WINCO-1229 UC-510

IDAHO CHEMICAL PROCESSING PLANT SPENT FUEL AND WASTE MANAGEMENT TECHNOLOGY DEVELOPMENT PROGRAM PLAN

1994 UPDATE

Applied Technology Department

September 1994

Westinghouse Idaho Nuclear Company, Inc.

PREPARED FOR THE
DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
UNDER CONTRACT DE-AC07-84ID12435

DISCLAIMER

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ACRONYMS

ADS	Activity Data Sheet
AEA	Atomic Energy Act
ANL-W	Argonne National Laboratory-West
APAQ	Air Permitting Applicability Questionnaire
BDAT	Best Demonstrated Available Technology
BRC	Below Regulatory Concern
BUD	Back-up Documentation
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CFR	Code of Federal Regulations
CPP	Chemical Processing Plant (building designator)
CRADA	Cooperative Research and Development Agreement
CSSF	Calcined Solids Storage Facility
CX	Categorical Exclusion
DD	Decontamination Development
DEQ	Division of Environmental Quality
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
-HQ	Headquarters
-ID	Idaho Operations Office
-OCRWM	Office of Civilian Radioactive Waste Management
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FDP	Flourinel Dissolution Process
FFCAct	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FPR	Fuel Processing Restoration
HEPA	High-efficiency Particulate Air (filter)
HFEF-N	Hot Fuel Examining Facility—North
HIP	Hot Isostatic Process
HLLW	High-level Liquid Waste
HLW	High-level Waste
ICPP	Idaho Chemical Processing Plant
IFSF	Irradiated Fuel Storage Facility
INEL	Idaho National Engineering Laboratory
IRC	Idaho Research Center
IX	Ion Exchange
LDR.	Land Disposal Restrictions
LLW	Low-level Waste
MCC	Multi-curie Cell
MSA	Major Systems Acquisition
MTHM	Metric Tons Heavy Metal
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NON	Notice of Noncompliance (Consent Order)

NRC	Nuclear Regulatory Commission
NWCF	New Waste Calcining Facility
NWPA	Nuclear Waste Policy Act
PA	Performance Assessment
PEW	Process Equipment Waste
PSD	Prevention of Significant Deterioration
PTC	Permit to Construct
PWAC	Preliminary Waste Acceptance Criteria
RCRA	Resource Conservation and Recovery Act
RD&D	Research, Development, and Demonstration
ROD	Record of Decision
RMW	Radioactive Mixed Waste
RSM	Radioactive Scrap Metal
SA	Systems Analysis
SF&WMTDP	Spent Fuel and Waste Management Technology Development Program
SNF	Spent Nuclear Fuel
SREX	Strontium Extraction
TAN	Test Area North
TDF	Technology Development Facility
TEAM	Technology Evaluation and Analysis Methodology (Model)
THC	TAN Hot Cell
TRA	Test Reactor Area
TRUEX	Transuranic Extraction
TSD	Treatment, Storage, and Disposal
VOG	Vessel Off-gas
WAC	Waste Acceptance Criteria
WAPS	Waste Acceptance Product Specifications
WA-SRD	Waste Acceptance-System Requirements Document
WIF	Waste Immobilization Facility
WINCO	Westinghouse Idaho Nuclear Company, Inc.
WMA	Waste Management Authority

EXECUTIVE SUMMARY

The Department of Energy (DOE) has received spent nuclear fuel (SNF) at the Idaho Chemical Processing Plant (ICPP) for interim storage since 1951 and for reprocessing since 1953. Until April 1992, the major activity of the ICPP was the reprocessing of SNF to recover fissile uranium and the management of the resulting high-level wastes (HLW); however, changing world events have eliminated the need to recover and recycle this material. In 1992, DOE chose to discontinue reprocessing SNF for uranium recovery and shifted its focus toward the continued safe management and disposition of SNF and radioactive wastes accumulated through reprocessing activities. Currently, 1.8 million gallons of radioactive liquid wastes (1.5 million gallons of radioactive sodium-bearing liquid wastes and 0.3 million gallons of high-level liquid waste), 3800 cubic meters (m^3) of calcine waste, and 289 metric tons heavy metal (MTHM) of SNF are in inventory at the ICPP.

Disposal of SNF and high-level waste (HLW) is planned for a repository. Preparation of SNF, HLW, and other radioactive wastes for disposal may include mechanical, physical, and/or chemical processes. This plan outlines the program strategy of the ICPP Spent Fuel and Waste Management Technology Development Program (SF&WMTDP) to develop and demonstrate the technology required to ensure that SNF and radioactive waste will be properly stored and prepared for final disposal in accordance with regulatory drivers. The program will be conducted in close coordination with the DOE's National SNF Program, the ongoing SNF & INEL Environmental Impact Statement (EIS)[1], and Federal Facilities Compliance Act (FFCAct) efforts.

ICPP involvement in past SNF reprocessing efforts has resulted in successful technology flowsheet development, pilot-plants, demonstration facilities, and production facilities. In addition to the reprocessing of SNF, calcination technology has been developed and used to convert radioactive high-level liquid waste (HLLW) to a stable granular solid. Such activities demonstrate ICPP's experience and ability to perform the necessary research and development to implement the technologies required to successfully process SNF and radioactive waste.

The ICPP SF&WMTDP consists of several technology development elements (see Figure 1), each of which support the goals of safe and efficient interim storage of SNF and radioactive waste, as well as the development of a process or processes to ultimately prepare the SNF and radioactive waste for final disposal.

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1 Short for the U.S. Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement.

Program elements in support of acceptable interim storage and waste minimization include:

- developing and implementing improved radioactive waste treatment technologies;
- identifying and implementing enhanced decontamination techniques;
- developing radioactive scrap metal (RSM) recycle capabilities: and
- developing and implementing improved technologies for the interim storage of SNF.

The program also establishes a systematic, converging development plan that progresses from evaluation of candidate treatment, storage, and immobilization options to implementation of a final process(es) to prepare SNF and radioactive waste for final disposal, and includes:

- performing a repository performance assessment to establish waste acceptance criteria and to direct technology development;
- identifying and evaluating new and existing technologies for implementation in radioactive waste and SNF disposition;
- characterizing radioactive waste forms;
- developing process flowsheets that will effectively and efficiently address all input streams and provide an optimal final product;
- identifying and planning facilities to support testing, development, and conditioning; and
- applying a systems engineering approach (as outlined in DOE order 4700.1) to improve understanding and resolution of programmatic issues, as well as to support informed strategic decision making.

This ICPP SF&WMTDP Plan presents a brief summary of each of the major elements of the SF&WMTDP; identifies key program assumptions and their bases; and outlines the key activities and decisions that must be completed to identify, develop, demonstrate, and implement a process(es) that will properly prepare the SNF and radioactive wastes stored at the ICPP for safe and efficient interim storage and final disposal. This plan is intended to provide a basis to ensure consistency and continuity within detailed planning, budgeting, and scheduling documents but does not specifically address funding levels, long-term schedules, or milestones. Such information will be presented in associated budget and schedule documents, as required.

