	Decon process equipment & piping internally.	18	18	72	18	--	--	--	--	18	144
A.2	Decon external surfaces of cell walls, equipment, piping and vessels.	32	32	128	32	--	--	--	--	32	256
A.3	Decon glove boxes and hoods.	4	4	16	4	--	--	--	--	8	36
A.4	Decon ventilation system and change filters.	3	3	12	3	3	--	--	--	6	30
A.5	Survey & fix residual contamination in accessible areas.	4	16	16	4	--	--	--	--	--	40
A.6	Deactivate system & utilities not required for interim care.	2	2	4	--	--	--	4	4	--	16
A.7	Final radiation survey.	3	12	3	6	--	--	--	--	--	24
	TOTAL Manweeks	66	87	251	67	3	--	4	4	64	546
	TOTAL Manyears	1.3	1.7	4.8	1.3	0.1	--	0.1	0.1	1.2	10.5

Craftsmen Labor Requirements to Place FRS in Layaway

(In Manweeks)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
B.0	FRS										
B.1	Removal of stored spent fuel.	3	3	6	--	3	--	--	--	--	15
B.2	Drain basin & remove solids.			20	--	--	--	--	--	--	20
B.3	Decon basin & storage racks.	4	4	16	--	4	--	--	--	4	32
B.4	Decon ventilation system & change filters.	1	1	4	--	1	--	--	1	2	10
B.5	Survey & fix residual contamination.	1	2	2	--	--	--	--	--	2	7
B.6	Deactivate systems & utilities not required for interim care.	1	1	1	--	--	--	1	1	--	5
B.7	Final radiation survey.	1	2	2	--	--	--	--	--	--	5
	TOTAL Manweeks	11	13	51	--	8	--	1	2	8	94
	TOTAL Manyears	0.2	0.2	1.0	--	0.2	--	--	--	0.2	1.8

TABLE 6.1-7

Craftsmen Labor Requirements to Place WTF in Layaway (Shelters Only)

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
C.0 WTF (Shelters Only)										
C.1 Survey and decon support systems as required.	1	6	--	--	--	--	--	--	--	7
C.2 Final radiation survey.	--	2	--	--	--	--	--	--	--	2
TOTAL Manweeks	1	8	--	--	--	--	--	--	--	9
TOTAL Manyears	0.02	0.2	--	--	--	--	--	--	--	0.2

TABLE 6.1-8

Craftsmen Labor Requirements to Place Auxiliary Facilities in Layaway

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
D.0 Auxiliary Facilities										
D.1 Install small boiler system.	3	--	--	--	3	6	6	12	--	30
D.2 Survey facilities outside secured area for unrestricted use.	1	4	2	--	--	--	--	--	--	7
D.3 Survey, decon and/or fix contamination within secured area.	--	4	4	--	--	--	--	--	--	8
D.4 Deactivate systems and utilities not required for interim care.	1	--	2	--	1	1	--	1	2	8
D.5 Final radiation survey.	--	8	--	--	--	--	--	--	--	8
TOTAL Manweeks	5	16	8	--	4	7	6	13	2	61
TOTAL Manyears	0.1	0.3	0.2	--	0.1	0.1	0.1	0.3	0.04	1.2

The manpower for interim care of the facility in layaway is estimated to require the equivalent of a full time effort from 30 people, plus the safety review committee. These people will be required to provide security, maintenance and surveillance for the high level liquid waste in storage, as well as the remainder of the facility. If fuel storage continues, an additional seven people would be required.

6.1.6 Occupational Radiation Exposure

The occupational radiation exposure estimate to place the facility in layaway was estimated to be 141 man-rem. Of this, 48 man-rem is estimated for the fuel storage area. In preparing the facility for layaway, most operations including internal and external decontamination would be performed remotely. Only the decontamination of the ventilation system will require significant personnel exposure.

In arriving at these estimates, it was assumed there would be judicious attention to the ALARA (as low as reasonably achievable) philosophy. The estimates shown in Tables 6.1-9 through 6.1-12 assume that 10 hours per week are spent performing work requiring no occupational radiation exposure, and that the majority of the remaining work is done in low background areas within the building.

6.1.7 Costs

This section describes the method of cost calculation, the cost in 1978 dollars to place the West Valley facility in layaway, and the cost to provide interim care for the facility prior to final disposition.

The costs of placing the facility in layaway and of caring for the facility in this status vary with the decision on disposition of the storage basin. If the basin remains in use, decommissioning operation costs would be lessened, but security costs during decommissioning and interim care would be greater. This larger security costs would undoubtedly be more than offset by fuel storage fees. Layaway costs were estimated assuming none of the work would be performed by subcontractors. Cost were divided into five principal categories:

TABLE 6.1-9

Occupational Radiation Exposure Estimate to Place Process Building in Layaway

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
A.0 Process Building							
A.1 Decon process equipment and piping internally.	144	4320	3	4300	0.1	20	14.9
A.2 Decon external surfaces of cell walls, equipment, piping, and vessels.	256	7680	3	7660	0.1	20	25
A.3 Decon glove boxes and hoods.	36	1080	3	1060	.010	20	3.4
A.4 Decon ventilation systems and change filters.	30	900	5	896.5	0.2 20	3 0.5	15.1
A.5 Survey and fix residual contamination in accessible areas.	40	1200	2	1200	--	--	2.4
A.6 Deactivate systems and utilities not required for interim care.	16	480	2	480	--	--	1
A.7 Final radiation survey.	24	720	2	720	--	--	1.4
							63.2

TABLE 6.1-10

Occupational Radiation Exposure Estimate to Place FRS in Layaway

Activity		Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
B.0	FRS							
B.1	Removal of stored spent fuel.	15	450	10	400	.01	50	2.5
B.2	Drain basin & remove solids.	20	600	5	550	0.1	50	7.8
B.3	Decon basin & storage racks.	32	960	5	900	0.5	60	34.5
B.4	Decon ventilation system & change filters.	10	300	5	299	1	1	2.5
B.5	Survey & fix residual contamination.	7	210	2	210	--	--	0.4
B.6	Deactivate systems & utilities not required for interim care.	5	150	2	150	--	--	0.3
B.7	Final radiation survey.	5	150	2	150	--	--	0.3
								48.3

TABLE 6.1-11

Occupational Radiation Exposure Estimate to Place WTF in Layaway

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
C.0 TANK FARM (Shelters Only)							
C.1 Survey and decon support systems as required	7	210	3	205	0.1	5	1.1
C.2 Final radiation survey	2	60	2	60	--	--	0.2
							1.3

TABLE 6.1-12

Summary of Occupational Radiation Exposure Estimates
—Layaway

Process Building	63.2
FRS	48.3
WTF (Shelters only)	1.2
Auxiliary Facilities	∿0
Subtotal	112.7
+ 25% Contingency	28.2
TOTAL	140.9 Man-rem

- Support Staff Labor
- Craftsmen Labor
- Equipment and Materials
- Shipping and Waste Disposal
- Utilities and Other Expenses

The cost to place the entire facility in layaway, if waste materials are being shipped to a disposal site 1000 miles from West Valley, is estimated at $5.58 million. See Table 6.1-13. If it is decided to ship waste materials to a site 3000 miles distant, the estimate is increased to $5.69 million. If the non-TRU wastes are to be buried onsite at West Valley and TRU wastes transported 1000 miles for burial, the cost estimate decreases to $5.53 million.

The cost to place most of the facility in layaway, but leave the storage basin as is in operable condition, is outlined in Table 6.1-14. Due to the increased security requirements, these costs are about $214,000 more than the estimate for layaway of the entire plant and its related facilities.

The basis for each portion of the overall cost estimate is outlined in the following paragraphs.

6.1.7.1 Labor Costs (Support staff and craftsmen)

Manpower requirements are summarized in Section 6.1.5. To convert from manyears to cost, labor rates were established for each employee classification and an adder of 70 percent to cover benefits and overheads was applied to determine owner cost. To arrive at staff support cost, an additional 10 percent was added to cover facility owner's administrative expense. These pay rates and owner costs are presented in Table 6.1-15. Craftsman labor and support staff costs are detailed in Tables 6.1-16 and 6.1-17.

TABLE 6.1-13

Summary of Layaway Cost Estimates[a]
(With no Further Spent Fuel Storage)

Expense Item	Costs (Thousands of 1978 Dollars) Planning	Decommissioning Operations	Total
Support Staff Labor	1,254	851	2,105
Craftsmen Labor	---	471	471
Subcontractor Activities	---	---	---
Equipment and Materials	13	497	510
Shipping and Waste Disposal			
1000-mile Shipment	---	374	374
3000-mile Shipment	---	460	460
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes	---	332	332
Utilities and Other Expenses	598	406	1,004
1000-mile Shipment TOTAL[b]	2,331	3,249	5,580
3000-mile Shipment TOTAL[b]	2,331	3,357	5,688
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes TOTAL[b]	2,331	3,197	5,528

[a]Interim Care cost estimates for Layaway are presented in Table 6.1-24.

[b]Includes 25% contingency.

TABLE 6.1-14

Summary of Layaway Cost Estimates
(Excluding Storage Basin)

Expense Item	Costs (Thousands of 1978 Dollars) Planning	Decommissioning Operations	Total
Support Staff Labor	1,366	908	2,274
Craftsmen Labor	---	408	408
Subcontractor Activities	---	---	---
Equipment and Materials	63.0	512.0	575.0
Shipping and Waste Disposal			
1000-mile Shipment	---	374	374
3000-mile Shipment	---	460	460
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes	---	332	332
Utilities and Other Expenses	598	406	1,004
1000-mile Shipment TOTAL[a]	2,534	3,260	5,794
3000-mile Shipment TOTAL[a]	2,534	3,368	5,902
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes TOTAL[a]	2,534	3,208	5,742

[a]Includes 25% Contingency.

TABLE 6.1-15

Pay Rates[a] and Owner Costs For Decommissioning Employees — Layaway

Employee	Annual Base Pay	Annual Owner Cost
Project Manager	43,000	73,100
Project Engineer	35,000	59,500
Health & Safety Supervisor	33,000	56,100
Quality Assurance Specialist	29,000	49,300
Decommissioning Operations Supervisor	32,000	54,400
Plant Operations & Maintenance Supervisor	32,000	54,400
Radiation Safety Specialist	24,000	40,800
Industrial Safety Specialist	25,000	42,500
SNM Accounting Specialist	25,000	42,500
Accountant	22,000	42,500
Radioactive Waste Disposal Specialist	22,000	42,500
Procurement Specialist	20,000	34,000
Security Force Supervisor	20,000	34,000
Laboratory Supervisor	22,000	42,500
Assistant QA Specialist	20,000	34,000
Secretary	12,000	20,400
Radwaste Disposal Clerk	12,000	20,400
QA Clerk	12,000	20,400
Accounting Clerk	12,000	20,400
Radiation Exposure Records Technician	16,000	27,200
Procurement Clerk	12,000	20,400
Supply Clerk	12,000	20,400
Custodian	12,000	20,400
Foreman	21,000	35,700
Shift Supervisor	22,000	42,500
Decommissioning Technician	20,000	34,000
Equipment Operator	18,000	30,600
Mechanical Technician	18,000	30,600
Equipment Operator	18,000	30,600
Maintenance Technician	18,000	30,600
Welder	16,000	27,200
Pipefitter	16,000	27,200
Electrician	19,000	32,300
Instrument Technician	20,000	34,000
Safety Technician	16,000	27,200
SNM Accounting Technician	16,000	27,200
Analytical Technician	16,000	27,200
Engineering Technician	16,000	27,200
Chemical Makeup Operator	15,000	25,500
Security Guard	15,000	25,500
Safety Review Committee[b]	---	500/day

[a]Pay rates are estimated to be representative of highly qualified experienced individuals in each job category in the nuclear industry.

[b]Work as consultants on a daily basis. An allowance for travel and living expenses is also included.

TABLE 6.1-16

Summary of Craftsmen Labor Costs -- Layaway

Employee	Costs (Thousands of 1978 Dollars) Process Building	FRS[a]	WTF	Auxiliary Facilities	Total
Foreman	46	7	--	4	57
Safety Technician	44	5	5	8	62
Decommissioning Technician	163	34	--	7	204
Analytical Technician	35	--	--	--	35
Equipment Operator	3	--	--	3	12
Welder	--	--	--	3	5
Electrician	3	--	--	3	6
Pipefitter	3	--	--	8	11
Other Skilled Labor	33	5	--	--	38
Subtotal	330	57	5	36	428
Owner Overheads	33	6	--	4	43
TOTAL	363	63	5	40	471

[a]Omit work in FRS if spent fuel storage is to be continued.

TABLE 6.1-17

Summary of Estimated Support Staff Labor Costs —Layaway

Employees (No.)	Cost (Thousands of 1978 Dollars) Planning Phase	Cost (Thousands of 1978 Dollars) Decommissioning Operations
Project Manager Personnel		
Project Manager	73	58
Quality Assurance Personnel		
Quality Assurance Specialist	49	39
Quality Assurance Clerks (2)	2	12
Decommissioning Operations Personnel		
Project Engineer	60	48
Decommmissioning Operations Supervisors (2)	54	44
Operations and Maintenance Supervisor	54	27
Engineering Technician	27	14
Maintenance Technicians (4)	122	61
Shift Supervisors (4)	170	85
Health and Safety Protection Personnel		
Safety Review Committee	30	15
Health and Safety Specialist	56	45
Safety technicians	3	--
Radiation Exposure Records Technician	3	16
Safeguards and Security Personnel		
SNM Accounting Specialist	13	26
SNM Accounting Technicians (2)	3	27
Security Force Supervisor	34	20
Security guards	230 [332]	115 [166]
Support Services Personnel		
Procurement Specialist	17	17
Supply Clerk	10	10
Custodian	21	12
Accountant	43	34
Accounting Clerk	6	12
Secretaries (3)	61	37
TOTAL	1,140 [1,242]	744 [825]

[ ] Values in brackets are manpower figures with fuel in storage.

6.1.7.2 Equipment and Materials

The estimated equipment and material required and associated costs are summarized in Table 6.1-18. The cost total is exclusive of burial containers, which are covered in conjunction with shipping and waste disposal costs. A considerable quantity of equipment presently available at the facility would also be used. Although some salvage value is possible from the equipment, there is a considerable probability that the equipment will become contaminated and will require either disposal or controlled future use.

6.1.7.3 Shipping and Waste Disposal

Shipping and waste disposal costs have been estimated for three cases: 1) burial at 1000 miles, 2) burial at 3000 miles, and 3) burial onsite (of all but transuranics).

In all cases, shipment is presumed to be by truck in Department of Transportation (DOT)-approved containers, and the amount of waste contaminated with transuranics in excess of 10 nCi/gram is expected to be minimized through judicious decontamination by chemicals, electro-polishing, and ultrasonic cleaning.

It is assumed that transuranic waste would be transported by exclusive-use truck to interim storage or to a federal repository.

The basic cost factors used in estimating waste disposal costs are summarized in Table 6.1-19. By applying these factors to the waste volumes in Section 6.1.4, the disposal costs shown in Tables 6.1-20 through 6.1-22 were calculated.

Only the shipment and cask rental costs vary between the 1000- and 3000-mile shipment. In the onsite burial option, only the time and equipment cost for burial are included. The decommissioning waste will increase the total curies in the burial ground by only a few percent and this is not expected to increase the extent or duration of surveillance required. Because of recent rule-making actions requiring retrievable storage for transuranics, offsite shipment of this material is planned.

TABLE 6.1-18

Estimated Equipment and Materials Costs
—Layaway[a]

Description	Quantity	Cost (Thousands of 1978 Dollars) Per Unit	Total
Package Boiler	1	16	16
Intrusion Alarm System	--	--	80
High Security Locks	--	--	3
Radiation Detection and Analyzing Equipment	--	--	75
Vacuum and Remote Cleaning Equipment	2	1	2
Air Equipment (with Compressor)	1	10	10
Flush Chemicals	--	--	170
Expendable Equipment and Supplies	18 mos.	12 mo@ $1 6 mo@ $5	42
Mist Eliminators	8	2	16
Ventilation Filter Replacement	--	--	50
Subtotal			464
Owner Overheads			46
TOTAL			510

[a]Does not include waste containers.

TABLE 6.1-19

Waste Disposal Cost Data

Expense Item	Costs (1978 Dollars)
Container Costs	
4 ft x 4 ft x 7 ft steel box	600 ea
4 ft x 4 ft x 4 ft steel box	450 ea
Plywood Box	$40/yd^3$
55-gallon Drum	20 ea
HLW Canister	5000 ea
Freight Charges	
Truck	1.05 per mile
Waste Disposal Costs	
Surface Burial	$5.00\ ft^3$
Interim Storage or Federal Repositories (High-level Waste)	$2220/ft^3$
Cask Rental Charges[a]	
High-level Waste Cask	2000/day
Intermediate-level Waste Cask	1000/day

[a]Values are from NUREG 0278, casks may be available commercially for substantially less.

TABLE 6.1-20

Estimated Packaging, Shipping, and Waste Disposal Costs for Layaway — 1000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Solids from low level Liquid Waste Treatment (55-gal. drums)	1	1	1	3
HEPA and Roughing Filters	2	1	6	9
Trash	14	11	25	50
Subtotal	17	13	32	62
TRU				
High Level Wastes[a]	5	51	222	278
Subtotal	22	64	254	340
Owner Overhead	2	6	26	34
TOTAL	24	70	280	374

[a]Shipping cost includes cask rental for 23 days.

TABLE 6.1-21

Estimated Packaging, Shipping, and Waste Disposal Costs for Layaway — 3000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Solids from Liquid Waste Treatment (55-gal. drums)	1	2	1	4
HEPA and Roughing Filters	2	3	6	11
Trash	14	32	25	71
Subtotal	17	37	32	86
TRU				
High Level Wastes[a]	5	105	222	332
Subtotal	22	142	254	418
Owner Overhead	2	14	26	42
TOTAL	24	156	280	460

[a]Shipping cost includes cask rental for 50 days per shipment.

TABLE 6.1-22

Estimated Packaging, Shipping, and Waste Disposal Costs for Layaway — Onsite Burial of Low Level Wastes

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Solids from Liquid Waste Treatment (55-gal. drums)	1	--	--	1
HEPA and Roughing Filters	2	--	1	3
Trash	14	1	5	20
Subtotal	17	1	6	24
TRU				
High Level Wastes[a]	5	51	222	278
Subtotal	22	52	228	302
Owner Overhead	2	5	23	30
TOTAL	24	57	251	332

[a]Shipment cost includes cask rental for 23 days per shipment and 1000-mile offsite shipment for disposal.

6.1.7.4 Utilities and Other Expenses

For the purpose of this portion of the estimate we have presumed that the facility would continue under an NRC license and New York State ownership. NFS is currently paying a lease fee of $664,000/yr which will be lost income to the State. Also, NFS currently pays property taxes, which the State would not. The estimated utilities and other expenses are shown in Table 6.1-23.

The cost of interim care is estimated to be $1.6 million with the entire facility shut down, and $1.9 million with the storage basin operating. The breakout of these costs is shown in Table 6.1-24.

6.1.8 Public and Worker Safety

Each facility disposition has been evaluated on the basis of probable environmental and worker impacts from both routine performance and probable accidents. These evaluations are preliminary and are intended to provide a basis for selection among alternatives. The performance of work required to put the facility into layaway, the interim care period, and the transportation of waste has been evaluated. The methods and assumptions are detailed for each alternative and the results are summarized in Section 1.

6.1.8.1 Normal Layaway Activities

The interiors of certain plant process cells are highly contaminated and decontamination activities may cause considerable resuspension of this contaminated material within the cells. Greater than 99.9 percent of this resuspended material will be removed by HEPA filtration. The remainder will be dispersed from the stack. Assuming airborne concentration of radionuclides in the cells will reach peak concentration 1000 times that of present values for one week, and that filtration efficiency remains at its present level, we can calculate a dose to the public of 0.05 man-rem for whole body and 0.41 man-rem to

TABLE 6.1-23

Estimated Cost of Utilities and Other Owners Expenses — Layaway

Expense Item	Cost (Thousands of 1978 Dollars)
License Fees	28
Electricity and Other Utilities	750
Travel and Miscellaneous	46
Insurance	180
TOTAL	1,004

TABLE 6.1-24

Estimated Annual Costs of Interim Care Activities — Layaway

Expense Item	Annual Cost (Thousands of 1978 Dollars) Entire Facility in Layaway	W/Spent Fuel Stored in FRS
Labor		
Project Manager	54	54
Technical Support	60	60
Secretarial	21	21
Accountant	43	43
Security Supervisor	34	34
Security (9) [13]	230	332
Radiation and Environmental Safety Specialist	41	41
Safety Technicians	82	82
Shift Supervisors (4)	143	143
Operations and Equipment Maintenance (9) [12]	275	398
Inspections	6	6
Subtotal	989	1214
Equipment and Materials	100	100
License Fee	8	8
Utilities	350	350
Taxes	--	--
Insurance[a]	15	15
Subtotal	1462	1687
Owner Overhead	146	169
TOTAL	1608	1856

[a]The cost of nuclear insurance required by the presence of fuel in basin would be handled by or passed on to the owners of the fuel.

[ ] Values in brackets are manpower figures with fuel in storage.

the lungs from layaway activities. Estimates of population dose from layaway activities are summarized in Table 6.1-25. Placing the facili in the layaway mode will likewise require some occupational radiation exposure to those performing the work. Work is estimated to require 141 man-rem of occupational exposure.

The facility in the layaway condition will continue to release some small quantity of radionuclides. Assuming that the facility in layaway emits one tenth the present shut down emission rate, the continuing population dose from this source would be 0.002 man-rem/year whole body exposure (see Tables 6.1-26 and 6.1-27).

6.1.8.2 Accidents During Layaway Activities

Those accidents which may occur while the facility is being placed in layaway status are generally similar to those which might have occurred during operation. However, since the radionuclide inventory in the facility is less than during operation, the consequences of probable accidents is correspondingly reduced.

Accidents analyzed for the operating facility include: criticality within any of the processing cells[1]; criticality in the fuel storage pool[1]; chemical explosion[1]; and other lesser accidents.[2]

A criticality is considered much less likely to occur during decommissioning than during operation due to the greatly reduced quantities of material in the facility. Safeguards to prevent criticality will include use of critically-safe geometry containers, "poison" tanks containing neutron-absorbing materials and dilution. For the operating facility, a criticality of 10^{20} fissions was predicted to give a 5.85 rem/person dose to the highest exposed member of the general population.[3] The dose to workers outside the cell where the criticality occurred would be slight due to the shielding provided.

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[1]FSAR REV4, Sept. 1969, FSAR 1973, Section X-3
[2]NRC - Interim Safety Evaluation
[3]FSAR 1973 Section X-3

TABLE 6.1-25

Estimated Dose to the General Population during Layaway Decommissioning Activities
(Assumes one-week release 1000 times present shutdown release)[a]

Contributing Isotope	Organ	Population Dose (man-rem)	
	Whole Body		
Sr 90	" "	3.26	E-2
Cs 134	" "	1.21	E-3
Cs 137+d[b]	" "	1.79	E-2
Pu 239	" "	1.00	E-4
Pu 238	" "	3.54	E-4
Pu 240	" "	1.54	E-4
Pu 241	" "	1.46	E-4
Am 242M	" "	8.09	E-6
TOTAL	" "	0.0526	
	Lung		
Sr 90	"	2.02	E-2
Y 90	"	3.64	E-4
Ru 106+d	"	6.07	E-6
I 129	"	2.02	E-6
Cs 134	"	1.21	E-3
Cs 137+d	"	1.79	E-2
Pm 147	"	2.43	E-5
Eu 154	"	1.016	E-5
Pu 239	"	6.68	E-5
Pu 238	"	4.59	E-4
Pu 240	"	1.70	E-4
Pu 241	"	8.09	E-6
Am 242M	"	2.02	E-6
TOTAL	"	0.4066	
	Bone		
Sr 90	"	2.104	E-1
Y 90	"	4.04	E-6
Ru 106+d	"	6.07	E-6
I 129	"	2.02	E-6

(a) 50 year dose committment
(b) + daughters

TABLE 6.1-25 (Cont'd.)

Contributing Isotope	Organ	Population Dose (man-rem)	
	Bone (Cont'd)		
Cs 134	"	1.21	E-6
Cs 137+d	"	1.79	E-2
Pm 147	"	5.66	E-5
Pu 239	"	2.48	E-3
Pu 238	"	1.39	E-2
Pu 240	"	6.29	E-3
Pu 242	"	6.07	E-6
Pu 241	"	7.04	E-3
Am 242M	"	1.17	E-4
TOTAL	"	0.2594	
	Thyroid		
Sr 90	"	3.27	E-2
Ru 106+d	"	6.06	E-6
I 129	"	2.02	E-6
Cs 134	"	1.21	E-3
Cs 137+d	"	1.79	E-2
Pm 147	"	2.02	E-6
Eu 154	"	1.01	E-5
Pu 239	"	6.06	E-5
Pu 238	"	3.54	E-4
Pu 240	"	1.54	E-4
Pu 241	"	1.46	E-4
Am 242M	"	8.09	E-6
TOTAL	"	0.0525	

TABLE 6.1-26

Maximum Dose to the Individual from the Plant in Layaway[a]

Critical Organ	Distance	Predominant Wind Directions	Dose (mRem)
Whole Body	500 m	NNW	0.001858
Bone	500 m	NNW	0.01235
Lung	500 m	NNW	0.001201
Thyroid	500 m	NNW	0.001858

[a] 50 year dose committment from 1 year exposure

TABLE 6.1-27

Estimated Dose to the General Population from the Plant in Layaway

Contributing Isotope	Organ	Population Dose (man-rem)
	Whole Body	
Sr 90	"	1.71 E-4
Cs 134	"	5.90 E-6
Cs 137+d	"	8.86 E-5
Pu 239	"	3.0 E-6
Pu 238	"	1.75 E-5
Pu 240	"	7.6 E-7
Pu 241	"	7.2 E-7
Pu 242M	"	4.0 E-8
TOTAL	"	0.00260
	Lung	
Sr 90	"	1.0 E-4
Y 90	"	1.8 E-6
Ru 106+d	"	3.0 E-8
I 129	"	1.0 E-8
Cs 124	"	3.86 E-5
Pm 147	"	1.0 E-7
Eu 154	"	5.0 E-8
Pu 239	"	3.3 E-7
Pu 238	"	2.27 E-6
Pu 240	"	8.4 E-7
Pu 241	"	4.0 E-8
Am 242M	"	1.0 E-8
TOTAL	"	0.00201
	Bone	
Sr 90	"	1.04 E-3
Y 90	"	2.0 E-7
Ru 106+d	"	3.0 E-8
I 129	"	1.0 E-8

TABLE 6.1-27 (Cont'd.)

Contributing Isotope	Organ	Population Dose (man-rem)
	Bone (Cont'd.)	
Cs 134	"	5.98 E-6
Cs 137+d	"	8.861 E-5
Pm 147	"	2.8 E-7
Pu 239	"	1.225 E-5
Pu 238	"	6.87 E-5
Pu 240	"	3.11 E-5
Pu 242	"	1.0 E-8
Pu 241	"	3.48 E-4
Am 242M	"	5.0 E-7
TOTAL	"	0.001282
	Thyroid	
Sr 90	"	1.61 E-4
Ru 106+d	"	3.0 E-7
I 129	"	1.0 E-8
Cs 134	"	5.98 E-6
Cs 137+d	"	8.86 E-5
Pm 147	"	1.0 E-8
Eu 154	"	5.0 E-8
Pu 239	"	3.0 E-7
Pu 238	"	1.75 E-6
Pu 240	"	7.6 E-7
Pu 241	"	7.2 E-7
Am 242M	"	4.0 E-8
TOTAL	"	0.0002597

A criticality in the fuel storage pool was evaluated for the operating plant. Physical design of the storage basin and safeguards employed during operation make a criticality incident in the fuel storage pool highly unlikely; however, if such an incident were to occur energy generation would be equivalent to a 10-MWT boiling water reactor for three hours. Radiation from the criticality would be shielded by the water in the basin. Offsite concentration of fission products which would be released through the pool water to the atmosphere would not exceed maximum permissible concentration (established in 10 CFR Part 20) even under the most adverse meteorological conditions.[1]

A chemical explosion, although potentially very serious in terms of worker safety and destruction of property, is not expected to exceed the maximum permissible concentration for mixed fission products at the site boundry.[2] Great care will be taken in preparing and approving chemical decontamination procedures to assure the compatibility of chemicals and to prevent the buildup of explosive gases.

Other lesser accidents have a potential for serious worker injury but are not expected to have serious offsite consequences. The accident rates shown in Table 6.1-28 have been observed during work in nuclear facilities[3] and applied to decommissioning studies.[4] It is expected that placing the facility in layaway would have an accident frequency less than in construction, but greater than in normal operation. We have conservatively assumed construction accident rates to predict 0.75 loss time injuries and 0.006 fatalities during preparation of the facilities for layaway.

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[1]FSAR VII 1.73, 1963

[2]Ibid

[3]Operational Accidents and Radiation Exposures Experienced Within the USAEC 1943-1970, Wash 1192, 1971

[4]NUREG 0278

TABLE 6.1-28

Construction/Industrial Accident Frequencies
(Nuclear Facilities)

Accident Category	Job Classification	Frequency (Accident/10^6 Manhours) 1943-70 28 Year Average
Lost Time Injuries:	Heavy Construction	10
	All Construction	5.36
	DOE Operations	2.12
Fatalities:	Construction	0.042
	DOE Operations	0.023
	Government Functions	0.004

Radiation exposures in excess of prescribed limits are also a possibility in any work involving radioactive materials.

The predicted frequency of occupational radiation overexposure was estimated from NRC data for nuclear power reactors from 1971 to 1975.[1] During that period there were 96 overexposures to external radiation for 58,030 man-rem of occupation radiation exposure. We have consequently estimated 0.165 overexposures per 100 man-rem (1 overexposure per 606 man-rem). We, therefore predict 0.23 overexposures to occur during preparation for layaway.

6.1.8.3 Interim Care

Existence of the West Valley facility in its layaway state will result in both public and occupational exposure to radionuclides. Cleanup of process cells is expected to reduce particulate effluents to at least 1/10 of the present shutdown value, resulting in a corresponding reduction in population dose from 0.02 man-rem/year to 0.002 man-rem/year.

Maintenance and surveillance of the shutdown facility is expected to result in about 20 man-rem/year exposure to the workers involved.

6.1.8.4 Accidents During Interim Care

The NRC has evaluated the safety of the West Valley Plant in its present state of reduced activity[2] and concluded that "there is very little risk to the health and safety of the public from the dormant reprocessing plant." The activities required to put the plant in a layaway status are designed to further reduce the small risk posed by the existence of the plant and its radionuclide inventories.

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[1]W. Wekreger, NRC Review for Assuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievable - Paper given Nov. 1976, ANS Meeting

[2]NRC, Interim Safety Evaluation I, August 1977, Docket No. 50-201

The primary potential release from the facility would be from breach of the confinement cells by an earthquake or tornado. A conservative estimate of the maximum earthquake which could be expected at the site is 0.2g free field acceleration at the surface. Such an earthquake is not likely once in a thousand years.[1]

The effect of such an earthquake on the confinement integrity of the cells and facility as a whole is under investigation by Lawrence Livermore Laboratory and Los Alamos Scientific Laboratory.[2]

Even a catastrophic earthquake would cause only a small amount of radioactivity to be released from the facility while in the layaway mode because of the effects of decontamination of the cells and process equipment.

A design basis tornado has a recurrence interval of 10 million years at the site; thus, a damaging tornado is extremely unlikely. The ventilation system is expected to withstand most tornadoes, based on the results of HEPA filter testing over extreme pressure drops.[2]

6.1.8.5 Transportation Safety

Transportation of radioactive material generated during layaway of the fuel processing plant will pose some risks to the public and to transportation workers. The radiological effects of layaway transport operations include potential external radiation exposure to the transportation worker and the general public from normal transport operations and potential radiation exposure to the public from release of radioactive material in a transportation accident. Nonradiological effects of layaway transport operations include the potential effect of chemical pollutants, injuries and fatalities such as may occur in the transportation of any material.

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[1]NRC - Interim Safety Evaluation

[2]NRC: Aug 1977 Interim Safety Evaluation I Docket No. 50-201 Nuclear Fuel Services, Inc., New York State Energy Research and Development Authories, Western New York Nuclear Service Center. West Valley, New York.

Estimated routine radiation doses from truck transport of the radioactive wastes are shown in Table 6.1-29. Dose calculations are based on maximum allowable dose rates for shipment in exclusive-use vehicles and are therefore conservative. Information on the number of truck shipments is taken from section 6.1.4.

