DOE/NP--0007P

DE91 004988

U.S. DEPARTMENT OF ENERGY
Office of New Production Reactors
Washington, DC 20585

New Production Reactors Program Plan

December 1990

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

GLOSSARY

A/E	Architect/Engineering
ACNPRS	Advisory Committee on New Production Reactor Safety
ALARA	As Low As Reasonably Achievable
AOP	Annual Operating Plan
ASME	American Society of Mechanical Engineers
ATR	Advanced Test Reactor
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CCB	Configuration Control Board
CETSG	Cost Evaluation Technical Support Group
CFR	Code of Federal Regulations
CI	Configuration Item
CIMS	Configuration Information Management System
CM	Configuration Management, also used for Construction Manager
COR	Contracting Officer Representative
CSCSC	Cost and Schedule Control Systems Criteria
CWBS	Contract Work Breakdown Structure
DEIS	Draft Environmental Impact Statement
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DP	Assistant Secretary of Energy for Defense Programs
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERAB	Energy Research Advisory Board
ES&H	Environmental, Safety, and Health
ESAAB	Energy Systems Acquisition Advisory Board (NP)
ETO	Engineering Technology Office
FEIS	Final Environmental Impact Statement
FSAR	Final Safety Analysis Report
GAO	General Accounting Office
GSRD	General Safety Requirements Document
HTGR	High-Temperature Gas-Cooled Reactor
HWPF	Heavy Water Processing Facility
HWR	Heavy Water Reactor
INEL	Idaho National Engineering Laboratory
IOC	Initial Operating Capability
ISAR	Integrated Safety Analysis Report
ISER	Integrated Safety Evaluation Report
KD	Key Decision
LMR	Liquid Metal Reactor
LWR	Light Water Reactor
M&O	Management and Operations
MCA	Material Control and Accountability
MHTGR	Modular High-Temperature Gas-Cooled Reactor
MOA	Memorandum of Agreement
MWt	Megawatt (thermal)
MWe	Megawatt (electric)
NEPA	National Environmental Policy Act
NP	Office of New Production Reactors
NPR	New Production Reactor
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NUREGS	NRC Regulatory Guides
O&M	Operations and Maintenance
OBS	Organizational Breakdown Structure
OMB	Office of Management and Budget
OE	Office of Environment (NP)
OSHA	Occupational Safety and Health Administration
OSQ	Office of Safety and Quality (NP)
PMO	Project Management Office
PNL	Pacific Northwest Laboratory
PQAP	Program Quality Assurance Procedures
PRISM	Power Reactor Inherently Safe Module
PSAR	Preliminary Safety Analysis Report
PSWBS	Program Summary Work Breakdown Structure
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QAR	Quality Assurance Requirements
R&D	Research and Development
RD	Requirements Document

RD&T	Research, Development, and Test
RM	Reactor Manufacturer, also used for Records Management
RFP	Request for Proposal
ROD	Record of Decision
RRS	Record Retention Schedule
S&S	Safeguards and Security
SDD	System Design Description
SEMP	Systems Engineering Management Plan
SEN	Secretary of Energy Notice
SET	Site Evaluation Team
SMG	Senior Management Group
SNM/ONM	Special Nuclear Materials/Other Nuclear Materials
SRS	Savannah River Site
Th	Thorium
TMI	Three Mile Island
UEG	Utility Engineering Group
USC	United States Code
WBS	Work Breakdown Structure
WNP	Washington Nuclear Plant
WPPSS	Washington Public Power Supply System

PART I
PROGRAM BACKGROUND AND RATIONALE

Part I of the New Production Reactors (NPR) Program Plan:

- Describes the policy basis of the NPR Program;
- Describes the mission and objectives of the NPR Program;
- Identifies the requirements that must be met in order to achieve the mission and objectives; and
- Describes and assesses the technology and siting options that were considered, the Program's preferred strategy, and its rationale.

To do so, Part I consists of the following sections:

- Section 1.0, Introduction, which provides an overview of the NPR Program;
- Section 2.0, Policy Basis for the NPR Program, which defines the specific national security and other policy responsibilities of the DOE;
- Section 3.0, Program Objectives and Requirements, which defines the central mission of the Office of New Production Reactors (NP) to construct safe and environmentally sound new production reactor capacity on an urgent schedule;
- Section 4.0, Description of Options, which provides details of the alternatives for meeting the stated requirements, including the types of reactors to be selected for construction and the sites on which the reactors are to be built; and
- Section 5.0, Assessment of Options, which describes the NPR Program's preferred strategy that meets the immediate mission needs of the Program. The results of the technology assessment and site assessment are provided along with an explanation of the methodology used to evaluate the options.