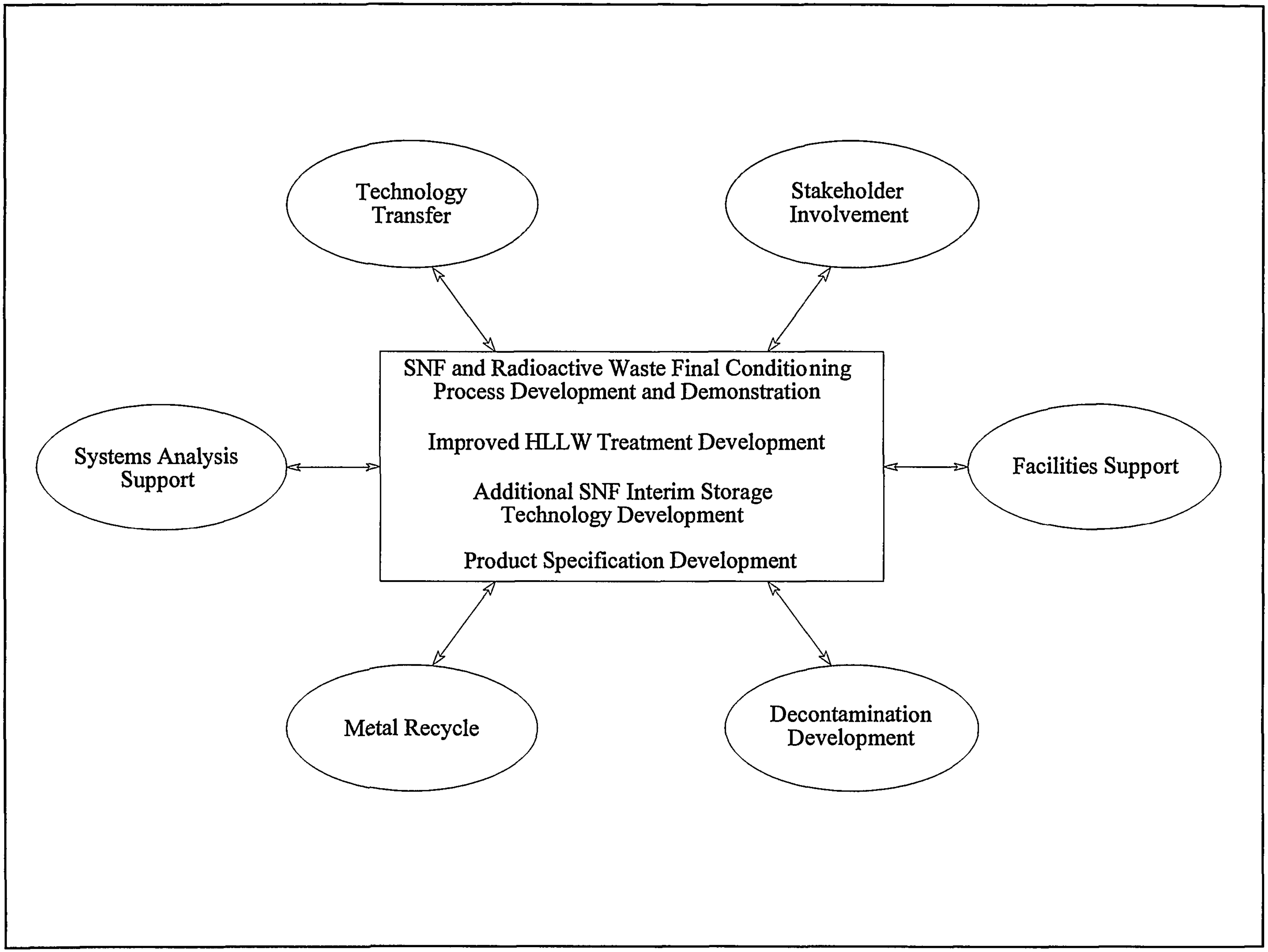

Figure 1: Key Elements of the ICPP SF&WMTDP

1.0 PROGRAM DESCRIPTION

The Idaho National Engineering Laboratory (INEL) has operated nuclear facilities to support national interests for several decades and, since 1953, has supported the development of technologies for the storage and reprocessing of SNF and the resultant radioactive wastes. The decision to discontinue reprocessing of SNF left nearly 289 MTHM of SNF in storage at the INEL with unspecified plans for future dispositioning. Additionally, 1.8 million gallons of radioactive liquid wastes (1.5 million gallons of radioactive sodium-bearing liquid wastes and 0.3 million gallons of HLLW) and 3800 m^3 of calcine waste are in inventory at the ICPP. These facts, along with increased environmental awareness within the DOE and among its contractors and stakeholders, mandate operation of existing and future facilities in an environmentally responsible manner and require satisfactory resolution of radioactive waste issues resulting from past activities. The SF&WMTDP was initiated to implement existing technologies, as well as develop new technologies, to support storage, preparation, and ultimate disposition of SNF and radioactive waste.

The SF&WMTDP plan, presented herein, is considered a "functional plan" under the ICPP Planning Hierarchy (see Figure 2). Input to strategic planning efforts, such as road-maps, the INEL Institutional Plan, and the INEL Strategic Plan, as well as the SNF & INEL EIS[2], will be provided on an on-going basis. Changes to these documents that impact the SF&WMTDP will also be incorporated periodically. The SF&WMTDP will be actively interfaced with other plant organizations, including Operations and Strategic Planning and Integration, in the development of technologies and processes in order to meet company needs.

Individual activities must be coordinated and integrated to ensure all program efforts efficiently converge to meet program objectives. Success will require clearly defining, communicating, and maintaining focus on the program's end result while implementing strategies which meet interim needs, accommodate uncertainty in future conditions, and address all relevant success factors (i.e., organizational, environmental, institutional, legal, and other socio-economic issues). This planning will be performed as an integral part of the SF&WMTDP and will be coordinated with other ICPP, INEL, and DOE strategic planning activities.

Throughout the SF&WMTDP, various program documentation (i.e., planning, technical development, and implementation documents) will be developed and distributed to identify and present program criteria, plans, reports, etc. Figure 3 presents the hierarchy of ICPP SF&WMTDP documentation.

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2 It is important to note that activities associated with the SF&WMTDP are being conducted in support of the SNF & INEL EIS. Any recommendations to DOE regarding SNF management and waste treatment alternatives are provided solely as input to the EIS decision-making process. Final dismissal or selection of activities and technologies addressed here and in other documents will be made by DOE in conjunction with the SNF & INEL EIS ROD, no later than June 1, 1995.

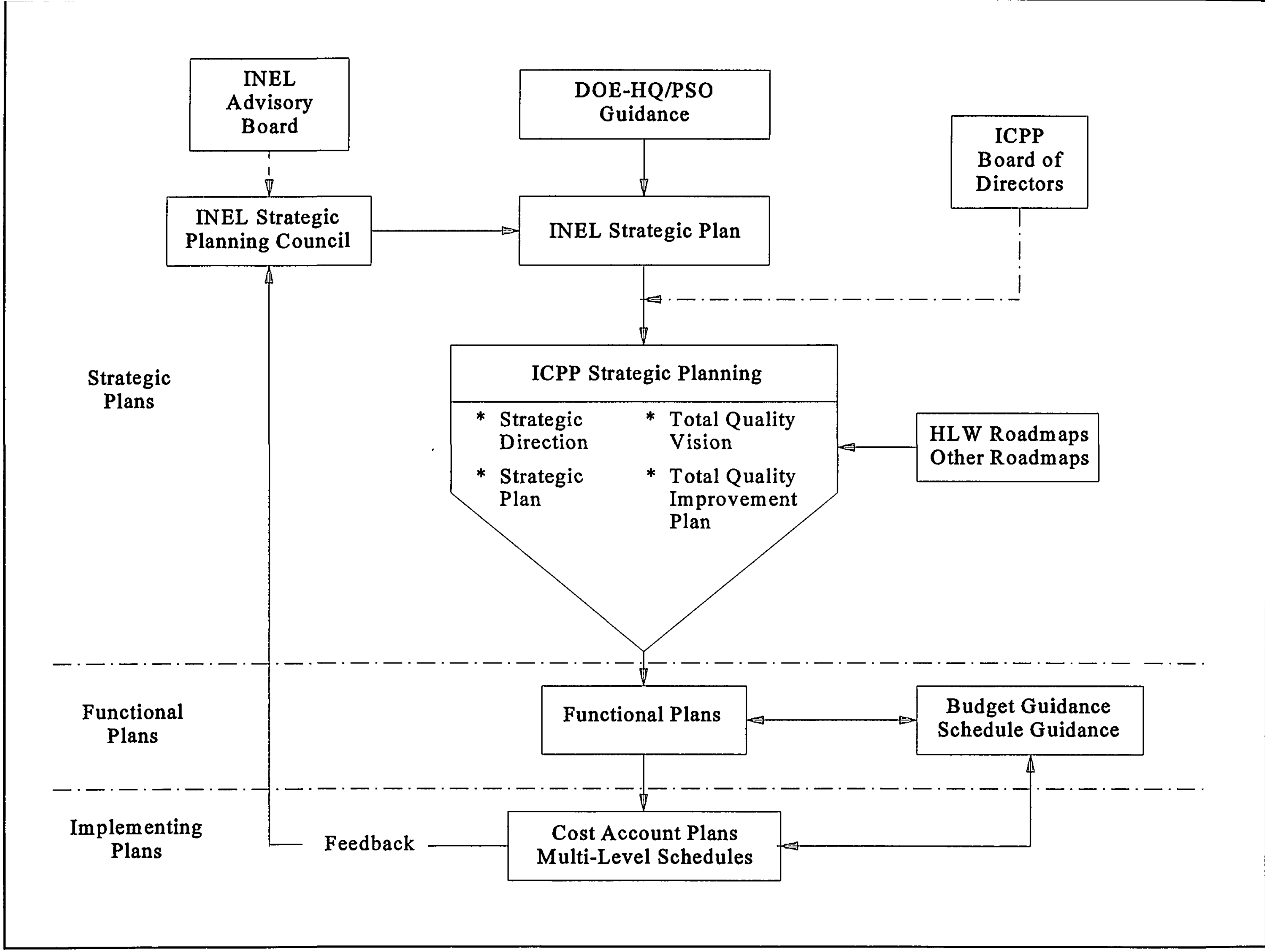

Figure 2: ICPP Planning Hierarchy

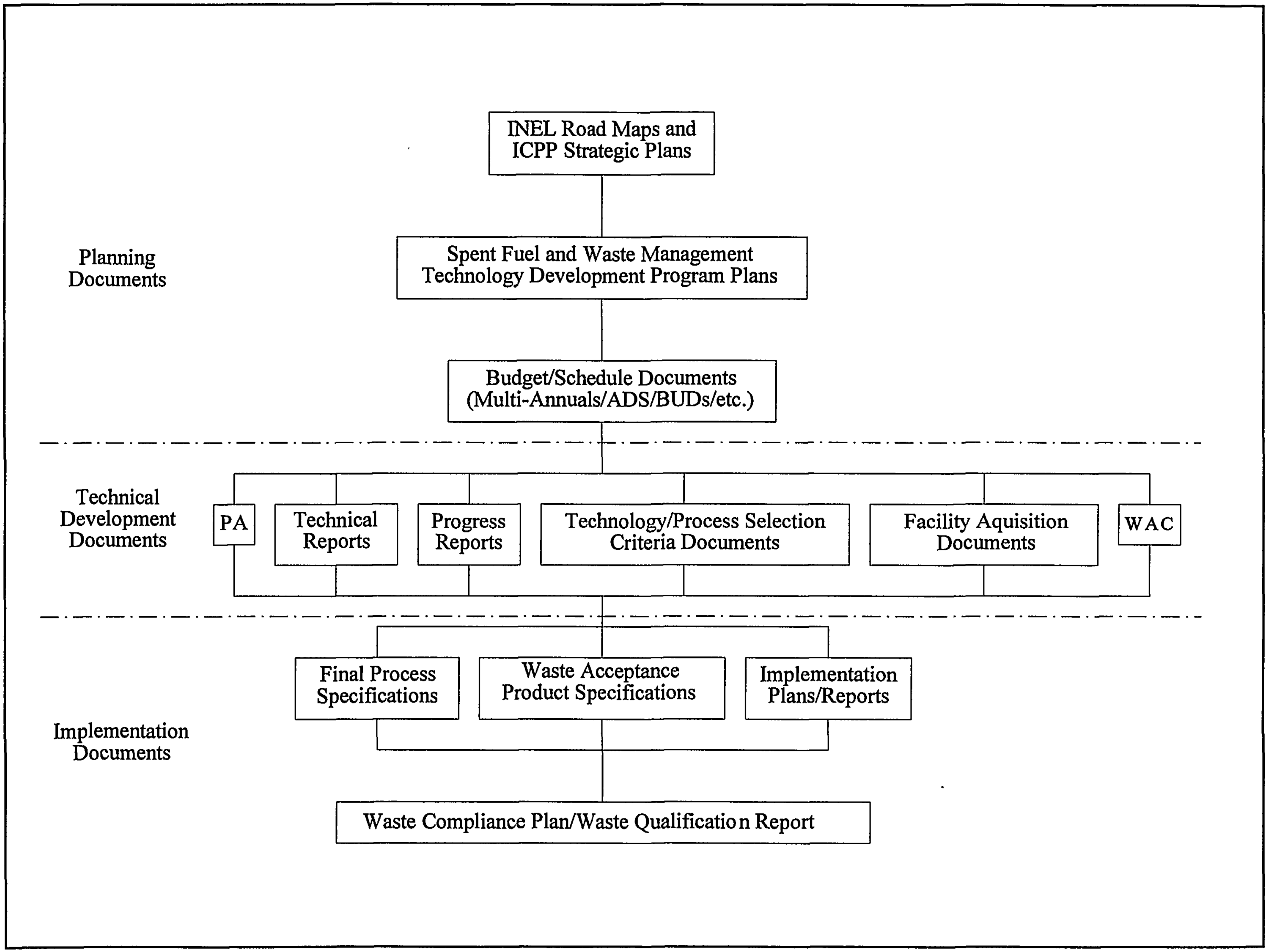

Figure 3: Hierarchy of ICPP SF&WMTDP Documentation

1.1 Program Objectives

The primary objective of the SF&WMTDP is to develop and demonstrate safe, cost-effective, and environmentally responsible methods for the conditioning, interim storage, qualification, and final disposition of SNF and radioactive wastes. The program will, ultimately, recommend and implement technologies and processes to facilitate the conditioning and certification of SNF and radioactive waste for permanent disposal. The program will also provide technical support to resolve current SNF and radioactive waste interim storage issues, such as SNF characterization and removal of sodium waste from the existing tank farm. Success will be measured in terms of safety, life-cycle cost, regulatory compliance, and waste volume.