For transporting wastes 1000 miles, the estimated radiation dose to the transportation workers is 2.0 man-rem, and to the general public less than 0.5 man-rem. For transporting wastes 3000 miles, the estimated radiation dose to the transportation workers is 5.9 man-rem, and 1.2 man-rem to the general public.

For burial onsite, it is assumed that a single driver will be required for an hour per each shipment. Non-TRU wastes are assumed to be trucked to the onsite burial ground in a DOT-approved vehicle, and associated limits on radiation levels will be applied. TRU wastes will be trucked to a Federal repository or to interim storage 1000 miles away. With these assumptions, the estimated radiation dose to the transportation worker is 0.18 man-rem. The radiation dose to the general public is estimated at 0.03 man-rem.

The potential radiological effect of layaway transportation accidents is the possible release of radioactive material and the resulting radiation dose to the public. Minor accidents are not likely to result in a loss of containment or a release of radioactivity. A small percentage of accidents of moderate severity are postulated to result in a breach of package containment and a release of material. Most serious accidents could result in some loss of containment.

Should a breach of containment occur and combustible waste burn in an open fire, only a small fraction of the radioactivity would be dispersed beyond the immediate area. Most of the radioactivity, perhaps as much as 99 percent, would remain in the ashes.[1]

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[1] Directorate of Regulatory Standards, Environmental Safety of Transportation of Radioactive Materials to and from Nuclear Power Plants, WASH-1238, U.S. AEC, Washington, D.C., 1972.

TABLE 6.1-29

Estimated Routine Radiation Dose

From Truck Transport of Radioactive Wastes From Layaway

Group	Dose Per Shipment (Man-rem)		Total Radiation Dose For All Shipment (Man-rem)
	1000 Miles Away		
Transportation Workers			
Truck Drivers	0.15		2.0
Garagemen	0.0015		0.02
		TOTAL	2.02
General Public			
Onlookers	0.015		0.195
Other General Public	0.015		0.195
		TOTAL	0.39
	3000 Miles Away		
Transportation Workers			
Truck Drivers	0.45		5.85
Garagement	0.0045		0.059
		TOTAL	5.91
General Public			
Onlookers	0.045		0.585
Other General Public	0.045		0.585
		TOTAL	1.17
	Onsite Burial of Non-TRU 1000 Mile Shipment of TRU		
Transportation Workers			
Truck Drivers			
Offsite	0.15		0.15
Onsite	0.002		0.024
Garagement	0.0015		0.0015
		TOTAL	0.18
General Public			
Onlookers	0.015		0.015
Other General Public	0.015		0.015
		TOTAL	0.03

In a transportation accident involving radioactive materials, carriers are required to follow DOT-prescribed procedures designed to mitigate the consequences. DOT regulations require prompt reporting of any transportation incident involving shipment of radioactive material in which fire, breakage, spillage, or suspected radioactive contamination occurs. The regulations also specify guidelines for remedial actions in the case of actual or suspected release of radioactivity from a shipping container.

The principal nonradiological transportation safety impact is the potential for injuries and fatalities from the transportation accident. Table 6.1-30 provides a summary of transportation accident statistics for truck transportation, and predicted transportation accidents for the waste disposal options.

Negligible safety impacts are expected from chemical pollutants from truck shipments. The number of truck shipments for transporting wastes generated by layaway operations is a miniscule portion of the total number of U.S. truck shipments.

TABLE 6.1-30

Nonradiation Transportation Accident Statistics — Layaway

Statistical Frequencies[a]		Expected Occurrences: 1000 Mile Shipment	3000 Mile Shipment	Onsite Burial[b]
Accidents/Vehicle Mile	6.9×10^{7}	9.0×10^{-3} Accidents	2.7×10^{-2}	6.9×10^{-4}
Injuries/Accident	0.51	4.6×10^{-3} Injuries	1.4×10^{-2}	3.5×10^{-4}
Fatalities/Accident	0.03	2.7×10^{-4} Fatalities	8.1×10^{-4}	2.1×10^{-6}

a Directorate of Regulatory Standards, Environmental Safety of Transportation of Radioactive Materials to and from Nuclear Power Plants, WASH-1238, U.S. AEC, Washington, D.C., 1972.

b One shipment will be TRU wastes trucked 1000 miles away.

6.2 Protective Storage

Protective storage is designed to place the facility in a condition that provides protection to the public and environment with limited maintenance and surveillance required.

Areas of the facility that are accessible during the surveillance period would be decontaminated to very low levels specified during license modification. All contaminated materials that are not removed from the facility would be placed in the cells. The cells would then be isolated from the accessible areas by rigid physical barriers placed over windows, doors, and hatches.

After the facility has been placed in protective storage, surveillance and maintenance activities would be limited to environmental and facility radiation monitoring and inspection, and repair of physical barriers, structures, and instrumentation. Additional security would be provided by the fence around the exclusion area (about 300 acres), high security locks on entrance doors, and electronic alarms. The remaining portion of the site (approximately 3,000 acres) might be released for restricted or conditional use during the surveillance and maintenance period. The facility would remain in protective storage until final dismantlement.

6.2.1 End Product Description

In the protective storage mode, all active plant operational systems would be shut down. Only those passive systems required for safety and surveillance would remain in service.

The cells would be used as a physical barrier against intruders. Loose contamination, such as cladding hulls in the PMC, would be picked up and packaged for storage in the cells. Housekeeping within each cell would be performed to minimize the spread of contamination in the event of loss of contamination control (resulting, for example, from a major tornado or earthquake, or from sabotage).

OTE: A reference list of West Valley Plant facility abbreviations and definitions is provided as Table 6.4-31.

Contaminated process equipment, glove boxes, laboratory equipment, ar any other contaminated equipment outside of the cells would be packaged and placed inside the cells. The ventilation system would be deactivated; all contaminated ducts and the stack would be removed and placed in the cells. A "breathing" filter would replace the existing cell ventilation system to permit equalization of atmospheric pressure without contamination spread. After removing all of the contaminated equipment from the building, the viewing windows and cell access doors would be sealed off. The accessible interior surfaces of the building would then be surveyed and decontaminated to unrestricted use levels.

The fuel within the storage basin would be removed and the storage basin drained. Storage racks and water treatment equipment would be placed in the cells. Contamination in the basin would be removed to unrestricted use levels.

Waste from the storage tank will have been removed and the tank flushed. The tank ventilation systems would be replaced with a passive "breathing" filter, and the tank shelters decontaminated to unrestricted use levels or removed.

The barbed wire-topped chain link fence which encloses the plant facility would remain intact. The surrounding buffer zone, approximately 3,000 acres, could be released for restricted or conditional use.

6.2.2 Planning and Preparation

Planning and preparation efforts will take place over a two-year period. During the first year, the efforts of the decommissioning staff will be devoted to preparation of the documentation that must be submitted to NRC to modify the facility license from an operating to a possession-only status. This documentation is expected to include a master decommissioning plan and safety analysis, a set of revised technical specifications to govern decommissioning and post-decommissioning operations, an environmental report or assessment, and a review of the decommissioning Quality Assurance (QA) plan.

The major planning activities are presented in Figure 6.2-1 along with the approximate time period over which they should occur. Detailed preparations for protective storage activities will take place during the second year of the planning period.

The master decommissioning plan is expected to include the decommissioning objectives for the facility and site including acceptable unrestricted release criteria, a description and schedule of the decommissioning activities, and an analysis of significant safey issues associated with the decommissioning activities.

The full requirements of a decommissioning safety analysis have not yet been identified by NRC. It is expected that this analysis would contain:

- An estimate of the radioactive inventories in the facility when decommissioning activities begin.
- An analysis of the adequacy of exisitng plant safety systems to protect the public health and safety during decommissioning operations and interim care.
- A description of special safety systems and procedures required during decommissioning and interim care.
- A review of industrial and radiological safety programs for decommissioning operations.
- A review of the decommissioning training program.

The QA program's primary purposes are: 1) to assure that adequate precautions are established to protect the health and safety of both the public and decommissioning workers during the decommissioning operations; 2) to assure that established safety precautions are followed during decommissioning activities; and 3) to audit the performance of decommissioning activities.

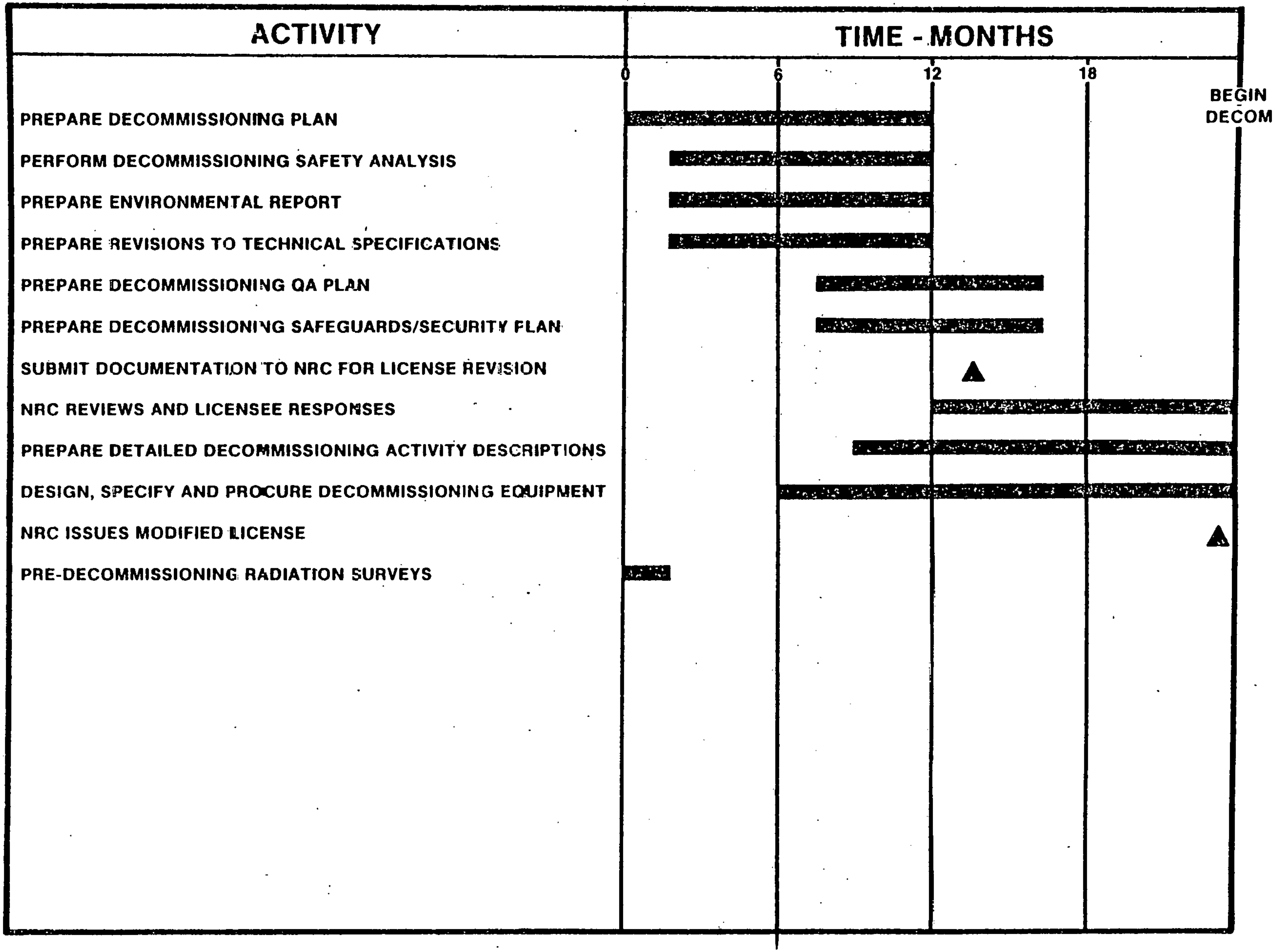

FIGURE 6.2-1

Approximate Schedule of Events for Protective Storage Planning and Preparation

The decommissioning environmental assessment or report will provide NRC with the basic information necessary to evaluate the environmental impact of the decommissioning activities and final facility disposition. Public hearings on the environmental impact of decommissioning the facility may be held before the NRC issues an Environmental Impact Statement or a Negative Declaration of Environmental Impact.

The existing technical specifications will require modifications because plant conditions will have changed as the plant reaches protective storage status. The specifications will delineate allowable operating conditions for plant safety systems, requisite administrative procedures to assure that the safety systems are operated within these limits, and environmental surveillance requirements.

The decommissioning staff will respond to questions from NRC during the Commission's review of the relicensing application, and will furnish other requested information. Modifications to the documents may be necessary as a result of the reviews. When the review process has been completed and all safety-related issues resolved, the modified license will be issued.

Detailed preparations will involve the development of activity descriptions and preparation of working procedures for the decommissioning operation. Cost estimates and detailed work schedules will be prepared, and equipment designed or specified and procured. Selection of chemicals for internal and external decontamination will be made by conducting tests on components of the process equipment.

6.2.3 Methods

To place the facility in protective storage, all hazardous materials and equipment will be removed from accessible areas and transported to the cells. Physical barriers placed over cells entrances will prevent access. All decommissioning work will be accomplished in accordance with the decommissioning plan, activity descriptions, detailed working procedures, and health and safety control programs developed during th planning and preparation phase.

For the purposes of this report, the facility was divided into four sections: main process building, fuel receiving and storage area, waste tank farm, and auxiliary facilities. The activities to be performed in each of these facility sections are outlined in Table 6.2-1 and a tenative schedule is presented in Figure 6.2-2.

6.2.3.1 Main Process Building

Placing the main process building in protective storage will begin with a thorough internal chemical decontamination generally following procedures and techniques used during plant operation. Procedures can be modified with moderate repiping work to concentrate on "hot" areas. Solutions and time requirements will be designed for maximum removal of residual contamination with little regard for corrosion of equipment. Solutions may be recycled from a relatively "clean" area to a more highly contaminated area and flushes repeated as necessary to reduce spreadable contamination and to lower dose rates. Chemicals may be selected for decontamination efficiency without regard to corrosion rates and may include chromic or hydrochloric acid, sodium hydroxide, and very strong oxidizing or reducing agents.

Internal flushes will be monitored to identify dissolved contaminants and indicate when the solutions have achieved their maximum effectiveness. Solutions having a significant quantity of plutonium or uranium may be processed to reclaim the products. Waste solutions will be processed onsite as they were when the plant was operating. Concentrated waste may be neutralized and treated as the liquid waste was, or be solidified for placement in a cell. Following internal chemical decontamination, the process systems will be flushed with water and drained.

TABLE 6.2-1

Outline of Protective Storage Activities

Main Process Building

1. Chemically decontaminate internals of process equipment and piping.
2. Chemically decontaminate cell walls and equipment externals.
3. Remove glove boxes and contaminated hoods and place in cells.
4. Remove contaminated equipment and piping from accessible areas and store in cells; seal all piping and equipment penetrations into walls.
5. Decontaminate accessible areas to levels defined in the decommissioning order.
6. Deactivate all uncontaminated equipment, piping, and other systems not required for interim care.
7. Install protective barriers and seal openings into cells; install HEPA-filtered vents for each cell.
8. Remove filters, contaminated ventilation system, and the stack and store in cells; install HEPA-filtered vents on the outside walls of the main process building.
9. Perform final radiation survey of the facility.
10. Install intrusion alarms and provide remote readout for intrusion, fire, and radiation alarms.
11. Deactivate systems and utilities not required for interim care.
12. Seal Building entrances not required for surveillance and maintenance.

Fuel Receiving and Storage Area

1. Remove stored spent fuel from basin.
2. Drain storage basin and CUP and remove solids.
3. Decontaminate pool and remove fuel storage racks.
4. Decontaminate or remove water treatment equipment.
5. Survey and decontaminate the FRS including the cask decontamination area.
6. Deactivate ventilation system and remove filters and contaminated ducts.

TABLE 6.2-1 (Cont'd.)

Fuel Receiving and Storage Area (Cont'd.)

7. Install intrusion alarms and provide remote readout for fire and radiation alarms.
8. Deactivate all utilities not required for interim care.
9. Perform final radiation survey of FRS.
10. Seal and secure exterior access to FRS.

Waste Tank Farm

1. Remove contaminated auxiliary systems.
2. Decontaminate equipment shelter to unrestricted use levels.
3. Replace off-gas system with HEPA-filtered vent.
4. Deactivate and remove equipment shelter ventilation system and install HEPA-filtered vent on outside wall.
5. Install intrusion alarms and high security locks on exterior doors.
6. Perform final radiation survey of WTF.

Auxiliary Facilities

1. Remove contaminated equipment from laundry room.
2. Survey and decontaminate auxiliary facilities to unrestricted release limits.
3. Deactivate all utilities not required for interim care.
4. Install intrusion larms and provide remote readout for fire and intrusion alarms.
5. Perform final radiation survey of auxiliary facilities.
6. Secure auxiliary facilities with high security locks.

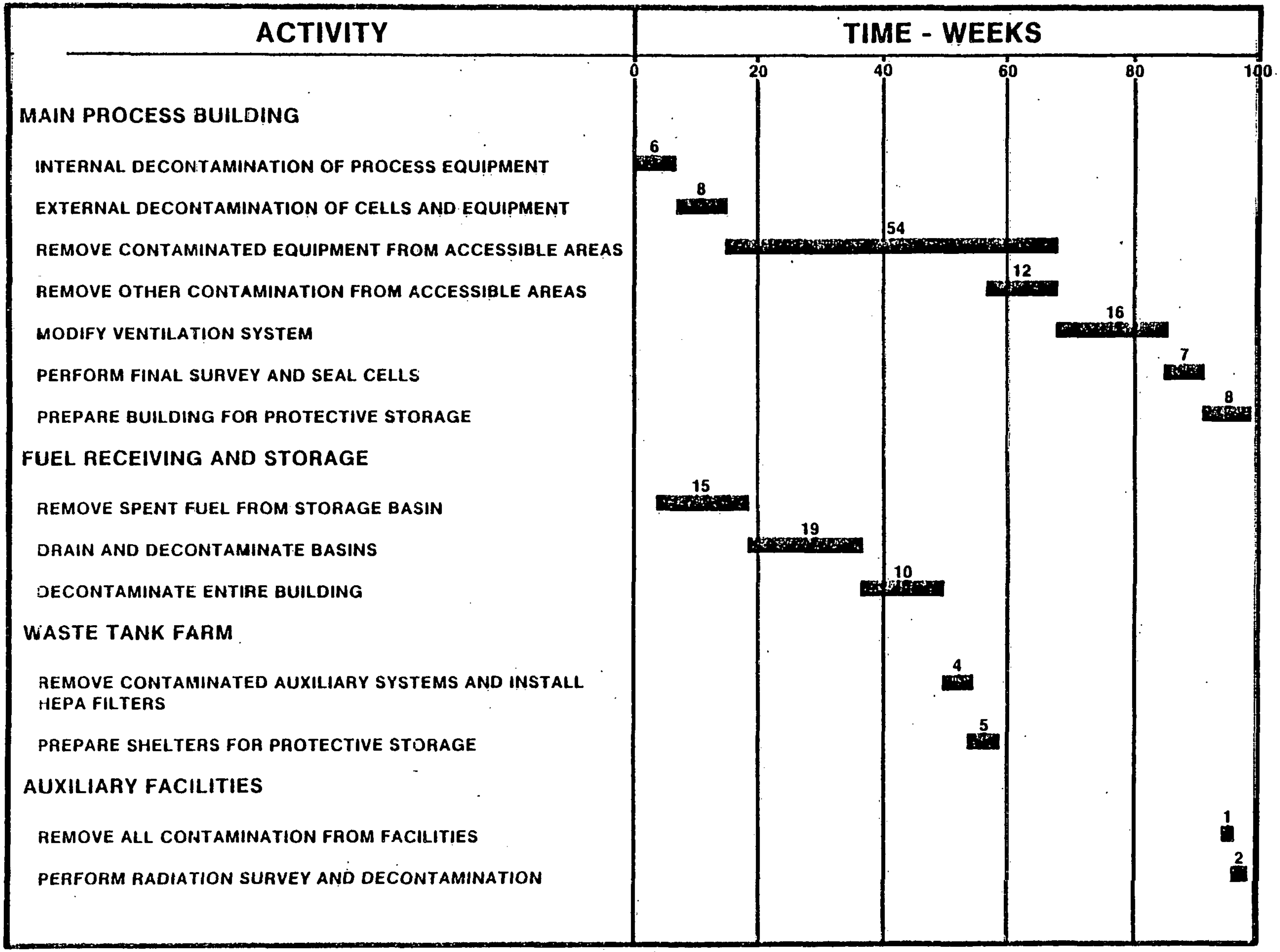

FIGURE 6.2-2

Schedule of Major Activities for Placing the Facility in Protective Storage

Following the internal decontamination process, equipment, vessels, piping, and the cell walls will be externally decontaminated. This will be done to minimize the spread of contamination in the event of a breach in cell confinement, and to utilize the liquid waste treatment facilities while they are operational. A variety of techniques may be used, depending on the type and extent of contamination. Loose contamination such as in the PMC and GPC can be vacuumed with criticality-safe vacuum cleaners operated with the installed manipulators. The residual contamination will be further reduced by swabbing with a decontamination solution and/or spraying with a high pressure nozzle. The solid waste generated will be packaged and placed in a cell. Liquid wastes will be processed onsite as they were when the plant was operating. Solutions will be sent through the evaporators, concentrated, neutralized, and either treated as the liquid from the waste tank was or be solidified for placement in cells.

Accessible areas of the main process building include the ANA, CR, DCS, MRS, XCR, operating and viewing aisles, laboratories, plutonium and uranium loadout and sample stations, and the stairwells. These areas will be surveyed and generally decontaminated to unrestricted use levels.

In areas where very low levels of contamination cannot be readily removed, the contamination will be fixed in place with high-integrity paint of a distinctive color. The location and characteristics of each such area will be noted in the permanent records of the protective storage operations. Process equipment and piping, ductwork, glove boxes, and instrumentations will be decontaminated, removed, packaged, and placed in the cells. Highly contaminated concrete surfaces and flooring will be spalled off to remove contamination.

Internally and externally contaminated piping and equipment not required for the safety systems (fire protection and radiation monitoring) will be decontaminated and/or removed, packaged, and placed in the cells. This piping will be severed at the wall penetrations and sealed as the cuts are made. To minimize the spread of contamination, a stripable plastic covering will be placed on uncontaminated floors and a radiation control envelope with roughing and HEPA filters will be placed over the work area.

Ductwork removal will involve filling the ducts with an expanding polyurethane foam which will harden in place. Plastic sheets will be placed around the area where the duct is to be cut. Working through gauntlets in the plastic, or using the plastic covering as a sleeve, the foamed duct will be cut apart with a reciprocating saw. Each section of duct will then be bagged and placed in wooden boxes for transport to the process cells. Where a duct penetrates a wall, the duct will be severed at the wall. The section that penetrates the wall will be internally decontaminated, painted, and the opening sealed.

Glove boxes and hoods will be removed in a similar manner to the ductwork. They will be injected with polyurethane foam and unbolted at the separation points. Plastic bags will be placed around the separation points to prevent contamination spread. Sections will be placed in wooden boxes for transport to the cells.

Instruments that are contaminated and not required for the safety systems will be salvaged for use in other nuclear facilities or, if they are unwanted, will be packaged and placed in a cell. Contaminated sample lines will be severed and sealed at the wall penetrations, packaged, and placed in a cell.

Structural decontamination of the accessible areas will progress from rooms, shops, and laboratories toward the aisles. A variety of decontamination methods may be used. Many areas will be cleaned using techniques such as vacuuming and scrubbing with cleaning agents. Ti on floors that may be contaminated will be removed and packaged as contaminated waste. Areas of contaminated concrete that cannot be cleaned by other methods will be removed by vacuum blasting for surface contamination, then chipping, drilling, and rock-splitting or jackhammering for embedded contaminations. The concrete rubble generated will be placed in metal or wooden boxes or 55-gallon drums and placed in the cells.

Noncontaminated equipment and systems in the facility that are not required for interim care will be salvaged or placed in a condition that will require minimum maintenance and permit salvage at a later date. Equipment deactivation procedures will be coordinated with facility decontamination operations. In some areas decontamination must be carried out before equipment deactivation, while in others the opposite approach may be necessary. The particular method used to deactivate each system or piece of equipment will be identified during the planning phase.

Systems inside the main process building will be deactivated by a variety of methods. Some systems will be isolated using existing valves and deactivated by removing the valve handles. Pipes that have contained hazardous chemicals will be flushed and blanked. Other systems will be drained and left open to the atmosphere. Electrical service and other utilities will be disconnected from instrumentation and equipment not required for interim care. A fresh coating of fire retardant material will be applied to all electrical cables in service during interim care.

Following decontamination of the accessible areas and deactivation of unnecessary systems, the contaminated areas will be isolated. Areas containing significant amounts of radioactive contamination will be isolated from the remainder of the facility by installing barriers to block potential contaminant migration and to prevent intruders from entering these areas. Areas in the main process building that will be isolated include:

- All process cells and supporting rooms
- Extraction cells
- Analytical and sample storage (if required) cells
- Shielded niches in the upper and lower warm aisles
- Ventilation cells

All piping, ventilation, instrumentation, equipment and other penetrations, and all access openings into these areas will be sealed.

All shielded viewing windows will be drained of the oil between the glass plates, and steel covers will be welded over them. Shielding plugs, manipulator sleeves, passing ports, and the accesses to the process cells will be welded shut. Welding is the preferred method of installing physical barriers to discourage unauthorized personnel entry into contaminated areas. Stainless steel will be used extensively in constructing the barriers to prevent unauthorized cutting with oxyacetylene torches. The hatches between the FRS and PMC, and between the SR and GPC will be sealed with steel covers.

Access into the XCs is through concrete hatch covers and doors on the lower levels. Stainless steel plates will be bolted to studs placed in the concrete floor and the bolts will be welded to the plate to discourage unauthorized removal.

If the ANC and SSC cannot be cleaned for unrestricted release, all penetrations will be sealed, including the shielded viewing windows, the manipulator sleeves, and the shielded access doors. After draining the oil from the windows, stainless steel plates will be bolted over the windows and the bolts welded to the plates. The manipulators will have been removed during the decontamination operations in the aisles, and blanks bolted over the sleeves. The blanks will be welded to discourage unauthorized removal. Steel plates will be welded over the access doors to the cells.

The UWA and LWA contain pumps and equipment in shielded concrete encl sures. These enclosures will be sealed by bolting a steel plate over the hatch covers and welding the bolts to the plate.

The final step in isolating a cell or contaminated area will be the sealing of the ventilation intake and exhaust ducts. This step will be coordinated with decontamination and isolation of the ventilation system. A HEPA-filtered vent will be installed in each of the isolated cells or areas to allow air to pass in and out during changes in air pressure and temperature. These vents will be inspected and maintained during the interim care period.

The main process building ventilation system will remain in operation while the cells are being sealed and isolated. Filters and ventilation exhaust ductwork, possibly including the stack, will be removed and placed in the ventilation rooms and cells. The SR and EDR may also be used to store the sectional ductwork or the stack.

Filters will be removed using procedures followed during plant operations, and the filter housing will be decontaminated. The ductwork will be removed in a manner similar to that used for the glove boxes. Ducts will be injected with polyurethane foam and sectioned with a reciprocating saw. The sections will be bagged, packaged in wooden boxes, and placed in one of the isolated cells. The stack may require chemical decontamination and/or fixing of the residual contamination before sectioning and placement in a cell.

As the final step in isolating the main process building ventilation system, the main intake and exhaust ducts for the building will be blanked at the point where they enter the building. Filtered vents will be installed to allow the building to equalize pressure during interim care.

The final preparations for surveillance and maintenance of the main process building will be coordinated with the isolation of the ventilation system. Most exterior doors to the facility, including the service doors to the SR and EDR, will be welded shut. High security locks and airtight gaskets will be used on the remaining exterior doors, and an electronic intrusion alarm system will be installed to detect unauthorized entry into the facility during the interim care period.

Safety systems that remain in operation during the interim care period will be upgraded as necessary. Fire detection, firefighting, and automatic radiation detection equipment will be refurbished and expanded as necessary. A remote readout capability will be installed in a neighboring local law enforcement or commercial security agency facility.

The main electrical power supply for the main process building will be disconnected and replaced by a smaller power supply with sufficient capacity to service the remaining equipment in operation during the interim care period.

6.2.3.2 Fuel Receiving and Storage Area

Operations in the FRS will begin with the removal of spent fuel from the storage basin. Equipment and procedures used during the operation of the plant will be employed. (The cost of fuel transport and storage has not been included in the cost of placing the facility in protective storage.)

The storage basin and CUP will be drained to a level approximately two feet above the bottom; this water will be sent to the low level waste treatment facility. While draining these pools, the walls and fuel storage racks will be washed down with a high pressure water nozzle to minimize the possibility of contaminants becoming airborne. The two feet of water will provide protective shielding and will prevent loose contamination from becoming airborne while any solids are removed.

A vacuum cleaner similar to those used for swimming pools will be used to remove residual solids from the basin and CUP. Solids will be trapped in the vacuum discharge filter system, and packaged for storage. Filtered liquids will be sent to the low level waste treatment facility. All remaining water will be drained from the basin and CUP and sent to the low level treatment facility.

After solids are removed and the pools completely drained, the storage racks and equipment used for operation of the pools will be removed, packaged, and placed in the cells. The pools will then be surveyed and decontaminated to unrestricted use levels. Removal of carboline coating from the walls and floors may be required. A vacuum-blaster will be used to remove any contaminated coating and to spall concrete surfaces in areas where contamination has penetrated the carboline. The drain to the low level waste treatment facility will be blanked and welded shut.

Equipment in the FRS will be deactivated using procedures similar to those outlined for the main process building. The water treatment area will be decontaminated by removing all contaminated equipment, placing it in the cells, and vacuum-blasting the contaminated wall and floor surfaces. The cask decontamination area may be decontaminated or dismantled and placed in the cells. The cranes, bridges, and platforms will be deactivated, surveyed, and decontaminated. If a piece of equipment cannot be surveyed and assured clean, it will be packaged and placed in a cell or possibly excessed to another nuclear facility.

The walkways, walls, ceiling, and work areas will be surveyed and decontaminated to unrestricted use levels. Steel surfaces will be stripped of paint and grime and be chemically decontaminated. Concrete surfaces will be spalled using a vacuum-blaster.

The FRS ventilation system will remain in operation while decontamination work is being carried on in the FRS building. When all contamination in the building has been removed, the ventilation system will be deactivated and the ducts and filters removed as outlined for the main process building.

The final steps in placing the FRS in protective storage will be to perform a thorough radiation survey. Any residual contamination will be removed to unrestricted use levels. Safety systems that remain in operation during the interim care period will be upgraded as necessary. Fire detection, firefighting, and automatic radiation detection equipment may be refurbished and expanded if necessary. High security locks will be installed on the exterior doors, and an electronic intrusion alarm system will be installed to detect unauthorized entry into the facility during the interim care period.

6.2.3.3 Waste Tank Farm

After the inventory of liquid waste and decontamination solutions generated during chemical decontamination of the main process building have been removed, the WTF will be placed in protective storage.

The waste tank equipment shelter will be placed in protective storage after the tanks have been isolated and piping between the tanks and the main process building has been blanked. Protective storage techniques will be similar to those described previously for the main process building. Highly radioactive equipment and areas will be chemically decontaminated, and contaminated equipment and piping will be removed and placed in the cells in the main process building. As equipment and piping are removed, open ends and the penetrations through walls and floors will be sealed. The shelters will be decontaminated to unrestricted use levels using techniques similar to those described previously for the accessible areas of the main process building. They will be fitted with a HEPA filter to serve as secondary containment for the tanks.

The final steps in placing the WTF in protective storage are to perfo a radiation survey of the shelters and surrounding area and to secure the shelters. Any residual contamination remaining will be removed. All utilities and systems not required during the interim care period will be deactivated. Fire detection, firefighting, and automatic radiation detection equipment will be tested and upgraded as necessary. High security door locks will be installed, and an electronic intrusion alarm system will be installed with remote readout capability to detect unauthorized entry into the shelters during the interim care period.

6.2.3.4 Auxiliary Facilities

The auxiliary facilities will be surveyed and decontaminated to unrestricted use levels. These facilities include: the office and utility room attached to the main process building, the maintenance shop, plumbing shop, temporary pipe shop, laundry building, warehouse, cooling towers, administration building, farm, environmental laboratory, electrical sub-station, guard house, and the meteorology station.