1.0 INTRODUCTION

1.1 BACKGROUND

Nuclear deterrence has been a key component of the U.S. national security posture since 1945. The effectiveness of our nation's deterrent capability depends on our ability to produce nuclear weapons suited to national military defense policies, and also our ability to maintain these weapons once they are operational. The purpose of the New Production Reactors (NPR) Program is to plan, design, and construct safe and environmentally acceptable new reactor capacity necessary for an assured supply of nuclear materials--primarily tritium--to maintain the nation's long term deterrent capability.

A variety of nuclear materials are used in U.S. nuclear weapons. One of these, tritium, is an isotope of hydrogen. Tritium is extremely rare in nature, so it must be produced via a nuclear reaction to obtain the quantities necessary for manufacturing and maintaining nuclear weapons. Also, tritium decays radioactively, so the continued readiness of U.S. nuclear weapons requires a constant, reliable source of tritium.

As of today, the only proven and practical method for producing large quantities of tritium is to irradiate lithium targets with neutrons in a nuclear reactor designed for that purpose; these are called "production reactors" and can be used to manufacture tritium and other nuclear materials. Over the last 40 years, DOE has built and operated more than 14 nuclear reactors to produce these materials as well as other isotopes for scientific and medical purposes.

Most of these reactors have been shut down and mothballed. In the 1980's, DOE operated three production reactors at the Savannah River Site (SRS) in South Carolina. The SRS reactors were commissioned in 1954 and are now over 35 years old. Aging effects and safety concerns have resulted in curtailing or suspending operations of these reactors. In March 1987, DOE reduced power limits at the SRS reactors to half of their normal operating levels as a result of concerns about the adequacy of their emergency cooling systems. In April 1988, the P and K Reactors were shut down for review and upgrading of their ability to withstand earthquakes. The L Reactor was shut down in June 1988 for refueling and annual maintenance. During the restart of the P Reactor in August 1988, deviations from expected power levels caused concern regarding operational qualifications, and reactor operations at SRS were suspended.

The Department of Energy is implementing a plan to ensure that the SRS production reactors can be operated safely. However, the Department does not believe that it is enough just to ensure basic safety. Rather, the Department intends that its new reactors will meet or exceed the rigorous safety and environmental standards that have been developed for modern privately-operated nuclear power reactors.

Unfortunately, the existing SRS reactors were built before these standards were conceived, and it would be difficult and expensive to modify them to strictly conform to today's standards. For example, commercial nuclear reactors are required to have containment structures; "human engineering" that limits the probability of operator errors; and design features throughout the reactor complex that mitigate potential accident initiators and limit the effects of any accidents that could occur. It would be extremely costly, and in some cases impossible, to bring the SRS reactors up to these standards without the total reconstruction of the plant. There are also serious questions as to whether the 35-year old reactors at SRS can provide the level of reliability for an additional 40 to 60 years of operation required for a key component of the U.S. nuclear weapons complex. Because a steady, highly reliable supply of tritium is required for the continued readiness of U.S. nuclear weapons, DOE believes that these concerns pose unacceptable risks. Planning, designing, constructing, testing and starting up a new reactor requires approximately 10 years, so, to ensure a reliable supply of tritium, it is necessary to proceed with urgency.

In light of ongoing arms control efforts and potential changes in U.S. military strategy, DOE is conducting a study to reevaluate the long term requirements for configuration of the nation's nuclear weapons production complex facilities. A Complex Reconfiguration Committee has been established, chaired by the Under Secretary of Energy, to develop a plan for configuration of the future complex that is consistent with the realities of the emerging international security environment and flexible enough to accommodate the likely range of deterrent contingencies. An important component of the reconfiguration will be the new production reactor capacity for the safe and reliable production of tritium.

1.2 THE NPR PROGRAM PLAN

This Program Plan is the top-level document for explaining, planning, and executing the New Production Reactors (NPR) Program. It explains the policy basis of the Program and its historical background. It also explains how the specific options that comprise the Program were selected. Finally, it provides the NPR Program's organization, management, and plans for implementation.