Emphasis will be placed on process robustness to ensure that processes will apply not only to INEL SNF and radioactive waste, but will also foster transfer of technologies to address the conditioning of a broad range of SNF and radioactive wastes throughout the DOE complex. The SF&WMTDP will aggressively pursue all technology transfer opportunities through established mechanisms such as Cooperative Research and Development Agreements (CRADAs) or, if appropriate, by negotiating innovative arrangements to suit the specialized needs of all interested parties.

1.2 Program Justification and Drivers

The responsible pursuit of nuclear technologies to support national economic and defense interests includes a means of dispositioning the by-products of nuclear operations. A national policy has been established by Nuclear Waste Policy Act (NWPA), which requires the final disposal of SNF and radioactive waste in accordance with U.S. Environmental Protection Agency (EPA) and Nuclear Regulatory Commission (NRC) standards, in other words, in a permanent geologic repository; DOE is currently developing a similar set of standards for the management of DOE-owned SNF. Until a final disposal site is available, however, additional interim storage may be needed to accommodate SNF inventories and to facilitate moving vulnerable SNF and radioactive waste out of aging facilities. Issues driving SF&WMTDP efforts are described below in greater detail.

In June of 1989, an INEL site inspection was performed by the EPA and the State of Idaho revealing that neither the tank farm vaults nor the lines and valve boxes in the tank farm meet Resource Conservation and Recovery Act (RCRA) requirements for secondary containment. The inspection resulted in a January 29, 1990, Notice of Noncompliance (NON).

Subsequently, a NON Consent Order was issued April 3, 1992, requiring DOE to take the following actions:

- "On or before March 31, 2009 . . . permanently cease use of [tank farm tanks with pillar and panel enclosure vault construction] and all associated vaults; or . . . achieve compliance with all secondary containment requirements set forth in IDAPA § 16.01.5009 (40 C.F.R. § 265.193) . . ."

- "On or before June 30, 2015. . . permanently cease use of [all remaining tank farm tanks] and all associated vaults; or . . . achieve compliance with all secondary containment requirements set forth in IDAPA § 16.01.5009 (40 C.F.R. § 265.193) . . ."

Additionally, on June 28, 1993, in response to environmental questions raised by the State of Idaho concerning the shipment and subsequent storage of Fort St. Vrain SNF at the ICPP, Senior United States District Judge H. L. Ryan issued an Opinion and Order that required DOE to:

- ". . . prepare a comprehensive, site-wide environmental impact statement [EIS] . . .";
- evaluate "a reasonable range of alternatives to each major federal action the transportation, receipt, processing, and storage of nuclear fuel at the Idaho National Engineering Laboratory . . ."; and
- cease "any further transportation, receipt, processing, and storage of spent nuclear fuel at the Idaho National Engineering Laboratory until the comprehensive environmental impact statement is completed, reviewed, and any challenges to the statement are resolved."

In light of these and other issues, Hazel O'Leary, Secretary of Energy; John H. Dalton, Secretary of the Navy; and Cecil B. Andrus, Governor of the State of Idaho entered into an agreement on August 9, 1993 proposing modifications to the U.S. District Court's Opinion and Order of June 28, 1993. On December 22, 1993, Judge H. L. Ryan issued an order ratifying the proposed modifications. As amended, DOE shall:

- "On or before April 30, 1995, . . . complete a final EIS . . ."
- ". . . not receive and store additional spent nuclear fuel in the North, Middle, or South Basins of Building 603 at INEL's Chemical Processing Plant . . ."
- ". . . accelerate the removal of the fuel from [the North, Middle, and South Basins of Building 603 at INEL's Chemical Processing Plant]. The North and Middle Basins shall be emptied by December 31, 1996, and the South Basin shall be emptied by December 31, 2000."
- ". . . accelerate activities related to the treatment and disposal of high-level radioactive wastes stored at the INEL."

Subsequently, the NON Consent Order of April 3, 1992, was amended on March 17, 1994, to include waste management stipulations outlined in the ratification order dated December 22, 1993. The amended NON Consent Order requires DOE to take the following actions:

- "Calcine all high-level liquid radioactive waste that does not contain sodium on or before January 1, 1998."

- "Calcine or otherwise process as much sodium-bearing high-level radioactive waste (sodium-bearing waste) as DOE and the [Idaho Department of Health and Welfare] mutually agree is practicable by January 1, 1998."

- ". . . evaluate and test Freeze Crystallization, Radionuclide Partitioning, and Precipitation, the sodium bearing treatment technologies identified by DOE in a November 15, 1993, letter."

- "Select the sodium-bearing waste pre-treatment technology, if necessary, and calcine or processing technology by June 1, 1995."

- "Select a technology for converting calcined waste into an appropriate disposal form by June 1, 1995."

- within ninety (90) days following the selection of "technologies for sodium-bearing waste calcination and calcine conversion into [an appropriate] disposal form, . . . enter into negotiations on the construction schedule for any necessary facilities to implement the technologies."

- if replacement of any of the high-level liquid tanks is needed," ...begin construction of the replacement tanks by close of construction season 1996, complete vault construction and initiate tank erection by October 1, 1998; and use its best efforts to complete construction by 1999 construction season, but no later than four (4) years after start of construction."

Additionally, the FFCAct of 1992 requires the Secretary of Energy to develop and submit Site Treatment Plans for the development of treatment capacity and technologies for treating mixed waste for each facility at which DOE stores or generates these wastes. These plans will identify how DOE will provide the necessary mixed waste treatment capacity, including schedules for bringing new treatment facilities into operation. An FFCAct Draft Site-Treatment Plan was issued in August, 1994, and includes a proposed preliminary schedule of commitments for processing radioactive liquid and calcine waste at the ICPP for final disposal; the Final Proposed Site Treatment Plan is to be submitted by February 1995.

Successful development, integration, and implementation of technologies to meet U.S. District Court Orders and FFCAct agreements, including the SNF & INEL EIS, will not only allow continued receipt of Naval and DOE-owned SNF in full compliance with regulations and agreements but will also afford many opportunities for technology transfer to private industry. Additionally, a successful SF&WMTDP will provide the substance needed to earn stakeholder confidence enabling continued use of INEL facilities to receive and condition SNF in support of national interests.

1.3 Program Assumptions

The following assumptions have been made in developing this program plan:

- Treatment and immobilization processes must accommodate (1) radioactive sodium-bearing and high-level liquid wastes, and (2) calcine.
- SNF management alternatives must accommodate a broad range of SNF types and be applicable throughout the DOE complex.
- Existing facilities will be utilized to the extent practical.
- SNF will be sent to the first available geologic repository, and will be placed in safe interim storage until such time. Processing will be done only to condition SNF for storage and final disposal, not for uranium recovery.
- For disposition approaches involving constituent separation, actinides, and fission products will be collected into an HLW stream.
- Low-level waste (LLW) will meet Nuclear Regulatory Commission (NRC) Class C, or lower, limits.
- Funding will be available to support signed agreements, consent orders, and FFCAct mandates.

1.4 SF&WMTDP Technology Development Approach

In compliance with DOE orders and Defense Nuclear Facilities Safety Board (DNFSB) recommendations, the SF&WMTDP is taking a systems engineering approach to the development of technologies for the treatment and disposition of SNF and radioactive waste. According to DOE, a systems engineering approach is:

> a sequence of activities and decisions that transforms an identified mission need into a description of systems performance parameters and a preferred systems configuration. The Department's [DOE] objective is to ensure that products satisfy their functional requirements, operate effectively in their intended environment, and demonstrate a level of performance and reliability that justifies the investment . . . The system engineering process considers all aspects of systems requirements from the earliest stages of design through development, test and operation. The process supports project management by ensuring that technical control is on a level and integrated with funds, cost, schedule, and performance controls . . . (*DOE 4700.1, III, part B*).

The fundamental philosophy is the systematic narrowing of a large number of candidate process options through identification and evaluation, laboratory and component-scale testing, hot and cold pilot plant-scale testing, and implementation. In selecting processes for further evaluation and testing, candidate options will be evaluated against the following criteria:

- Safety of process to workers, the public, and the environment;
- Life-cycle cost (i.e., development, construction, operations, decontamination development (DD), disposal, etc.);
- High-level and low-level waste volumes generated;
- Final waste forms;
- Flexibility of the process to handle multiple input streams;
- Criticality, technical, and contamination risks;
- Compatibility with other DOE-owned SNF and radioactive waste; and
- Compliance with all applicable regulations.

The evaluation will consider process development technical data and test results, as well as employ systems analysis (SA) tools and techniques—described in Section 2.3.1, to (1) enhance program integration and coordination, (2) clarify and maintain focus on program objectives, (3) facilitate group interaction, and (4) to support informed selection of optimum strategies and technologies. The result of each decision point will be the selection of the most promising process options to continue on through the development process. Ultimately, process option(s) that best meet the stated criteria will be selected by decision makers for development into an operating facility(s) to condition and prepare INEL SNF and radioactive waste for placement in a final repository.