Only the laundry building will require the removal of contaminated equipment, piping, ventilation ducts and hoods. It houses the washing machines and dryers for cleaning the protective clothing used in radiation zones. The equipment will be packaged and placed in a cell in the main process building. Penetrations into the floor and walls will be sealed when the equipment is removed. Contaminated hoods and ducts will be removed using techniques similar to those used in removing the ducts from the main process building. Remaining equipment and piping which may be contaminated will be removed, packaged, and placed in cells. A final radiation survey will be performed to ensure that the building has been decontaminated to unrestricted use levels. High security locks will be installed on the exterior doors, and an intrusion alarm system will be installed to notify law enforcement officials of unauthorized entry.

Activities in the remaining auxiliary facilities will involve a thorough radiation survey. It is not anticipated that these facilities are contaminated, but any contamination detected will be removed to unrestricted use levels using techniques similar to those employed in decontaminating the accessible areas of the main process building.

6.2.4 Wastes and Waste Disposal

Wastes generated during protective storage activities at the West Valley Plant will include:

- Glove boxes and hoods.
- Spent fuel storage racks from the fuel storage basin.
- Contaminated instruments and process equipment and piping external to the cells, including equipment from the WTF equipment shelter and the laundry building.
- Filters, ventilation ductwork, and stack.
- Concrete rubble from mechanical decontamination of accessible areas and FRS.
- Combustible and noncombustible trash (protective clothing contaminated tools, paper, plastic, metal scrap, etc.).

It is anticipated that most of the contaminated wastes generated will be non-TRU. Wastes containing more than 10 nCi/g TRU contamination will be segregated and packaged separately to facilitate ultimate dismantling.

Waste containers will be designed to be appropriate to the type of contaminated material to be packaged. Equipment and piping, glove boxes, filters and ductwork, and fuel storage racks will be packaged in plywood or sheet metal boxes. Concrete rubble will be placed in steel boxes. Both types of boxes will be designed for stacking in the cells.

The boxes will be placed in cells with low radiation levels and very little loose contamination in order to facilitate entry and later dismantlement. These cells include: the SR, EDR, XCs 2 and 3, LWC, and OGC. Although the CPC is a high radiation zone, remote handling equipment and the rail spurs allow contaminated waste to be stored in also.

6.2.5 Manpower

Estimates of the manpower required to place the West Valley Fuel Reprocessing Plant in protective storage, and to maintain the plant in that condition, are presented in this section. The organization and staffing to plan and carry out protective storage is presented in Figure 6.2-3. The planning effort for protective storage is expected to require two years; the decommissioning operation will require an additional two years. The management and support staff requirements are presented in Table 6.2-2. Craftsmen labor requirements are summarized in Table 6.2-3 and detailed in Tables 6.2-4 through 6.2-7.

We have estimated a total of 163 manyears to plan and carryout protective storage disposition of the West Valley Plant. A period of interim care will follow, requiring approximately two people full time. Surveillance and maintenance of the facility in this condition would continue until it was finally dismantled. We have not estimated the manpower needed to dismantle the facility from the protective storage state. In all probability, techniques and regulatory requirements will have changed sufficiently to make any present estimates irrelevant.

6.2.6 Occupational Radiation Exposure

The occupational radiation exposure required to place the facility in protective storage is estimated to be 300 man-rem. This estimate assumes maximum use of decontamination, shielding, and remote handling as well as judicious adherance to the philosophy that radiation exposure should be As-Low-As-Reasonably-Achievable (ALARA). Radiation exposure estimates for each task are given in Tables 6.2-8 through 6.2-10, and summarized in Table 6.2-11.

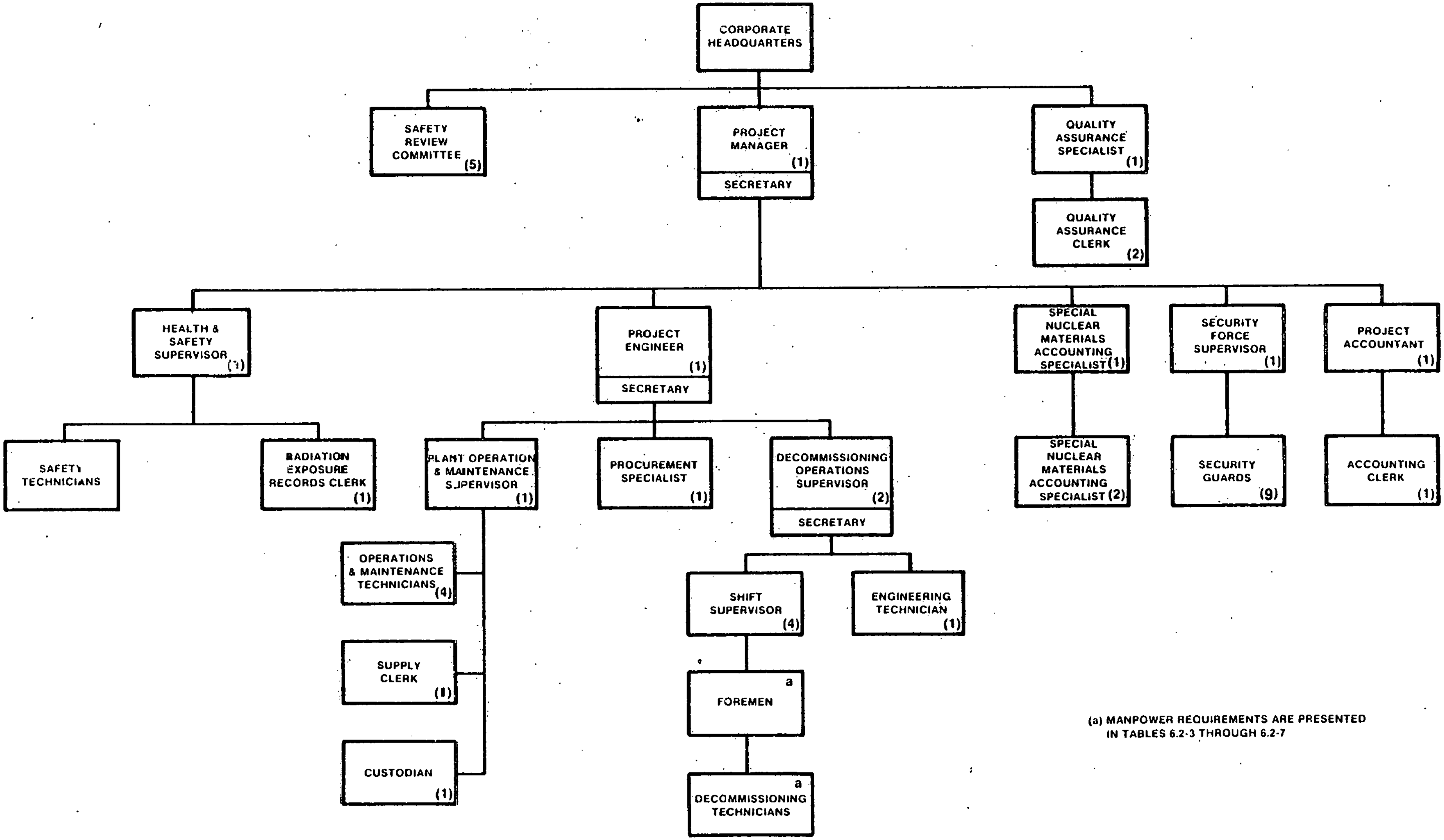

FIGURE 6.2-3

Staff Organization for Protective Storage

TABLE 6.2-2

Summary of Estimated Support Staff Labor Requirements —Protective Storage

Employees (No.)	Manyears of Labor: Planning Phase	Manyears of Labor: Decommissioning Operations
Project Management Personnel		
Project Manager	2	2
Quality Assurance Personnel		
Quality Assurance Specialist	2	2
Quality Assurance Clerks (2)	0.6	4
Decommissioning Operations Personnel		
Project Engineer	2	2
Decommissioning Operations Supervisor	1.8	2
Operations and Maintenance Supervisor	0.2	2
Engineering Technician	2	2
Maintenance Technicians (4)	8	8
Shift Supervisors (4)	8	8
Health and Safety Protection Personnel		
Safety Review Committee (5)	--[a]	--[a]
Health and Safety Supervisor	2	2
Safety Technicians	0.1	--
Radiation Exposure Records Technician	0.2	2
Safeguards and Security Personnel		
SNM Accounting Specialist	0.6	2
SNM Accounting Technicians (2)	0.2	4
Security Force Supervisor	2	2
Security Guards (5)	10	10
Support Services Personnel		
Procurement Specialist	1	2
Supply Clerk	0.2	2
Custodian	2	2
Accountant	2	2
Accounting Clerk	0.6	2
Secretaries (3)	6	6
TOTAL	53.5	70

[a]Committee consists of 5 members meeting 1 day per month.

TABLE 6.2-3

Summary of Estimated Craftsmen Labor Requirements —Protective Storage

(In Manyears)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building	2.8	3.5	11.4	1.4	5.1	1.5	1.1	1.5	4.6	32.9
B.0	FRS	0.4	0.4	1.8	--	0.4	0.3	0.2	0.2	1.2	4.9
C.0	Tank Farm	0.1	0.2	0.3	--	0.1	0.1	0.2	--	0.4	1.4
D.0	Auxiliary Facilities	0.1	0.2	0.2	--	--	--	--	--	0.1	0.6
	TOTAL Manyears	3.4	4.3	13.7	1.4	5.6	1.9	1.5	1.7	6.3	39.8

TABLE 6.2-4

Craftsmen Labor Requirements to Place Process Building in Protective Storage

(In Manweeks)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building										
A.1	Internal decon of process equipment and piping.	18	18	72	18	--	--	--	--	18	144
A.2	Decon external surfaces of cell walls, equipment, piping, and vessels.	32	32	128	32	--	--	—	--	32	256
A.3	Decon glove boxes and hoods, and place in cells.	6	6	24	6	12	--	—	--	12	66
A.4	Remove process piping and equipment external to cells and place in cells.	48	48	192	--	192	48	43	48	96	720
A.5	Install breathing filters on cells, and remove ventilation system and place in cells.	16	16	96	--	32	16	--	--	32	208
A.6	Survey and decon accessible areas to unrestricted release.	12	48	72	12	24	--	--	--	24	192
A.7	Seal cells with rigid barriers.	4	--	--	--	4	12	--	--	8	28
	Subtotal Manweeks	136	168	534	68	264	76	43	48	222	1614

TABLE 6.2-4 (Cont'd)

(In Manweeks)

Activity		Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building										
A.8	Deactivate systems and utilities not required, and install intrusion alarms and high security locks.	8	2	4	--	--	--	8	32	16	70
A.9	Final radiation survey.	3	12	3	6	--	--	--	--	--	24
	Subtotal A.8-9	11	14	7	6	--	--	8	32	16	94
	Subtotal A.1-7	136	168	584	68	264	76	48	48	222	1614
	TOTAL Manweeks	147	182	591	74	264	76	56	80	238	1708
	TOTAL Manyears	2.8	3.5	11.4	1.4	5.1	1.5	1.1	1.5	4.6	32.9

TABLE 6.2-5

Craftsmen Labor Requirements to Place FRS in Protective Storage

(In Manweeks)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
B.0	FRS										
B.1	Removal of stored spent fuel.	3	3	6	--	3	--	--	--	--	15
B.2	Drain basin & remove solids.			20	--	--	--	--	--	--	20
B.3	Decon basin & storage racks.	4	4	16	--	4	--	--	--	4	32
B.4	Remove racks, cranes and filter system and place in cells.	5	5	20	--	10	10	10	10	26	96
B.5	Survey & decon facility to unrestricted release levels.	6	6	24	--	--	--	--	--	24	60
B.6	Remove ventilation system.	3	3	6	--	3	6	--	--	6	27
B.7	Final radiation survey.	1	2	2	--	--	--	--	--	--	5
	TOTAL Manweeks	22	23	94	--	20	16	10	10	60	255
	TOTAL Manyears	0.4	0.4	1.8	--	0.4	0.3	0.2	0.2	1.2	4.9

TABLE 6.2-6

Craftsmen Labor Requirements to Place WTF in Protective Storage

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
C.0 WTF										
C.1 Remove auxiliary systems and replace ventilation system with breathing filter.	4	4	16	--	4	4	4	--	8	44
C.2 Install high security barriers and intrusion alarms.	3	--	--	--	--	3	6	--	12	24
C.3 Final radiation survey.	--	4	--	--	--	--	--	--	--	4
TOTAL Manweeks	7	8	16	--	4	7	10	--	20	72
TOTAL Manyears	0.1	0.2	0.3	--	0.1	0.1	0.2	--	0.4	1.4

TABLE 6.2-7

Craftsmen Labor Requirements to Place Auxiliary Facilities in Protective Storage

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
D.0 Auxiliary Facilities										
D.1 Survey and decon facilities to unrestricted release levels.	2	8	6	--	2	1	--	1	2	22
D.2 Deactivate systems and utilities not required for interim care.	1	--	2	--	1	1	--	1	2	8
TOTAL Manweeks	3	8	8	--	3	2	--	2	4	30
TOTAL Manyears	0.1	0.2	0.2	--	0.1	0.04	--	0.04	0.1	0.6

TABLE 6.2-8

Occupational Radiation Exposure Estimate to Place Process Building in Protective Storage

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
4.0 Process Building							
A.1 Decon process equipment and piping internally.	144	4320	3	4300	0.1	20	14.9
A.2 Decon external surfaces of cell walls, equipment, piping, & vessels).	256	7680	3	7660	0.1	20	25
A.3 Decon gloveboxes and hoods, and place in cells.	66	1980	3	1940	.01	40	6.2
A.4 Remove process piping and equipment external to cells and place in cells.	720	21600	2	21000	0.01	600	48.
A.5 Install breathing filters on cells, and remove ventilation system and place in cells.	208	6240	5	6215.5	0.2 20	20 .5	45.1
A.6 Survey and decon accessible areas to unrestricted release.	192	5760	2	5760	--	--	11.5
A.7 Seal cells with rigid barriers.	28	840	2	840	--	--	1.7

TABLE 6.2-8 (Cont'd.)

Occupational Radiation Exposure Estimate to Place Process Building in Protective Storage

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
4.0 Process Building							
A.8 Deactivate systems and utilities not required for interim care, and install intrusion alarms and high security locks.	70	2100	2	2100	--	--	4.2
A.9 Final radiation survey.	24	720	2	720	--	--	1.4
							158

TABLE 6.2-9

Occupational Radiation Exposure Estimate to Place FRS in Protective Storage

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
B.0 FRS							
B.1 Remove stored spent fuel.	15	450	5	400	.01	50	2.5
B.2 Drain basin and remove solids.	20	600	5	550	0.1	50	7.8
B.3 Decon basin and storage racks.	32	960	5	900	0.5	60	34.5
B.4 Remove racks, cranes, and filter system and place in cells.	96	2880	5	2860	0.3	20	20.3
B.5 Decon facility to unrestricted release levels.	60	1800	2	1800	--	--	3.6
B.6 Remove ventilation system and place in cells.	27	810	5	809	1.	1.	5.0
B.7 Perform final survey.	5	150	0	150	--	--	0
							73.7

TABLE 6.2-10

Occupational Radiation Exposure Estimate to Place WTF in Protective Storage

Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
C.0 WTF							
C.1 Remove auxiliary systems and replace ventilation systems with breathing filters.	44	1320	3	1280	0.1	40	7.8
C.2 Install high security barriers and intrusion alarms.	24	720	2	720	--	--	1.4
C.3 Final radiation survey.	4	120	2	120	--	--	0.2
							9.4

TABLE 6.2-11

Summary of Occupational Radiation Exposure Estimates
—Protective Storage

Process building	158.0
FRS	73.3
WTF	9.4
Auxiliary Facilities	∿0
Subtotal	241.1
+ 25% Contingency	60.3
TOTAL	301.4 Man-rem

6.2.7 Costs

This section describes the method of cost calculation, the cost in 1978 dollars to place the West Valley facility in protective storage, and the cost to provide interim care for the facility prior to final disposition.

We have divided the decommissioning cost into five principal categories:

- Support Staff Labor
- Craftsmen Labor
- Equipment and Materials
- Shipping and Waste Disposal
- Utilities and Other Expenses

Protective storage costs were estimated assuming none of the work would be performed by subcontractors. The cost to place the entire facility in protective storage is estimated at $11.3 million (see Table 6.2-12). The annual interim care cost is estimated at $213,000. The basis for each portion of the overall cost estimate is outlined in the following paragraphs.

6.2.7.1 Labor Costs (Support Staff and Craftsmen Labor)

Manpower requirements are summarized in Section 6.2.5. To convert from manyears to cost, labor rates were established for each employee and an adder of 70 percent to cover benefits and overheads was applied to determine owner cost. These pay rates and owner costs are presented in Table 6.2-13. Before arriving at staff support cost, an additional 10 percent was added to cover facility owner's administrative expense. Craftsmen labor and support staff costs are detailed in Tables 6.2-14 and 6.2-15.

6.2.7.2 Equipment and Materials

The estimated equipment and material required and associated costs are summarized in Table 6.2-16. The cost total, $753,000, is exclusive of waste containers, which are listed separately. A considerable quantity of equipment presently available at the facility would also be used. Although some salvage value is possible from both new and used equipment, there is a considerable probability that equipment will become

TABLE 6.2-12

Summary of Cost Estimates—Protective Storage

Expense Item	Costs (Thousands of 1978 Dollars			
	Planning	Decommissioning Operations	Total	Annual Interim Care
Support Staff Labor	2,152	2,688	4,840	59
Craftsmen Labor	---	1,354	1,354	47
Subcontractor Activities	---	---	---	11
Equipment and Materials	26	727	753	17
Containers	---	500	500	---
Utilities, and Other Expenses	707	883	1,590	36
Subtotal	2,885	6,152	9,037	170
+ 25% Contingency	721	1,538	2,259	43
TOTAL	3,606	7,690	11,296	213

TABLE 6.2-13

Pay Rates[a] and Owner Costs for Decommissioning Employees — Protective Storage

Employee	Annual Base Pay	Annual Owner Cost
Project Manager	43,000	73,100
Project Engineer	35,000	59,500
Health & Safety Supervisor	33,000	56,100
Quality Assurance Specialist	29,000	49,300
Decommissioning Operations Supervisor	32,000	54,400
Plant Operations & Maintenance Supervisor	32,000	54,400
Radiation Safety Specialist	24,000	40,800
Industrial Safety Specialist	25,000	42,500
SNM Accounting Specialist	25,000	42,500
Accountant	22,000	42,500
Radioactive Waste Disposal Specialist	22,000	42,500
Procurement Specialist	20,000	34,000
Security Force Supervisor	20,000	34,000
Laboratory Supervisor	22,000	42,500
Assistant QA Specialist	20,000	34,000
Secretary	12,000	20,400
Radwaste Disposal Clerk	12,000	20,400
QA Clerk	12,000	20,400
Accounting Clerk	12,000	20,400
Radiation Exposure Records Technician	16,000	27,200
Procurement Clerk	12,000	20,400
Supply Clerk	12,000	20,400
Custodian	12,000	20,400
Foreman	21,000	35,700
Shift Supervisor	22,000	42,500
Decommissioning Technician	20,000	34,000
Equipment Operator	18,000	30,600
Mechanical Technician	18,000	30,600
Equipment Operator	18,000	30,600
Maintenance Technician	18,000	30,600
Welder	16,000	27,200
Pipefitter	16,000	27,200
Electrician	19,000	32,300
Instrument Technician	20,000	34,000
Safety Technician	16,000	27,200
SNM Accounting Technician	16,000	27,200
Analytical Technician	16,000	27,200
Engineering Technician	16,000	27,200
Chemical Makeup Operator	15,000	25,500
Security Guard	15,000	25,500
Safety Review Committee[b]	---	500/day

[a]Pay rates are estimated to be representative of highly qualified experienced individuals in each job category in the nuclear industry.

[b]Work as consultants on a daily basis. An allowance for travel and living expenses is also included.

TABLE 6.2-14

Summary of Craftsmen Labor Costs
—Protective Storage

Employee	Costs (Thousands of 1978 Dollars) Process Building	FRS	WTF	Auxiliary Facilities	Total
Foreman	100	14	4	4	122
Safety Technician	95	11	5	5	116
Decommissioning Technician	388	61	10	7	466
Analytical Technician	38	--	--	--	38
Equipment Operator	156	12	3	--	171
Welder	41	8	3	--	52
Electrician	36	6	6	--	48
Pipefitter	41	5	--	--	46
Other Skilled Labor	125	33	11	3	172
Subtotal	1020	150	42	19	1231
Owner Overheads	102	15	4	2	123
TOTAL	1122	165	46	21	1354

TABLE 6.2-15

Summary of Estimated Support Staff Labor Costs —Protective Storage

Employees (No.)	Cost (Thousands of 1978 Dollars) Planning Phase	Decommissioning Operations
Project Manager Personnel		
Project Manager	146	146
Quality Assurance Personnel		
Quality Assurance Specialist	99	99
Quality Assurance Clerk	12	82
Decommissioning Operations Personnel		
Project Engineer	119	119
Decommmissioning Operations Supervisor	98	109
Operations and Maintenance Supervisor	11	109
Engineering Technician	54	54
Maintenance Technicians (4)	245	245
Shift Supervisors (4)	340	340
Operating Technicians (4)	--	--
Health and Safety Protection Personnel		
Safety Review Committee	60	60
Health and Safety Supervisor	112	112
Safety Technician	3	--
Radiation Exposure Records Technician	5	54
Safeguards and Security Personnel		
SNM Accounting Specialist	26	85
SNM Accounting Technicians (2)	5	109
Security Force Supervisor	68	68
Security Guards (5)	255	255
Support Services Personnel		
Procurement Specialist	34	68
Supply Clerk	4	41
Custodian	41	41
Accountant	85	85
Accounting Clerk	12	41
Secretaries (3)	122	122
TOTAL	1,956	2,444

TABLE 6.2-16

Estimated Equipment and Materials Costs —Protective Storage[a]

Description	Quantity	Cost (Thousands of 1978 Dollars) Per Unit	Total
Modified Rock Splitter and Power Supply	2	8	16
Air Operated Rock Drills	2	1	2
Pneumatic Jackhammer and Compressor	2	--	10
Portable Plasma Torch and Power Supply	2	50	100
Arc Welder	2	1	2
Paint Sprayers	2	1	2
Radiation Detection and Analyzing Equipment	--	--	75
High Pressure Decontamination Sprayers	4	2	8
Adjustable Height Mechanical Scaffold	1	--	32
Air Operated Hack Saws	2	0.5	1
High Security Locks	--	--	3
Polysulfide Adhesive	300ℓ	--	2
3/8-in. 304L Stainless Steel Plate	500 sq.ft.	--	6
Intrusion Alarm System	--	--	80
Ventilation Filters	--	--	2
Inorganic Absorbant	--	--	2
Temporary Greenhouse	--	--	10
Flush Chemicals	--	--	170
Mist Eliminators	8	2	16
Expendable Supplies	48 mos.	24 mo@ \$1 24 mo@ \$5	144
Vacuum and Remote Cleaning Equipment	2	--	2
Subtotal			685
Owner Overheads			68
TOTAL			753

[a]Does not include waste containers.

contaminated and will require either disposal in the cells or control future use.

6.2.7.3 Shipping and Waste Disposal

We have assumed that all radioactive material would be placed within the cells. There may be some advantages to disposing of some material in other ways. Burying slightly contaminated or combustible material in the burial grounds might facilitate ultimate dismantlement. The cost would not be materially affected by onsite burial of some materials. Offsite burial would add to the cost.

6.2.7.4 Utilities and Other Expenses

For the purpose of this portion of the estimate, we have considered that the facility would continue under an NRC license and New York State ownership. NFS is currently paying a lease fee of $664,000/yr which will be lost income to the State. NFS also currently pays property taxes, which the State would not. The estimated utilities and other expenses are shown in Table 6.2-17.

The cost of interim care is estimated to be $213,000. The breakout of this cost is shown in Table 6.2-18.

6.2.8 Public and Worker Safety

Each facility disposition has been evaluated on the basis of probable environmental and worker impacts from both routine performance and possible accidents. These evaluations are preliminary and are intended to provide a basis for selection among alternatives. The performance of work required to put the facility into protective storage, interim care, and transportation of waste have been evaluated. The methods and assumptions are detailed below for protective storage; results are summarized in Section 1.

TABLE 6.2-17

Estimated Cost of Utilities and Other Owner Expenses
— Protective Storage

Expense Item	Cost (Thousands of 1978 Dollars)
License Fees	40
Electricity and Other Utilities	1,100
Insurance	380
Travel and Miscellaneous	70
TOTAL	1,590

TABLE 6.2-18

Estimated Annual Costs of the Interim Care Activities
— Protective Storage

Expense Item		Annual Cost (Thousands of 1978 Dollars)
Labor		
Interim Care Superivsion		54
Radiation and Environmental Monitoring		43
Local Contract Services		
Security, Maintenance and Inspections		10
Equipment and Materials		15
Utilities		15
Taxes		--
Insurance		10
License Fee		8
	Subtotal	155
	Owner Overheads	15
	+ 25% Contingency	43
	TOTAL	213

6.2.8.1 Normal Protective Storage Activities

The interiors of certain process cells are highly contaminated and decontamination activities may cause considerable resuspension of this material within the cells. Greater than 99.9 percent of this resuspended material will be removed by HEPA filtration. The remainder will be dispersed from the stack. Assuming airborne concentration of radionuclides in the cells will reach peak concentration 1000 times that of present values for one week, and that filtration efficiency will remain at its present level, we can calculate a dose to the public of 0.05 man-rem whole body exposure and 0.41 man-rem to the lungs. The distribution of this exposure is explained more fully in Section 6.1. The public will receive no routine radiation exposure from the facility in protective storage except the exposure from previous ground disposition which is discussed in Section 5.

As estimated in Section 6.2.6, placing the facility in protective storage will require approximately 300 man-rem of occupational exposure. Interim care of the facility in protective storage will require less than one man-rem per year.

6.2.8.2 Accidents During Protective Storage

Those accidents which may occur while that facility is being placed in protective storage are generally similar to those which might have occurred during operation. However, since the radionuclide inventory in the facility is less than during operation, the consequences of possible accidents are correspondingly reduced.

Accidents analyzed for the operating facility include: criticality within any of the processing cells[1], criticality in the fuel storage pool[1], chemical explosion[1], and other lesser accidents.[2]

[1]FSAR REV 4, Sept. 1969, FSAR 1973, Section X-3

[2]NRC - Interim Safety Evaluation

A criticality is considered much less likely to occur during decommissioning than during operation due to the greatly reduced quantities of material in the facility. Safeguards to prevent criticality will include use of criticality-safe containers, "poison" tanks (tanks containing neutron-absorbing material), and dilution. For the operating facility, a criticality of 10^{20} fissions was predicted to give a 5.85 rem/person dose to the highest exposed member of the general population.[1] The dose to workers outside the cell where the criticality occurred would be slight due to the shielding provided.

A criticality in the fuel storage pool was evaluated for the operating plant. All fuel would be removed in accordance with normal operating procedures prior to any other decommissioning activity. Physical design of the storage basin and safeguards employed during operation make a criticality incident in the fuel storage pool highly unlikely; however, if such an incident were to occur, energy generation would be equivalent to a 10-MWT boiling water reactor for three hours. Radiation from the criticality would be shielded by the water in the basin. Fission products released into the pool water would not exceed maximum permissible concentrations established in 10 CFR Part 20 under the most adverse meteorological conditions.[1]

A chemical explosion, although potentially very serious in terms of worker safety and destruction of property, is not expected to exceed the maximum permissible concentration for mixed fission products at the site boundary.[1] Great care will be taken in preparing and approving chemical decontamination procedures to assure the compatibility of chemicals and to prevent the buildup of explosive gases.

Other lesser accidents have a potential for serious worker injury but are not expected to have serious offsite consequences. The accident

[1] FSAR VII 1.73, 1963

TABLE 6.2-19

Construction/Industrial Accident Frequencies
(Nuclear Facilities)

Accident Category	Job Classification	Frequency (Accident/10^6 Manhours) 1943-70 28 Year Average
Lost Time Injuries:	Heavy Construction	10
	All Construction	5.36
	DOE Operations	2.12
Fatalities:	Construction	0.042
	DOE Operations	0.023
	Government Functions	0.004

rates shown in Table 6.2-19 have been observed on work in nuclear facilities[1] and applied to other decommissioning studies.[2] If we apply these figures to the protective storage mode we can expect an accident frequency less than in construction phase and greater than in normal operation. We have conservatively assumed construction accident rates in predicting 1.9 loss time injuries and 0.015 fatalities during protective storage operations.

The predicted frequency of radiation overexposure was estimated from NRC data for nuclear power reactors from 1971 to 1975.[3] During that period there were 96 overexposures to external radiation for 58,030 man-rem of occupational radiation exposure. We have therefore estimated 0.165 overexposures per 100 man-rem (1 overexposure per 606 man-rem). To accomplish protective storage of the facility will require 300 man-rem. We therefore predict 0.50 overexposures.

6.2.8.3 Transportation Safety

Protective storage does not require truck transportation of wastes, and therefore no radiological or nonradiological transportation hazard will occur. Radiation exposure to the decommissioning worker transferring contaminated waste into the cells is treated as part of the decommissioning operation in Section 6.2.5, Occupational Radiation Exposure. Nonradiation related safety impacts from transferring wastes into the cells is covered in Section 6.2.8.2.

[1] Operational Accidents and Radiation Exposures Experienced Within the USAEC 1943-1970, Wash 1192, 1971.

[2] NUREG 0278

[3] W. Wekreger, NRC Review for Assuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievable - Paper given Nov. 1976, ANS Meeting

6.3 Preparation For An Alternate Nuclear Use

This mode of decommissioning is intended to prepare the facility for an alternate nuclear use. Extensive decontamination and equipment removal would be performed. Residual contamination would be fixed in place to allow normal working conditions for installing new equipment and to minimize security, maintenance, and surveillance requirements.

For this description we have considered removing all process equipment from all cells; however, it is highly probable that some of the present equipment might be retained for the new use, and that not all of the cells in the facility would be required for the new process.

6.3.1 End Product Description

Process equipment and smearable contamination would be removed from the cells and accessible areas of the main process building. Glove boxes would likewise be removed. Highly contaminated sections of the ventilation systems would be decontaminated or replaced. Although contamination would remain in portions of the facility, working dose rates would be low throughout the facility and airborne radioactivity would be minimal. If no alternate nuclear use had been identified for the facility, the facility could be placed in a "layaway" or "protective storage" state.

In preparing for alternation, fuel would be removed from the storage basin, and the basin would be drained and decontaminated. Residual contamination would be fixed in place.

Auxiliary facilities inside the exclusion fence would be surveyed and decontaminated. Residual contamination would be fixed in place if necessary. Auxiliary facilities outside the exclusion fence would be surveyed and decontaminated for unrestricted use. Many of the facilities would be used to support operations in the alternate nuclear use.

NOTE: A reference list of West Valley Plant facility abbreviations and definitions is provided as Table 6.4-31.

The underground tanks, emptied and decontaminated, would each be filled with soil to support the tank roof when the walls eventually decay (in several hundred years).

Much of the land surrounding the facility would be available on a temporary basis for conditional use. It would not be released for unrestricted use until a decision on land needed for the planned alternate nuclear use of the facility was received, and a thorough survey conducted. Installation of passive remote-readout alarm systems and onsite surveillance would assure protection of the public.

6.3.2 Planning and Preparation

The scope of the planning and preparation activities is similar to that of layaway and protective storage modes; however, the level of effort required is somewhat higher and would probably be incorporated with plans for the new use.

The new nuclear use will require a special nuclear materials or source materials license from NRC, or the State of New York. Conversion of the West Valley Plant license will probably be done in conjunction with the new operating license; however, the effort required for the decommissioning portion alone would be approximately the same as if it were handled as a separate licensing action (where the operating license would be converted to a possession-only license and the technical specifications revised).

The planning activities are presented in Figure 6.3-1 along with the approximate time period over which they should take place. This documentation is expected to include a master decommissioning plan and safety analysis, and a set of revised technical specifications that will govern post-shutdown and equipment removal operations. Decommissioning operations would be covered as part of the environmental report for the facility conversion.