1.2.1 Components and Organization of the Program Plan. The NPR Program Plan has several objectives:

- As a planning support device, it makes clear the Program's goals, missions, objectives, and requirements.
- As an overall organizational device, the plan defines the Program's organizational structure, decision-making processes and procedures, lines of authority, schedules, and budget.
- As a measurement tool, the plan provides clear standards for evaluating the progress and performance of the program as it proceeds so that corrective measures, if needed, can be taken in a timely fashion.
- Finally, the NPR Program Plan provides a common framework to coordinate efforts of participants, managers, and officials responsible for oversight.

The new production reactors are a major acquisition requiring the integrated efforts of Washington, D.C. offices, site offices, and contractors spread across the country. Thousands of individuals will take part in the Program; the Program Plan provides a uniform set of requirements, assumptions, and expectations for the use of all participants.

The Program Plan is organized according to a logical path that includes the following steps (illustrated in Figure 1-1):

- A statement of the policies on which the Program is based. This section explicitly identifies the basis of the Program in statutes and executive orders. This statement makes clear the intentions of the responsible officials who established the general objectives for the Program. It also provides the charter of the organization responsible for implementing the Program in order to establish the extent of that organization's authority. The NPR Program relevant policies include:
  - -- Statutes assigning DOE responsibility for producing and maintaining nuclear weapons;
  - -- DOE directives for carrying out these responsibilities;
  - -- Congressional authorization of the Program; and
  - -- The DOE Memorandum that serves as the charter of the Office of New Production Reactors (NP).
- A mission statement of the generic means through which the policy objectives are to be achieved. The central mission of NP is to construct safe and environmentally sound new production reactor capacity on an urgent schedule.
- An analysis of requirements. This section explicitly identifies the specific tasks that must be carried out or capabilities that must be provided in order to achieve the objectives of the Program. Examples of NP requirements include:
  - -- Any new production reactor will meet or exceed levels of safety required by regulations for civilian nuclear reactors;
  - -- Any new production reactor must meet all applicable standards of the National Environmental Policy Act (NEPA); and
  - -- When completed, the system of new reactors will have no single point of failure