2.0 PROGRAM ELEMENTS

The primary focus of the SF&WMTDP is to develop and demonstrate technologies that safely and efficiently support resolution of SNF and radioactive wastes issues at the INEL. To help prioritize development efforts, program elements and activities have been divided into three broad categories: (1) Major Program Elements (i.e., Spent Nuclear Fuels Technology and Development, Sodium-bearing Liquid and Calcine Waste Technologies Development, Interim Storage Technologies Development, and Product Specification Development), (2) Waste Minimization Program Elements (i.e., Metal Recycle, and Decontamination Development), and (3) Supporting Program Elements (i.e., Systems Analysis, Stakeholder Involvement, and Technology Transfer).

2.1 Major Program Elements

2.1.1 Spent Nuclear Fuels Technology and Development

SNFs stored at the INEL are composed of a wide variety of cladding (aluminum alloy, stainless steel, graphite, and zircaloy) and fuel (uranium metal, uranium dioxide, uranium carbide, and uranium zirconium hydride) materials, with uranium enrichments varying from 3.5 to 93 atom percent. Also included in the INEL SNF inventory is a substantial quantity of spent commercial fuel, composed of zircaloy-clad uranium dioxide pellets. Much of this fuel is currently in storage in both underwater and dry storage facilities at the ICPP. One of those facilities, CPP-603, consists of three underwater basins—North and Middle (built in 1951) and South (built in 1959)—and an adjoining dry storage facility called the Irradiated Fuel Storage Facility (IFSF), built in 1974. Most of these underwater basins are old and no longer meet current storage regulations, and some of the fuel elements stored in them (especially those that are aluminum-clad) are corroding. Newer underwater storage facilities are available in CPP-666 (built in 1984), and the movement of vulnerable fuels out of CPP-603 into this newer facility is already underway. Additional fuel relocation options include temporarily storing SNF that cannot be moved to CPP-666 (without contaminating its basin water) in the South basin of CPP-603, at the IFSF, or at future dry storage facilities. Further development and demonstration of technologies and interim storage facilities to resolve these issues is a top priority within the SF&WMTDP.

The Draft SNF & INEL EIS, published in June, 1994, identifies five candidate alternatives for the management of DOE-owned SNF: (1) no action; (2) regionalization; (3) centralization; (4) decentralization; and (5) adherence to the 1992/1993 planning basis. In addition, a number of sub-alternatives capable of meeting DOE-owned SNF management needs have been identified by the National SNF Program to help ensure decision-maker consideration of the broadest range of SNF management alternatives possible.

Identified SNF management alternatives are currently under preliminary evaluation—using a computerized simulation model—to determine which fuels are economically feasible to process, where to place the fuel for interim storage, and how long it will take to reach stable interim storage. This activity will aid in the further development of sub-alternatives and hybrid approaches (i.e., an optimal combination of two or more SNF management alternatives or sub-alternatives) for decision-makers' consideration. An SNF database is also being developed to provide a comprehensive source of information and documentation regarding the inventory of SNF throughout the DOE complex. Where vital information is lacking, characterization is planned to provide the missing information. Three categories are planned to describe the levels of characterization. These categories are: (1) routine inspection of the spent fuel, (2) quantitative characterization to evaluate the need for fuel stabilization, and (3) material characterization to support the development of conditioning technologies. Each succeeding category will build on the information from the previous category. This information will better facilitate the development and evaluation of processes for dry interim storage and the conditioning of SNF for final disposal.

Following selection of a preferred SNF management alternative in the SNF & INEL EIS Record of Decision (ROD), to be issued June 1, 1995, the SF&WMTDP will continue its development of SNF conditioning and disposal technologies specific to fuels stored at the INEL. Currently, technology development efforts focus on (1) advancing fuel inspection technologies, (2) collecting information for the SNF database, (3) destructive fuels examination to aid in interim storage planning, (4) demonstration of dry storage for high-enriched uranium DOE fuels, (5) Fort St. Vrain SNF mechanical disassembly, (6) testing of conditions and requirements for placing SNF into dry storage, (7) material interactions when moving SNF from wet to dry storage, and (8) strategies and processes for the final disposition of SNF.

2.1.2 Sodium-bearing Liquid and Calcine Waste Technologies Development

Despite the decision to discontinue SNF reprocessing, sodium-bearing radioactive liquid wastes continue to be generated during decontamination and solvent recovery operations at the ICPP. The current method for treating and solidifying sodium-bearing liquid waste is to calcine it by blending it with either first-cycle raffinate from SNF reprocessing or nonradioactive chemical additives to dilute the sodium concentration, making it compatible with the New Waste Calcining Facility (NWCF) waste solidification process. However, raffinate is no longer available for blending with the sodium-bearing waste, and the addition of significant quantities of non-radioactive chemical additives to the radioactive waste stream is unattractive due to increased waste volume and increased calcining, interim storage, solid waste immobilization, and long-term disposal needs and costs. To date, the ICPP has generated and is temporarily storing approximately 3,800 m^3 of calcine in shielded stainless steel bins, and additions to this inventory are anticipated from the calcination of wastes currently stored in the tank farm and those generated through future decontamination of various ICPP facilities, as mentioned above.

According to the NWPA, HLW (including radioactive liquid waste and calcine) requires "permanent isolation" for disposal. Furthermore, under current RCRA Land Disposal Restrictions, all hazardous waste streams must be processed to meet all applicable treatment standards for land disposal. Of added concern is the NON Consent Order, regarding inadequate secondary containment of waste tanks. As outlined in section 1.2, this order requires that DOE "cease use" of the tank farm pillar and panel tanks by 2009 and the remainder of the tanks by 2015. To satisfy this order and the December 22, 1993, modifications to the U.S. District Court's Opinion and Order of June 28, 1993 (see Section 1.2), the SF&WMTDP is following the systems engineering strategy presented in Figure 4 to develop, evaluate, and demonstrate safe and cost-effective integrated process(es) for the treatment and immobilization of the radioactive and hazardous constituents of ICPP radioactive liquid and calcine waste.

Efforts are currently underway to:

- Qualify and verify a cost effective alternative process for treating and immobilizing sodium-bearing waste and calcine into a final low volume/low cost waste form; and

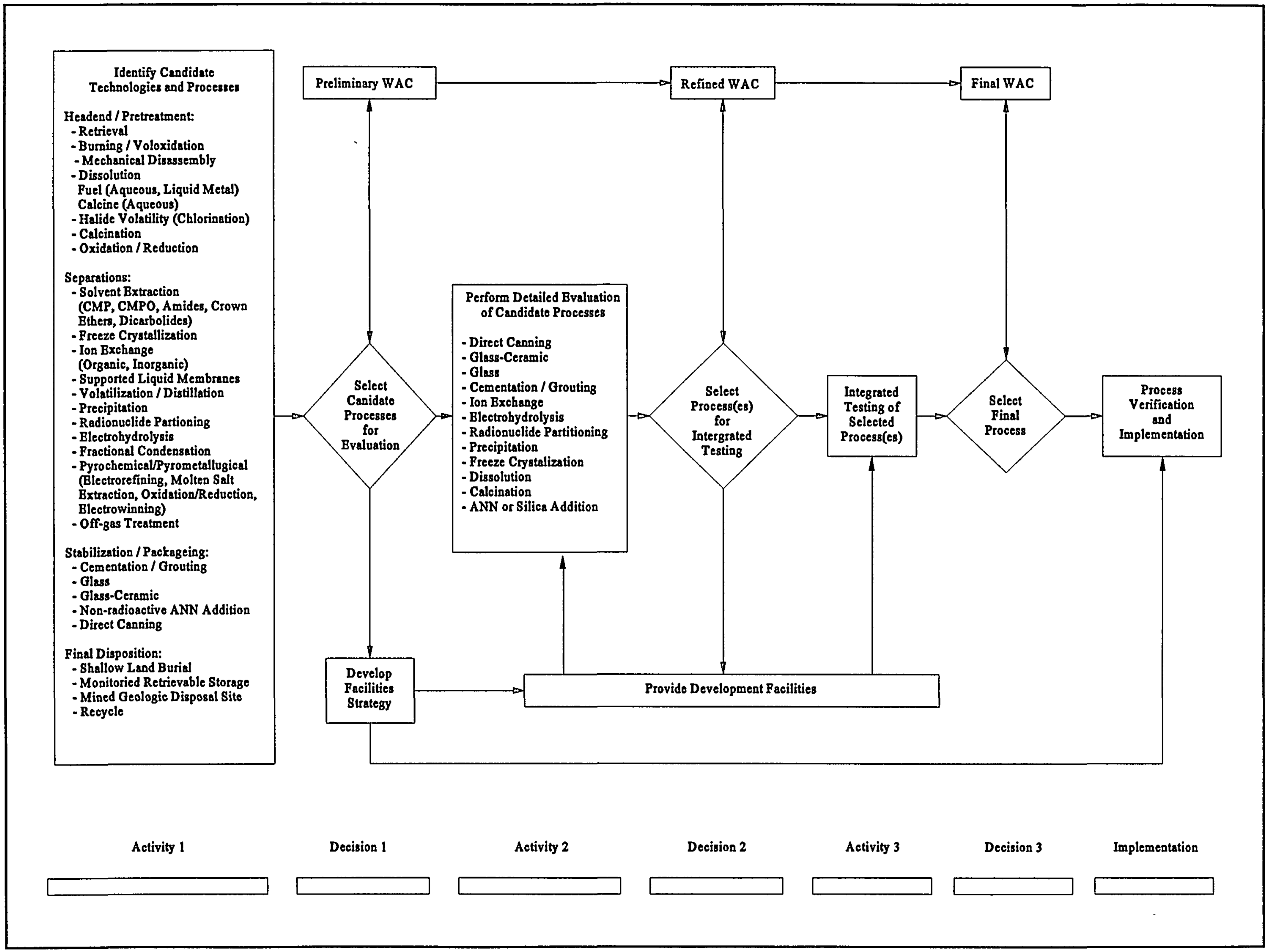

Figure 4: SF&WMTDP Radioactive Liquid and Calcine Technologies Development Strategy

- Develop decontamination methods that are either compatible with current and future sodium-bearing waste processing methods, eliminate the use of sodium, or extract sodium constituents for recycle to be used for further decontamination and decommissioning (see section 2.2.2—Decontamination Development).