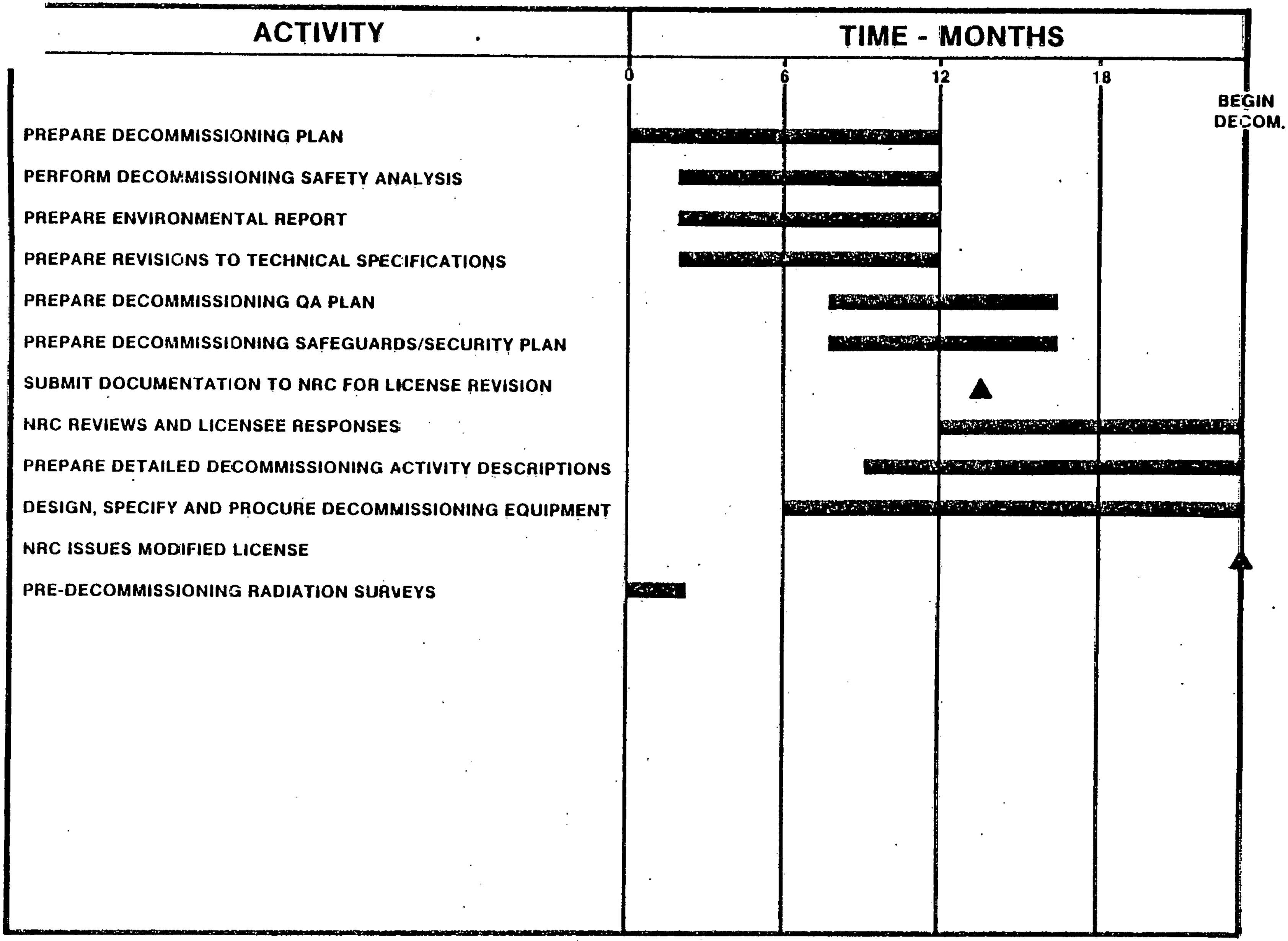

FIGURE 6.3-1

Approximate Schedule of Events for Preparation for Alternate Nuclear Use
Planning and Preparation Phase

The master decommissioning plan is expected to include: the decommissioni objectives for the facility and site, including acceptable release criter... and survey methods for unrestricted and restricted release; a description of the decommssioning activities (including a schedule of events); an analysis of the significant safety issues associated with the decommissioning activities; and a review of the decommissioning Quality Assurance (QA) plan.

The full requirements of a decommissioning safety analysis have not yet been identified by NRC. It is expected that the decommissioning safety analysis would contain:

- An estimate of the radioactive inventories in the facility when decommissioning activities begin.
- An analysis of the adequacy of existing plant safety systems to protect the public health and safety during decommissioning operations.
- A description of special safety systems and procedures required both during decommissioning and by the residual materials remaining.
- A review of the industrial and radiological safety program to be used in performing the work.
- A review of the decommissioning training program.

The QA program's primary purposes are: 1) to assure that adequate precautions are established to protect the health and safety of the public and decommissioning workers during the decommissioning operations; 2) to assure that established safety precautions are followed during decommissioning activities; and 3) to audit the performance of decommissioning activities.[1]

[1] A more detailed outline of the QA program presented in Volume 2, Appendix E. of NUREG-0278.

The environmental report will provide NRC with the basic information necessary to assess the environmental impact of the decommissioning activities and the impact of final facility disposition. Public hearings on the environmental impact of converting the facility to its new use may be required before NRC issues an Environmental Impact Statement or Negative Declaration of Environmental Impact.

The technical specifications will require major modifications due to changes in plant conditions and processes after decommissioning activities. The modified specifications submitted as part of the application for license conversion will delineate allowable operating conditions for plant safety systems, administrative procedures that must be followed to assure that the safety systems are operated within these limits, and plant effluent surveillance.

NRC will review the package of documentation for modification of the plant and licensing of the new process. The decommissioning staff will respond to questions from NRC and furnish any additional information requested. Modifications to the documents may be necessary as a result of the review. When the review process has been completed and all safety-related issues resolved, the modified license will be issued.

During license modification, detailed physical preparations for equipment removal/decontamination activites will begin. These preparations take place during the final year of the planning period. Activity descriptions and working procedures for the decommissioning operation will be developed. Cost estimates and work schedules will be prepared, and equipment designed or specified and procured. Changes necessitated by NRC reviews of the decommissioning plan will be implemented.

Personnel will be added to the decommissioning staff as necessary throughout the planning period. The staff training program will be developed. Training of the decommissioning workers will become a major effort in the latter stages of the planning period and the first stages of the decommissioning period.

6.3.3 Methods

Activities during preparation for alternate nuclear use consist of all the tasks necessary to remove, package, and ship most of the hazardous materials and equipment from the facility. All decommissioning work is accomplished in accordance with a written plan, task specifications, detailed working procedures, and health and safety control programs developed during the planning and preparation phase.

For the purposes of this report, the West Valley Plant was divided into four major sections: main process building, fuel receiving and storage area, waste tank farm, and auxiliary facilities. The activities to be performed in each of these facility sections are outlined, in Table 6.3-1, and a tentative schedule is presented in Figure 6.3-2.

6.3.3.1 Main Process Building

Preparation for alternate nuclear use will begin with a thorough chemical decontamination of the main process cells and main process equipment. The primary purpose of chemical decontamination is to reduce radiation levels for the equipment removal phase, and to prepare for entry as necessary when converting the facility.

Chemical decontamination will generally follow procedures and techniques which were used during plant production operations. During facility shutdown activities, XCs 2 and 3 were chemically decontaminated to levels which allow personnel entry; therefore, further chemical decontamination of these cells may not be necessary. Decontamination procedures can be modified with moderate replumbing work to concentrate on remaining "hot" areas. Solutions and time requirements for flushes may be designed for maximum removal of residual contamination with only moderate concern for corrosion of equipment. Solutions may be recycled from a relatively "clean" area to a more highly contaminated area and flushes may be repeated as necessary.

TABLE 6.3-1
Outline of Preparation for
Alternate Nuclear Use Activities

Main Process Building

1. Chemically decontaminate internals of process equipment and piping.
2. Vacuum loose materials from PMC and GPC.
3. Chemically decontaminate cell walls and equipment externals in the cells except XCs-2 and 3.
4. Disconnect utilities not required for equipment removal/decontamination.
5. Remove equipment from CPC, MPC, GPC, XCs.
6. Decontaminate ventilation ductwork.
7. Survey and chemically decontaminate cell walls.
8. Prepare waste handling area to cut up and package equipment.
9. Decontaminate, fill with foam, and remove glove boxes.
10. Remove equipment from and decontaminate piping and instrument galleries.
11. Remove equipment from and decontaminate other galleries, stations, and laboratories in the main process building.
12. Decontaminate waste handling area and remove miscellaneous equipment.
13. Decontaminate ventilation ductwork, including the stack, and change filters.
14. Perferential radiation survey of facility; fix residual contamination in accessible areas.

Fuel Receiving and Storage

1. Remove stored spent fuel from basin.
2. Drain storage basin and remove solids.
3. Decontaminate basin and storage racks.
4. Remove and/or fix smearable contamination in basin area.
5. Remove and/or fix smearable contamination in other areas and deactivate cranes if required.
6. Decontaminate ventilation system; change out filters.
7. Perform final radiation survey of FRS.

TABLE 6.3-1 (Cont'd.)

Waste Tank Farm

1. Decommission auxiliary systems.
2. Remove auxiliary systems.
3. Excavate to top of stainless steel vault.
4. Erect greenhouse over top of vault.
5. Remove top section of vault and tank.
6. Fill tank with soil.
7. Recap tank and vault.
8. Decommission carbon steel tank in manner similar to the stainless steel tank.
9. Backfill WTF and restore original ground contour.

Auxiliary Facilities

1. Survey facilities outside of the exclusion area to unrestricted release levels.
2. Survey, decontaminate, and/or fix contamination in facilities within secured area.
3. Deactivate systems and utilities not required for interim care.
4. Perform final radiation survey of the auxiliary facilities.

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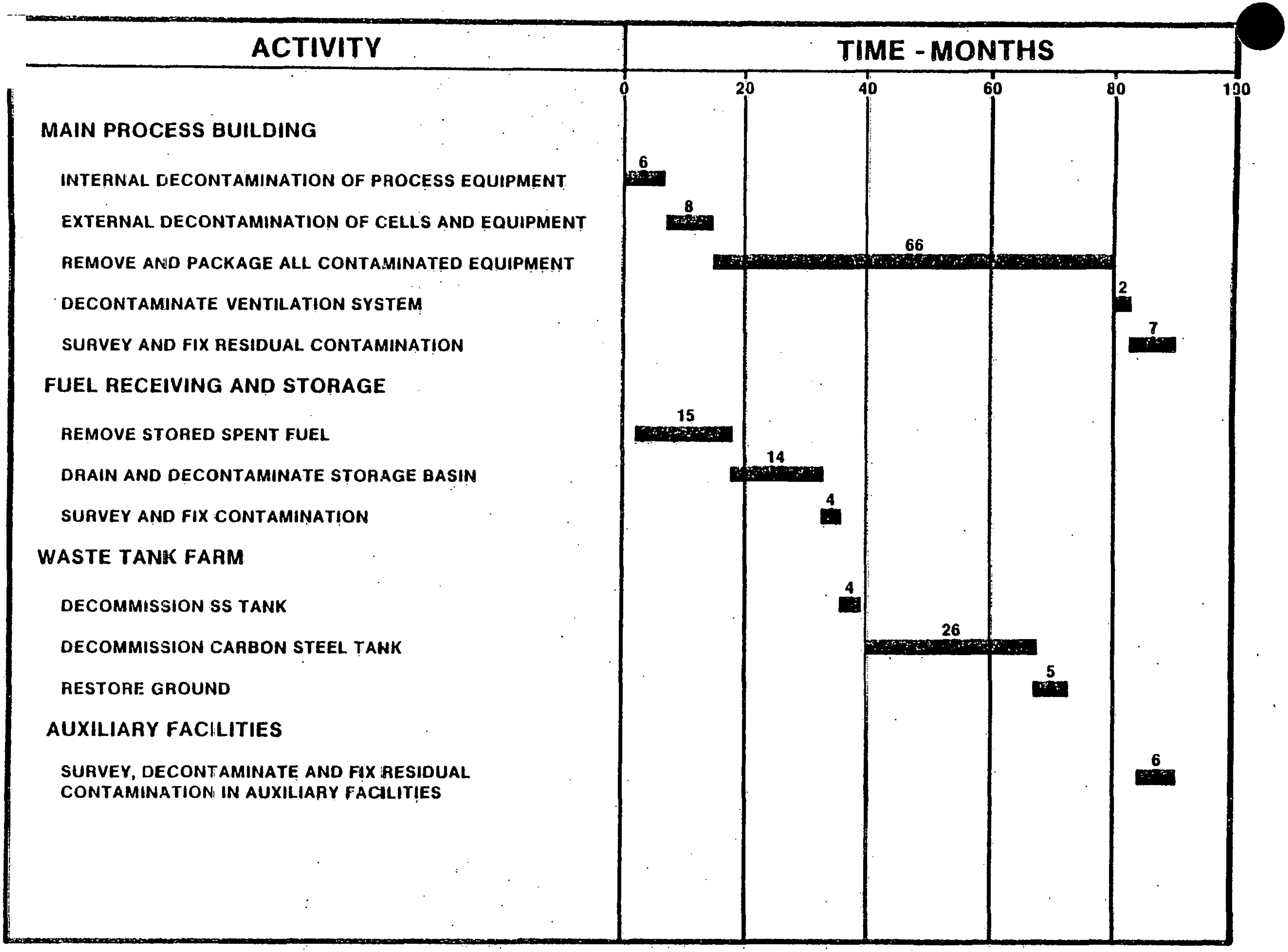

FIGURE 6.3-2

Schedule of Major Activities to Prepare the Facility for an Alternate Nuclear Use

The progress of the equipment internal flushes will be monitored in two ways. Before chemical decontamination begins, shielded directional gamma radiation detectors will be installed at strategic locations in each cell. These assist in monitoring the flushing and in identifying "hot" spots or areas that resist chemical decontamination. Radiation spectrographic information from these detectors helps identify the radionuclides present. Successive flushes will then be tailored for improved removal of these radionuclides. In addition, the decontaminating solutions will be sampled from existing sample points at scheduled intervals and analyzed for dissolved contaminants. A particular flushing sequence will be terminated when these tests indicate that it has achieved its maximum effectiveness.

Areas that might contain significant amounts of plutonium will be carefully monitored to ensure that the plutonium in the flush solution does not exceed the normal operating maximum concentrations or quantities. Solutions approaching these limits will be removed from the area and fresh solutions introduced. If solutions have significant quantities of plutonium or uranium, they may be reclaimed. Waste solutions will be processed onsite in the evaporators and low level waste treatment plant, as they were when the plant operated. Concentrated waste may be neutralized and treated with the liquid waste onsite, or be solidified for burial. After internal chemical decontamination, the process systems will be flushed with water and drained.

Following internal chemical decontamination, external decontamination of process cell walls and equipment surfaces can begin. A variety of techniques will be used, depending on the type and extent of the contamination. Loose contamination such as in the PMC and GPC can be vacuumed with a criticality-safe vacuum cleaner controlled remotely using the installed manipulators. Contamination in inaccessible areas can be reduced using portable high pressure decontamination solution sprayers operated with the master-slave manipulators or, if dose rates are low enough, with contact methods.

In the PMC and GPC, equipment can be disassembled or cut up and packaged for burial using existing manipulators and viewing windows. Much of the equipment in the PMC has already been removed.

The EDR has the capability for remote removal and chemical decontamination of equipment from the CPC. Equipment can be remotely disassembled and brought out by crane or rail. Remote sectioning of large equipment items with a plasma torch or other suitable means may be done in the CPC before it is removed.

Any equipment with large quantities of smearable contamination or sufficient transuranics will be decontaminated using chemicals, electropolishing, or ultrasonic techniques.

Operations in the XCs and PPC will require some contact labor and considerable contamination control. A portable greenhouse will be constructed over each XC to prevent the spread of contamination during cutting operations by maintaining a negative pressure in the cell relative to the outside atmosphere, and by filtering exhausted air. A portable crane, erected over each cell, will be used to lift out pieces of equipment to be packaged for burial.

At present, radiation levels in XC-2, XC-3, and the PPC are low enough for contact operations and it is planned to decontaminate XC-1 to a level where it can be entered and work conducted in the cell. Some cutting operation may be done from a shielded working cage remotely or semi-remotely from the top of the cell.

The disassembly of contaminated equipment in an otherwise "clean" area, such as the low-enriched uranium product weigh tank, will require special procedures to prevent contamination spread. A stripable plastic coating will be applied to the floor and a greenhouse will be constructed over the equipment to confine and collect particulate material produced by the cutting process. A typical greenhouse is illustrated in Figure 6.3-3. A

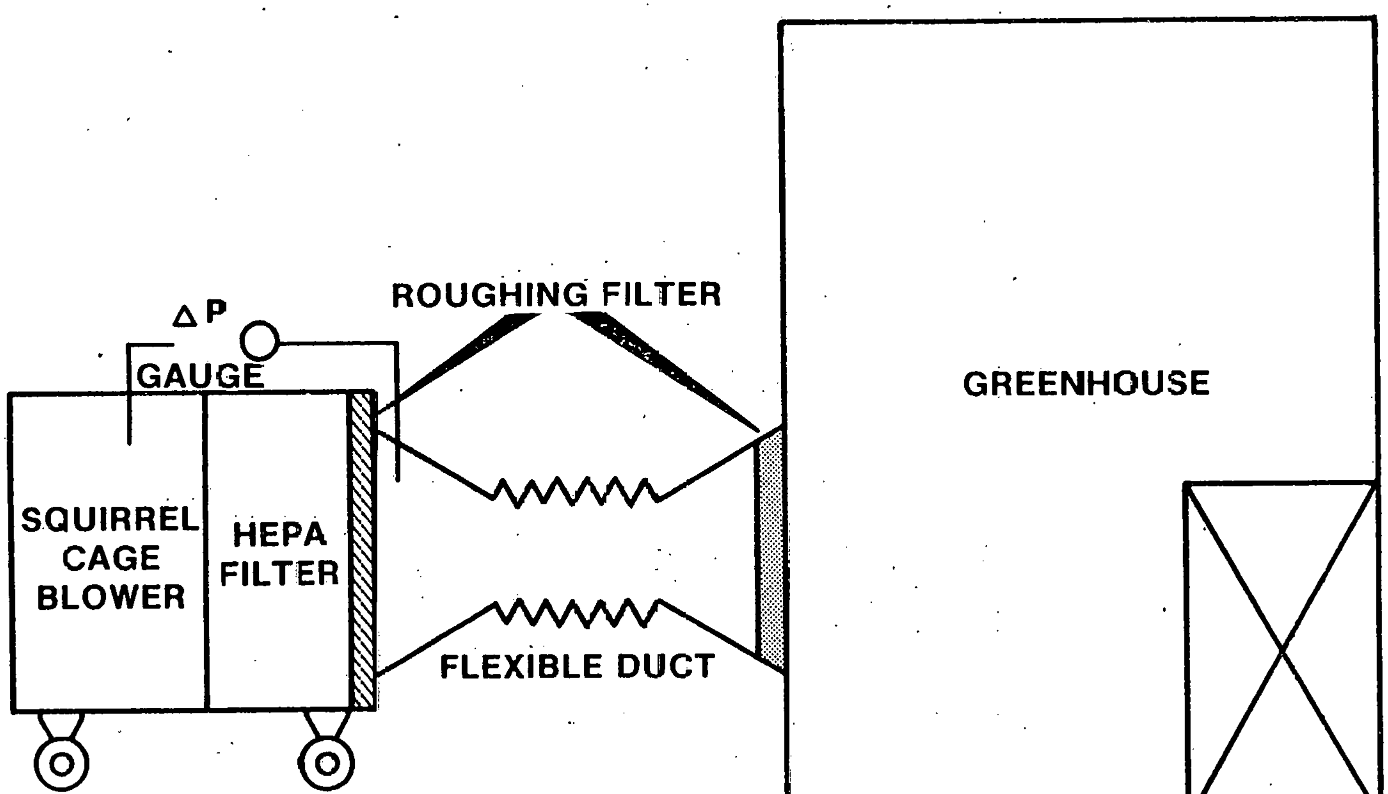

FIGURE 6.3-3

Typical Greenhouse Enclosure

large squirrel-cage blower will be used to pull air through a HEPA filter preceded by a fiberglass roughing filter, all of which is mounted on a wheeled cart. A flexible duct will couple the cart unit to the enclosure where the cutting will be done. Another fiberglass roughing filter will be installed in the ventilation outlet of the enclosure. Radiation detection devices will be used to monitor the buildup of radioactive material on the filters. The pressure drop across the HEPA filter will be monitored to detect buildup of particulates. The filters will be changed when either the dose rate from the collected radioactive particles or the differential pressure across the HEPA filter reaches predetermined levels.

The glove boxes will be packaged and removed using proven techniques. The interior of each glove box will be vacuumed with a criticality-safe vacuum cleaner. The interior surfaces will then be wiped down with a sponge soaked in decontamination solution or, if the glove box is watertight, a high pressure nozzle sprayer will be used. The glove boxes will then be completely filled with foam-in-place polyurethane.

Equipment removal activities in the ARC, HAC, LWA, LWC, MRR, SST, and UWA require a thorough radiation survey to ensure that dose rates will allow contact work to be done. "Hot" spots will be removed or shielded as necessary to minimize exposure to personnel.

Access into the LWC is through a single door. The nine tanks in the cell range in diameters from 3 feet 6 inches to 9 feet, and up to lengths of 11 feet 6 inches. Hoists and scaffolding will be erected and the tanks sectioned with a plasma arc torch for handling and packaging in the cell.

Equipment in the HAC will be removed in a manner similar to that used in the LWC, since both primarily contain tanks.

There are five ANCs, an SC and an SSC which are connected by hatches through interfacing walls. Access into the ANCs and the SC is through the cell doors located in the analytical decontamination area. The SSC has a concrete hatch in its ceiling and a conveyor system between the cells.

The cells are equipped with master-slave manipulators and viewing windows to allow remote operations. For this study, it is anticipated that conditions in the cells will permit contact activities.

The ventilation system will be decontaminated and filters changed after it is no longer needed for equipment removal. Where required, portable filtering systems and enclosures will be used to contain the contamination.

The VSR has background radiation from contaminated exhaust ducts. If it is not required for the alternate nuclear use, equipment will be surveyed and removed. Normal contact equipment removal procedures will be followed.

The two main exhaust filters will be removed using the plant maintenance procedures; the filter niche will be decontaminated and the filters replaced. Exhaust ducts will be decontaminated or removed if excessively contaminated.

Contact activities are planned in the VWR, which contains an air washer circulation pump. Shielding will be provided where necessary to reduce exposure rates.

The OGC begins at the 100-foot level (which is the ground level) and extends to the 144-foot level. Filters, blowers, scrubbers, heaters, coolers, and condensers are contained in the cell. It is anticipated that dose rates will be low enough in the OGC for contact activities. Access into the OGC is from the 100-foot level or through the ARC. Concrete hatchcovers can be removed on the 144-foot level to gain access through the top. For equipment removal, a greenhouse will be erected over the top hatch and a hoist used to lift the equipment out.

The HEV room serves the PMC, GPC, and the CPC. It contains moderate levels of contamination, and contact activities are planned here. Filters will be removed and the ductwork decontaminated or removed and replaced.

Contaminated equipment and materials in accessible areas of the process building will be removed and packaged. These areas contain instrumentations, glove boxes, ductwork, and laboratory equipment.

Procedures for equipment removal/decontamination in accessible areas begin with equipment removal in the laboratories and shops and proceed to the aisles. Dose rates are low enough to allow contact operations. Process piping that runs through these areas and has high radiation level readings will be severed and the wall penetrations sealed. Ductwork that has excessive contamination, such as the ductwork on top of the roof and outside of the control room, will be decontaminated and removed; if required for alternate site use, it will be replaced. Floor tiles that are contaminated will be removed and the adhesive scraped off. A radiation survey will be taken to locate smearable and fixed residual contamination, and these areas will be painted to fix and identify the contaminants. A final radiation survey will be performed to assure that all residual contamination in accessible areas of the process building is fixed.

6.3.3.2 Fuel Receiving and Storage

Equipment removal/decontamination operations in the FRS begin with the removal of the existing spent fuel assemblies, using present plant operation procedures and methods. The fuels will be sent to approved offsite fuel storage facilities. The pool will be drained to within approximately two feet of the bottom to shield radiation from any solids that may have settled. As the pool is drained, a high pressure water nozzle sprayer will be used to wash down the walls to prevent loose contamination from drying and becoming airborne. The solids will be removed with a swimming pool-type vacuum cleaner; particles will be trapped in the vacuum discharge filter system. The pool will then be completely drained and thoroughly washed down with the high pressure water sprayer. The fuel racks may then be removed and packaged as low level waste. The sumps and penetrations in the walls will require concentrated effort to decontaminate because of inaccessibility. A survey of the pool will be taken and any residual contamination fixed with paint. (It should be noted that the pool had been cleaned out at the time the facility was shut down in 1972.)

The cask decontamination area, cask unloading area, cask unloading crane, fuel canister crane, and other equipment will be decontaminated and residual contamination fixed. The equipment in the FRS may be decontaminated and remain if required for alternate nuclear use. The ventilation system filters and ductwork will either be decontaminated or removed and a passive, breathing filter installed.

6.3.3.3 Waste Tank Farm

The WTF includes the 600,000-gallon carbon steel tank and its slightly contaminated spare, the 12,000-gallon stainless steel tank and its slightly contaminated spare, and the auxiliary systems related to these tanks. With an alternate use of the facility, the four tanks would be filled with dirt and remain in place. It is assumed that the liquid wastes and heel will already have been removed and the tanks decontaminated to a degree.

Procedures for burying the tanks in place require that the auxiliary facilities and the shelter which houses them be removed, and the area over the top of the vaults enclosed with a greenhouse. The auxiliary facilities and systems include the ventilation system and the instrumentation and controls located in the WTF shelter (directly above the tanks at grade level). These can be removed using contact removal procedures.

The top of the tank will then be exposed by excavation and an opening approximately 6 feet by 8 feet made so the tanks can be filled with earth and the area backfilled. The tanks will be backfilled with silty till to minimum overhead depths of eight feet for the carbon steel tanks, and six feet for the stainless steel tanks.

The less contaminated stainless steel storage tanks will be excavated and filled first, in order to test procedures and equipment. The concrete vault will be penetrated with the use of explosives or other conventional means. A greenhouse large enough to accomodate dump trucks will be constructed over the tank to provide contamination control when the tank is broken into. The greenhouse will be designed for ease of decontamination and to withstand year-round weather conditions and be portable enough to be repositioned above the other contaminated tank.

After the stainless tanks are filled with dirt, the greenhouse will be transported to each of the carbon steel tanks for a repeat of the process. The area will be backfilled to the original surface contour and vegetation planted for erosion control. The site will be marked as a burial ground.

6.3.3.4 Auxiliary Facilities

The auxiliary facilities include: the office and utility room attached to the main process building, the maintenance shop, plumbing shop, temporary pipe shop, laundry building, warehouse, cooling towers, administration building, farm, environmental laboratory, electrical sub-station, guard house, and the meteorology station.

Decommissioning activities in the auxiliary facilities involve a thorough radiological survey of the facilities. Facilities outside the security fence will be surveyed to unrestricted release limits. The remaining facilities are in the secured area and will be surveyed, decontaminated as necessary, and any residual contamination fixed with paint.

The laundry building is a single story concrete block structure that houses the laundry facility, lockers and showers, and storage space for clothing. These may be needed for the new site use, but will be surveyed and contamination fixed.

6.3.4 Wastes and Waste Disposal

Large quantities of radioactive wastes will be generated during equipment removal/decontamination for an alternate nuclear use. The wastes will be packaged and shipped offsite and/or to the onsite burial grounds for disposal.

Wastes generated during equipment removal/decontamination of the facility include:

- Glove boxes and hoods.
- Spent fuel storage racks from the fuel storage basin.
- Contaminated instruments and process equipment and piping, including equipment from the WTF equipment shelter.
- Filters, ventilation ductwork, and stack.
- Concrete rubble from mechanical decontamination of accessible areas and FRS.
- Combustible and noncombustible trash (protective clothing contaminated tools, paper, plastic, metal scrap, etc.).

Wastes containing transuranic (TRU) contamination above 10 pCi/g will be shipped to approved interim storage or to a Federal repository. Non-TRU wastes will be buried onsite if possible, or in burial grounds at 1000 or 3000 miles distant.

TRU wastes will be categorized as low-level or intermediate-level, depending on the radiation level from the waste. Equipment with TRU contamination will be decontaminated for disposal as non-TRU radioactive waste wherever possible. Techniques available for decontaminating TRU wastes include electropolishing, ultrasonic cleaning, and chemical decontamination. The EDR will be utilized for decontamination operations because it contains a stainless steel soaking pit.

NRC has proposed that commercially generated wastes contaminated with TRU elements must be shipped to Federal repositories for interim storage or permanent disposal.[1] Fire safety requirements at a repository are

[1] Proposed Rulemaking on Transuranic Waste Disposal. Published in Federal Register, Volume 39, No. 32992, November 1969.

assumed to require that all material accepted for disposal be packaged in nonflammable containers. For this study, container and shipping requirements outlined in the Barnwell FRP study, NUREG-0278, are assumed. TRU wastes with low external radiation levels will be packaged in steel boxes and 55-gallon drums which will be placed inside steel cargo containers. Cargo containers will be trucked in exclusive use vehicles. Approximately 10 percent of the contaminated equipment and 30 percent of the HEPA filters from the plant will be packaged in 30-inch diameter by 10-feet long cylindrical steel canisters and shipped to the burial ground with 3- to 5-inch lead shielding. Truck-mounted casks such as these are currently licensed for the shipment of spent fuel. Auxiliary cooling would not be required.

Low-level, non-TRU wastes will be packaged for disposal in containers such as steel or plywood boxes or 55-gallon drums, and transported by truck to a commercial burial ground.

Volume and packaging information for wastes generated in preparing the facility for an alternate nuclear use is summarized in Table 6.3-2. Shipping volume was calculated by taking the total volume of major pieces of equipment such as vessels, tanks, condensers, coolers, evaporators, etc., from the facility and multiplying it by a factor of one and one-half. Piping volume was based on information provided by NFS on the extraction cells; ratio of linear feet of pipe per major piece of equipment was calculated for these cells. This ratio was assumed to also hold true for other cells. Waste volume for pipe was calculated assuming a 1½-inch average diameter and a package volume of 1½ times pipe volume.

The shipping volumes for the fuel storage racks, HEPA and roughing filters, and trash were taken from the Barnwell study. The estimate for the shipping volume of the glove boxes was based on inspection of the glove boxes in the facility. The volume of liquid waste was calculated from the low level liquid waste treatment facility average output of 36 55-gallon drums of solidified liquid waste generated from every million gallons of liquid

TABLE 6.3-2

Packaging and Shipping Data for Wastes Generated in Preparation for an Alternate Nuclear Use

Waste Category	Shipping Volume (ft^3)	Weight (Tons)	Container Type	Number of Containers	Number of Shipments
TRU Waste (High Level)	500	17.5	Steel Canister	10	3
Non-TRU - Solidified Solids From Low Level Liquid Waste Treatment	270	9.5	55-gal Drum	36	1
Non-TRU - Equipment and Piping	50,000	1750.0	4 ft x 4 ft x 7 ft Steel Box	450	45
Non-TRU - Fuel Storage Racks	24,000	180.0	4 ft x 4 ft x 7 ft Plywood Box	215	22
Non-TRU - Glove Boxes	2,000	50.0	4 ft x 4 ft x 7 ft Plywood Box	18	2
Non-TRU - Trash	10,500	157.5	55-gal Drum	1430	20
Non-TRU - Filters	1,100	5.5	Plywood Box	10	1
TOTALS	88,370	2170.0	---	---	94

put through the facility. It was estimated that one million gallons of low level waste would be generated from draining the fuel storage basin and internally decontaminating the process piping and equipment. The densities of the wastes were calculated from the Barnwell study (NUREG-0278) and applied to the wastes estimated here to obtain the total weight of the wastes.

6.3.5 Manpower

This section presents estimates of the manpower required to prepare the West Valley Fuel Reprocessing Plant for an alternate nuclear use. The organization for planning and carrying out the decommissioning work is shown in Figure 6.3-4. This organization would function for the first two years preparing procedures, environmental reports, and license revisions. During the last months of this time period, additional personnel would be added to the organization to be trained for work in the facility. Decommissioning operations would take place during the last two years of the project.

Manpower estimates for each task in the dismantling process are shown in Tables 6.3-3 through 6.3-8. These estimates were based on an assessment of the quantity of equipment and the radiation and contamination levels in each portion of the facility. Crews were assigned consisting of a foreman and several craftsmen selected according to the work required. An estimate was made of the time required for such a crew to complete the work. By multiplying the number of workers in each job category by the time required, we arrived at the manweek estimates presented in Tables 6.3-4 through 6.3-8.