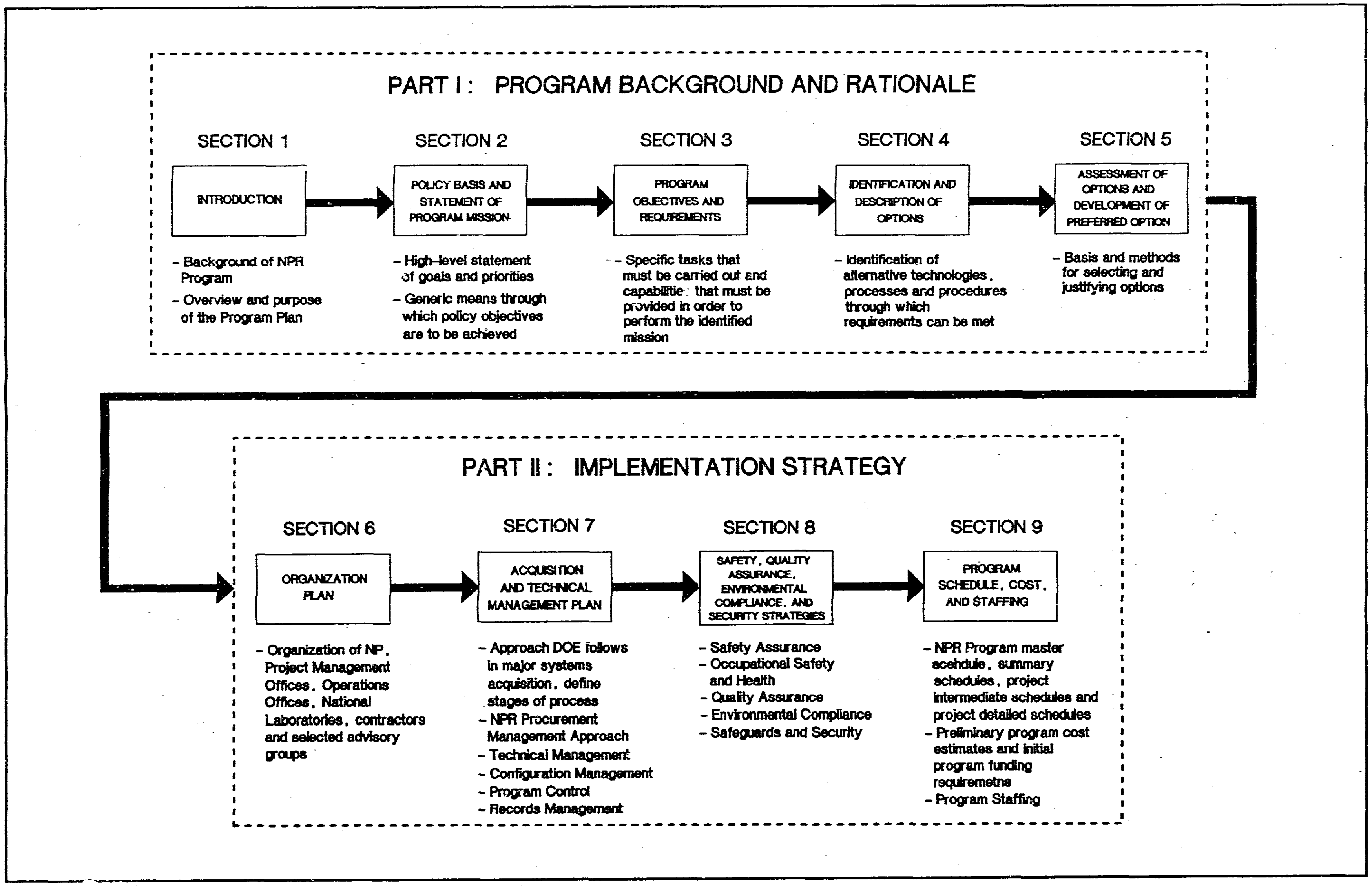

Figure 1-1
Organization of the Program Plan

that could completely curtail tritium production.

- Identification of options and evaluation criteria for selection. The Program Plan describes the alternatives for meeting the stated requirements that were considered, as well as the analysis that led to the selection of particular options. These options included the reactor technologies, the number of reactors, and the sites that were considered.

- Implementation strategy. Part II explains how the Program will carry out the option that was selected. In addition to the design and construction strategy for the Program, Part II describes the organizational structure, operational procedures, cost estimates, staffing requirements, and schedule for the Program.

- Monitoring and oversight systems. These explain how the officials responsible for the project will be made aware of its progress and of any problems or issues that arise in its completion.

1.2.2 Planned Updates of the Program Plan. This Program Plan is a living document that reflects the current status of the Program; as choices are selected, progress is made, and additional data become available, the Plan will be updated to embody the latest information and policies. Thus, the Plan will be revised as the NPR Program proceeds -- annually or as circumstances warrant. It is prescriptive in nature and all participants and subtier documents shall conform to it. Updated versions of the Plan will provide greater detail -- especially on the later stages of the Program having to do with the actual construction of the reactors. As subsequent decisions are made and additional data become available, NP will revise and refine its estimates on costs and schedules.

The New Production Reactors Program is a design and construction program that is in the earliest stages of design. As a result, detailed budget quality cost and schedule data are not available at this time. What are available, and are provided in this report, are updated cost and schedule estimates based upon information provided by industrial proponents at the request of the Energy Research Advisory Board in 1988 and which have been previously given to the Congress.

The Director of the NPR Program has put in place the means by which budget quality cost and schedule estimates will be developed for both Executive Branch review and to assist in reporting to Congress. As each subsequent reactor design phase is completed, the quality and accuracy of the costs and schedules will improve. The Record of Decision, which is scheduled for December 1991, will announce the Department's final selection of reactor technologies and sites, and will use the cost and schedule estimates derived during the conceptual and preliminary design (Title I) phases of the Program. Another level of improved accuracy will be available at the completion of the detailed design (Title II) which will take place after the Record of Decision has determined the final choices of technologies and sites.

1.2.3 The NPR Program Family of Documents. The NPR Program Plan also serves as the organizing framework for the plans used by component offices within NP. Figure 1-2 depicts the hierarchy of NP planning documents.

There are four specific levels of plans in the NP document hierarchy. Each level has a single definitive document, as follows:

Level I - NP Program Plan

Level II - Technology Project Plan

Level III - Technology Project Management Plan

Level IV Contractor Management Plans

Within each level, there will be a number of implementing documents that provide the details on the conduct of business on the Program. The implementing documents at the specific levels are defined as follows:

Level I - NP or Program policy, guidance, directives, requirements or procedures signed by the Director NP, or designee.