Through mid 1993, using program goals and baseline requirements as guides, extensive investigations were conducted to identify potential technologies that could be employed at the ICPP to treat and dispose of radioactive liquid and calcine wastes. Identified technologies were then sub-divided into pretreatment, separations, and immobilization categories and combined into process systems (flowsheets) capable of handling ICPP radioactive liquid and calcine waste. These technologies are defined in detail in Section 3.3 of the ICPP Radioactive Liquid and Calcine Waste Technologies Evaluation Interim Report, published in June, 1994. Additionally, the Westinghouse Idaho Nuclear Company, Inc. (WINCO) Systems Analysis Section, in conjunction with sodium-bearing waste technologies development and management personnel, completed the ICPP Tank Farm Systems Analysis in February of 1994. This analysis focused on alternatives for removing all sodium waste from the existing tank farm, and made recommendations to DOE concerning processes for treating sodium waste inventories without having to construct additional storage tanks.

Mass balance calculations resulting from literature studies and laboratory testing were made for processing systems compatible with ICPP radioactive liquid and calcine wastes, with radioactive waste compositions of current and projected inventories being used as inputs. Mass balances were then used to evaluate candidate technology flowsheet performance relative to ICPP radioactive waste streams and to develop estimates of cost, schedule, throughputs, and radioactive waste volumes. ICPP radioactive liquid and calcine waste technologies evaluation personnel, along with a panel of outside experts, evaluated the technical maturity of each candidate technology. Processes that did not meet the baseline requirements, could not be developed in time to meet regulatory requirements, or were viewed as technically inferior to other technologies were eliminated from further consideration. Processes that still showed promise following initial development were advanced to the next stage of analysis. In a November 15, 1993, letter to the State of Idaho, DOE identified "Freeze Crystallization, Radionuclide Partitioning, and Precipitation" as alternative technologies for the treatment of radioactive liquid wastes at the ICPP. These technologies, along with direct vitrification and calcination, have resulted in 27 viable waste treatment technology combinations, currently under evaluation through the ICPP radioactive liquid and calcine waste technologies evaluation project; four additional technologies (i.e., glass, glass-ceramic, grout, and FUETAP grout) are being evaluated for the immobilization of radioactive liquid and calcine wastes.

The Technology Evaluation and Analysis Methodology (TEAM) model, a computerized decision support tool, was developed to assist in the evaluation and analysis of technologies. Each candidate process was then optimally configured, using a uniform basis for each cost element, to ensure an objective comparison of waste treatment alternatives by presenting each alternative in its most cost-effective configuration. The analysis identified development activities needed to support technology evaluation, prioritized development efforts by identifying essential information needed prior to selecting a process, and established relationships between available data and process selection criteria. Additionally, the potential impacts of existing uncertainties were investigated, resulting in the recommendation of programs to resolve those issues. Current efforts focus on verifying and presenting analysis data on all twenty-seven potential radioactive liquid and calcine waste treatment options and on making a technical recommendation of preferred alternatives to DOE. Analysis results are available in the Final Draft of the ICPP Radioactive Liquid and Calcine Waste Technologies Evaluation Report, issued to DOE on September 30, 1994; a final recommendation of preferred alternatives will tentatively be made to decision-makers in March of 1995, following resolution of stakeholder issues.

Selection of final technologies for both the treatment and immobilization of radioactive liquid waste and calcine will be made in conjunction with the SNF & INEL EIS ROD, to be issued June 1, 1995.

2.1.2.1 FY-95 Key Activities

The following ICPP radioactive liquid and calcine waste technologies evaluation activities are planned to support DOE in selecting optimum technologies for the treatment and immobilization of radioactive liquid and calcine wastes, as ordered by the Amended Court Order of December 22, 1993, and the subsequent Modified NON Consent Order of March 23, 1994.

- Complete and issue the Final Draft of the ICPP Radioactive Liquid and Calcine Waste Evaluation Report by September 30, 1994, a DOE-ID milestone. This report will be submitted to DOE for review and publication, with an expected issue date of late October, 1994.

- Based on data as of September 30, 1994, and discussion of preferred treatment and immobilization alternatives, continue development of the flowsheet for option 10 (i.e., a phased Waste Immobilization Facility (WIF) utilizing radionuclide partitioning of radioactive liquid waste, glass immobilization for HLW, and FUETAP grout immobilization for LLW) according to the needs of a conceptual and later title design.

- Begin efforts to conduct hot pilot plant testing to validate recommended Option 10 flowsheet.

- Focus development efforts on recommended technologies (i.e., radionuclide partitioning via transuranic extraction (TRUEX), strontium extraction (SREX), and ion-exchange (IX); glass immobilization for HLW, and grout immobilization for LLW).

- Submit a short-form data sheet, begin conceptual design, and support KD-0 for the Phase 1 WIF.

- Support recommendations of the Tank Farm Systems Analysis regarding removal of liquid waste from the ICPP tank farm in the most efficient, cost-effective way possible to meet the NON Consent Order deadline of 2009.

- Continue development of alternative decontamination techniques to ensure minimization of future liquid flows to the tank farm. The NON Consent Order to cease use of the tank farm can not be met unless the WIF (or an alternative facility) is built and waste flows to the tank farm are greatly reduced.

- Begin LLW dispositioning options, including location of storage facility studies.

- Conduct stakeholder involvement activities to obtain stakeholder input for consideration in the technology selection process.

- Interface with EIS and FFCAct activities.

- Conduct interactive meetings with DOE-ID and DOE-HQ personnel on the technology selection considerations.

These activities will support the issuance of a final evaluation report and recommendation to DOE in March, 1995. Follow-on activities will support the requirement of the NON Consent Order; the conceptual design of the WIF; and the day-to-day operations of the tank farm, the calciner, the Liquid Effluent Treatment and Disposal facility, and the Process Equipment Waste (PEW) system.

2.1.3 Interim Storage Technologies Development

Interim storage for SNF and radioactive waste will be necessary until the final repository is available and the requisite treatment and transportation facilities are in place. The interim storage facilities must provide safe conditions that eliminate unacceptable degradation through corrosion or other aging mechanisms. Additional interim storage capabilities are needed at the ICPP to safely store, inspect, and characterize SNF and to manage immobilized radioactive liquid and calcine wastes; this will help provide the information needed to support future SNF and radioactive waste conditioning processes for dry storage.

The primary technology used to date for the storage of metal-clad, DOE-owned SNF has been underwater storage pools that provide cooling, shielding, and corrosion control via water treatment systems. Limited dry storage facilities have been constructed and used for graphite and non-economically processable fuels. The operating history of all DOE-owned SNF underwater storage facilities has shown conclusively that some SNF cannot be stored underwater for extended periods of time without corroding. Some existing underwater SNF storage facilities and equipment also have degraded or do not meet new design requirements. Replacement storage facilities are necessary to resolve current storage facility problems. Dry storage is currently the preferred storage method based on commercial fuel storage experience and the interim storage time required before a permanent repository becomes available.

New activities are necessary to support dry storage of the DOE-owned SNF. These activities include development of the technical basis for corrosion control, elevated temperature impacts, safety and environmental risk assessments, monitoring and inspection intervals, etc. The development will include laboratory studies, hot cell examinations, engineering studies, and technology demonstrations using the available dry storage and/or hot cell facilities (i.e., IFSF, CPP-666 Flourinel Dissolution Process (FDP) Cell, Argonne National Laboratories-West (ANL-W) Hot Fuel Examining Facility-North (HFEF-N), Test Reactor Area (TRA) Hot Cells and CPP-749), and provision to support construction of new storage facilities. In the near term, a dry fuel storage demonstration is planned, and cooperative agreements with the commercial dry storage industry are being pursued.

The technologies for the characterization and packaging of SNF and radioactive waste to support development of treatment processes for final disposal, as well as waste acceptance criteria (WAC), will be developed. The technologies for establishing criteria for canning the SNF that has degraded in existing underwater storage facilities or that may need special storage medium, such as inert gas, will be developed to support the canning process.

Other technology development efforts expected to support interim SNF and radioactive waste storage include: support of an accelerated effort for removing all SNF from the CPP-603 underwater storage facility by FY 2000; assessing the capabilities of the CPP-603 dry storage and CPP-666 underwater storage facilities to meet extended interim storage requirements; developing SNF characterization and testing capability for the proposed CPP-666 hot cell; and providing technology support for ongoing SNF and radioactive waste interim storage operations and improvements.

2.1.4 Product Specification Development

Product Specification includes the development of WAC, the completion of a Performance Assessment (PA) of waste forms at potential repository sites, and Waste Certification.

2.1.4.1 Waste Acceptance Criteria

Preliminary Waste Acceptance Criteria [PWAC] for the ICPP Spent Fuel and Waste Management Technology Development Program was issued in September, 1993. A WAC would normally be the responsibility of the repository operator; however, since a repository for all of the INEL SNF and wastes has not been determined and technology development needs to progress, the SF&WMTDP has developed a PWAC to provide direction for the development program and a basis for future waste form evaluation. The PWAC defines the waste form characteristics necessary to ensure compliance with federal regulations. To further confirm that established criteria are sound and have a high probability of meeting federal regulations, PAs will be conducted by modeling waste form placement in various hypothetical repositories. These efforts are being conducted in close coordination with the DOE Office of Civilian Radioactive Waste Management (DOE-OCRWM), and will be subject to OCRWM peer reviews prior to official publication.

2.1.4.2 Performance Assessment

PAs are an internationally accepted method, required by Title 40 of the Code of Federal Regulations (CFR) Part 191, Subpart B, for the analyses of engineered disposal systems for proper isolation of radioactive waste. PAs quantify aspects of waste disposal decisions by identifying and examining the effects of various processes and events on the performance of the disposal system and estimating the cumulative releases of radionuclides and hazardous materials as required by regulatory agencies.

Initial PAs were conducted during FY-93 and FY-94 for the candidate waste forms, and the Initial Performance Assessment of the Disposal of Spent Nuclear Fuel and High-Level Waste Stored at Idaho National Engineering Laboratory was issued in December, 1993. A report of the 1994 PA effort will undergo a technical peer review in December, 1994, with plans for publication in late January or early February, 1995. Waste form performance information, as well as information regarding major contributors to radionuclide releases and parameters that have the greatest effects on the waste form's performance in the repository, will be used to finalize the PWAC. Such information will then be used to direct development efforts and to ensure that the important characteristics and parameters of the potential waste form are verified or confirmed. Currently, results of the FY-93 and FY-94 PA efforts are being used in various Systems Analysis Models to rank process options based on established criteria, to guide technology developmental efforts, and to aid in the selection of SNF and radioactive waste conditioning and disposal forms with the highest probability for success.