The manpower estimates do not include any portion of the work required to convert the facility to an alternate use, or to license such use.

We have estimated a total of 208 manyears to plan, obtain approval for, and carry out equipment removal and decontamination of the facility in preparation for installation of equipment for some alternate nuclear use; 165.1 manyears are management, support staff, and licensing, and 43 manyears

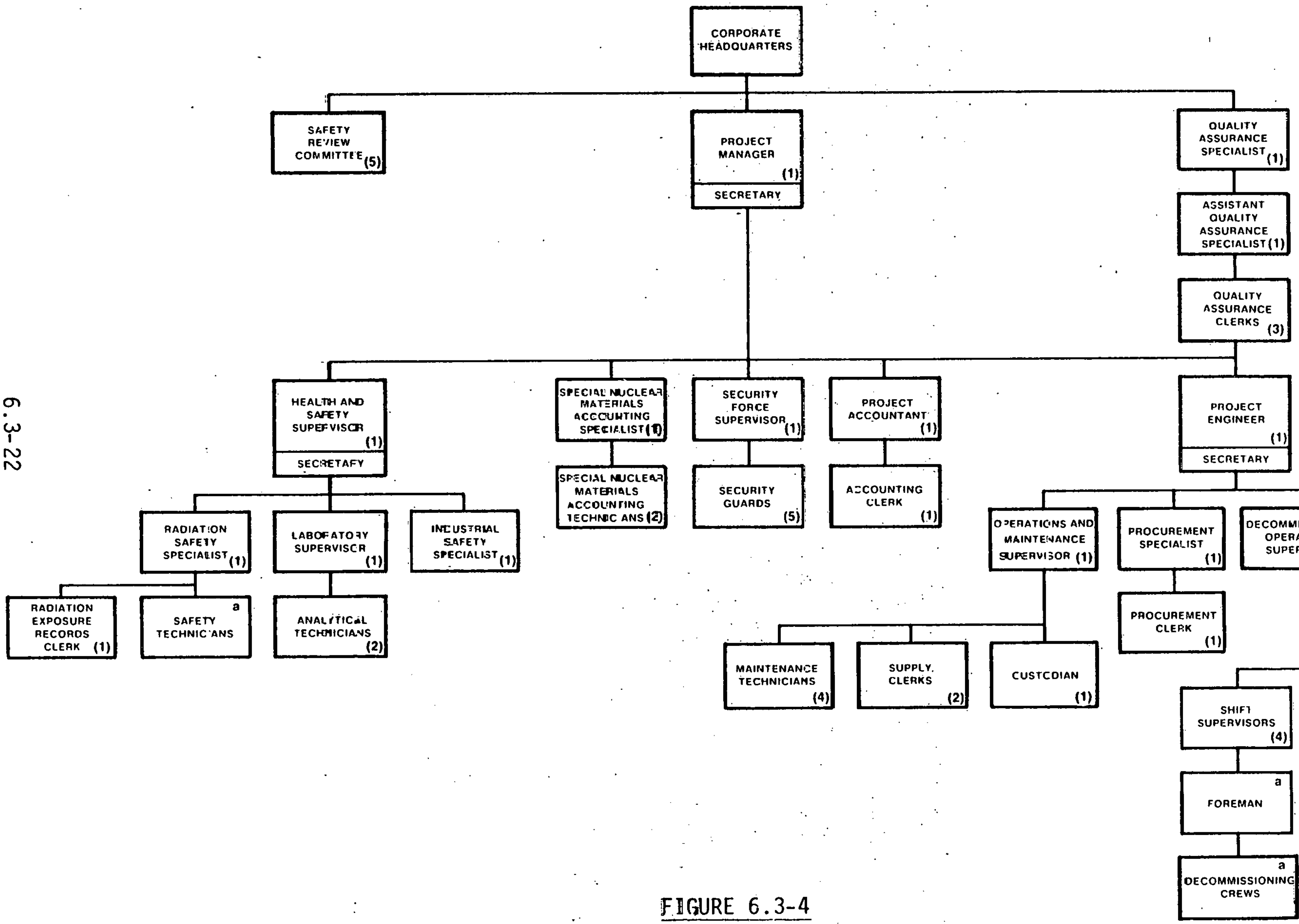

FIGURE 6.3-4

Support Staff Organization for Preparation for Alternate Nuclear Use

[a] Manpower numbers presented in Tables 6.3-4 through 6.3-10

TABLE 6.3-3

Summary of Estimated Support Staff Labor Requirements
— Preparation for Alternate Nuclear Use

Employees (No.)	Manyears of Labor Planning Phase	Manyears of Labor Decommissioning Operations
Project Management Personnel		
Project Manager	2	2
Quality Assurance Personnel		
Quality Assurance Specialist	2	2
Assistant Quality Assurance Specialist	1	2
Quality Assurance Clerks (3)	0.6	6
Decommissioning Operations Personnel		
Project Engineer	2	2
Decommissioning Operations Supervisor	2	2
Operations and Maintenance Supervisor	0.2	2
Engineering Technicians (3)	3	6
Radioactive Waste Disposal Specialist	1.5	2
Radioactive Waste Disposal Clerk	1.5	2
Maintenance Technicians (4)	8	8
Shift Supervisors (4)	8	8
Health and Safety Protection Personnel		
Safety Review Committee	a	a
Health and Safety Supervisor	2	2
Radiation Safety Specialist	2	2
Industrial Safety Specialist	2	2
Laboratory Supervisor	2	2
Radiation Exposure Records Clerk	0.3	2
Safeguards and Security Personnel		
SNM Accounting Specialist	0.6	4
SNM Accounting Technicians (2)	---	4
Security Force Supervisor	2	2
Security Guards (5)	10	10
Support Services Personnel		
Procurement Specialist	1	2
Procurement Clerk	1	2
Supply Clerks (2)	0.4	4
Custodian	2	2
Accountant	2	2
Accounting Clerk	2	2
Secretaries (5)	6	10
TOTAL	67.1	98

Committee consists of 5 members meeting 1 day per month.

TABLE 6.3-4

Summary of Estimated Craftsmen Labor Requirements
—Preparation for Alternate Nuclear Use

(In Manyears)

Activity		Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building	2.4	2.8	9.5	1.3	4.9	1.2	1.2	1.2	3.6	28.1
B.0	FRS	0.2	0.2	2.0	--	0.2	--	--	--	0.4	7.8
C.0	Tank Farm	1.2	1.0	0.2	--	2.5	2.3	0.7	--	4.7	12.6
D.0	Auxiliary Facilities	--	0.3	0.1	--	--	--	--	--	--	0.4
	TOTAL Manyears	3.8	4.3	10.8	1.3	7.6	3.5	1.9	1.2	8.7	42.9

TABLE 6.3-5

Craftsmen Labor Requirements to Prepare Process Building for Alternate Nuclear Use

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technical	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0 Process Building										
A.1 Decon process equipment & piping internally	18	18	72	18	--	--	--	--	18	144
A.2 Decon external surfaces of cell walls, equipment, piping & vessels	32	32	128	32	--	--	--	--	32	156
A.3 Remove & package for burial all equipment & piping	60	60	240	--	240	60	60	60	120	900
A.4 Decon & remove gloveboxes & hoods	6	6	24	6	12	--	--	--	12	66
A.5 Decon ventilation systems and change filters	3	3	12	3	3			--	6	30
A.6 Survey & fix residual contamination in accessible areas	4	16	16	4	--	--	--	--	--	40
A.7 Final radiation survey	3	12	3	6	--	--	--	--	--	24
TOTAL Manweeks	126	147	495	69	255	60	60	60	188	1460
TOTAL Manyears	2.4	2.8	9.5	1.3	4.9	1.2	1.2	1.2	3.6	28.1

TABLE 6.3-6

Craftsmen Labor Requirements to Prepare FRS for Alternate Nuclear Use

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
B.0 FRS										
B.1 Remove stored spent fuel	3	3	6	--	3	--	--	--	--	15
B.2 Drain basin & remove solids			20	--	--	--	--	--	--	20
B.3 Decon basin & storage racks	4	4	16	--	4	--	--	--	4	32
B.4 Decon ventilation system & change filters	1	1	4	--	1	--	--	1	2	10
B.5 Survey & fix residual contamination	1	2	2	--	--	--	--	--	2	7
B.6 Deactivate systems & utilities not required for interim care	1	1	1	--	--	--	1	1	--	5
B.7 Final radiation survey	1	2	2	--	--	--	--	--	--	5
TOTAL Manweeks	11	13	51		8		1	2	8	94
TOTAL Manyears	0.2	0.3	1.0		0.2		0.02	0.03	0.2	1.8

TABLE 6.3-7

Craftsmen Labor Requirements to Prepare WTF for Alternate Nuclear Use

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
C.0 WTF (all tanks)										
C.1 Decon and remove auxiliary systems	3	3	12	--	3	3	3	--	3	30
C.2 Erect greenhouse over each tank	16	16	--	--	16	96	32	--	32	208
C.3 Excavate to top of tanks	8	8	--	--	8	--	--	--	32	56
C.4 Cut opening thru vault roofs & tank tops	8	8	--	--	16	4	--	--	32	68
C.5 Fill tanks with soil	18	16	--	--	68	--	--	--	96	198
C.6 Recap vault openings and restore ground contour	8	--	--	--	18	18	--	--	48	92
C.7 Final radiation survey	--	2	--	--	--	--	--	--	--	2
TOTAL Manweeks	61	53	12	--	129	121	35	--	243	654
TOTAL Manyears	1.2	1.0	0.2	--	2.5	2.3	0.7	--	4.7	12.6

TABLE 6.3-8

Craftsmen Labor Requirements to Prepare Auxiliary Facilities for Alternate Nuclear Use

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
D.0 Auxiliary Facilities										
D.1 Survey facilities outside secured area for unrestricted release	1	4	2	--	--	--	--	--	--	7
D.2 Survey, decon, & fix contamination within secured area		4	4	--	--	--	--	--	--	8
D.3 Final radiation survey		8	--	--	--	--	--	--	--	8
TOTAL Manweeks	1	16	6	--	--	--	--	--	--	23
TOTAL Manyears	0.02	0.3	0.1	--	--	--	--	--	--	0.4

are craft labor. This estimate includes removing the equipment and packaging it for burial, but does not include manpower for transportation to the site and final burial, since this was estimated from waste volumes, weight, and distances.

6.3.6 Occupational Radiation Exposure

Occupational radiation exposure estimates were prepared for the activities required by this facility disposition mode. It was assumed that judicious attention would be paid to the as-low-as-reasonably-achievable (ALARA) philosophy in reducing radiation exposure. This assumes maximum use of remote operations, destructive decontamination, shielding, distance, and training to reduce radiation exposure. Occupational radiation exposure estimates were formulated from work times and present dose rates by assuming decontamination factors as follows:

External Decontamination	
PMC and GPC	100
All Other Areas	10
Internal Decontamination	
XCs 2 and 3	2
All Other Piping Areas	10
Remote Removal of Highly Radioactive Equipment and Shielding	2-50

If conditions are not as expected or if exposure controls are not adequate, the actual exposure received in doing the work could easily run twice the estimated 410 man-rem or more.

The estimates shown in Tables 6.3-9 through 6.3-13 assume that 10 hours per week are spent performing work requiring no occupational radiation exposure, and that the majority of the remaining work is done in low background areas within the plant.

TABLE 6.3-9

Occupational Radiation Exposure Estimate to Prepare Process Building for Alternate Nuclear Use

Activity	Total Manweeks	Manhours in Radiation areas[a]	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background Area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
A.0 Process Building							
A.1 Decon process equipment & piping internally	144	4,320	3	4,300	0.1	20	14.9
A.2 Decon external surfaces of cell walls, equipment, piping & vessels	256	7,680	3	7,660	0.1	20	25
A.3 Remove & package for burial all equipment & piping	900	27,000	2	26,715	0.50 0.20 0.50 1 10	100 100 50 10 5	183.4
A.4 Decon & remove gloveboxes & hoods	66	1,980	3	1,960	0.01	20	6.1
A.5 Decon ventilation systems and change filters	30	900	5	891.5	0.2 20	3 0.5	15.1
A.6 Survey & fix residual contamination in accessible areas	40	1,200	2	1,200	--	--	2.4
A.7 Final radiation	24	720	2	720	--	--	1.4
							248.3

[a]Obtained by assuming 2 hours of each 8 hour day are spent in change rooms, training and planni erformed in non-radiation areas.

TABLE 6.3-10

Occupational Radiation Exposure Estimate to Prepare FRS for Alternate Nuclear Use

Activity	Total Manweeks	Manhours in Radiation areas[a]	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background Area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
B.0 FRS							
B.1 Removal of stored spent fuel	15	450	5	400	.01	50	2.5
B.2 Drain basin & remove sludge	20	600	5	550	0.1	50	7.8
B.3 Decon basin & storage racks	32	960	5	900	0.5	60	34.5
B.4 Decon ventilation system & change filters	10	300	5	299	1	1	2.5
B.5 Survey & fix residual contamination	7	210	2	210	--	--	0.4
B.6 Deactivate systems & utilities not required for interim care	5	150	2	150	--	--	0.3
B.7 Final radiation survey	5	150	2	150	--	--	0.3
							48.3

TABLE 6.3-11

Occupational Radiation Exposure Estimate to Prepare Two Carbon Steel Tanks for Alternate Nuclear Use

Activity	Total Manweeks	Manhours in Radiation areas	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background Area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
C.0 WTF							
C.1 Decon and remove auxiliary systems	20	600	5	580	1 0.1	10 20	14.9
C.2 Erect Greenhouse over tanks	104	3120	0.5	3120	--	--	1.6
C.3 Excavate to top of tank	36	1080	0.5	--	--	--	0.5
C.4 Cut opening thru vault roof and tank top	40	1200	3	1170	0.02	30	4.1
C.5 Fill tanks with soil	192	5760	0.5	5760	--	--	2.9
C.6 Recap tanks and vaults and restore ground	60	1800	--	--	--	--	--
C.7 Final radiation survey	1	--	--	--	--	--	--
							24.0

TABLE 6.3-12

Occupational Radiation Exposure Estimate to Prepare Two Stainless Steel Tanks for Alternate Nuclear Use

Activity	Total Manweeks	Manhours in Radiation areas[a]	Background Level for Remote Work or Ent/exit (mR/hr)	Manhours in Background Area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
C.0 WTF							
C.1 Decon and Remove Auxiliary System	10	300	5	280	0.1	20	2.1
C.2 Construct greenhouse over tank	104	3120	1	3120	--	--	3.1
C.3 Excavate to top of tank	20	600	0.5	600	--	--	0.3
C.4 Cut opening thru vault and in tank top	28	840	3	840	--	--	2.5
C.5 Fill tanks with soil	6	180	0.5	180	--	--	0.1
C.6 Recap tank and vault and restore ground	16	480	--	--	--	--	--
C.7 Final Radiation Survey	1	30	--	--	--	--	---
							8.1

TABLE 6.3-13

Summary of Occupational Radiation Exposure Estimates
—Preparation for Alternate Nuclear Use

Process Building	248.3
FRS	48.3
WTF	32.1
Auxiliary Facilities	∿0
Subtotal	328.7
+ 25% Contingency	82.2
TOTAL	410.9 Man-rem

6.3.7 Costs

This section describes the method of cost calculation and the cost (in 1978 dollars) to prepare the West Valley facility for alternate nuclear use. We have divided the decommissioning cost into five principal categories:

- Support Staff Labor
- Craftsmen Labor
- Equipment and Materials
- Shipping and Waste Disposal
- Utilities and Other Expenses

The total cost varies depending on the location of waste disposal. If all non-TRU wastes can be buried onsite, the estimated cost is $1.82 million. If all wastes must be shipped 3000 miles for disposal, the cost is estimated at $19.3 million. In an intermediate case, if the waste is trucked 1000 miles the cost is $18.8 million.

The contribution to the total cost of each of the five categories is summarized in Table 6.3-14; the origin of the data used in this table is explained below. Because of the conceptual nature of the estimate, a 25 percent contingency has been added to compensate for possible omission.

6.3.7.1 Labor Costs (Support Staff and Craftsmen Labor)

Manpower requirements are summarized in Section 6.3.5. To convert from manyears to cost, labor rates were established for each employee classification and an additional 70 percent to cover benefits and overheads was applied to determine owner cost. To arrive at staff support cost, an additional 10 percent was added to cover facility owner's administrative expense. These pay rates and owner costs are presented in Table 6.3-15. Craftsmen labor costs and support staff costs are detailed in Tables 6.3-16 and 6.3-17, respectively.

TABLE 6.3-14

Summary of Cost Estimate —
Preparation for Alternate Nuclear Use

Expense Item	Costs (Thousands of 1978 Dollars) Planning	Process Bldg.	FRS	WTF	Aux. Fac.	Total
Support Staff Labor	2,661	2,782	186	614	35	6,278
Craftsmen Labor		960	64	405	12	1,441
Equipment and Materials	26	1,413	94	596	18	2,147
Shipping and Waste Disposal						
1000-mile Shipment	--	1,618	108	682	20	2,428
3000-mile Shipment	--	1,882	126	795	24	2,827
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes	--	1,289	86	544	16	1,935
Utilities and Other Expenses	1,160	1,046	70	441	13	2,730
1000-mile Shipment TOTAL[a]	4,809	9,774	652	3,423	122	18,780
3000-mile Shipment TOTAL[a]	4,809	10,104	675	3,564	127	19,279
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes TOTAL[a]	4,809	9,363	625	3,250	117	18,164

[a]Includes 25% Contingency.

TABLE 6.3-15

Pay Rates[a] and Owner Costs for Decommissioning Employees — Preparation for Alternate Nuclear Use

Employee	Annual Base Pay	Annual Owner Cost
Project Manager	43,000	73,100
Project Engineer	35,000	59,500
Health & Safety Supervisor	33,000	56,100
Quality Assurance Specialist	29,000	49,300
Decommissioning Operations Supervisor	32,000	54,400
Plant Operations & Maintenance Supervisor	32,000	54,400
Radiation Safety Specialist	24,000	40,800
Industrial Safety Specialist	25,000	42,500
SNM Accounting Specialist	25,000	42,500
Accountant	22,000	42,500
Radioactive Waste Disposal Specialist	22,000	42,500
Procurement Specialist	20,000	34,000
Security Force Supervisor	20,000	34,000
Laboratory Supervisor	22,000	42,500
Assistant QA Specialist	20,000	34,000
Secretary	12,000	20,400
Radwaste Disposal Clerk	12,000	20,400
QA Clerk	12,000	20,400
Accounting Clerk	12,000	20,400
Radiation Exposure Records Technician	16,000	27,200
Procurement Clerk	12,000	20,400
Supply Clerk	12,000	20,400
Custodian	12,000	20,400
Foreman	21,000	35,700
Shift Supervisor	22,000	42,500
Decommissioning Technician	20,000	34,000
Equipment Operator	18,000	30,600
Mechanical Technician	18,000	30,600
Equipment Operator	18,000	30,600
Maintenance Technician	18,000	30,600
Welder	16,000	27,200
Pipefitter	16,000	27,200
Electrician	19,000	32,300
Instrument Technician	20,000	34,000
Safety Technician	16,000	27,200
SNM Accounting Technician	16,000	27,200
Analytical Technician	16,000	27,200
Engineering Technician	16,000	27,200
Chemical Makeup Operator	15,000	25,500
Security Guard	15,000	25,500
Safety Review Committee[b]	--	500/day

[a]Pay rates are estimated to be representative of highly qualified experienced individuals in each job category in the nuclear industry.

[b]Work as consultants on a daily basis. An allowance for travel and living expenses is also included.

TABLE 6.3-16

Summary of Craftsmen Labor Costs
— Preparation for Alternate Nuclear Use

Worker Cost

Employee	Costs (Thousands of 1978 Dollars) Main Process Building	FRS	Tank Farm	Auxiliary Facilities	Total
Foreman	86	7	43	--	136
Safety Technician	76	5	27	8	116
Decommissioning Technician	323	34	7	3	367
Analytical Technician	35	--	--	--	35
Equipment Operator	150	6	77	--	233
Welder	33	--	63	--	96
Electrician	39	--	23	--	62
Pipefitter	33	--	--	--	33
Other Skilled Labor	98	5	128	--	232
SUBTOTAL	873	58	368	11	1310
Owner Overheads	87	6	37	1	131
TOTALS	960	64	405	12	1441

TABLE 6.3-17

Summary of Support Staff Labor Costs
—Preparation for Alternate Nuclear Use

Employees (No.)	Cost (Thousands of 1978 Dollars) Planning Phase	Decommissioning Operations
Project Manager Personnel		
Project Manager	146	146
Quality Assurance Personnel		
Quality Assurance Specialist	99	99
Assistant Quality Assurance Clerk	34	68
Quality Assurance Clerks (3)	12	122
Decommissioning Operations Personnel		
Project Engineer	119	119
Decommissioning Operations Supervisor	109	109
Operations and Maintenance Supervisor	11	109
Engineering Technicians (3)	82	163
Radioactive Waste Disposal Specialist	64	85
Radioactive Waste Disposal Clerk	31	41
Maintenance Technicians (4)	245	245
Shift Supervisors (4)	340	340
Health and Safety Protection Personnel		
Safety Review Committee[a] (5)	60	60
Health and Safety Supervisor	112	112
Radiation Safety Specialist	82	82
Industrial Safety Specialist	85	85
Laboratory Supervisor	85	85
Radiation Exposure Records Technician	8	54
Safeguards and Security Personnel		
SNM Accounting Specialist	21	170
SNM Accounting Technicians (2)		109
Security Force Supervisor	68	68
Security Guards (5)	255	255
Support Services Personnel		
Procurement Specialist	34	68
Procurement Clerk	20	41
Supply Clerks (2)	8	82
Custodian	41	41
Accountant	85	85
Accounting Clerk	41	41
Secretaries (3)	122	204
TOTAL	2,419	3,288

[a] Committee consists of 5 persons meeting 1 day each month.

6.3.7.2 Equipment and Materials

The estimates of equipment and material required and the associated cost are summarized in Table 6.3-18. These costs are exclusive of burial containers, which are included with shipping and waste disposal costs. A considerable quantity of equipment presently available at the facility would also be used. Although some salvage value is possible from both new and used equipment, there is a considerable probability that equipment will become contaminated and require either disposal or controlled future use.

6.3.7.3 Shipping and Waste Disposal

Shipping and waste disposal costs have been estimated for three cases: burial onsite (of all but transuranics), burial at 1000 miles, and burial at 3000 miles. In all cases, shipment is presumed to be in Department of Transportation (DOT) approved containers, and the amount of waste contaminated with transuranics in excess of 10 nCi/gram[1] is expected to be minimized through judicious decontamination by chemicals, electropolishing, and ultrasonic cleaning. Onsite burial cost might be further reduced by using facility tanks as burial containers and by transporting oversized loads instead of using DOT-approved shipping containers and procedures.

The basic cost factors used in estimating waste disposal costs are summarized in Table 6.3-19.

By applying these factors to the waste volumes presented in Section 6.3.4, we calculated the disposal costs shown in Tables 6.3-20 through 6.3-22. Only the shipment costs vary between the 1000 and 3000 mile shipments. In the onsite burial option, only the time and equipment cost for burial are included. The decommissioning waste will increase the total curies in the burial ground by only a few percent, and this is not expected to increase the extent of duration of surveillance required. Because of recent rulemaking actions which propose retrievable storage for transuranics, offsite shipment of this material is planned.

[1] Values from proposed NRC rulemaking action.

TABLE 6.3-18

Estimated Equipment and Materials Costs[a]
—Preparation for Alternate Nuclear Use

Description	Quantity	Cost (Thousands of 1978 Dollars) Per Unit	Total
Portable Plasma Torch & Power Supply	4	50	200
Track Drill	1	40	40
Shielded Five-Ton Crane	1	100	100
Three-Ton Crane	1	13	13
Shielded Front-end Loader	1	54	54
Shielded Working Platform	1	230	230
Shielded Working Cage	1	450	450
Greenhouse Building	1	115	115
Adjustable Scaffolding	1	10	10
6 Jackhammers & 2 Compressors	6 + 2	--	54
Air Operated Hack Saw	2	0.5	1
Polyurethane Foam Generator	1	5	5
Mockup and Training Facilities	1	100	100
Radiation Protection & Detection Equipment	--	--	75
Mist Eliminators	8	2	16
Flush Chemicals	--	--	170
Expendable Supplies	48 mos.	24 mo@ $1 24 mo@ $5	264
Ventilation Filter Replacement	--	--	50
Vacuum and Remote Cleaning Equipment	2	--	2
Subtotal			1,949
Owner Overheads			195
TOTAL			2,144

[a]Does not include waste containers.

TABLE 6.3-19

Waste Disposal Cost Data

Expense Item	Costs (1978 Dollars)
Container Costs	
4 ft x 4 ft x 7 ft steel box	600 ea
4 ft x 4 ft x 4 ft steel box	450 ea
Plywood Box	40/yd^3
55-gallon Drum	20 ea
HLW Canister	5000 ea
Freight Charges	
Truck	1.05 per mile
Waste Disposal Costs	
Surface Burial	5.00 ft^3
Interim Storage or Federal Repositories (High-level Waste)	2220/ft^3
Cask Rental Charges[a]	
High-level Waste Cask	2000/day
Intermediate-level Waste Cask	1000/day

[a]Values are from NUREG 0278, casks may be available commercially for substantially less.

TABLE 6.3-20

Estimated Packaging, Shipping, and Waste Disposal Costs for Preparation for Alternate Nuclear Use — 1000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars)			
	Container	Shipping	Disposal	Total
NON-TRU				
Solids from Liquid Waste Treatment	1	1	1	3
Equipment and Piping	270	47	250	567
Fuel Storage Racks	36	23	120	179
HEPA and Roughing Filters	6	1	6	13
Glove Boxes	3	2	10	15
Trash	29	21	76	126
Subtotal	345	95	463	903
TRU				
High Level Wastes[a]	50	144	1,110	1,304
Subtotal	395	239	1,573	2,207
Owner Overhead	40	24	157	221
TOTAL	435	263	1,730	2,408

[a]Shipping includes cask rental for 23 days per shipment.

TABLE 6.3-21

Estimated Packaging, Shipping, and Waste Disposal Costs for Preparation for Alternate Nuclear Use — 3000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Solids from Liquid Waste Treatment	1	2	1	4
Equipment and Piping	270	142	250	662
Fuel Storage Racks	36	69	120	225
HEPA and Roughing Filters	6	1	6	13
Glove Boxes	3	6	10	19
Trash	29	63	76	168
Subtotal	345	283	463	1,091
TRU				
High Level Wastes[a]	50	319	1,110	1,479
Subtotal	395	602	1,573	2,570
Owner Overhead	40	60	157	257
TOTAL	435	662	1,730	2,827

[a]Shipping costs includes cask rental for 50 days per shipment.

TABLE 6.3-22

Estimated Packaging, Shipping, and Waste Disposal Costs - Preparation for Alternate Nuclear Use — Onsite Burial of Low Level Wastes

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Solids from Liquid Waste Treatment	1	--	--	1
Equipment and Piping	270	10	52	332
Fuel Storage Racks	36	5	24	65
HEPA and Roughing Filters	6	--	1	7
Glove Boxes	3	--	2	5
Trash	29	5	11	45
Subtotal	345	20	90	455
TRU				
High Level Wastes[a]	50	144	1,110	1,304
Subtotal	395	164	1,200	1,759
Owner Overhead	40	16	120	176
TOTAL	435	180	1,320	1,935

[a]Shipping cost includes cask rental for 23 days per shipment and 1000-mile offsite shipment for disposal.

6.3.7.4 Utilities and Other Expenses

For the purpose of the portion of the estimate, we have considered that 1 facility would continue under an NRC license and New York State ownership. NFS is currently paying a lease fee of $664,000/year which will be lost income to the State. NFS also currently pays property taxes, which will not be required of the State. The utilities and other expenses are estimated in Table 6.3-23.

6.3.8 Public and Worker Safety

The environmental impacts and probable accidents which may occur during preparation of the West Valley facility for an alternate nuclear use have been evaluated. The impacts from installing new equipment or performing new processes have not been assessed, nor has the impact of possible interim care after the equipment has been removed.

6.3.8.1 Planned Activities to Prepare for Alternate Nuclear Use

The major environmental release of airborne effluents will originate in this disposition mode from initial processes in external decontamination of the cells, just as in the layaway and protective storage modes. Public exposure from this activity will result in 0.05 man-rem whole body exposure and 0.41 man-rem to the lungs for the general population. (Details of the radiation exposure estimates are provided in Section 6.1.8.) Additionally, airborne vapors generated by sectioning of equipment within the cells will be removed by HEPA filtration. Occupational radiation exposure is estimated at 410 man-rem.

Liquid effluents will be generated in the same manner and concentration as in the layaway and protective storage modes.

The radiation exposure and industrial safety hazards to which workers will be subjected in this option are much greater than in other modes which require less work and less manpower in the facility.

TABLE 6.3-23

Estimated Cost of Utilities and Other Owner Expenses
— Preparation for Alternate Nuclear Use

Expense Item	Cost (Thousands of 1978 Dollars)
License Fees	40
Electricity and Other Utilities	2,200
Insurance	400
Travel and Miscellaneous	90
TOTAL	2,730

6.3.8.2 Accidents During Preparation for Alternate Nuclear Use
Those accidents which may occur while the facility is being prepared for alternate nuclear use are generally similar to those which might have occurred during operation. However, the radionuclide inventory in the facility, and therefore the probable consequences of accidents, is substantially less than during operation.

Accidents analyzed for the operating facility include: criticality within any of the processing cells[1], criticality in the fuel storage pool[1], chemical explosion[1], and other lesser accidents.[2]

A criticality is considered much less likely to occur during decommissioning than during operation due to the greatly reduced quantities of material in the facility. Safeguards to prevent criticality will include use of cirticality-safe containers, "poison" tanks (tanks containing neutron-absorbing material), and dilution. For the operating facility, a criticality of 10^{20} fissions was predicted to give a 5.85 rem/person dose to the highest exposed member of the general population.[3] The dose to workers outside the cell where the criticality occurred would be slight due to the shielding provided.

A criticality in the fuel storage pool was evaluated for the operating plant. All fuel would be removed in accordance with normal operating procedures prior to any other decommissioning activity.

Physical design of the storage basin and safeguards employed during operation make a criticality incident in the fuel storage pool highly unlikely; however, if such an incident were to occur energy generation would be equivalent to a 10-MWT boiling water reactor for three hours. Radiation from the criticality would be shielded by the water in the basin. Fission

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[1] FSAR REV4, Sept. 1969, FSAR 1973, Section X-3
[2] NRC - Interim Safety Evaluation
[3] FSAR VII 1.73, 1963

products released into the pool water would not exceed maximum permissible concentrations established in 10 CFR Part 20 under the most adverse meteorological conditions.[1]

The predicted frequency of radiation overexposure was estimated from NRC data for Nuclear Power Reactors from 1971 to 1975.[2] During that period there were 96 overexposures to external radiation for 58,030 man-rem of occupation radiation exposure. We have therefore estimated 0.165 overexposures per 100 man-rem (1 overexposure per 606 man-rem). To prepare the facility for alternate nuclear use will require 410 man-rem. We therefore predict 0.68 overexposures.

A chemical explosion, although potentially very serious in terms of worker safety and destruction of property, is not expected to exceed the maximum permissible concentration for mixed fission products at the site boundary.[3] Great care will be taken in preparing and approving chemical decontamination procedures to assure the compatibility of chemicals and to prevent the buildup of explosive gases.

Other lesser accidents have a potential for serious worker injury but are not expected to have serious offsite consequences. The accident rates shown in Table 6.3-24 have been observed on work in nuclear facilities[4] and applied to other decommissioning studies.[5]

Applying these rates to preparation for alternate nuclear use mode one can expect an accident frequency less than construction, but greater than in normal operation. We have conservatively assumed construction accident

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[1] FSAR VII 1.73, 1963

[2] W. Wekreger, NRC Review for Assuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievable - Paper given Nov. 1976, ANS Meeting

[3] FSAR VII 1.73, 1963

[4] Operational Accidents and Radiation Exposures Experienced Within the USAEC 1943-1970 Wash 1192, 1971

[5] NUREG 0278

TABLE 6.3-24

Construction/Industrial Accident Frequencies
(Nuclear Facilities)

Accident Category	Job Classification	Frequency (Accident/10^6 Manhours) 1943-70 28 Year Average
Lost Time Injuries:	Heavy Construction	10
	All Construction	5.36
	DOE Operations	2.12
Fatalities:	Construction	0.042
	DOE Operations	0.023
	Government Functions	0.004

rates in predicting 2.3 loss time injuries and 0.018 fatalities during preparation for alternate nuclear use.