Level II - Project specific guidance or requirements from the appropriate NP Engineering Technology Office (ETO) Director. Technology

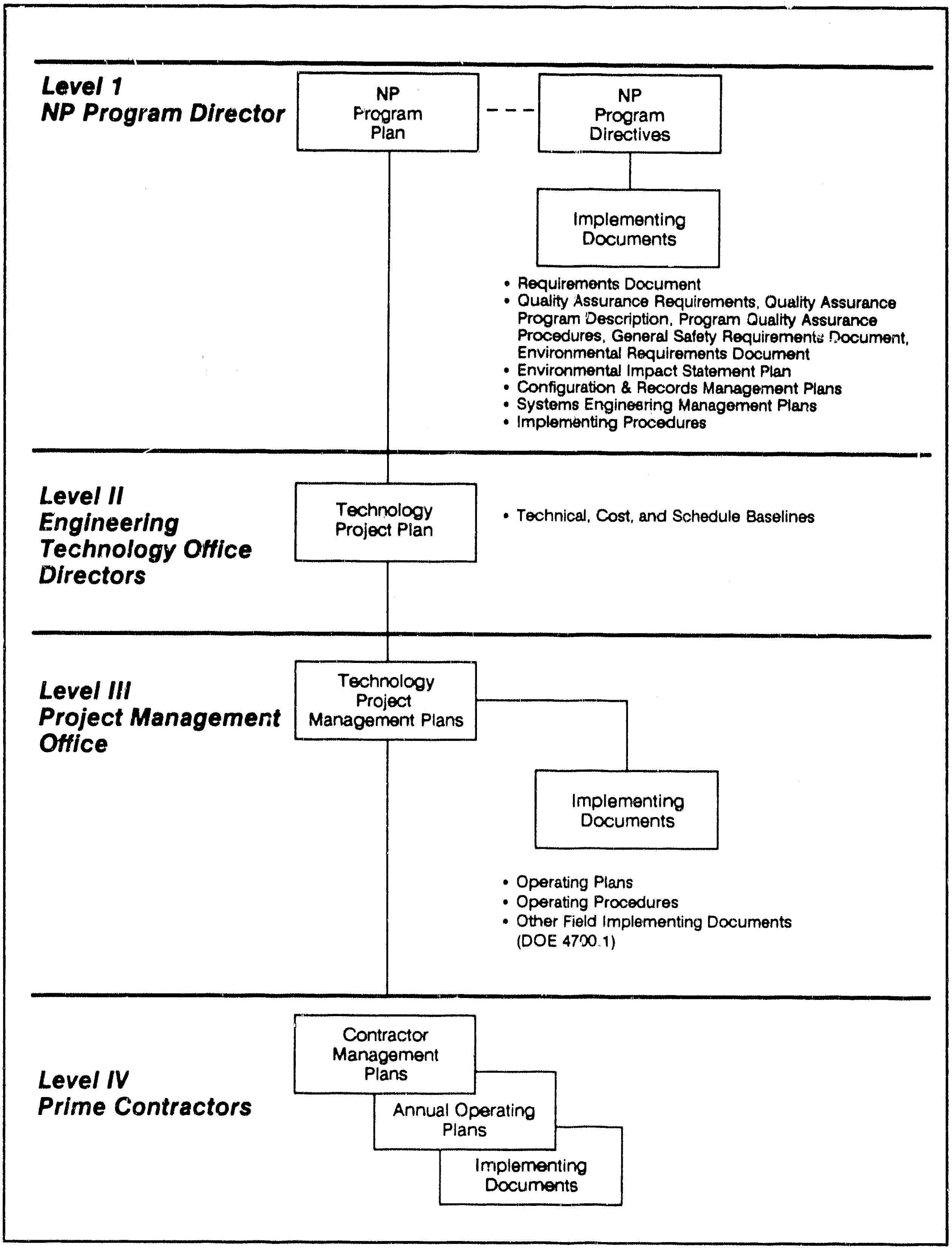

Figure 1-2
NPR Program Document Hierarchy

Project Plans are prepared by the ETO Directors and approved by the NP Director.

Level III - The Technology Project Management Plan and its implementing documents prepared by the Project Management Office (PMO), concurred in by the ETO Director and approved by the Chief Engineer and the Construction Manager.

Level IV - Contractor documents implementing the Program, Project, and Project Management Plan requirements.

2.0 POLICY BASIS OF THE NPR PROGRAM

The construction and operation of the new production reactors must respond to a specific production mission while also satisfying a range of national and DOE policies. These policies include, of course, the responsibility of the Department of Energy to provide nuclear materials for nuclear weapons as identified for U.S. national security needs. Just as important, though, are the national and DOE policies adopted to ensure that these national security measures are carried out in a responsible manner. These policies have been fully integrated into the NPR Program Plan, and are supported by both the formal requirements and the implementation measures that comprise the Program.