One aspect of the PA, which applies to the safe emplacement of SNF, is the consideration of scenarios under which the SNF might form a critical mass. The regulatory requirements for long-term storage are not clear at this time, but it is expected that criticality must be prevented for at least 10,000 years. However, it is speculated that criticality prevention requirements will evolve to the point that a criticality incident must not occur over any period of time. This could pose problems for direct disposal and encapsulation technologies associated with SNF, since fissile material migration and deposition cannot be ruled out over geological time scales. The SF&WMTDP will address the criticality safety issues associated with placement of highly enriched SNF in a geological repository.

2.1.4.3 Waste Certification

The criteria to be met for the disposal of SNF and radioactive waste are based on EPA and NRC regulations that were established to supplement RCRA, the Atomic Energy Act

(AEA), and the NWPA. Revision 1 of the Waste Acceptance-System Requirements Document (WA-SRD), outlining top-level criteria required to certify DOE-owned high-level radioactive wastes for disposal, was issued in March of 1994. The WA-SRD describes the operational requirements that must be met for DOE to accept title to waste and assigns responsibility for various aspects of the operation. Once a repository is selected, the repository operator will be responsible for issuing a WAC specific for the repository. Waste form producers will be responsible for certifying that their waste forms meet established criteria.

The first step in certifying a waste form is to generate Waste Acceptance Product Specifications (WAPS) based upon the repository's WAC. The Waste Acceptance Product Specifications for Vitrified High-level Waste Forms, published in February, 1993, describes in detail the physical and chemical properties and other characteristics that the waste form must exhibit to meet the WAC. The methods to be used to demonstrate compliance with the WAPS will be described in a waste form compliance plan and will include laboratory tests, analysis of process control data, and prototypical production runs.

Presently, approved WAPS and WACs for SNFs and glass-ceramic waste forms are unavailable; it is, therefore, difficult to develop and assess candidate waste form fabrication technologies. However, there is enough generic information available about potential disposal sites to allow a PWAC (i.e., hypothetical WAC) to be formulated. This PWAC (described in section 2.1.4.1) and the preliminary WAPS derived from them will form a framework to be used to guide development and selection of candidate waste form fabrication technologies. As the waste form development process proceeds, preliminary specifications will be revised to take advantage of technological advances. A preliminary waste compliance plan will be prepared to form a basis for selecting conditioning processes, quality assurance specifications, and analytical methods that will eventually be used to qualify the waste form. The waste qualification report will document the actions taken to qualify the waste forms.

Preparing preliminary criteria, specifications, and qualification plans will expedite the licensing process and provide guidance for development activities leading to a process plan for a waste processing facility.

2.2 Waste Minimization Program Elements

2.2.1 Metal Recycle

INEL Metal Recycle personnel, working with universities, other DOE laboratories, and private industry, are developing the technologies for recycling RSM into needed products, rather than disposing of it as radioactive waste. This work involves developing decontamination and melting technologies, characterizing the amount and types of feedstock available, and identifying the products to be made from the recycled metal.

The INEL Metal Recycle technical program is divided into three phases: (1) technology development and cost evaluation; (2) pilot-scale demonstration using non-radioactive metals; and (3) pilot-scale demonstration using radioactive scrap metal. During these phases, the INEL and other participating groups will test decontamination, melting, and refining techniques in an effort to produce a DOE/NRC certifiable product. After completing development work on non-contaminated metal, the groups will demonstrate recycling techniques with actual RSM. The INEL will also perform a cost analysis of a recycling system, assess market economics and regulatory requirements, and develop feedstock data. The final goal of the program is to commercialize the concepts developed in the three phases.

2.2.2 Decontamination Development

Past decontamination and solvent based uranium recovery activities at the ICPP have resulted in the accumulation of 1.5 million gallons of radioactively-contaminated sodium-bearing liquid waste. Future activities, using the current decontamination techniques of chemical/water flushes and steam-jet cleaning, could result in the generation of additional radioactively-contaminated sodium-bearing liquid waste. New decontamination methods which result in higher decontamination factors and generate lower amounts of sodium-bearing and other radioactive liquid wastes are needed.

The primary initiative of the INEL decontamination program is the development of methods to eliminate or minimize the use of sodium-bearing decontamination chemicals. The Decontamination Development (DD) group has performed on-site demonstration and evaluation activities at the ICPP on CO_2 pellet blasting, liquid abrasive grit blasting, and novel chemical flushing. Additional off-site testing, sponsored by or in cooperation with the ICPP, has resulted in testing and evaluation of light ablation, liquid nitrogen blasting, CO_2 snowflake blasting, and improved concrete scabbling equipment. Some of these techniques are being implemented at the ICPP. Research continues on concrete cleaning, light ablation, mobile abrasive grit blasting and remote decontamination techniques. Technology transfer opportunities to the private sector will be employed where practical to reduce costs and assist the commercial market in this ever-growing area.

2.3 Supporting Program Elements

2.3.1 Systems Analysis

A major challenge for both managers and organizations striving to deal with complex and changing programs is to understand and manage the impact of individual decisions and actions on the overall program. To help understand and manage problems, complexities, and uncertainties associated with the SF&WMTDP and to help make better programmatic decisions, the SA organization is (1) following of a formal systems engineering process, as outlined in DOE Order 4700.1; and (2) applying systems analysis tools and techniques to support informed decision making throughout the systems engineering process.

The process (compare Figure 4) consists of six principal elements or steps:

- Define the Problem and Establish the Program Goal
- Determine the Functional Requirements
- Identify Alternatives that Meet the Functional Requirements
- Develop and Evaluate the Alternatives
- Optimize the Alternatives
- Present Optimized Alternatives for Selection and Implementation

Key factors in the success of a systems approach are effective inter-program communications and maintenance of a program-wide perspective when making decisions. To this end, a principle responsibility of the SA organization is to help facilitate group interaction using organizational learning techniques to help clarify objectives, scrutinize implicit assumptions, surface inconsistencies, and build shared understanding of critical issues. Additionally, the SA organization helps identify and resolve cross-cutting issues that need high-level attention and ensures that management strategies consider a broad range of factors which affect program success, such as stakeholder concerns, regulatory uncertainties, legal matters, institutional issues, budget requirements, and sociological concerns.

SA tools and techniques in support of systems engineering and program integration efforts include the following:

- Providing systems modeling (see Section 2.3.1.1, below) capabilities for developing technical, flowsheet, facility, and decision support computer simulations.

- Conducting performance assessments to help establish waste acceptance criteria and estimate final product performance system engineering methods to enhance understanding and identify key factors for success.

This approach supports the DOE in selecting the most effective SNF and radioactive liquid and calcine waste management plan to implement in compliance with established regulations, court orders, and agreements by helping decision makers (1) ensure optimum strategies are developed for SNF management and radioactive liquid and calcine waste treatment and immobilization, (2) assess tradeoffs between various performance criteria, (3) test the near- and long-term consequences of various strategies and scenarios, (4) identify uncertainties in performance parameters, (5) focus development efforts on options that best satisfy stakeholder concerns, and (6) establish a basis for informed decision making.

2.3.1.1 Systems Modeling

Systems models are computer simulation programs developed using software and hardware that allow "what if. . ." testing of the various decisions, strategies, and approaches for future scenarios. Systems Modeling is used to evaluate program strategies based on both technical and non-technical factors (i.e., regulatory compliance, risk, cost, public perception, and stakeholder interest) and to simulate the effects of future uncertainties. Systems Modeling assists the decision-making process by evaluating future possibilities based on the relationships among the various factors affecting the results of the program. Computerized simulation models have already been developed for the ICPP Radioactive Liquid and Calcine Waste Technologies Evaluation Program, and for the ICPP Projects Scheduling Analysis. Additionally, efforts are underway on similar tools to aid the National SNF Program in evaluating alternatives for the management of DOE-owned SNF. As the SF&WMTDP advances, Systems Modeling will continue to help focus the development efforts on the processes that have the highest probability of success.

2.3.2 Stakeholder Involvement

DOE's Office of Policy and Program Information (EM-4) has established a public participation policy that focuses on increasing the role of stakeholders (i.e., any person, organization, or group with a vested interest in a specific issue or problem and in how the issue or problem is being solved) in DOE's decision-making processes. The goal of increased stakeholder participation in the SF&WMTDP activities at the INEL is to create an open, visible, and fair process that results in decisions that attend to the technical, socioeconomic, legal, institutional, environmental, and health and safety concerns of the stakeholders and DOE. Achieving this goal requires that stakeholder questions, concerns, and needs be identified early and that efforts be made to seek input and integrate stakeholder concerns into the decision-making process. To accomplish this goal the INEL has developed the Public Participation Plan to achieve the following:

- Establish and maintain two-way communication with stakeholders through workshops, working groups, and person-to-person contacts;

- Present understandable, consistent, factual information to the stakeholders in a timely manner;

- Provide consistent information throughout the SF&WMTDP;

- Address stakeholder issues and focus efforts on resolving conflict; and

- Be responsive in explaining how public input was or was not used in INEL decision-making.

The SF&WMTDP will support INEL Public Participation Plan initiatives and will coordinate specific stakeholder programs through the INEL Public Participation Plan office.

2.3.3 Technology Transfer

Responding to DOE's emphasis to share developed technologies, knowledge, and information with the private sector, the INEL has developed a Technology Transfer Program. Through Technology Transfer, the SF&WMTDP will strive to develop a stronger partnership between the INEL and private industry. Implementation of the Technology Transfer Program began in January of 1993, and the first of a series of workshops designed to expose INEL employees to the technical, intellectual, and legal ramifications involved in the Technology Transfer process was provided in August, 1993. Since the inception of the Technology Transfer program, INEL personnel have witnessed a nearly 350% increase in invention disclosures, as well as a substantial rise in the number of industrial partnerships or collaborations (i.e., CRADAs, cost shared contracts, and contributions) being entered into. Individuals within Metals Recycle, Sodium Waste Technologies, and Calcine Technologies Development programs of the SF&WMTDP, for example, have a number of cost shared contracts either in place or in negotiation, and are pursuing several others regarding waste classification, tank farm extraction, and decontamination, among other things. The ICPP SF&WMTDP will continue its pursuit of technology transfer opportunities in an effort to apply SNF and radioactive waste management technologies to problems beyond the boundaries of the INEL.