6.3.8.3 Transportation Safety

Transportation of radioactive wastes generated from preparation for alternate nuclear use of the fuel reprocessing plant will pose some risks to the public and to transportation workers. Radiological effects of transport operations include external radiation exposure to the transportation worker and the public from normal transport operations, and potential radiation exposure to the public from release of radioactive material in transport accidents. Nonradiological effects of transportation operations include the potential of chemical pollutant releases, injuries and fatalities similar to the transport of other materials.

Estimated routine radiation doses from truck transport of the radioactive wastes are shown in Table 6.3-25. Dose calculations are based on maximum allowable dose rates for shipment in exclusive-use vehicles and are therefore conservative. Information on the number of truck shipments is taken from Section 6.3.4.

The method and assumptions used in estimating the radiation dose from normal transport operations were based on NUREG 0278 assumptions that workers were exposed to the maximum allowable dose. As shown in Table 6.3-25, the estimated routine radiation dose to the transportation workers when transporting wastes 1000 miles is 14.2 man-rem. Dose to the general public at this shipment distance is estimated at 2.8 man-rem. For transporting wastes 3000 miles, the estimated radiation dose to the transportation workers is 42.7 man-rem, and to the general public 8.5 man-rem.

For burial onsite, it is assumed that a single driver will be required for one hour per shipment. Non-TRU wastes will be trucked to the onsite burial ground in a DOT-approved exclusive use vehicle, and associated limits on radiation levels will be applied. TRU wastes will be trucked to a Federal repository or to interim storage 1000 miles away. With these assumptions,

TABLE 6.3-25

Estimated Routine Radiation Dose from Truck Transport of Radioactive Wastes from Preparation for Alternate Nuclear Use

Group	Dose Per Shipment (Man-Rem)		Total Radiation Dose for All Shipment (Man-Rem)
	1000 Miles Away		
Transportation Workers			
Truck Drivers	0.015		14.1
Garagemen	0.0015		.14
		TOTAL	14.24
General Public			
Onlookers	0.015		1.41
Other General Public	0.015		1.41
		TOTAL	2.82
	3000 Miles Away		
Transportation Workers			
Truck Drivers	0.45		42.3
Garagemen	0.0045		0.42
		TOTAL	42.72
General Public			
Onlookers	0.045		4.23
Other General Public	0.045		4.23
		TOTAL	8.46
	Onsite Burial of Non-TRU 1000 Mile Shipment of TRU		
Transportation Workers			
Truck Drivers			
Offsite	0.15		0.45
Onsite	0.002		0.18
Garagemen	.0015		0.005
		TOTAL	0.64
General Public			
Onlookers	0.015		0.045
Other General Public	0.015		0.045
		TOTAL	0.09

the estimated radiation dose to the transportation worker is 0.64 man-rem. The radiation dose to the general public is estimated at 0.09 man-rem.

The primary radiological effect of transportation accidents which may be incurred with this disposition mode is the potential release of radioactive material and the resulting radiation dose to the public. Minor accidents are not likely to result in a loss of containment or a release of radioactivity. A small percentage of accidents of moderate severity are postulated to result in a breach of package containment and a release of material. Most serious accidents would result in some loss of containment.

Should a breach of containment occur, and combustible waste burn in an open fire[1], only a small fraction of the radioactivity would be widely dispersed. Most of the radioactivity, perhaps as much as 99 percent, would remain in the ashes.

A severe mechanical impact that resulted in breach of a container of concrete rubble would cause some dispersion of material. However, most of the material would return to the ground within a few hundred feet of the point of release. The fraction for respirable materials released is estimated to be less than 10^{-3}. Concrete is noncombustible and the effects of a fire would be very limited.

Decontamination of process equipment, stainless steel plate, and other items of metal scrap would result in the removal of all loosely held surface contamination prior to shipment. The most likely result of a transportation accident involving contaminated metal parts would be a release of semivolatile surface contamination as the result of a high temperature fire.

In a transportation accident involving radioactive materials, carriers are required to follow DOT-prescribed procedures designed to mitigate accident

[1]Directorate of Regulatory Standards, Environmental Safety of Transportation of ~idioactive Materials to and from Nuclear Power Plants, WASH-1238, USAEC, ıshington, D.C., 1972

consequences. DOT regulations require prompt reporting of any transportation incident involving shipment of radioactive material in which fire, breakage, spillage, or suspected radioactive contamination occurs. The regulations also specify guidelines for remedial actions in the case of actual or suspected release of radioactivity from a shipping container.

The principal nonradiological transportation safety impact is the potential for injuries and fatalities from the transportation accident. Table 6.3-26 provides a summary of transportation accident statistics for truck transport operations.

Negligible safety impacts are expected from chemical pollutants for truck shipments. The number of truck shipments for transporting wastes generated from preparation for alternate nuclear use is a miniscule portion of the total number of U.S. truck shipments.

TABLE 6.3-26

Nonradiation Transportation Accident Statistics — Preparation for Alternate Nuclear Use

Statistical Frequencies[a]		Expected Occurrences: 1000 Mile Shipment	Expected Occurrences: 3000 Mile Shipment	Expected Occurrences: Onsite Burial[b]
Accidents/Vehicle Mile	6.9×10^{7}	6.5×10^{-2} Accidents	1.9×10^{-1}	2.1×10^{-3}
Injuries/Accident	0.51	3.3×10^{-2} Injuries	9.9×10^{-2}	1.1×10^{-3}
Fatalities/Accident	0.03	1.9×10^{-3} Fatalities	5.8×10^{-3}	6.2×10^{-5}

a Directorate of Regulatory Standards, Environmental Safety of Transportation of Radioactive Materials to and from Nuclear Power Plants, WASH-1238, U.S. AEC, Washington, D.C., 1972.

b Three shipments will be TRU wastes trucked 1000 miles.

6.4 Dismantlement

To accomplish dismantlement, all contaminated systems would be decontaminated, disassembled, removed from the facility, and transported to a federally regulated disposal site on or offsite. The remaining clean structures would then be demolished. Dismantlement might be deferred to a time following layaway or protective storage, but immediate dismantlement is assumed for the purposes of this study.

In immediate dismantlement, larger initial commitments of funds and occupational radiation exposure are made in exchange for availability of the plant site for other purposes, and for the elimination of continued security, maintenance, and surveillance. Because this work is performed within a few years after plant shutdown, decay of the residual radioactive material would not be as advanced as for delayed cleanup modes. Thus, more occupational radiation exposure could be expected. The facility structures would be decontaminated to unrestricted use levels and either put to some beneficial use or demolished, at the owner's option. Demolition has been assumed for this study.

Deferred dismantlement, as might occur at the end of 30 to 100-year interim care period following layaway or protective storage, would be a less difficult job than immediate dismantlement. Presumably, questions regarding acceptable waste storage will have been resolved. Radiation levels within the facility will have been reduced, but dismantlement activities would still be affected by radiation levels in the plant from long-lived radionuclides. The potential benefits to be gained by deferred dismantlement because of the lower radiation levels include reduction in dismantlement costs (except for the effects of inflation) and in occupational radiation exposures, and postponement of dismantlement costs. These benefits must be weighed against the potential disadvantages of deferring dismantlement, such as interim care costs, value of or impending need for the reclaimed site, and lack of public acceptance of the interim condition of the facilities.

NOTE: A reference list of West Valley Plant facility abbreviations and definitions is provided as Table 6.4-31.

6.4.1 End Product Description

Dismantlement would remove all radioactive material above uncontrolled release limits from the buildings and tank farm. No structures would remain above grade, although clean concrete and other structural materials would be buried at the building and tank sites. Sufficient soil coverage to support vegetation would be placed over buried debris and the area would be replanted. A radiation survey would be conducted of the entire 3,345-acre site to determine the degree of release possible.

No further monitoring or security would be required at the site unless areas which were first released for conditional use (no agriculture), were later designated to be released for unrestricted use. (Except for the burial grounds, lagoons, and associated areas which are outside of the scope of this study.)

6.4.2 Planning and Preparation

The scope of the planning and preparation activities will be similar to that given for the preparation for alternate nuclear use mode of decommissioning. The time frame for decommissioning planning and preparation activities will be two years. The efforts of the decommissioning staff during the first year of the planning period will be devoted primarily to preparing the documentation that must be submitted to NRC to amend the facility license from an operating to a possession-only license. This documentation is expected to include a master decommissioning plan and safety analysis, a set of revised technical specifications that will govern post-shutdown and decommissioning operations, and an environmental report.

The major planning and preparation activities are presented in Figure 6.4-1 along with the approximate time period over which they should take place.

The master decommissioning plan is expected to include the decommissioning objectives for the facility and site including criteria and survey methods for unrestricted release; a description of the decommissioning activities

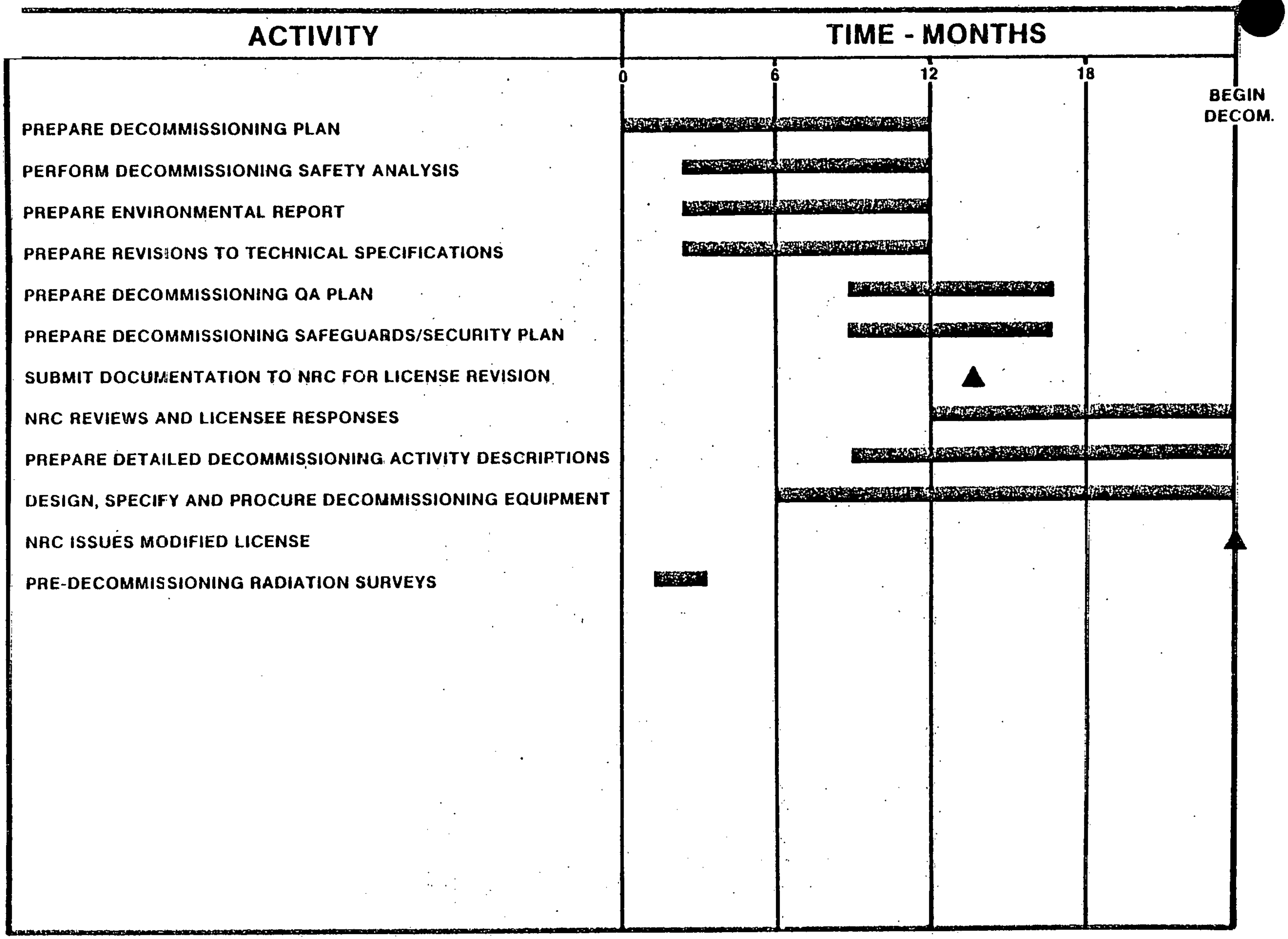

FIGURE 6.4-1

Approximate Schedule of Events for Preparation for Dismantlement Planning and Preparation Phase (including a schedule of events); an analysis of the significant safety issues associated with the decommissioning activities; and a review of a decommissioning Quality Assurance (QA) plan.

The full requirements of a decommissioning safety analysis have not yet been identified by NRC. It is expected that the decommissioning safety analysis would contain:

- An estimate of the radioactive inventories in the facility when decommissioning activities begin.
- An analysis of the adequacy of existing plant safety systems to protect the public health and safety during decommissioning operations.
- A description of special safety systems and procedures required both during decommissioning and for any areas cleared for conditional use.
- A review of the industrial and radiological safety program to be used in performing the work.
- A review of the decommissioning training program.

The QA program's primary purposes are: 1) to assure that adequate precautions are established to protect the health and safety of the public and decommissioning workers during decommissioning operations; 2) to ensure that established safety precautions are followed during decommissioning activities; and 3) to audit the performance of decommissioning activities. The program is divided into two phases--planning and operations. Procedures that will be used to fulfill QA objectives during both phases are delineated in the QA plan.[1]

The environmental report will provide NRC with the basic information necessary to assess the environmental impact of the decommissioning activities, and the impact of final facility disposition. Public hearings on the

1 A more detailed outline of the QA program is presented in Volume 2, Appendix E.1 of NUREG 0278.

environmental impact of dismantling the facility and releasing the site may be required before NRC issues an Environmental Impact Statement or Negative Declaration of Environmental Impact.

The technical specifications will require major modifications due to changes in plant conditions and processes following decommissioning activities. The modified specifications submitted as part of the application for license conversion will delineate allowable operating conditions for plant safety systems, administrative procedures that must be followed to assure that the safety systems are operated within these limits, and plant effluent surveillance.

NRC will review the package of dismantlement documentation. The decommissioning staff will respond to questions from NRC and furnish any additional information requested. Modifications to the documents may be necessary as a result of the reviews. When the review process has been completed and all safety-related issues resolved, the modified license will be issued.

Detailed physical preparations for equipment removal/decontamination activities will begin during the NRC review. These preparations take place during the second year of the planning period. Activity descriptions and working procedures for the decommissioning operation will be developed. Cost estimates and work schedules will be prepared, and equipment designed or specified, procured, and tested. Changes necessitated by NRC reviews of the decommissioning plan will be implemented.

Personnel will be added to the decommissioning staff as necessary throughout the planning period. The staff training program will be developed. Training of the decommissioning workers will become a major effort in the latter stages of the planning period and the first stages of the decommissioning phase.

6.4.3 Methods

Activities during dismantlement of the facility will consist of all tasks necessary to remove, package, and ship all hazardous materials and equipment from the facility. All dismantlement work will be accomplished in accordance with the decommissioning plan, task specifications, detailed working procedures, and health and safety control programs developed during the planning and preparation phase.

For the purposes of this report, the West Valley Plant has been divided into four major sections: main process building, fuel receiving and storage area, waste tank farm, and auxiliary facilities. The activities to be performed in each of these facility sections are outlined in Table 6.4-1, and a tentative schedule is presented in Figure 6.4-2.

6.4.3.1 Main Process Building

Dismantlement will begin with a thorough chemical decontamination of the main process cells and main process equipment. The primary purpose of chemical decontamination is to reduce radiation levels for the equipment removal phase, and to prepare for entry and contact work. Chemical decontamination will generally follow procedures and techniques which were used during plant production operations. During facility shutdown activities, XCs 2 and 3 were chemically decontaminated to a level which allows personnel entry; therefore, further chemical decontamination of these cells may not be necessary. Decontamination procedures can be modified with moderate replumbing work to concentrate on "hot" areas. Solutions and time requirements for flushes will be designed for maximum removal of residual contamination with minimal regard for corrosion of equipment. Solutions may be recycled from a relatively "clean" area to a more highly contaminated area and flushes will be repeated as necessary.

The progress of the equipment internal flushes will be monitored in two ways. Before chemical decontamination begins, shielded directional gamma radiation detectors will be installed at strategic locations in each cell. These will assist in monitoring the flushing and in identifying "hot" spots or areas that resist chemical decontamination. Radiation spectographic

TABLE 6.4-1

Outline of Dismantlement Activities

Main Process Building

1. Chemically decontaminate internals of process equipment and piping.
2. Chemically decontaminate cell walls and equipment externals.
3. Remove equipment and piping from the process cells.
4. Decontaminate cell walls to unrestricted release limits and remove stainless steel lining.
5. Remove glove boxes and hoods.
6. Remove equipment and piping from accessible areas.
7. Mechanically decontaminate accessible areas to unrestricted release limits.
8. Remove filters and ventilation ductwork.
9. Perform final radiation survey of the facility.
10. Demolish main process building.

Fuel Receiving and Storage

1. Remove stored spent fuel from basin.
2. Drain storage basin and cask unloading pool.
3. Decontaminate pools and remove fuel storage racks.
4. Decontaminate and remove water treatment equipment.
5. Remove cask decontamination house.
6. Survey and decontaminate the FRS building to unrestricted release levels.
7. Deactivate ventilation system and remove filters and contaminated ducts.
8. Perform final radiation survey of FRS.
9. Demolish FRS structure.

TABLE 6.4-1 (Cont'd.)

Waste Tank Farm

1. Decommission auxiliary systems.
2. Remove auxiliary systems.
3. Excavate to top of stainless steel tank vault.
4. Erect greenhouse over top of vault.
5. Remove top section of vault.
6. Dismantle both tanks and package for burial.
7. Survey and decontaminate pans and vault.
8. Backfill vault to original contour.
9. Decommission both carbon steel tanks in a manner similar to the stainless steel tanks.
10. Backfill WTF and restore original ground contour.

Auxiliary Facilities

1. Remove contaminated equipment from laundry room.
2. Survey and decontaminate auxiliary facilities to unrestricted release limits.
3. Perform final radiaiton survey of auxiliary facilities.
4. Demolish and remove all structures.
5. Perform radiation survey of the site outside the exclusion area.

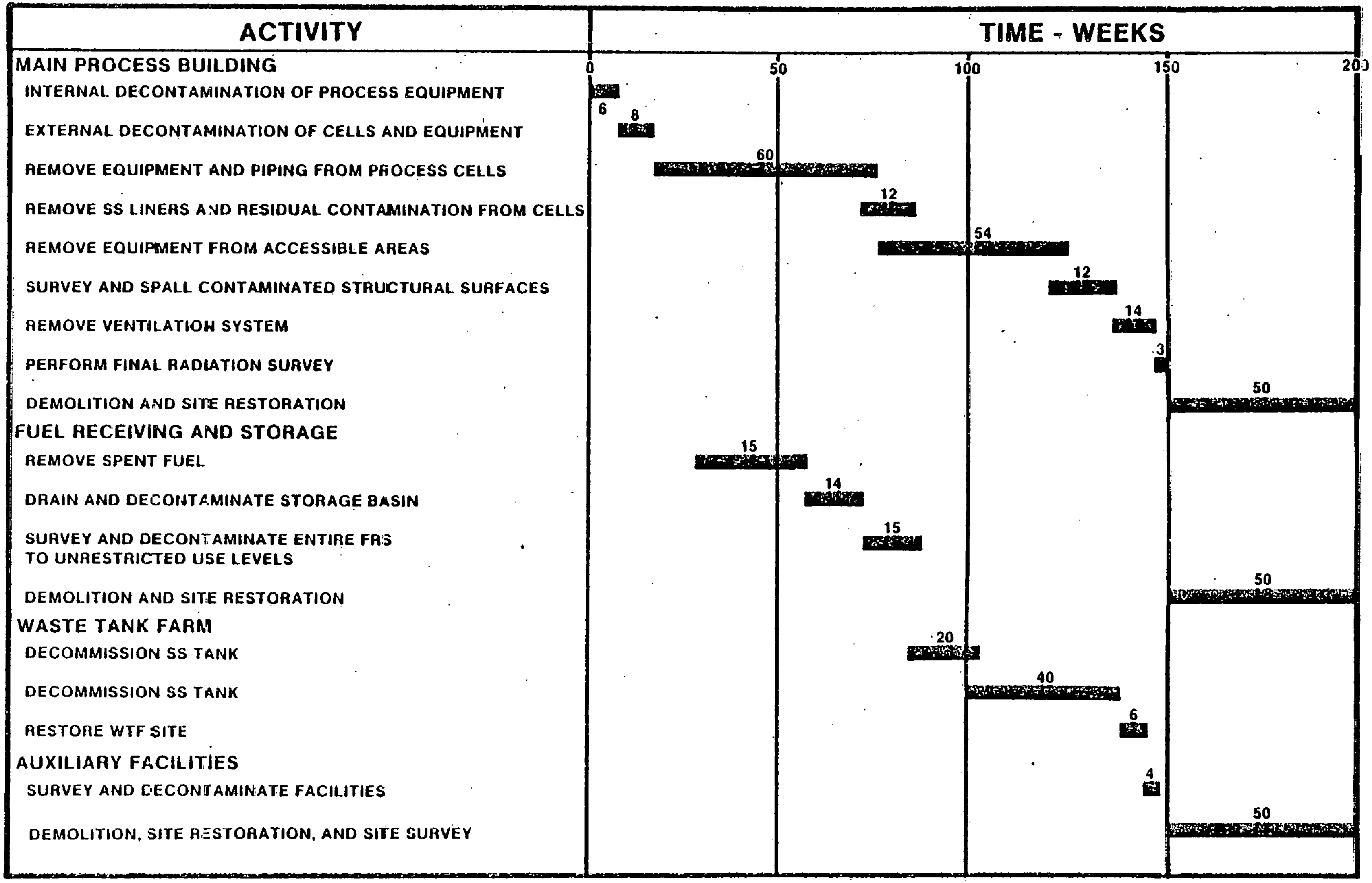

FIGURE 6.4-2

Schedule of Major Activities—Dismantlement information from these detectors will help identify the radionuclides that remain after a flush. The succeeding flush will then be tailored for improved removal of these radionuclides. In addition, the decontamination solutions will be sampled from existing sample points at scheduled intervals and analyzed for dissolved contaminants. A particular flushing sequence will be terminated when tests indicate that it has achieved its maximum effectiveness.

Areas that might contain significant amounts of plutonium will be carefully monitored to ensure that the plutonium in the flush solution does not exceed the normal operating maximum concentrations or quantities. Solutions approaching these limits will be removed from the area and fresh solutions introduced. If solutions have significant quantities of plutonium or uranium, they may be reclaimed. Waste solutions will be processed onsite in the evaporators and low level waste treatment plant, as they were when the plant operated. Concentrated waste may be neutralized and treated with the liquid waste onsite, or be solidified for burial. After internal chemical decontamination, the process systems will be flushed with water and drained.

Following internal chemical decontamination, external decontamination of process cell walls and equipment surfaces will begin. A variety of techniques will be used, depending on the type and extent of the contamination. Loose contamination such as in the PMC and GPC can be vacuumed with a criticality-safe vacuum cleaner controlled remotely using the installed manipulators. Contamination in inaccessible areas can be reduced using portable high pressure decontamination solution sprayers operated with the master-slave manipulators, or, if dose rates are low, with contact methods. In the PMC and GPC, equipment can be disassembled or cut up and packaged for burial using existing manipulators and viewing windows. Much of the equipment in the PMC has already been removed.

The EDR has the capability for remote removal and chemical decontamination of equipment from the CPC. All equipment within the CPC can be remotely disassembled and brought out by crane or rail. Remote sectioning of large equipment items with plasma torch or other suitable means may be done in the CPC before it is removed.

Any equipment with large quantities of smearable contamination or sufficient transuranics will be decontaminated using chemical, electropolishing, or ultrasonic techniques.

Operations in the XCs and PPC will require some contact labor and considerable contamination control. A portable greenhouse will be constructed over each XC to prevent the spread of contamination during cutting operations by maintaining a negative pressure in the cell relative to the outside atmosphere, and by filtering exhausted air. A portable crane, erected over each cell, will be used to lift out pieces of equipment to be packaged for disposal.

At present, radiation levels in XC-2, XC-3, and the PPC are low enough for contact operations and it is planned to decontaminate XC-1 to a level where it can be entered and work conducted in the cell. Some cutting operations may be done from a shielded working cage remotely or semi-remotely from the top of the cell.

The disassembly of contaminated equipment in an otherwise "clean" area, such as the low-enriched uranium product weigh tank, will require special procedures to prevent contamination spread. A stripable plastic coating will be applied to the floor and a greenhouse will be constructed over the equipment to confine and collect particulate material produced by the cutting process. A typical greenhouse is illustrated in Figure 6.4-3. A large squirrel-cage blower will be used to pull air through a HEPA filter preceded by a fiberglass roughing filter, all of which will be mounted on a wheeled cart. A flexible duct will couple the cart unit to the enclosure unit where the cutting will be done. Another fiberglass roughing filter will be installed in the ventilation outlet of the enclosure. Radiation

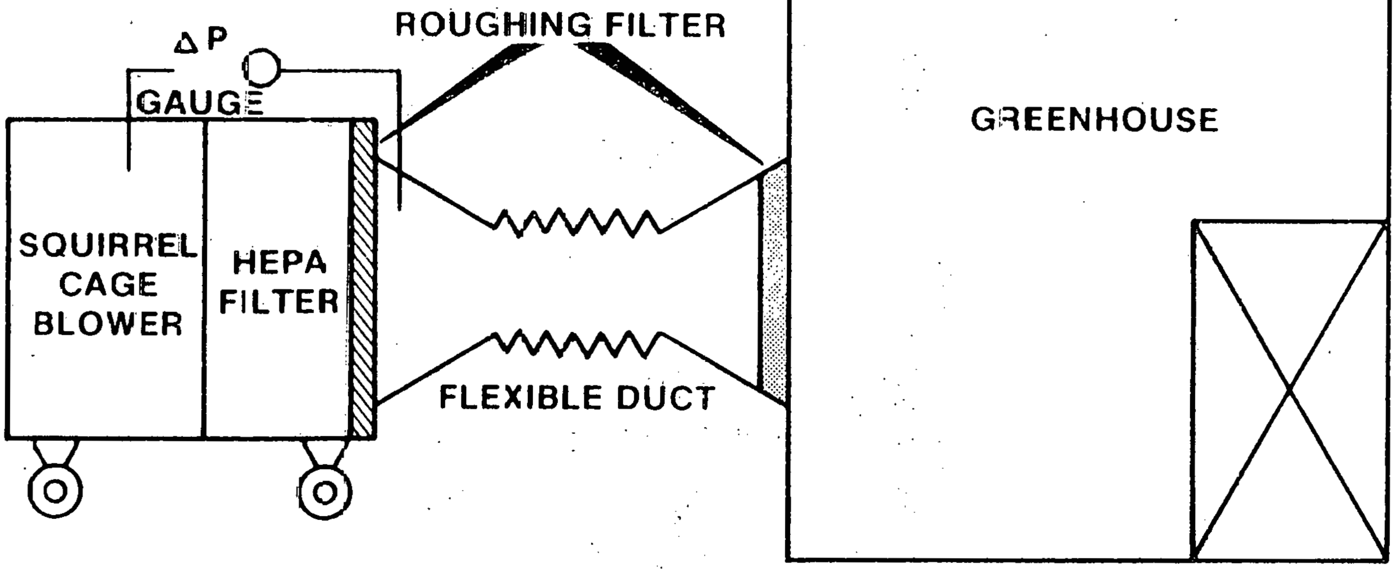

FIGURE 6.4-3

Typical Greenhouse Enclosure

detection devices will be used to monitor the buildup of particulates. The filters will be changed when either the dose rate from the collected radioactive particles or the differential pressure across the HEPA filter reaches predetermined levels.

The glove boxes will be packaged and removed using proven techniques. The interior of each glove box will be vacuumed with a criticality-safe vacuum cleaner. The interior surfaces will then be wiped down with a sponge soaked in decontamination solution or, if the glove box is watertight, a high pressure nozzle sprayer will be used. The glove boxes will then be completely filled with foam-in-place polyurethane and sectioned for packaging.

Equipment removal activities in the ARC, HAC, LWA, LWC, MRR, SST, and UWA require a thorough radiation survey to ensure that dose rates will allow contact work to be done. "Hot" spots will be removed or shielded as necessary to minimize exposure to personnel.

Access into the LWC is through a single door. The nine tanks in the cell range in diameters from 3 feet 6 inches to 9 feet, and up to lengths of 11 feet 6 inches. Hoists and scaffolding will be erected and the tanks sectioned with a plasma arc torch for handling and packaging in the cell.

Equipment in the HAC will be removed in a manner similar to that used in the LWC, since both primarily contain tanks.

There are five ANCs, an SC, and an SSC which are connected by hatches through interfacing walls. Access into the ANCs and the SC is through the cell doors located in the analytical decontamination area. The SSC has a concrete hatch in the ceiling and a conveyor system between the cells. The cells are equipped with master-slave manipulators and viewing windows to allow remote operations. It is anticipated that conditions in the cells will permit contact activities.

Contaminated equipment and materials in accessible areas of the process building will be removed and packaged. These areas contain instrumentation, glove boxes, ductwork, and laboratory equipment.

Procedures for removing contaminated equipment and decontamination of accessible areas begin with equipment removal in the laboratories and sho and proceed to the aisles. Dose rates are low enough to allow contact operations. Contaminated process piping in these areas will be severed at the wall penetration and decontaminated to unrestricted use levels. If decontamination to this level is not possible, the pipe will be sealed and removed at the time of demolition. All floor tiles will be removed, the adhesive scraped off, and the floors surveyed. Any contaminated concrete will be removed by spalling.

Following equipment removal from the main processing building, the next phase will be mechanical decontamination of the process area structures. Many of the process cells are either completely stainless steel-lined or the floors are stainless steel-lined and walls and ceiling are coated with Carboline. Carboline-coated surfaces will be washed down, surveyed, and the residual contamination spalled off using a vacuumblaster or similar device. Stainless steel liners will be cut free and sectioned using a plasma torch. Highly contaminated liners will be transported to the EDR for decontamination in the soaking pit. The contaminated floor drains in the cells will be capped, and removed during demolition.

The accessible area structures will be surveyed and decontaminated, starting with the laboratories and working towards potentially "cleaner" operating and viewing aisles. Loose contamination will be vacuumed and residual contamination spalled off.

The ventilation system will be the last portion of the main process building to be decontaminated. Most of the contamination requiring removal is located in the process cell exhaust duct system. Other duct systems will be surveyed and decontaminated or removed as necessary. Uncontaminated ductwork may be removed for salvage or left in place for removal during building demolition.

The HEV room serves the PMC, GPC, and the CPC and is expected to require considerable decontamination efforts. The filters will be removed following procedures used during plant operations. The filter housing will then be decontaminated and removed. The ductwork upstream of the HEV will be filled with ployurethane foam and sectioned with a reciprocating saw.

The VWR and OGC will also require decontamination. The VWR contains an air washer and air washer circulation pump; contact activities are planned here. Shielding will be provided where necessary to reduce dose rates when removing equipment and decontaminating the room. The OGC begins at the 100-foot level (which is the ground level) and extends to the 144-foot level. Filters, blowers, scrubbers, heaters, coolers, and condensers are contained in the cell. It is anticipated that dose rates will be low enough in the OGC for contact activities. Access into the OGC is from the 100-foot level or through the ARC. Concrete hatchcovers at the 144-foot level can be removed to gain access through the top. A greenhouse will be erected over the top hatch and a hoist used to lift the equipment out.

A final radiation survey will be performed of the entire process building, except the floor drains and wall-penetrating pipe sections which will have been capped (these will be extracted during demolition), to ensure that all contamination has been removed. This will complete decommissioning operations and is the first step toward demolition.

The main process building will be demolished concurrently with the FRS, once decontamination of the FRS is completed. Demolition will be performed by a subcontractor using appropriate industrial demolition procedures and techniques. Decommissioning personnel will dispose of contaminated piping.

6.4.3.2. Fuel Receiving and Storage (FRS) Area

The FRS will be decontaminated to unrestricted use levels and then be dismantled. Decontamination will involve removing the stored spent fuel, draining and decontaminating the basin, removing all contamination from the facility, and preparing for demolition.