2.1 DOE NUCLEAR MATERIAL PRODUCTION RESPONSIBILITIES

A primary mission of the Department of Energy is to provide nuclear materials to meet national defense requirements as determined by the President's Nuclear Weapons Stockpile Memorandum. Specifically, Section 91 of the Atomic Energy Act of 1954, as amended, authorizes the DOE to "engage in the production of atomic weapons, or atomic weapon parts..." (42 USC 2121).

2.1.1 Tritium Production Requirements. Current U.S. nuclear weapons are based on the use of a variety of nuclear materials, including a rare gas known as tritium. Tritium is one of the nuclear materials crucial to our nuclear deterrent capability. The use of tritium in weapons makes it possible to build smaller, yet more powerful weapons and also makes it possible to reduce the amount of plutonium in each weapon. Consequently, the United States has based its strategic nuclear weapons and delivery systems on designs using tritium. The nation's nuclear defense program requires a steady, assured supply of tritium not only to manufacture new weapons, but also to replenish the tritium in existing weapons.

Tritium is the radioactive form of hydrogen. It differs from hydrogen in that it has two neutrons in its nucleus while hydrogen has none, and it is radioactive while hydrogen is not. Tritium is found naturally in both water and the atmosphere, though in very small amounts. The atomic structures of hydrogen and tritium are illustrated in Figure 2-1.

Unlike most other nuclear weapons materials, which can be easily stockpiled for very long periods, tritium must be replenished because it naturally decays by about 5.5 percent a year. After 12.3 years, only half of any given initial quantity of tritium remains. Because of this radioactive decay, tritium must be replenished regularly in operational weapons and a reliable, steady supply of tritium is thus a necessary component of the continuing support of U.S. nuclear weapons.

There is no known practical method of collecting and concentrating natural tritium into the quantities needed for defense purposes, so it is necessary to manufacture it. This is done by bombarding another element, lithium, with neutrons. Currently the only technologically proven and practical method for carrying out such a process is to use a nuclear reactor designed for this purpose. Tritium production is depicted in Figure 2-2.

The United States has produced tritium in production-level quantities for its nuclear weapons program since the early 1950s. Most recently the reactors dedicated to tritium production are those located at the Savannah River Site in South Carolina. Reliable tritium production cannot be supported indefinitely with these existing production reactor facilities, as they are over 35 years old and are experiencing aging effects that reduce their operational reliability and operational lifetime.

DOE is developing an integrated, prioritized plan for reconfiguring the nation's nuclear weapons complex facilities. The NPR Program is an important component of this long term plan for the redesign of the nuclear weapons complex which, when completed, will provide the nation the reliable support that it requires for its nuclear deterrent, while also meeting all anticipated requirements for safety and environmental protection.