3.0 FACILITY SUPPORT

Facilities are required for the development, evaluation, and implementation of technologies associated with the SF&WMTDP. Required testing facilities may include: (1) laboratory space to identify and evaluate candidate technologies, (2) cold pilot-plant space to perform detailed evaluation of candidate processes, and (3) hot pilot-plant space for integrated testing of selected processes. New facilities, in addition to existing facilities, are necessary for cold pilot-plant testing; hot pilot-plant testing will be conducted in existing facilities. A Waste Immobilization Facility (WIF) has been proposed for the implementation of radioactive waste treatment and immobilization process(es) and may, based on the SNF & INEL EIS ROD, consist of a separations, LLW denitration and grouting, HLW vitrification, off-gas/ventilation, HLW interim storage, LLW interim drum storage, and bulk chemical storage facilities. The design of the WIF will incorporate processing and stabilization of radioactive liquid and calcine wastes.

3.1 Laboratory-scale Tests

Laboratory-scale testing space is available in existing facilities, CPP-637 for example, though some modifications will be necessary to accommodate sodium-bearing liquid, calcine, and SNF handling during testing of SF&WMTDP technologies. Additionally, laboratory-scale testing will be conducted under contract with various universities.

Laboratory-scale experimentation will involve, but will not be limited to, studies on the effects of varying feed compositions, residence time, pressure, temperature, and throughput variables for each technology. These tests will help (1) determine the feasibility of each process, (2) establish compliance with minimum acceptance criteria, (3) identify and narrow parameter options within a given process, and (4) assist in the design of larger pilot-plant scale units. Conceptual design work for pilot-plants needed for the testing of disposal process options will be completed and title design initiated during the laboratory-scale testing phase of the program.

Each laboratory-scale test entails designing laboratory experiments and equipment, writing specifications for procuring equipment, assembling test systems, developing test plans and procedures, performing the studies, and evaluating data. Reports will be issued documenting the results and evaluations from each test.

3.2 Pilot-plant Tests

Following early testing of various program components, hot verification and full-scale integrated testing will be required. Additionally, technologies that may not be amenable to laboratory-scale testing (i.e., freeze crystallization) will be studied at the pilot-plant scale level. The primary purpose of pilot-plant testing will be to optimize each process technology in addition to defining key scale-up parameters.

A preliminary analysis of pilot-plant facilities has shown that insufficient space is available for cold pilot-plants and hot cell operations. New pilot plant space for integrated large-scale testing will be provided in a Technology Development Facility (TDF), and hot-testing space is being acquired from existing facilities. The TRA may be available for mechanical disassembly component tests and for SNF exam mock-ups. Full-scale mechanical disassembly and direct disposal could be performed at CPP-637, with full-scale cold integrated pilot-plant testing being performed at either CPP-637, CPP-620, the TDF, or TRA. Near-term cold pilot-plant space is also available for sorption column and electro-hydrolysis testing on radioactive liquid waste, and pilot-plant scale tests are underway in the centrifugal contactor mock-up facility for TRUEX and SREX solvent extraction flowsheets. Hot pilot-plant testing (e.g., hot stabilization and calcine characterization testing) may be performed at several hot facilities, such as the Hot Fuel Examining Facility-North (HFEF-N) at ANL-W, the Test Area North (TAN) Hot Cell (THC), the Hot Cell Annex, the Multi-Curie Cell (MCC), or the FDP facility.

3.3 The WIF Complex

The proposed WIF complex would condition mixed radioactive wastes for interim storage and final disposition and have a nominal operating life of 40 years. It would be architecturally similar to other ICPP buildings, with human factors being considered in the building's arrangement and function, the placement of equipment, viewing windows, manipulators, instruments, and process controls. The complex would be accessible by major roads within the ICPP to provide for material movements into the facility.

Feasibility studies for the Proposed WIF will be completed by October 21, 1994, with conceptual design efforts to start in August, 1995. The feasibility studies include descriptions of the process and facility design, comprising block flow and process flow diagrams, process and utility system design, equipment sizing and layout, facility general arrangement sketches showing layout of the process. Other areas include utility and support systems, material handling and conveyance, process cells/canyon design features, remote equipment, maintenance and operations features, containment and confinement features, secondary code treatment and disposal, radiological and utility requirements and interim product storage.

3.3.1 WIF Design and Construction

The proposed WIF would be designed and constructed in two phases. Phase I would include a radioactive liquid waste transport line from the tank farm to the separation facility, where partitioning of radioactive liquid waste into HLW and LLW constituents would take place. The separation facility would utilize the existing Fuel Processing Restoration (FPR) structure to contain as much of the WIF process as is reasonably possible. Following separation, the LLW would be transported to the LLW grouting facility for immobilization; the grout would then be placed into 71 gallon drums for temporary storage in a LLW interim storage facility. The HLW would be concentrated and accumulated in the separation facility for future processing. A bulk chemical storage building would be required for process support.

Phase II would include facilities for treating the concentrated and accumulated HLW in FPR and for treating calcine. The calcine would be transported to the vitrification facility from the Calcined Solids Storage Facility (CSSF) and dissolved to facilitate separation of the HLW and LLW constituents prior to grouting or vitrification. The high level constituents, as well as the concentrated and accumulated HLW in FPR, would then be vitrified in the vitrification facility and stored in a HLW interim storage facility; the LLW would be transported to the LLW grouting facility for immobilization and stored in the LLW interim storage facility.

Construction of the proposed WIF complex will most likely fall under Major System Acquisition (MSA) and, due to the Congressional funding cycle and various required approvals and permits, may take up to 13 years from the conceptual design phase to start-up. A project schedule for an MSA usually includes seven to eight years of pre-construction project activities; actual construction time is generally only 40% of the total project schedule.

A Scope of Work for Feasibility Studies for the WIF phased approach has been initiated. These studies will further develop selected concepts and option for the Proposed WIF complex, and will help the start of conceptual design efforts planned for May, 1995.

3.3.2 The WIF Process

The thrust of the phased treatment and storage option for radioactive liquid and calcine wastes is to provide the potential for deferring vitrification of the HLW fraction until Phase II of the process, thereby minimizing the initial capital cost of the project. Deferral of the calcine processing and HLW vitrification facility until Phase II will support level annual funding criteria for the INEL, as well as meet all project regulatory drivers.

3.3.2.1 Phase I

During Phase I, radioactive liquid waste stored in large underground tanks at the ICPP are received and stored in the existing FPR. Undissolved solids are concentrated and accumulated for future processing, and the liquid phase is processed via the TRUEX, SREX, and IX chemical separation processes to remove final traces of fission products and transuranic compounds.

The TRUEX separations process feed stream consists of clarified sodium-bearing liquid waste, and clear liquid and sodium-bearing waste solids from the calcine dissolution process. This combined feed stream is processed to remove transuranic isotopes, which are then stored for future processing. Dirty organic solution from the TRUEX process, including CMPO and TBP organic compound, is alternately scrubbed with dilute nitric acid and sodium carbonate solutions before reuse, and spent organics are periodically discharged to an organic thermal decomposition unit for final disposal.

TRUEX raffinate is sent to the SREX separations process where strontium is preferentially removed. Strontium-rich material is temporarily stored for future processing, and the SREX raffinate is sent to the IX column to remove cesium; the raffinate then goes to the LLW denitrator. Spent IX resin containing cesium is periodically sent to temporary storage. Dirty SREX organic solution, which includes crown ether, is alternately scrubbed with dilute nitric acid and sodium carbonate solution before reuse, and the spent organics are periodically discharged to the organic thermal decomposition unit for final disposal.

Liquid LLW is collected from the IX column and concentrated in the LLW denitrator where elemental mercury is separated from the LLW stream. Vapor from the LLW denitrator is condensed and the non-condensibles are sent to the vessel off-gas (VOG) system for high-efficiency particulate air (HEPA) filtration. Denitrator condensate is then treated to remove mercury and sent to the WIF PEW system. The concentrated slurry from the LLW denitrator is mixed with grout and other pozzolans, liquid additives, and water; poured into square 71-gallon steel drums; and allowed to cure for approximately three days. The grout-filled drums are then transferred to the LLW Interim Storage Facility. This facility would have a 7 year storage capacity for grout-filled drums resulting from WIF production activities.

3.3.2.2 Phase II

During Phase II, calcine, a granular solid stored in the CSSF at the ICPP, is pneumatically transferred into the vitrification facility and dissolved in nitric acid. The calcine dissolver output is centrifuged to remove undissolved solids and sent to the separation facility for treatment through the TRUEX, SREX and IX extraction processes. The resulting HLW concentrated solids, composed of undissolved calcine and the concentrated and accumulated HLW, are slurried with water and sent to the HLW vitrification plant. Off-gas from the calcine dissolver is sent to the VOG system for HEPA filtration and routed to the exhaust fans.

Liquid HLW, containing transuranic and strontium compounds from the TRUEX and SREX extraction processes, is sent to the HLW evaporator, where the volume of fluid is reduced by a ratio of 10:1. After evaporation, the concentrated HLW solution is combined with slurried undissolved solids from calcine and sodium-bearing solid waste dissolution. Mercury is removed from the HLW slurry via formic acid, steam stripping, and condensation of the resulting elemental mercury vapor and transferred to the LLW facility, where it is combined with the mercury recovered from the LLW denitrator.

The HLW feed stream is then combined with glass forming materials and, occasionally, spent IX resin, and further concentrated in the slurry mix evaporator. It is then dried in a rotary kiln, fed to the melter, and heated to glass-forming temperatures. The molten glass is poured into stainless steel canisters and allowed to cool. Cooled canisters are sealed by welding, decontaminated using grit slurry blasting, and transported to the vitrified HLW Interim Storage Facility. The melter and support system design and layout is patterned after COGEMA's 25kg/hr T7 Vitrification Plant located at LaHague, France.

4.0 ENVIRONMENTAL DOCUMENTATION AND PERMITTING

If selection of both the integrated testing candidates and the final process are to occur as scheduled, environmental documentation and permitting for new test facilities and pilot-plants must be initiated as early as possible and, to avoid redundancy or conflict, be coordinated with development of the SNF & INEL EIS. Documentation and permitting will require compliance with the National Environmental Policy Act (NEPA); RCRA as amended by the FFCAct; and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in addition to any other applicable air and water permitting regulations.