Operations in the FRS will begin with the removal of the spent fuel in the storage basin. Equipment and procedures used during plant operation will be employed.

The storage basin and CUP will be drained to a level approximately two feet above the bottom; this basin water will be sent to the low level waste treatment facility. While draining these pools, the walls and fuel storage racks will be washed down with a high pressure water nozzle to minimize the possibility of contaminants becoming airborne. The two feet of water will provide protective shielding and prevent loose contamination from becoming airborne. A vacuum cleaner similar to those used for swimming pools will be used to remove residual solids from the basin and CUP. Solids will be trapped in the vacuum discharge filter system and packaged for disposal. Filtered liquids will be sent to the low level waste treatment facility. All remaining water will be drained from the basin and CUP and sent to the low level waste treatment facility.

After the pools have been drained, the storage racks and equipment used for operation of the pools will be removed and packaged for burial. The pools will then be surveyed and decontaminated to unrestricted use levels. Removal of the Carboline coating from the pool walls and floors may be required. A vacuumblaster will be used to spall off the contaminated coating and areas where contamination has penetrated the coating. The drain to the low level waste treatment facility will be blanked for removal during demolition.

The water treatment equipment will be removed and the area decontaminated. The cranes, bridges, and platforms will be deactivated and decontaminated for salvage, other nuclear use, or disposal. The adjacent cask decontamination house, constructed of stainless steel, will be dismantled and decontaminated. The walkways, walls, ceiling, and work areas in the FRS will be surveyed and decontaminated to unrestricted use levels. Steel surfaces will be stripped of paint and grime, or chemically decontaminated. Concrete surfaces will be spalled using methods previously described.

The FRS ventilation system will remain in operation while decontamination work is being carried on in the FRS building. When all contamination in the building has been removed, the ventilation system will be deactivated and the ducts and filters removed. Contaminated ducts will be injected with polyurethane foam and sectioned for packaging and disposal, in a manner similar to that used for glove boxes and other ducts. Filters will be removed following procedures used during plant operations.

The final step conducted before demolition will be a radiation survey. Any residual contamination detected will be removed. Demolition of the FRS will be done in conjunction with the main process building, following normal demolition procedures. Below-grade structures and foundations will be removed to a depth of two feet below grade. The site will then be back-filled, contoured with the surrounding terrain, and planted with native vegetation. Uncontaminated concrete will be buried onsite, a large portion of it in the below grade sections of buildings.

6.4.3.3 Waste Tank Farm

The waste tanks will be dismantled and removed. The less contaminated tanks will be removed first to test procedures and equipment.

Procedures for removing the waste tanks will require that they be empty and the heel removed. The auxiliary facilities will then be removed, a green-house erected over the vault, the area over the top of the vaults excavated, the tanks removed, and the clean vault backfilled.

The auxiliary systems that require removal are the ventilation system and the instrumentation and controls. These systems, located in the WTF shelter directly over the tanks, will be removed using contact removal methods. Prior to removing equipment, a portable filtering system will be attached to the vents of the tanks to prevent uncontrolled releases of contamination to the environment. As equipment is removed, severed pipes will be sealed. The shelter ventilation system will be decontaminated and removed after all equipment has been taken from the shelter. The shelter will then be removed.

Dismantlement of the stainless steel storage tanks will probably be done first as a system test. Dismantlement procedures will be evaluated and modified if necessary before beginning the larger task of removing the carbon steel tanks.

Decontamination sprayers will be installed through penetrations made in the tank and vault. A chemical solution will be sprayed in, circulated, and pumped out.

To prevent the release of radioactivity to the environment while penetrating the tank top, and to support operations in the tank, a large greenhouse structure designed to withstand year-round weather conditions will be erected. Provisions will be made for simplified decontamination of the greenhouse.

Dismantlement will begin with major penetrations being made in the tank top for removal of the tank internals. Water will be pumped into the tank to a few feet above the bottom to shield personnel from residual contamination on the tank floor. Radiation surveys will be taken to determine actual shielding requirements. A shielded platform and remote cutting and handling equipment will allow for more direct operations inside the tank, and will be used for removing the tank internals, including the vault support columns.

Tank internals will be removed in sections small enough to fit into shipping containers for burial. Contamination levels will be measured as the sections are extracted. Sections that do not meet requirements for disposal as low-level non-TRU waste will be decontaminated using electropolishing or ultrasonic decontamination equipment located in a specially equipped area of the greenhouse, or in the soaking pit of the EDR. Tank internals will then be packaged and shipped for burial.

The tanks and drain pans will be sectioned, using a plasma arc torch, and removed. These sections will also be surveyed for radioactivity and further decontaminated as necessary. The concrete vault ceilings, walls, and floors will be mechanically decontaminated as required, and drainage holes made in the bottom of the vaults. Radiation surveys will be conducted to ensure that all radioactivity has been removed. The greenhouse will then be dismantled and erected over the two carbon steel tanks successively. As the final step, the vault cavities will be backfilled, contoured, and vegetation planted.

6.4.3.4 Auxiliary Facilities

Dismantlement will involve the removal of equipment, structures, and any contamination from auxiliary facilities on the site. A radiation survey will be conducted to identify contaminated areas. The laundry building is the only area known to be contaminated; the utility room, maintenance shop, warehouse, guard house, and temporary pipe shop are within the contamination control area. Facilities outside of the eight-foot high exclusion fence are not expected to be contaminated, but will be surveyed prior to dismantlement. These facilities include the meteorology station, administration building, electrical sub-station, environmental laboratory, and farm.

The laundry building houses washing machines and dryers for cleaning the protective clothing used in radiation zones. This equipment will be disconnected and packaged for disposal. Contaminated hoods and ducts will be removed using techniques similar to those used in the main process building. Remaining equipment and piping which could be contaminated, but cannot be 100 percent surveyed, will be removed and packaged as radioactive waste.

The entire site will be surveyed to determine which portions may be released for unrestricted use, and the extent of controls required on the remaining portions. Site survey will include a sensitive gamma radiation survey using portable instrumentation, and a comprehensive program of soil and vegetation analysis to determine the distribution of radionuclides and resulting probable doses to humans. Radiochemical analysis will be used to determine concentration of Iodine 129, as well as plutonium and certain other radionuclides, in soil and vegetation.

6.4.4 Wastes and Waste Disposal

Large quantities of radioactive wastes will be generated during the disma tlement of the fuel reprocessing plant. These wastes must be disposed of in a licensed burial ground or respiratory either on or offsite.

Radioactive wastes generated during dismantlement of the plant will include:

- Concrete rubble from mechanical decontamination of process cells, fuel storage pools, waste tank vaults, and work areas.
- Protective stainless steel liners removed from the floors and walls of high contamination areas.
- Contaminated process vessels, equipment, and piping.
- Sections of the waste tanks.
- Spent fuel storage racks from the fuel storage pools.
- HEPA and roughing filters from the off-gas and building ventilation systems.
- Glove boxes.
- Sections of ventilation ductwork and the main stack.
- Decontamination solutions.
- Combustible and noncombustible trash (protective clothing, contaminated tools, paper, plastic, metal scrap, etc.).

As in the other decommissioning modes, we have assumed waste containing more than 10 nCi/g transuranics will be classified as TRU wastes and shipped to a federal repository or to interim storage. Non-TRU wastes will be packaged in DOT-approved containers and either be buried onsite or shipped to a commercial burial ground 1000 or 3000 miles from the West Valley site.

Whenever possible, TRU wastes will be decontaminated for disposal as non-TRU wastes. Techniques availabe for decontaminating TRU equipment include electropolishing, ultrasonic cleaning, and chemical decontamination. The EDR will be utilized for decontamination operations because of its stainless steel soaking pit.

TRU wastes will be categorized as low-level, intermediate-level, or high level depending on the radiation level detected. Most TRU wastes will originate in the CPC, PMC, GPC, and XC-1. Piping and process equipment will be decontaminated for disposal as non-TRU radioactive waste. The majority of TRU waste will be contaminated concrete.

NRC has proposed that commercially generated wastes contaminated with TRU elements above 10 nCi/g must be shipped to a federal repository for permanent disposal.[1] Neither a federal repository nor interim storage is commercially available at the present time. Fire safety requirements at a repository are assumed to require that all material accepted for disposal be packaged in nonflammable containers. For this study, container and shipping requirements outlined in NUREG 0278 are assumed. TRU wastes with low external radiation levels will be packaged in steel boxes and 55-gallon drums which will be placed inside steel cargo containers measuring 8 x 8 x 20 feet. Cargo containers will be trucked in exclusive use vehicles. Approximately 10 percent of the contaminated equipment and 30 percent of the HEPA filters from the plant will require packaging in 30-inch diameter by 10-feet long cylindrical steel canisters with 3 to 5 inches of lead shielding, and shipment to the burial ground. Truck-mounted casks such as these are currently licensed for the shipment of spent fuel. Auxiliary cooling would not be required.

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1 Proposed Rulemaking on Transuranic Waste Disposal. Published in Federal Register, Volume 39, No. 32992, November 1969.

Low-level, non-TRU wastes will be packaged for disposal in containers such as steel or plywood boxes, or 55-gallon drums, and be transported by truck to a commercial burial ground.

Volume and packaging information for wastes generated in dismantling the facility is summarized in Table 6.4-2. Shipping volume was calculated by taking the total volume of major pieces of equipment such as vessels, tanks, condensers, coolers, evaporators, etc., from the facility and multiplying it by a factor of one and one-half. Piping volume was based on information provided by NFS on the XCs. A ratio of linear feet of pipe per major piece of equipment was calculated for the XCs, and this ratio was assumed to also hold true for other cells. Waste volume for pipe was assumed to be one and one-half times the average volume of 1 1/2-inch diameter pipe.

The volume of contaminated concrete rubble was arrived at by taking 35 percent of the estimated concrete rubble waste presented in the Barnwell study (NUREG 0278). This was based on the fact that there are more stainless steel-lined cells in the West Valley Fuel Reprocessing Plant, it is a smaller facility, and has operated a shorter time so that concrete coatings have a higher integrity.

The quantity of TRU waste was estimated from NUREG 0278 values and the facility design. It was assumed that only a small quantity of equipment and filters would be buried as TRU wastes because of decontamination. The majority of TRU wastes will be composed of contaminated concrete generated by decontamination activities.

The shipping volumes for the fuel storage racks, HEPA and roughing filters, and trash were taken from the Barnwell study. The estimate for shipping volume of the glove boxes was based on inspection of the glove boxes in the facility. The volume of liquid waste was calculated from the low level liquid waste treatment facility average output of 36 55-gallon drums of solidified liquid waste generated from every million gallons of liquid put through the facility. It was estimated that one million gallons of low

TABLE 6.4-2

Packaging and Shipping Data for Radioactive Wastes
Generated in Dismantlement

Waste Category	Shipping Volume ft^3	Weight (Tons)	Container Type	Number of Containers	Number of Shipments
TRU Waste - high level	500	17.5	Steel Canister	10	3
- low level	4,500	158.	Steel Boxes	41	5
Non-TRU Concrete	9,000	324.	Plywood Box	80	10
Non-TRU Liquid Waste Treatment	270	9.5	55-gal. Drum	36	1
Non-TRU Stainless Steel Liners	16,000	121.8	4 x 4 x 7 ft Steel Box	143	14
Non-TRU Equipment and Piping	50,000	1750.	4 x 4 x 7 ft Steel Box	450	45
Non-TRU Fuel Storage Racks	24,000	180.	4 x 4 x 7 ft Steel Box	215	22
Non-TRU Filters	1,100	5.5	Plywood Box	10	1
Non-TRU Glove Boxes	2,000	50.	4 x 4 x 7 ft Plywood Box	20	2
Non-TRU Trash	10,500	157.5	55-gal. Drum	1,430	20
TOTALS	117,870	2773.8	--	--	123

level waste would be generated from the fuel storage basin and internal and external decontamination of process piping and equipment. The densities of the wastes were calculated from the Barnwell study and applied to the wastes estimated here to obtain their total weight.

6.4.5 Manpower

Estimates of the manpower required to dismantle the West Valley Fuel Reprocessing Plant are presented in this section. It has been estimated that a total 319 manyears are required to plan, obtain approval for, and carry out dismantlement of the facility. Of this total, 230 manyears are management and support staff, and 89 manyears are craft labor. This estimate does not include manpower requirements for demolition by a subcontractor. It also does not include manpower for transportation of radioactive wastes to the burial site and for final burial, since the cost for burial was estimated from waste volumes, weight, and distances.

The decommissioning work force is divided into two parts: 1) the decommissioning support staff which plans, supervises, and provides supporting services for the decommissioning activities; and 2) the craftsmen who perform the actual decommissioning activities.

6.4.5.1 Support Staff Requirements

Support staff requirements were developed after a review of the dismantling operations. The staff organization needed for dismantlement of the West Valley Plant is presented in Figure 6.4-4; the support staff will be assembled during the planning phase. The initial management staff consists of the project manager, project engineer, QA specialist, health and safety supervisor, and project accountant. Other staff personnel will be added as their services are required during the planning and operational phases. The support staff will gradually be reduced toward the end of dismantling operations. Dismantlement support staff labor requirements are shown in Table 6.4-3.

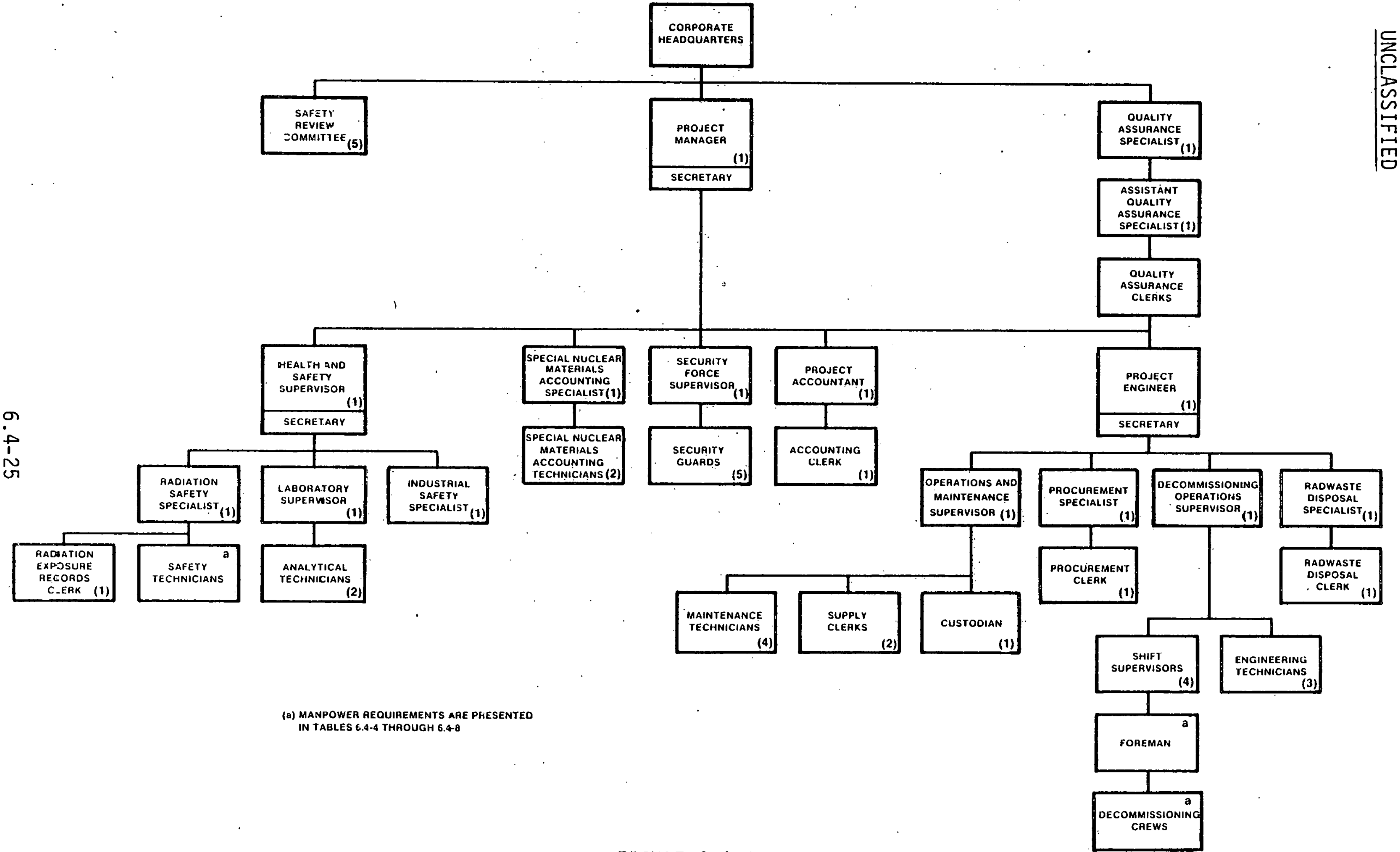

FIGURE 6.4-4

Support Staff Organization for Preparation for An Alternate Nuclear Use

6.4.5.2 Dismantlement Worker (Craftsmen) Requirements

Manpower estimates for each task were based on a decommissioning crew composed of a foreman and several craftsmen selected according to the work to be done. The time required to perform each task was estimated by reviewing the quantity of equipment and the radiation and contamination levels in each portion of the facility. Manweek estimates were arrived at by multiplying the number of workers in each job category by the time required to complete each task. A summary of the craftsmen manpower requirements for dismantlement of the facility is presented in Table 6.4-4, and further detailed in Tables 6.4-5 through 6.4-8.

6.4.6 Occupational Radiation Exposure

Occupational radiation exposure estimates were calculated for those activities required to prepare the facility for demolition. Since virtually all radioactive material will be removed prior to actual demolition, the demolition work itself will require no radiation exposure. The occupational radiation exposure estimates assume judicious attention to the as-low-as-reasonably-achievable (ALARA) standard in reducing radiation exposures. This includes maximum use of remote operations, destructive decontamination, shielding, distance, and training to reduce radiation exposure. The estimates were formulated from work times and present dose rates assuming decontamination factors as follows:

External Decontamination	
PMC and GPC	100
All Other Areas	10
Internal Decontamination	
XCs 2 and 3	2
All Other Piping Areas	10
Remote Removal of Highly Radioactive Equipment and Shielding	2-50

TABLE 6.4-3

Summary of Estimated Support Staff Labor Requirements --Dismantlement

Employees (No.)	Manyears of Labor Planning Phase	Decommissioning Operations	Demolition and Site Restoration
Project Management Personnel			
Project Manager	2	3	1
Quality Assurance Personnel			
Quality Assurance Specialist	2	3	--
Assistant Quality Assurance Specialist	1	3	--
Quality Assurance Clerks (3)	0.6	9	--
Decommissioning Operations Personnel			
Project Engineer	2	3	1
Decommissioning Operations Supervisor	1.8	3	--
Operations and Maintenance Supervisor	0.2	3	--
Engineering Technicians (3)	3	9	--
Radioactive Waste Disposal Specialist	1.5	3	--
Radioactive Waste Disposal Clerk	1.5	3	--
Maintenance Technicians (4)	8	12	--
Shift Supervisors (4)	8	12	--
Health and Safety Protection Personnel			
Safety Review Committee (5)	a	a	--
Health and Safety Supervisor	2	3	--
Radiation Safety Specialist	2	3	--
Industrial Safety Specialist	2	3	--
Safety Technicians[b]	--	--	1
Laboratory Supervisor	2	3	4
Analytical Technician (2)[b]	--	--	2
Radiation Exposure Records Clerk	0.3	3	--
Safeguards and Security Personnel			
SNM Accounting Specialist	0.6	6	--
SNM Accounting Technicians (2)	--	6	--
Security Force Supervisor	2	3	--
Security Guards (5)	10	15	4
Support Services Personnel			
Procurement Specialist	1	3	--
Procurement Clerk	1	3	--
Supply Clerks (2)	0.4	6	--
Custodian	2	3	--
Accountant	2	3	1
Accounting Clerk	2	3	1
Secretaries (5)	6	15	1
TOTAL	66.9	147	16

[a]Committee consists of 5 members meeting 1 day per month.

[b]Safety Technicians and Analytical Technicians are accounted for in the craftsmen requirement during decommissioning operations but are considered support staff during demolition activities.

TABLE 6.4-4

Summary of Estimated Craftsmen Labor Requirements -- Dismantlement

(In Manyears)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Process Building	3.9	5.0	16.1	1.4	10.0	2.9	2.1	2.1	6.8	50.3
B.0	FRS	0.4	0.4	1.8	--	0.4	0.3	0.2	0.2	1.2	4.9
C.0	Tank Farm	2.5	3.8	3.0	--	4.3	9.1	0.7	--	10.4	33.7
D.0	Auxiliary Facilities	0.1	0.3	0.1	--	--	--	--	--	--	0.5
	TOTAL Manyears	6.9	9.5	21.0	1.4	14.7	12.3	3.0	2.3	18.4	89.4

TABLE 6.4-5

Craftsmen Labor Requirements to Prepare Process Building for Dismantlement

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0 Process Building										
A.1 Decon Process Equipment and piping internals.	18	18	72	18	--	--	--	--	18	144
A.2 Decon external surfaces of cell walls, equipment piping, and vessels.	32	32	128	32	--	--	--	--	32	256
A.3 Remove equipment and piping from the process cells, extraction cells, and product cells.	38	38	152	--	152	38	38	38	76	570
A.4 Remove equipment and piping from remaining cells.	22	22	88	--	88	22	22	22	44	330
A.5 Decon cell walls to remove residual contamination and remove stainless steel linings.	12	24	24	--	24	24	--	--	36	144
Subtotal Manweeks	122	134	464	50	264	84	60	60	206	1444

TABLE 6.4-5 (Cont'd)

(In Manweeks)

Activity		Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
A.0	Main Process Building										
A.6	Decon and remove glove boxes and hoods.	6	6	24	6	12	--	--	--	12	66
A.7	Remove equipment and piping from accessible areas.	48	48	192	--	192	48	48	48	96	720
A.8	Survey and mechanically decon accessible areas for unrestricted release.	12	48	72	12	24	--	--	--	24	192
A.9	Remove ventilation system.	14	14	84	--	28	16	--	--	14	170
A.10	Radiation Survey.	3	12	3	6	--	--	--	--	--	24
	Subtotal A.6-10	83	128	375	24	256	64	48	48	146	1172
	Subtotal A.1-5	122	134	464	50	264	84	60	60	206	1444
	TOTAL Manweeks	205	262	839	74	520	132	108	108	352	2616
	TOTAL Manyears	3.9	5.0	16.1	1.4	10.0	2.9	2.1	2.1	6.8	50.3

Table 6.4-6

Craftsmen Labor Requirements to Prepare FRS for Dismantlement

(In Manweeks)

	Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
B.0	FRS										
B.1	Remove stored spent fuel.	3	3	6	--	3	--	--	--	--	15
B.2	Drain storage basin and cask unloading pool & remove solids.	--	--	20	--	--	--	--	--	--	20
B.3	Decon basin and storage racks.	4	4	16	--	4	--	--	--	4	32
B.4	Remove racks cranes and water treatment equipment.	5	5	20	--	10	10	10	10	26	96
B.5	Survey and decon FRS building including the cask decontamination area.	6	6	24	--	--	--	--	--	24	60
B.6	Remove ventilation system and filters.	3	3	6	--	3	6	--	--	6	27
B.7	Final radiation survey.	1	2	2	--	--	--	--	--	--	5
	TOTAL Manweeks	22	23	94	--	20	16	10	10	60	255
	TOTAL Manyears	0.4	0.4	1.8	--	0.4	0.3	0.2	0.2	1.2	4.9

TABLE 6.4-7

Craftsmen Labor Requirements to Dismantle Waste Tark Farm

(In Manweeks)

Activity		Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
C.0	WTF										
C.1	Decon and remove auxiliary facilities.	3	3	12	--	3	3	3	--	3	30
C.2	Erect greenhouse over each tank.	16	16	--	--	16	96	32	--	32	208
C.3	Excavate to top tanks.	10	10	--	--	10	--	--	--	32	62
C.4	Remove top of concrete vaults.	12	12	--	--	24	24	--	--	48	120
C.5	Dismantle tanks and package as waste.	64	112	64	--	112	352	--	--	352	1056
C.6	Survey and decon pans and vaults.	14	34	80	--	22	--	--	--	12	162
C.7	Backfill vaults to original ground contour and plant vegetation.	12	8	--	--	36	--	--	--	60	116
	TOTAL Manweeks	131	195	156	--	223	475	35	--	539	1754
	TOTAL Manyears	2.5	3.8	3.0	--	4.3	9.1	0.7	--	10.4	33.7

TABLE 6.4-8

Craftsmen Labor Requirements to Prepare Auxiliary Facilities for Dismantlement (or Unrestricted Use)

(In Manweeks)

Activity	Foreman	Safety Technician	Decommissioning Technician	Analytical Technician	Equipment Operator	Welder	Electrician	Pipefitter	Other Skilled Labor	Total
D.0 Auxiliary Facilities										
D.1 Remove contaminated equipment from laundry room.	2	2	2	--	2	--	--	--	1	9
D.2 Perform survey and remove all contamination from facilities.	2	4	4	--	--	--	--	--	--	10
D.3 Perform final survey of facilities.	--	8	--	--	--	--	--	--	--	8
D.4 Perform radiation survey of the site outside the exclusion area.[a]	--	--	--	--	--	--	--	--	--	--
TOTAL Manweeks	4	14	6	--	2	--	--	--	1	27
TOTAL Manyears	0.1	0.3	0.1	--	0.03	--	--	--	0.02	0.5

[a] This task is performed by "support staff" during dismantling operations and estimated under support staff and in Table 6.4-3.

If conditions are not as expected or if exposure controls are not adequate, the actual exposure received in doing the work could easily run twice the estimated 750 man-rem or more.

The estimates shown in Tables 6.4-9 through 6.4-12 assume that 10 hours per week are spent performing work requiring no occupational radiation exposure, and that the majority of the remaining work is done in low background areas within the plant.

6.4.7 Costs

This section presents an estimate of costs for dismantling the West Valley Fuel Reprocessing Plant. Costs are included for direct labor and subcontractor activities; equipment and material; contaminated waste packaging, transportation, and disposal; and utilities, services and other overheads.

The cost to dismantle the facility is estimated at $31.0 million for transporting radioactive wastes 1000 miles away, $32.1 million for transporting radioactive wastes 3000 miles away, and $30.2 million for burying non-TRU wastes onsite and disposing of TRU wastes 1000 miles away. Table 6.4-13 summarizes the cost estimates for dismantlement of the fuel reprocessing plant. These figures were calculated by dividing the dismantlement costs into two principal categories: decommissioning operations, and demolition and site restoration (which was assumed to be subcontracted).

6.4.7.1 Decommissioning Operations Costs

Decommissioning operations costs were further divided into five categories:

- Support Staff Labor
- Craftsmen Labor
- Equipment and Materials
- Shipping and Waste Disposal
- Utilities and Other Expenses.

These costs are summarized in Table 6.4-14.

TABLE 6.4-9

Occupational Radiation Exposure Estimate to Dismantle Process Building

Activity		Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
A.0	Process Building							
A.1	Decontaminate process equipment internals.	144	4,320	3	4,300	0.1	20	14.9
A.2	Decontaminate cell walls, equipment, piping, and vessels.	256	7,680	3	7,660	0.1	20	25
A.3	Remove equipment and piping from the process cells, extraction cells and product cells.	570	17,100	2	16,935	0.05 0.5 1.0 10.0	100 50 10 5	123.9
A.4	Remove equipment and piping from remaining cells.	330	9,900	2	9,780	0.2 1.0	100 20	59.6
A.5	Decontaminate cell walls to remove residual contamination and remove stainless steel linings.	144	4,320	2	4,220	0.02	100	10.4
A.6	Decontaminate and remove glove boxes and hoods.	66	1,980	3	1,960	0.01	20	6.1

TABLE 6.4-9 (Cont'd.)

	Activity	Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
A.7	Remove equipment and piping from accessible areas	720	21,600	2	21,600	--	--	43.2
A.8	Survey and mechanically decontaminated accessible areas for unrestricted release	192	5,760	--	5,760	--	--	5.8
A.9	Remove ventillation system	170	5,100	5	5,079	0.2 20	20 2	39.4
A.10	Final radiation system	24	630	0	630	--	--	0
								328.3

TABLE 6.4-10

Occupational Radiation Exposure Estimate to Dismantle FRS

Activity		Total Manweeks	Manhours in Radiation Areas	Background Level for Remote Work or Ent/exit (mr/hr)	Manhours in Background area	Dose Rate for radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
B.0	FRS							
B.1	Removed stored spent fuel.	15	450	5	400	0.01	50	2.5
B.2	Drain storage basin and cask unloading pool and remove sludge.	20	600	5	550	0.1	50	7.8
B.3	Decontaminated basin and storage racks.	32	960	5	900	0.5	60	34.5
B.4	Remove racks, cranes and water treatment equipment.	96	2880	5	2820	0.3	60	32.4
B.5	Survey and decontaminate FRS building including the cask decontamination area.	60	1800	2	1800	--	--	3.6
B.6	Remove ventilation system and filters.	27	810	5	809	1	1	5.1
B.7	Perform final radiation survey of FRS.	5	150	0	150	--	--	0
								85.9

TABLE 6.4-11

Occupational Radiation Exposure Estimate to Dismantle WTF

Activity	Total Manweeks	Manhours in Radiation Areas	Background Dose Rate for Remote Work or Ent/exit (mR/hr)	Manhours in Background area	Dose Rate for Radiation Work (R/hr)	Manhours in Radiation Work	Total Exposure for Task (man-rem)
C.0 Waste Tank Farm							
C.1 Decontaminate and remove auxiliary facilities.	30	900	3	860	0.1	40	6.6
C.2 Erect greenhouse over top of each vault	208	6240	1	6240	--	--	6.2
C.3 Excavate to top of tanks	62	1860	0.5	1860	--	--	0.9
C.4 Remove top of concrete vaults	120	3600	2	3570	0.02	30	7.7
C.5 Dismantle tanks and package as waste	1056	31,680	5	31,640	0.1	40	158.6
C.6 Survey and decontaminate pans and vaults	162	4860	1	--	--	--	4.9
C.7 Backfill vaults to original ground contour and plant vegetation.	116	3480	0	--	--	--	0
							184.9

TABLE 6.4-12

Summary of Occupational Radiation Exposure Estimates
— Dismantlement

Process Building	328.3
FRS	85.9
WTF	184.9
Auxiliary Facilities	~0
Subtotal	599.1
+ 25% Contingency	149.8
TOTAL	748.9 Man-rem

TABLE 6.4-13

Summary of Dismantlement Costs for Various Burial Ground Locations

	Cost (Millions of 1978 Dollars)		
	1000 Miles	Onsite[a]	3000 Miles
Decommissioning Operations	26.3	25.5	27.4
Demolition and Site Restoration	4.7	4.7	4.7
TOTAL	31.0	30.2	32.1

[a]Assumes 1000-mile shipment of TRU wastes.

TABLE 6.4-14

Summary of Cost Estimates for Preparation for Dismantlement

Expense Item	Planning	Process Bldg.	FRS	WTF	Aux. Fac.	Total
	Costs (Thousands of 1978 Dollars)					
Support Staff Labor[a]	2,654	3,117	302	1,963	29	8,065
Craftsmen Labor	---	1,712	166	1078	16	2,972
Equipment and Materials[a]	26	1,302	126	820	12	2,286
Shipping and Waste Disposal[a]						
1000-mile Shipment	---	1,984	192	1,249	19	3,444
3000-mile Shipment	---	2,505	243	1,577	23	4,348
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes	---	1,621	157	1,020	15	2,813
Utilities and Other Expenses[a]	1,500	1,584	154	997	15	4,250
1000-mile Shipment TOTAL[b]	5,225	12,124	1,175	7,634	114	26,272
3000-mile Shipment TOTAL[b]	5,225	12,774	1,239	8,044	119	27,401
Onsite Burial of Non-TRU Wastes, 1000-mile Shipment of TRU Wastes TOTAL[b]	5,225	11,670	1,131	7,348	109	25,483

[a]These costs have been apportioned to each section of the facility in the same ratio as the craft labor costs.

[b]Includes 25% contingency.

Labor costs were arrived at by applying owner costs for each employee classification to manyears (from Section 6.4.5, Manpower). Owner costs were determined by adding 70 percent of labor rates, to cover benefits and overheads, to current labor rates. These pay rates and owner costs are presented in Table 6.4-15. Staff support costs to the owner were arrived by adding another 10 percent to cover the facility owner's administrative expense. Support staff costs are detailed in Table 6.4-16. Craftsmen labor costs are presented in Table 6.4-17.