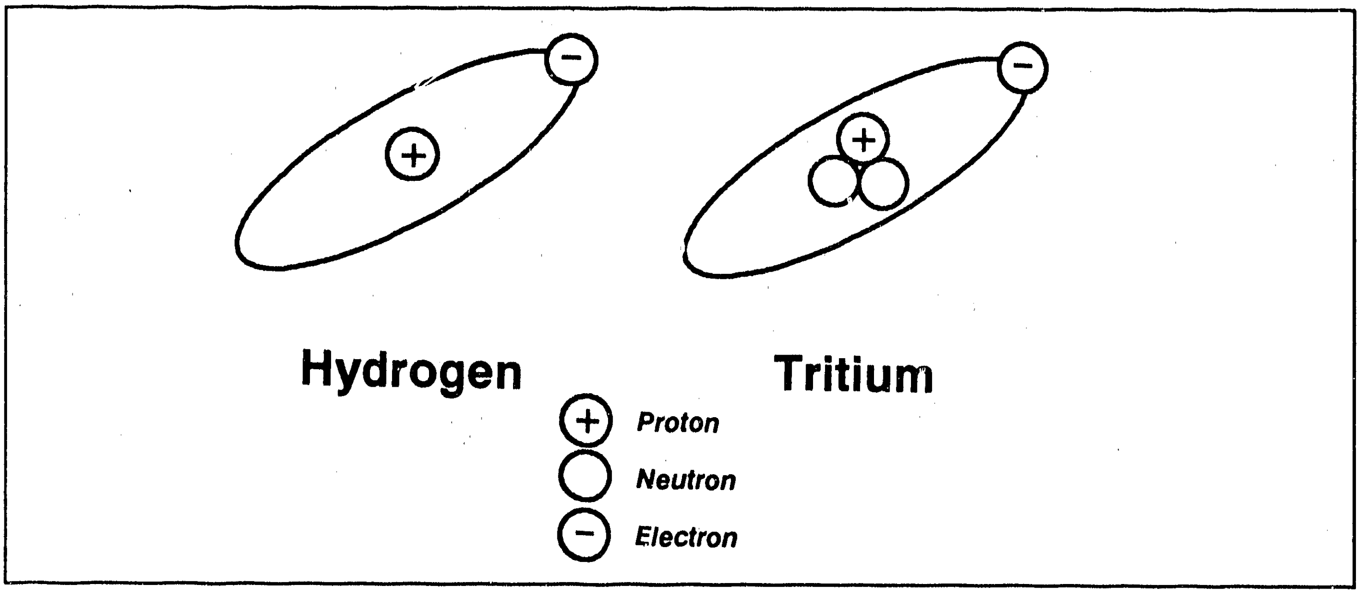

Figure 2-1
Atomic Structure of Hydrogen and Tritium

2.1.2 Reserve Capacity Requirements. Two critical deficiencies in the nation's existing nuclear weapons complex are a lack of redundancy and diversity. Also, it lacks the reserve capacity to meet unexpected demands. The existing complex can, with extensive upgrades and proper maintenance, meet production requirements provided no urgent life limiting phenomena are identified. However, as Secretary Watkins observed on May 17, 1989 before the United States Senate Committee on Armed Services:

> *"We intuitively realize that "crisis management" is not the hallmark of operational excellence, yet that is what we perpetuate if we allow future technology and capability decisions to be determined by parochial needs. The nuclear weapons program has been through many cycles in its 40-year history. Over time, the trend has been to correlate facilities and capabilities with specific stockpile demands. As the stockpile has declined from peak levels, so too have our facilities and capabilities."*

In developing its reconfiguration plan, DOE has started from the premise that absolute, minimal-level stockpile demands are an unacceptably risky standard for sizing the capacity of the nuclear weapons complex. Rather, the system should be designed so as to enable an increase in

$$ {}_{0}n^{1} + {}_{3}Li^{6} \longrightarrow {}_{3}Li^{7} \longrightarrow {}_{1}H^{3} + {}_{2}He^{4} $$

(Neutron) Lithium-6 Lithium-7 Tritium (Alpha Particle)

Figure 2-2
Tritium Production

the total capacity of the complex should such a requirement arise.

2.1.3 Redundancy, Diversity, and Survivability Requirements. Possibly even more importantly, the current nuclear weapons complex lacks the redundancy, diversity, and survivability necessary to support the nation's requirements for nuclear materials in the face of such threatening situations as:

- Natural disasters that may damage a facility;
- An unanticipated technical concern that forces the shutdown of a facility--or, in the case of a generic concern, several facilities sharing similar design characteristics; or
- Sabotage.

The need to be prepared for such situations has become especially clear in recent years. For example, the risks of relying on a single technology have been illustrated in the recent shutdown of the production reactors at the Savannah River Site, which share similar designs and currently suffer from similar operational and safety concerns. Likewise, the fact that a malfunction or damage in one reactor may render an adjacent reactor unserviceable has been illustrated in the Three Mile Island and Chernobyl incidents.

DOE has determined that the current marginal capability to withstand such threats to tritium production creates a significant risk to U.S. security. In May 1989, in a prepared statement before the United States Senate Committee on Armed Services, Secretary Watkins stated:

> *"Today's nuclear weapons complex is basically a "single track" system that lacks needed duality or redundancy in key critical areas. We do have flexibility in some areas, but "choke points" that exist today in critical areas can bring the complex to a halt. This situation is unacceptable from a national security standpoint..."*

DOE policy has been designed to respond to Presidential directives for nuclear material production while following the statutory responsibilities of the Department. This policy provides for a nuclear weapons complex that ensures reliable tritium production for not just normal conditions, but also with the flexibility and resilience necessary for meeting unexpected adverse conditions.