WINCO's Waste Management Authority (WMA), formed in January, 1993, to monitor and control the generation of wastes at the ICPP and the Idaho Research Center (IRC), will ensure that the waste streams generated through the SF&WMTDP are controlled, minimized, and handled in compliance with applicable laws, rules, and regulations.

4.1 NEPA

As required by NEPA, a pre-evaluation of any new DOE actions must be made to assess what impact, if any, these actions will have on the human environment. If impact levels are found to be significant, then an EIS must be prepared and a ROD published prior to proceeding with proposed activities. Similarly, if the significance of impact is unclear, then an Environmental Assessment (EA) must be prepared to determine significance. If results of the EA indicate the need for an EIS, then an EIS is prepared and appropriate documentation published. If, however, results of the EA indicate that an EIS is not required, a Finding of No Significant Impact

(FONSI) document is issued for any action that is not clearly insignificant and activities proceed as proposed. Activities whose impact is clearly insignificant are categorically excluded from the need to prepare either an EA or an EIS. As a practical matter, DOE implements this requirement by requiring either a Categorical Exclusion (CX) Determination, or an approved NEPA document (EA with FONSI, or EIS with ROD) before starting Title II design or purchase of materials. Figure 5, below, shows the NEPA process in as described here.

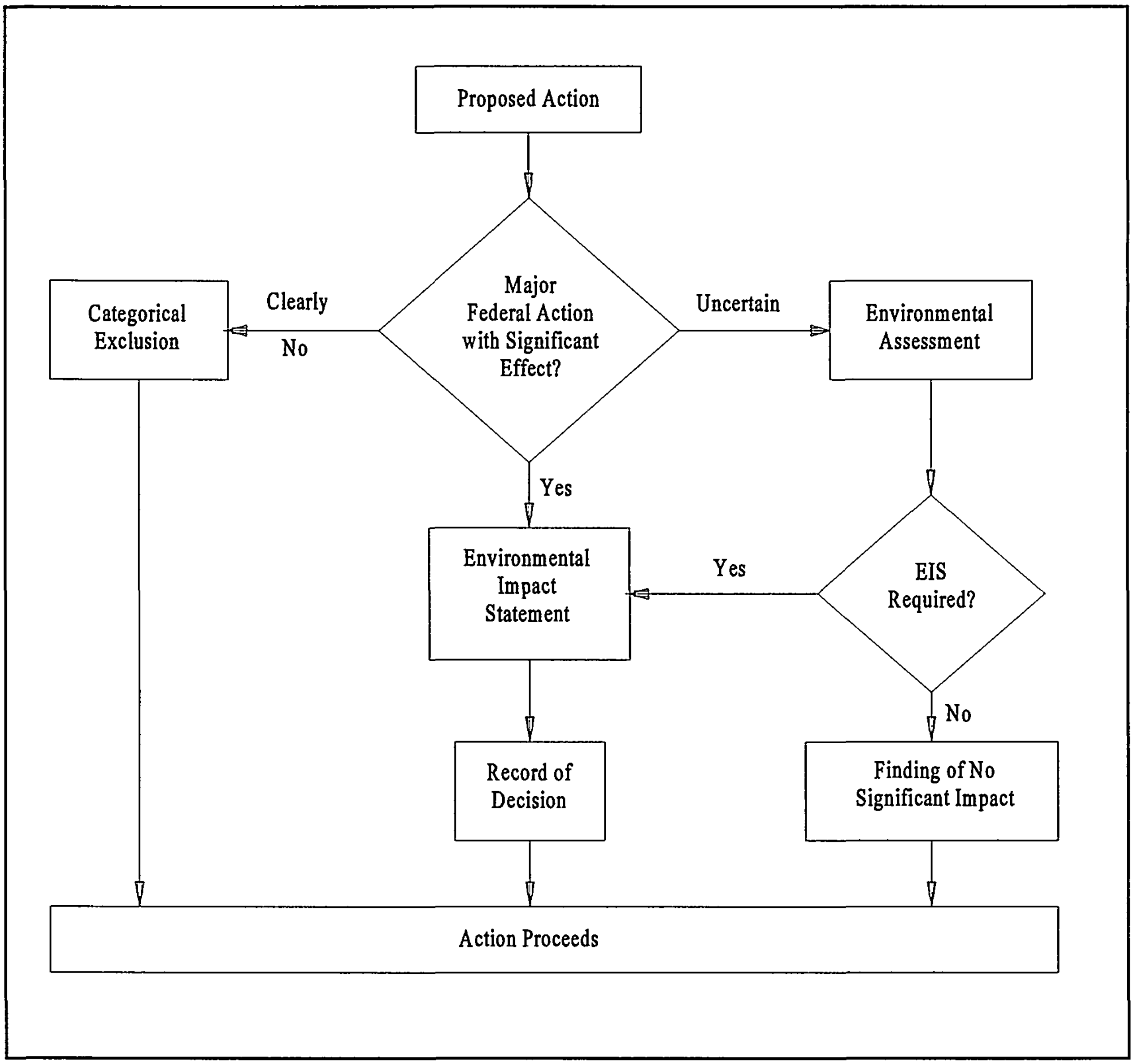

Figure 5: NEPA Documentation Process

4.2 RCRA

RCRA of 1976 ensures the environmentally sound management of solid wastes to (1) protect human health and the environment, (2) reduce waste and conserve energy and natural resources, and (3) reduce or eliminate the generation of hazardous waste as expeditiously as possible. Under RCRA, permits must be obtained to treat, store, and dispose of hazardous and/or radioactive mixed waste (RMW).

In 1988, INEL completed Part A of the RCRA Treatment, Storage, and Disposal (TSD) permit application and was granted Interim Status for its existing hazardous and mixed waste management units. Under Interim Status, a facility is restricted to employing processes and operating within facility design capacities to treat, store, or dispose of wastes only as specified in Part A of the permit application. Since that time, ICPP has been required to operate its TSD facilities according to the RCRA Interim Status regulations outlined in 40 CFR 265/270. Part B permit applications, for various existing facilities, are currently being prepared by INEL personnel; new facilities will require a RCRA permit prior to construction. Additionally, areas at the ICPP used to perform research, development, and demonstration (RD&D) on mixed waste streams, such as calcine, may require a RCRA RD&D permit under 40 CFR 270.65. In some instances, research using hazardous waste may be done under a treatability study exclusion.

RCRA also requires that final waste forms generated from radioactive waste conditioning processes meet LDR. LDR, as stated in the Hazardous and Solid Waste Amendments to RCRA, restricts the land disposal of certain hazardous wastes beyond specified dates unless the wastes are treated to meet all applicable treatment standards. Upon selection and demonstration of a final waste management technology, that technology will be submitted to the Environmental Protection Agency (EPA) as an equivalent alternative treatment technology, or a treatability variance will be sought.

The FFCAct of 1992 waives sovereign immunity for Federal Government facilities with respect to substantive and procedural requirements regarding the storage of mixed hazardous waste, including fines and penalties as a result of violations of RCRA. The effective date of waiver is delayed for three years with respect to 3004 (j) mixed waste storage violations "so long as the waste is managed in compliance with all applicable requirements." On October 6, 1995, the delay from the 1992 FFCAct Waiver of Sovereign Immunity ends, and DOE becomes subject to enforcement actions if a Consent Order is not in place. DOE may submit a compliance plan that, if approved by the State of Idaho, will continue to exempt DOE from the waiver as long as they are in compliance with the plan.

The Solid Waste Act requires DOE to submit plans for developing treatment for wastes, regardless of the time they were generated. Plans shall contain: (1) a schedule for submission of all permits, (2) construction, (3) systems testing, (4) commencement of operations, and (5) processing of backlog waste. For wastes that have no identified treatment DOE shall submit a schedule for identifying treatments and developing treatments including funding requirements.

Leading technology possibilities, a proposed schedule, and supporting text detailing the SF&WMTDP appear in the Draft Site-Treatment Plan, issued in August, 1994. This information will be updated to reflect current developments and integrated with the Final Site Treatment Plan to be submitted in February, 1995, in compliance with the act.

4.3 CERCLA

CERCLA, passed by Congress in 1980, addresses (1) environmental problems resulting from past practices and (2) environmental emergencies caused by the release of hazardous substances. CERCLA gives the federal government authority to respond to releases or the threat of releases of hazardous substances that may present an imminent or substantial danger to public health and welfare or to the environment. As it applies to the SF&WMTDP, CERCLA requires that any proposed project or activity be checked against WINCO drawing #094752 to see if the proposed action will effect any Environmentally Controlled Areas at ICPP. For those actions falling inside of Environmentally Controlled Areas, proper permits must be obtained prior to commencement of the proposed activities (i.e., excavation permits, etc.).

4.4 Water Permitting

As required by the State of Idaho and the EPA, any proposed new water discharge must be reviewed for water permitting requirements. For the SF&WMTDP, each proposed activity must be evaluated and necessary documentation completed for Waste Water Land Application Permit requirements, modifications to sewer lines and potable water mains, and National Pollution Discharge Elimination System permit requirements.

4.5 Air Permitting

The air permitting program, which is administered by the State of Idaho Division of Environmental Quality (DEQ), ensures that Permit to Construct (PTC) requirements be addressed prior to construction or modification of any stationary source, major facility, or major modification. As it applies to the SF&WMTDP, PTC requirements must be evaluated for all laboratory testing, pilot plant testing, and final process implementation. If an activity triggers an air permitting requirement, the emissions levels will determine whether a Below Regulatory Concern (BRC) determination, a PTC, or a Prevention of Significant Deterioration (PSD) PTC is sought from the DEQ.

The National Emission Standards for Hazardous Air Pollutants (NESHAP) Program, regulated by the EPA, has requirements for specific pollutants above designated levels. Proposed activities that have the potential to generate levels above the given limits may be effected by NESHAP and must be evaluated. If the evaluation determines levels above the given limits, a NESHAP application will need to be prepared.

For the SF&WMTDP, air permitting will begin by completing an Air Permitting Applicability

Questionnaire (APAQ) for any new project of modification. The APAQ is an internal WINCO document available through the Environmental Permitting Group. The APAQ will be used by the Environmental Permitting Group to determine what form of air permitting will be required in order to stay in compliance with the rules and regulations.

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