The estimated equipment and material required and associated costs are summarized in Table 6.4-18. These costs are exclusive of burial containers, which are covered in conjunction with shipping and waste disposal costs. A considerable quantity of equipment presently available at the facility would also be used. Although some salvage value is possible from the equipment, there is a considerable probability that it will become contaminated and will require either disposal or controlled future use.

Shipping and waste disposal costs have been estimated for three cases: burial of all wastes at 1000 miles, burial at 3000 miles, and burial onsite of all but TRU wastes. In all cases, shipment is presumed to be in DOT-approved containers. Because of proposed rulings[1], all TRU wastes have been assumed to be transported offsite. Where non-TRU wastes are buried onsite, TRU wastes were assumed to be transported 1000 miles for interim care or to a federal repository (neither site is presently available).

The basic factors used in estimating waste disposal costs are summarized in Table 6.4-19. By applying these factors to the waste volumes in Section 6.4-4, the disposal costs were calculated as shown in Tables 6.4-20 through 6.4-22. Only the shipment costs vary between the 1000 and 3000 mile shipments. In the onsite burial option, only the time and equipment cost for burial are included. The decommissioning wastes will increase the total curies in the burial ground by only a small percentage and this is not expected to increase the extent or duration of surveillance required. Additional savings might be realized in onsite burial by not using DOT-approved shipping containers and by transporting oversized loads.

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1 Federal Register, Volume 39, No. 32992, November 1969.

TABLE 6.4-15

Pay Rates[a] and Owner Costs for Decommissioning Employees — Dismantlement

Employee	Annual Base Pay	Annual Owner Cost
Project Manager	43,000	73,100
Project Engineer	35,000	59,500
Health & Safety Supervisor	33,000	56,100
Quality Assurance Specialist	29,000	49,300
Decommissioning Operations Supervisor	32,000	54,400
Plant Operations & Maintenance Supervisor	32,000	54,400
Radiation Safety Specialist	24,000	40,800
Industrial Safety Specialist	25,000	42,500
SNM Accounting Specialist	25,000	42,500
Accountant	22,000	42,500
Radioactive Waste Disposal Specialist	22,000	42,500
Procurement Specialist	20,000	34,000
Security Force Supervisor	20,000	34,000
Laboratory Supervisor	22,000	42,500
Assistant QA Specialist	20,000	34,000
Secretary	12,000	20,400
Radwaste Disposal Clerk	12,000	20,400
QA Clerk	12,000	20,400
Accounting Clerk	12,000	20,400
Radiation Exposure Records Technician	16,000	27,200
Procurement Clerk	12,000	20,400
Supply Clerk	12,000	20,400
Custodian	12,000	20,400
Foreman	21,000	35,700
Shift Supervisor	22,000	42,500
Decommissioning Technician	20,000	34,000
Equipment Operator	18,000	30,600
Mechanical Technician	18,000	30,600
Maintenance Technician	18,000	30,600
Welder	16,000	27,200
Pipefitter	16,000	27,200
Electrician	19,000	32,300
Instrument Technician	20,000	34,000
Safety Technician	16,000	27,200
SNM Accounting Technician	16,000	27,200
Analytical Technician	16,000	27,200
Engineering Technician	16,000	27,200
Chemical Makeup Operator	15,000	25,500
Security Guard	15,000	25,500
Safety Review Committee[b]	---	500/day

[a]Pay rates are estimated to be representative of highly qualified experienced individuals in each job category in the nuclear industry.

ork as consultants on a daily basis. An allowance for travel and living expenses is also included.

TABLE 6.4-16

Summary of Estimated Support Staff Labor Costs — Dismantlement

Employees (No.)	Cost (Thousands of 1978 Dollars) Planning Phase	Decommissioning Operations
Project Manager Personnel		
Project Manager	146	219
Quality Assurance Personnel		
Quality Assurance Specialist	99	148
Assistant Quality Assurance Clerk	34	102
Quality Assurance Clerks (3)	12	184
Decommissioning Operations Personnel		
Project Engineer	119	179
Decommissioning Operations Supervisor (1)	98	163
Operations and Maintenance Supervisor	11	163
Engineering Technicians (3)	82	245
Radioactive Waste Disposal Clerk	31	61
Radioactive Waste Disposal Specialist	64	128
Maintenance Technicians (4)	245	367
Shift Supervisors (4)	340	510
Health and Safety Protection Personnel		
Safety Review Committee	60	90
Health and Safety Supervisor	112	168
Radiation Safety Specialist	82	112
Industrial Safety Specialist	85	128
Safety Technicians[a]	--	--
Laboratory Supervisor	85	128
Analytical Technicians (2)[a]	--	--
Radiation Exposure Records Technician	8	82
Safeguards and Security Personnel		
SNM Accounting Specialist	26	255
SNM Accounting Technicians (2)		163
Security Force Supervisor	68	102
Security Guards (5)	255	382
Support Services Personnel		
Procurement Specialist	34	102
Procurement Clerk	20	61
Supply Clerks (2)	8	122
Custodian	41	61
Accountant	85	128
Accounting Clerk	41	61
Secretaries (3)	122	306
TOTAL	2,413	4,920

[a]Safety and analytical technicians for planning and decommissioning operations are included in craftsmen labor estimates.

TABLE 6.4-17

Summary of Craftsmen Labor Costs — Dismantlement

Worker Cost

Employee	Costs (Thousands of 1978 Dollars) Process Building	FRS	WTF	Auxiliary Facilities	Total
Foreman	139	14	89	4	246
Safety Technician	136	11	103	8	258
Decommissioning Technician	548	61	102	3	714
Analytical Technician	38	--	--	--	38
Equipment Operator	306	12	132	--	450
Welder	79	8	248	--	335
Electrician	68	6	23	--	97
Pipefitter	57	6	--	--	63
Other Skilled Labor	185	33	283	--	501
Subtotal	1556	151	980	15	2702
Owner Overheads	156	15	98	1	270
TOTAL	1712	166	1078	16	2972

TABLE 6.4-18

Estimated Equipment and Materials Costs[a]
—Dismantlement

Description	Quantity	Cost (Thousands of 1978 Dollars) Per Unit	Total
Portable Plasma Torch and Power Supply	4	50	200
Track Drill	1	40	40
Modified Rock Splitters and Power Supplied	6	8	48
Shielded Five-Ton Crane	1	100	100
Three-Ton Crane	1	13	13
Shielded Front-End Loader	1	54	54
Shielded Working Cage	1	--	450
Shielded Working Platform	1	--	230
Greenhouse Building	1	--	115
Adjustable Scaffolding	1	10	10
6 Jackhammers and 2 Compressors	6 + 2	--	54
Air Operated Rock Drill	3	1	3
Air Operated Hack Saw	2	0.5	1
Polyurethane Foam Generator	1	5	5
Radiation Detection and Analyzing Equipment	--	--	75
Mist Eliminators	8	2	16
Flush Chemicals	--	--	170
Expendable Supplies	60 mos.	24 mo@ $1 36 mo@ $10	384
Ventilation Equipment	--	--	10
Mockup and Training Facilities	--	--	100
Vacuum and Remote Cleaning Equipment	2	1	2
Subtotal			2,080
Owner Overheads			208
TOTAL			2,286

[a]Does not include waste containers.

TABLE 6.4-19

Waste Disposal Cost Data

Expense Item	Costs (1978 Dollars)
Container Costs	
4 ft x 4 ft x 7 ft steel box	600 ea
4 ft x 4 ft x 4 ft steel box	450 ea
Plywood Box	40/yd^3
55-gallon Drum	20 ea
HLW Canister	5000 ea
Freight Charges	
Truck	1.05 per mile
Waste Disposal Costs	
Surface Burial	5.00 ft^3
Interim Storage or Federal Repositories	
High-level Waste	2220/ft^3
Low-level Waste	65/ft^3
Cask Rental Charges[a]	
High-level Waste Cask	2000/day
Intermediate-level Waste Cask	1000/day

[a]Values are from NUREG 0278, casks may be available commercially for substantially less.

TABLE 6.4-20

Estimated Packaging, Shipping, and Waste Disposal Costs for Dismantlement — 1000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Concrete Rubble	48	11	46	105
Solids from Low Level Liquid Waste Treatment	1	1	2	4
Stainless Steel Lines	86	15	80	181
Equipment and Piping	270	47	250	567
Fuel Storage Racks	36	23	120	179
HEPA and Roughing Filters	6	1	6	13
Glove Boxes	3	2	10	15
Trash	29	21	76	126
Subtotal	479	121	590	1190
TRU				
High Level Wastes[a]	50	466	1,110	1,626
Low Level Wastes	18	5	292	315
Subtotal	547	592	1,192	3,131
Owner Overhead	55	59	199	313
TOTAL	602	651	2,191	3,444

[a]Shipping includes high level waste cask rental for 23 days per shipment.

TABLE 6.4-21

Estimated Packaging, Shipping, and Waste Disposal Costs for Dismantlement — 3000-mile Shipment

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Concrete Rubble	48	52	46	146
Solids from Low Level Liquid Waste Treatment	1	2	2	5
Stainless Steel Lines	86	44	80	210
Equipment and Piping	270	142	250	662
Fuel Storage Racks	36	69	120	225
HEPA and Roughing Filters	6	1	6	13
Glove Boxes	3	6	10	19
Trash	29	63	76	168
Subtotal	479	379	590	1,448
TRU				
High Level Wastes[a]	50	1,019	1,110	2,179
Low Level Wastes	18	16	292	326
Subtotal	547	1,414	1,992	3,953
Owner Overhead	55	141	199	395
TOTAL	602	1,555	2,191	4,348

[a]Shipping includes high level waste cask rental for 50 days/shipment.

TABLE 6.4-22

Estimated Packaging, Shipping, and Waste Disposal Costs for Dismantlement — Onsite Burial of Low Level Wastes

Waste Category	Cost (Thousands of 1978 Dollars) Container	Shipping	Disposal	Total
NON-TRU				
Concrete Rubble	48	3	10	61
Solids from Liquid Waste Treatment	1	--	--	1
Stainless Steel Lines	86	2	12	100
Equipment and Piping	270	10	52	332
Fuel Storage Racks	36	5	24	65
HEPA and Roughing Filters	6	--	1	7
Glove Boxes	3	--	2	5
Trash	29	5	11	45
Subtotal	479	25	112	616
TRU				
High Level Wastes[a]	50	466	1,110	1,626
Low Level Wastes	18	5	292	315
Subtotal	547	496	1,514	2,557
Owner Overhead	55	50	151	256
TOTAL	602	546	1,665	2,813

[a]Shipping includes high level waste cask rental for 23 days.

The estimated costs of utilities, license fees, and other owner expenses for decommissioning operations are presented in Table 6.4-23. The expenses included in the table are: electricity and other utilities, license fees, travel and miscellaneous expenses, and nuclear liability and conventional insurance premiums. For this estimate we have considered that the facility would continue under NRC license and New York State ownership. NFS is currently paying a lease fee of $664,000/year which will be lost income to the State. NFS also currently pays property taxes, which will not be required of the State.

6.4.7.2 Demolition and Site Restoration Cost

Demolition and site restoration costs were divided into five categories to calculate the cost:

- Support Staff Labor
- Subcontractor Activities
- Shipping and Waste Disposal
- Utilities and Other Expenses
- Miscellaneous

Table 6.4-24 presents a summary of cost estimates for demolition and site restoration.

The support staff consists of management, engineering, safety, security, and other personnel not directly involved with the demolition and site restoration operations. Support staff labor costs for demolition and site restoration are presented in Table 6.4-25.

The estimated costs of demolition and site restoration activities carried out by a subcontractor are summarized in Table 6.4-26. The major expense item is demolition of the main process building and the FRS. Demolition of the West Valley facility is estimated to involve 30,000 cubic yards of concrete. Contractor demolition costs to demolish a structure are estimated at $\$80/yd^3$. The volume estimate was scaled down and the cost per cubic yard was escalated from the NUREG 0278 estimate to allow for inflation. A separate $100,000 subcontract to analyze samples for unrestricted release of the site is also included.

TABLE 6.4-23

Estimated Cost of Utilities and Other Owner Expenses — Preparation for Dismantlement

Expense Item	Cost (Thousands of 1978 Dollars)
License Fees	50
Electricity and Other Utilities	2,600
Insurance	500
Travel and Miscellaneous	1,100
TOTAL	4,250

TABLE 6.4-24

Summary of Cost Estimates for Demolition and Site Restoration

Expense Item		Cost (Thousands of 1978 Dollars)
Support Staff Labor		525
Craftsmen Labor		---
Subcontractor Activities		3,190
Shipping and Waste Disposal		5
Utilities, and Other Expenses		45
Miscellaneous		13
	Subtotal	3,778
	+ 25% Contingency	945
	TOTAL	4,723

TABLE 6.4-25

Summary of Estimated Support Staff Labor Costs —Demolition and Site Restoration

Employees (No.)	Cost (Thousands of 1978 Dollars) Demolition
Project Manager Personnel	
Project Manager	73
Decommissioning Operations Personnel	
Project Engineer	60
Health and Safety Protection Personnel	
Health and Safety Supervisor	56
Safety Technicians	109
Analytical Technicians	54
Safeguards and Security Personnel	
Security Guards	102
Support Services Personnel	
Accountant	43
Accounting Clerk	21
Secretary	20
Subtotal	538
Owner's Overhead	54
TOTAL	592

During demolition of the building structures, contaminated process piping, and drains embedded in the concrete will be removed. The costs for shipping containers and waste disposal for these materials removed during demolition is estimated to be $5,000. The estimated utilities and other expenses are shown in Table 6.4-27. Costs for office supplies, minor cash outlays, and other miscellaneous expenses are covered under miscellaneous costs (estimated at $13,000).

6.4.8 Public and Worker Safety

Consequences of activities and accidents which may occur during dismantlement of the West Valley Plant have been evaluated and are discussed in the following sections.

6.4.8.1 Planned Activities to Prepare for Dismantlement

The major environmental release of airborne effluents in this disposition mode will originate from initial processes in external decontamination of the cells, just as in the other modes evaluated. Public exposure from this activity will result in 0.05 man-rem whole body exposure and 0.41 man-rem to the lungs for the general population (details of the radiation exposure estimates are provided in Section 6.1.8). Additionally, airborne vapors generated by sectioning of equipment within the cells will be removed by HEPA filtration. Occupational radiation exposure is estimated at 750 man-rem.

Liquid effluents will be generated in the same manner and concentration as in the layaway and protective storage modes.

The radiation exposure and industrial safety hazards to which workers will be subjected in dismantlement are significantly greater than in other modes which require fewer manhours in the facility.

TABLE 6.4-26

Estimated Subcontractor Costs for Demolition and Site Restoration

Process Building	Cost (Thousands of 1978 Dollars)
Demolish Process Building and FRS	
Lower main stack	22
Remove roof, doors, structural steel, etc.	63
Remove building equipment	64
Demolish concrete structure	2,400
Backfill to grade	16
Demolish auxiliary facilities	110
Restore site	125
Analyze samples from site summary	100
Subtotal	2,900
Owner's Overhead	290
TOTAL	3,190

TABLE 6.4-27

Estimated Cost of Utilities and Other Owner Expenses — During Demolition

Expense Item		Cost (Thousands of 1978 Dollars)
License Fees		10
Electricity and Other Utilities		10
Insurance		25
Miscellaneous		13
	TOTAL	58

6.4.8.2 Accidents During Dismantlement

Those accidents which may occur while the facility is being prepared for dismantlement are generally similar to those which might have occurred during operation. However, since the radionuclide inventory in the facility is less than during operation, the consequences of possible accidents are correspondingly reduced.

Accidents analyzed for the operating facility include: criticality within any of the processing cells[1], criticality in the fuel storage pool[1], chemical explosion[1], and other lesser accidents.[2]

A criticality is considered much less likely to occur during decommissioning than during operation due to the greatly reduced quantities of material in the facility. Safeguards to prevent criticality will include use of criticality-safe containers, "poison" tanks (tanks containing neutron-absorbing material), and dilution. For the operating facility, a criticality of 10^{20} fissions was predicted to give a 5.85 rem/person dose to the highest exposed member of the general population[3]. The dose to workers outside the cell where the criticality occurred would be slight due to the shielding provided.

A criticality in the fuel storage pool was evaluated for the operating plant. All fuel would be removed in accordance with normal operating procedures prior to any other decommissioning activity.

Physical design of the storage basin and safeguards employed during operation make a criticality incident in the fuel storage pool highly unlikely; however, if such an incident were to occur, energy generation would be equivalent to a 10-MWT boiling water reactor for three hours. Radiation from the criticality would be shielded by the water in the basin. Fission products released into the pool water under the most adverse meteorological conditions would not exceed maximum permissible concentrations established in 10 CFR Part 20.[1]

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1 FSAR REV4, Sept. 1969, FSAR 1973, Section X-3

2 NRC - Interim Safety Evaluation

3 FSAR VII 1.73, 1963

The predicted frequency of radiation overexposure was estimated from NRC data for nuclear power reactors from 1971 to 1975.[2] During that period, there were 96 overexposures to external radiation for 58,030 man-rem of occupation radiation exposure. We have estimated 0.165 overexposures per 100 man-rem (1 overexposure per 606 man-rem). To prepare the facility for dismantlement will require 750 man-rem. We therefore predict 1.2 overexposures.

A chemical explosion while the facility is being prepared for demolition, although potentially very serious in terms of worker safety and destruction of property, is not expected to exceed the maximum permissible concentration for mixed fission products at the site boundary.[3] Great care will be taken in preparing and approving chemical decontamination procedures to assure the compatibility of chemicals and to prevent the buildup of explosive gases.

Other lesser accidents have a potential for serious worker injury but are not expected to have serious offsite consequences. The accident rates shown in Table 6.4-28 have been observed on work in nuclear facilities[4] and applied to other decommissioning studies.[5]

If we apply these rates to the preparation for dismantlement activities, we can expect an accident frequency less than for construction, but greater than for normal operation. We have conservatively assumed construction accident rates in predicting 3.6 loss time injuries and 0.030 fatalities during preparation for dismantlement.

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1 FSAR VII 1.73, 1963

2 W. Wekreger, NRC Review for Assuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievalbe - Paper given Nov. 1976, ANS Meeting

3 FSAR VII 1.73, 1963.

4 Operational Accidents and Radiation Exposures Experienced within the USAEC 1943-1970 Wash 1192, 1971

TABLE 6.4-28

Construction/Industrial Accident Frequencies
(Nuclear Facilities)

Accident Category	Job Classification	Frequencies (Accident/10^6 Manhours) 1943-70 28 Year Average
Lost Time Injuries:	Heavy Construction	10
	All Construction	5.36
	DOE Operations	2.12
Fatalities:	Construction	0.042
	DOE Operations	0.023
	Government Functions	0.004

Actual demolition of onsite structures will require the use of a considerable quantity of explosives and many hours of heavy equipment operation. This type of work is routinely performed in industry but does entail some risk. The large buffer zone around the site should prevent damage to the general population from all activities but transportation of explosives to the site, which will be done in strict accordance with DOT regulations.

6.4.8.3 Transportation Safety

Transportation of radioactive wastes generated during the dismantlement of the fuel reprocessing plant will pose some risks to the public and to transportation workers. Radiological effects of dismantlement transport operations include external radiation exposure to the transportation worker and the public from normal transport operations, and potential radiation exposure to the public from the release of radioactive material in transportation accidents. Nonradiological effects of dismantlement transport operations include the potential of chemical pollutant releases, and injuries and fatalities similar to accidents in the transport of nonradioactive materials.

Estimated routine radiation doses from truck transport of the radioactive wastes are shown in Table 6.4-29. Dose calculations are based on maximum allowable dose rates for shipment in exclusive-use vehicles and are therefore conservative. Information on the number of truck shipments is taken from Section 6.4.4.

The method and assumptions used in estimating the radiation dose from normal transport operations were based on NUREG-0278 assumptions. As seen in Table 6.4-29, the estimated routine radiation dose to the transportation workers and general public is about 22 man-rem for transporting the wastes 1000 miles, about 67 man-rem for transporting the wastes 3000 miles, and about 3.2 man-rem for onsite burial of non-TRU and 1000 mile shipment of TRU.

TABLE 6.4-29
Estimated Routine Radiation Dose From
Truck Transport of Radioactive Wastes from Dismantlement

Group	Dose Per Shipment (Man-rem)		Total Radiation Dose For All Shipment (Man-rem)
	1000 Miles Away		
Transportation Workers			
Truck Drivers	0.15		18.45
Garagemen	0.0015		.18
		TOTAL	18.63
General Public			
Onlookers	0.015		1.85
Other General Public	0.015		1.85
		TOTAL	3.70
	3000 Miles Away		
Transportation Workers			
Truck Drivers	0.45		55.35
Garagemen	0.0045		.55
		TOTAL	55.90
General Public			
Onlookers	0.045		5.54
Other General Public	0.045		5.54
		TOTAL	11.07
	Onsite Burial of Non-TRU 1000 Mile Shipment of TRU		
Transportation Workers			
Truck Drivers			
Offsite	.002		.016
Onsite	.015		1.73
Garagemen	.0015		.17
		TOTAL	1.92
General Public			
Onlookers	0.15		1.20
Other General Public	0.015		.12
		TOTAL	1.32

For burial onsite of non-TRUE wastes, it is assumed that a single driver will be required for one hour per each shipment, that wastes will be trucked to the onsite burial ground in a DOT-approved exclusive use vehicle, and that associated limits on radiation levels will be applied. TRU wastes will be trucked to a Federal repository or to interim storage 1000 miles away. With these assumptions, the estimated radiation dose to the transportation worker is 1.9 man-rem. The radiation dose to the general public is estimated at 1.3 man-rem.

The primary potential radiological effect of dismantlement transportation accidents is the release of radioactive material and the resulting radiation dose to the public. Minor accidents are not likely to result in a loss of containment or a release of radioactivity. A small percentage of accidents of moderate severity are postulated to result in a breach of package containment and a release of material. Most serious accidents would result in some loss of containment.

Should a breach of containment occur and combustible waste burn in an open fire, only a small fraction of the radioactivity would be widely dispersed. Most of the radioactivity, perhaps as much as 99 percent, would remain in the ashes.[1]

A severe collision or other impact that resulted in breach of a container of concrete rubble would cause some dispersion of material. However, most of the material would return to the ground within a few hundred feet of the point of release. The fraction of respirable materials released is estimated to be less than 10^{-3}. Concrete is noncombustible and the effects of a fire would be very limited.

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1 Directorate of Regulatory Standards, Environmental Safety of Transportation of Radioactive Materials to and from Nuclear Power Plant, WASH-1238, U.S. AEC, Washington D.C., 1972.

Decontamination of process equipment, stainless steel plate, and other items of metal scrap would result in the removal of all loosely held surface contamination prior to shipment. The most likely result of a transportation accident involving contaminated metal parts would be a release of semivolatile surface contamination as the result of a high temperature fire.

In a transportation accident involving radioactive materials, carriers are required to follow DOT-prescribed procedures designed to mitigate the consequences. DOT regulations require prompt reporting of any transportation incident involving shipment of radioactive material in which fire, breakage, spillage, or suspected radioactive contamination occurs. The regulations also specify guidelines for remedial actions in the case of actual or suspected release of radioactivity from a shipping container.

The principal nonradiological transportation safety impact is the potential for injuries and fatalities from the transportation accident. Table 6.4-30 provides a summary of transportation accident statistics for truck transport operations.

Negligible safety impacts are expected from chemical pollutants for truck shipments. The number of truck shipments for transporting wastes generated by dismantlement operations is a miniscule portion of the total number of U.S. truck shipments.

TABLE 6.4-30

Nonradiation Transportation Accident Statistics — Dismantlement

Statistical Frequencies[a]		Expected Occurrences: 1000 Mile Shipment	Expected Occurrences: 3000 Mile Shipment	Expected Occurrences: Onsite Burial[b]
Accidents/Vehicle Mile	6.9×10^{-7}	8.5×10^{-2} Accidents	2.5×10^{-1}	5.5×10^{-3}
Injuries/Accident	0.51	4.3×10^{-2} Injuries	1.3×10^{-1}	2.8×10^{-3}
Fatalities/Accident	0.03	2.5×10^{-3} Fatalities	7.6×10^{-3}	1.6×10^{-4}

a Directorate of Regulatory Standards, Environmental Safety of Transportation of Radioactive Materials to and from Nuclear Power Plants, WASH-1238, U.S. AEC, Washington, D.C., 1972.

b Three shipments will be TRU wastes trucked 1000 miles away.

TABLE 6.4-31

West Valley Plant Facilities and Abbreviations

ANA	Analytical Aisle
ANC	Analytical Cells
ARC	Acid Recovery Cell & Pump Room
CCR	Chemical Crane Room
COA	Chemical Operating Aisle
CPC	Chemical Process Cell
CR	Control Room
CUP	Cask Unloading Pool
CVA	Chemical Viewing Aisle
DCS	Decontamination Shop
EDR	Equipment Decontamination Room
FRS	Fuel Receiving & Storage
GPA	GCP-MC Operating Aisle
GPC	General Purpose Cell
GCR	GPC Crane Room
HAC	Hot Acid Cell
HEV	Head End Ventilation & Entire Duct System
LAB	Laboratories
LWC	Liquid Waste Cell
LWA	Lower Warm Aisle
LXA	Lower Extraction Aisle
MC	Miniature Cell
MCR	Mechanical Crane Room
MOA	Mechanical Operating Aisle
MRR	Manipulator Repair Room
MRS	Master Slave Manipulator Repair Shop
MS	Maintenance Shop
OFF	Office Building
OGA	OGC-ARC Aisle
OGC	Off-Gas Cell
PCR	Process Chemical Room
PEA	Pulse Equipment Aisle
PMC	Process Mechanical Cell
PPC	Product Purification Cell
PPS	Product Packaging & Shipping
RER	Ram Equipment Room
SC	Sample Cell
SGR	Switch Gear Room
SL	Storage Lagoon
SR	Scrap Removal Area
SSC	Sample Storage Cell
SST	Solvent Storage Tanks
UPC	Uranium Product Cell
UR	Utility Room
UWA	Upper Warm Aisle
UXA	Upper Extraction Aisle
VEC	Ventilation Exhaust Cell
VSR	Ventilation Supply Room
VWR	Ventilation Wash Room
WHSE	Warehouse
WTF	Waste Tank Farm
XC1	Extraction Cell #1
XC2	Extraction Cell #2
XC3	Extraction Cell #3
XCR	Extraction Chemical Room (Extraction Cold Chemical)
XSA	Extraction Sample Aisle
YARD	Yard

TABLE 6.4-31

West Valley Plant Facilities and Abbreviations

(OPEN LEAF)

7.0 COST CONSIDERATIONS

The alternative courses of action that can be taken in decommissioning the fuel reprocessing plant have been identified and defined in Section 2, and examined in Section 6. The purpose of this section is to identify and compare key financial parameters to be considered in making a choice between these decomissioning alternatives.

Which decommissioning approach will minimize the direct cost of the undertaking to the facility owner? This question cannot be easily answered since the expenditure of funds may be distributed over time periods ranging from five years to perhaps more than 100 years. Some means must be arrived at to permit comparative analysis of expenditures.

One approach is to compute and sum up the present dollar values of all of the future expenditures for each decommissioning alternative, and compare these sums. The present value of a future expenditure of money is given by the following equation.

EQUATION:

$$P_b = \frac{S_b}{(1+k)^b} \qquad (7\text{-}1)$$

Here, P_b is the present value of an expenditure (S_b) made b years from now, with k being the discount rate. Definitions of discount rate, interest rate, and inflation rate are given in Table 7-1.

Equation 7-2 gives the present value cost of future expenditures in the case of dismantlement at year ℓ.

$$P_D = \sum_{a=1}^{\ell} \frac{D_a(1+j)^a}{(1+k)^a} \qquad (7\text{-}2)$$

Here, D represents the dismantlement mode. D_a is the estimated dismantlement cost in current dollars, for the a^{th} year; j is the annual inflation rate.

TABLE 7-1

Definition of Terms

Interest Rate--The rate of return on capital invested in normal securities, i.e., bonds, certificates of deposit, and similar financial instruments.

Inflation Rate--The rate of increase in cost of goods and services, on an annual basis, as determined from the nation's economic indicators by the Federal Department of Labor.

Discount Rate--The rate of return on capital that could have been realized in the alternative investments, if the money were not committed to the plan being evaluated, i.e., the opportunity cost of alternative investments. This cost is equivalent to the weighted average cost of capital.[1] For an investor-owned corporation, the weighted average cost of capital should reflect the corporation's costs for debt and equity, and retained earnings which are used for capital investments.[2]

Present Value of Money--When different business activites require disbursement of funds over different time frames, it is difficult to compare the actual cost of each activity to the sponsoring organization. One generally accepted method of placing these various disbursements on a common basis is to compute the value of those disbursements in terms of current dollars, i.e., the present value of money to be paid out or received at some time other then the present. For an investor, "the present value of future payment or series of payments is the present investment necessary to secure the promise of that future payment or series of payments."[3]

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[1]R.W. Johnson, Capital Budgeting, Wadsworth Publishing Co. Inc., Belmont, CA, pp 48, 1970.

[2]W.G. Lewellen, The Cost of Capital, Wadsworth Publishing Co. Inc., Belmont, CA, 1969.

[3]E.L. Grant, W.G. Ireson and R.S. Leavenworth, Principles of Engineering Economy, 6th edition, The Ronald Press Co., New York, 1976.

Equation 7-3 gives the present value cost of expenditures in the preparation for alternate nuclear use mode.

EQUATION: $$P_A = \sum_{a=1}^{n} \frac{A_a(1+j)^a}{(1+k)^a} \qquad (7\text{-}3)$$

Here, A represents the preparation for an alternate nuclear use mode. A_a is the cost of this alternative in current dollars, for the a^{th} year.

Equation 7-4 gives the present value cost of expenditures in layaway or protective storage with deferred dismantlement.

EQUATION: $$P_{LD} = \sum_{a=1}^{\ell} \frac{L_a(1+j)^a}{(1+k)^a} + \sum_{b=\ell}^{m} S_b \frac{(1+j)^b}{(1+k)^b} + \sum_{c=m}^{n} D_c \frac{(1+j)^c}{(1+k)^c} \qquad (7\text{-}4)$$

Here, L_a is the estimated layaway cost, in current dollars, for a^{th} year. S_b is the estimated maintenance and surveillance cost in current dollars, for the b^{th} year. D_c is the estimated dismantlement cost in current dollars, for the c^{th} year.

The layaway effort takes place over years 1 to ℓ, the maintenance and surveillance effort takes place over years ℓ to m, and the deferred dismantlement takes place over years m to n.

A similar equation applies for the case of protective storage, with P_{LD} replaced by P_{PD} (the protective storage mode with deferred dismantlement) and L_a is replaced by P_a (the protective storage costs) in current dollars for the a^{th} year.

The present value approach is useful for comparisons over the near future (1-20 years), but becomes less meaningful for time periods approaching 100 years. For example, the present value of one dollar expended 50 years from now, with a discount rate of 10 percent and no inflation, is less than one cent. Thus, it always appears advantageous to delay major expenditures as long as possible whe using uninflated present values for comparisons.

Another area of interest is related to land cost, in that the land surrounding the retired nuclear facility has to be leased from the State of New York as long as it cannot be used for other purposes. Consideration must also be given to the cost of liability insurance on the retired facility durng any interim care period.

Other important considerations include:

1) The value of materials expended or recovered.

2) The amount of labor expended.

3) The amount of occupational radiation exposure received by the decommissioning work force.

4) The potential for radiation exposure to the general public as a result of selecting a particular decommissioning approach.

5) The potential for industrial accidents during the decommission effort.

6) The impact (cultural and aesthetic) of the decommissioning program on the surrounding community.

Items (1) and (2) are implicitly included in the total cost calculations. No universally accepted method has been developed for relating occupational radiation exposure to dollar values. Therefore, in these comparisons of decommissioning approaches, the as-low-as-reasonably-achievable (ALARA) philosophy will prevail as the basic criterion. Similarly, the radiation exposure to the public as a result of decommissioning activities should be kept low. The decommissioning mode that minimizes the probability and consequences of industrial accidents and injuries is, of course, the desirable approach to take. The cultural and aesthetic impacts of the decommissioning activities on the surrounding community are very difficult to quantify, and no attempt is made here to do so. These latter impacts are mentioned only to point out that the community may bring social pressures to bear on the facility owner to complete the decommissioning program (including deferred dismantlement) at the earliest feasible time.