2.2 ADDITIONAL POLICY CONCERNS

In addition to the pressing need to restore the nation's capacity to produce an assured supply of tritium, several other policy-level concerns have guided the NPR Program. The most notable of these include ensuring public safety, protecting the environment, and maintaining necessary security and safeguards. During the four decades that have passed since the U.S. nuclear weapons complex began operation, government and public understanding of all three of these issues has increased markedly. The NPR Program has been designed to respond to new, more stringent, diverse, and encompassing requirements in these areas.

2.2.1 Environmental Protection. In announcing that DOE would conduct full-scale environmental assessments of its nuclear weapons complex reconfiguration plans, Secretary Watkins stated in an official DOE press release (January 12, 1990):

> *"This decision further demonstrates my personal commitment to chart a new environmental course for the Department of Energy...I intend for DOE to comply fully with the letter and spirit of NEPA [the National Environmental Policy Act] in its decision-making."*

DOE is committed to environmental protection in all of its activities. As part of this commitment, the NPR Program will be conducted in compliance with all applicable Federal, state, and local environmental statutes, regulations, and standards.

2.2.2 Public Safety. The NPR Program is committed to the highest safety principles in accomplishing its mission to provide tritium production capacity for the nation's defense. DOE intends that this new reactor capacity will provide a level of safety and safety assurance that meets or exceeds that offered by modern commercial nuclear power plants.

The new production reactor capacity being proposed will adopt advances in nuclear technology that have developed in the nuclear industry over the past 30 years, thus correcting design shortcomings that evolved in the older production facilities. The reactor designs will incorporate advanced safety, instrumentation, and control systems that will simplify operations and reduce the potential for accidents. They will also include features such as a containment designed to prevent or mitigate releases of radioactive materials into the environment under most severe accident scenarios. In addition, the designs will incorporate the use of both "inherent" phenomena and "passive" systems relying on natural phenomena and forces, such as a negative reactivity temperature coefficient and convection or gravity. This will minimize the need for operator action or external power in order to safely respond to potential accident initiators and events. The lessons we have learned from past experiences, including Three Mile Island and Chernobyl, have proven valuable to DOE in this process.

2.2.3 Safeguards and Security. Safeguards and security are critical aspects of any nuclear facility design. NP policy requires that the three elements to safeguards and security--physical protection, material control, and material accountability--receive consideration at the earliest phase of the design and at every subsequent phase. Plans to address these elements shall be comprehensive, defining safeguards and security systems for the new production reactors, their supporting fuel cycle, and their target processing facilities to protect against the DOE-defined generic threat for all applicable categories of potential inside and outside adversaries, or combinations of insiders and outsiders.

The security and safeguard measures shall include physical protection against both acts of theft of special nuclear materials and other nuclear materials which might present a threat to public safety, as well as sabotage that might interrupt the production of required nuclear materials. Such measures must also include materials and personnel control systems and material accountability systems for protecting nuclear materials from unauthorized movement within a facility or removal from a facility.

2.3 THE NP CHARTER

To meet the pressing need for restoring a long-term source for an assured tritium supply, on October 1, 1988, Secretary Herrington established the Office of New Production Reactors (NP). The New Production Reactors Program was established to fulfill the following mission:

> ***To provide new production reactor capacity in a safe and environmentally sound manner on an urgent schedule for an assured supply of nuclear materials, primarily tritium, to maintain the nation's nuclear deterrent capability.***

To carry out this mission, the charter of NP has assigned the Office the following functions and responsibilities (Quoted from Memorandum to the Secretary from the Assistant Secretary for Management and Administration, Establishment of the Office of New Production Reactors, dated September 8, 1988):

- Define requirements for and conduct necessary development and testing to support design, construction, analysis, safety, certification, and documentation attendant to reactor deployment.

- Provide safety and quality certification data; establish safety and quality requirements and criteria; and develop and implement a strategy for interfacing with appropriate safety oversight and advisory organizations.

- Assure environmental protection and quality; develop NEPA compliance strategy; and prepare NEPA documentation.

- Develop and implement a plan for interacting with and informing interested Executive Branch agencies and Congress on the status of the NPR Program; in coordination with cognizant Operations Offices, work with State and local authorities, as appropriate, on safety, environmental, siting, construction and other institutional matters; and conduct a public affairs program.

- Develop program and project planning strategy and reporting documentation.

- Formulate, justify and execute the budget; develop manpower allocations and utilization plans; and provide personnel support.

The NPR Program is unique within the Department. The importance of tritium to U.S. national security makes the NPR Program especially critical. The mission and objectives of the Program dictate an especially urgent schedule. Moreover, the coordination of input from numerous offices, agencies, laboratories, and private industry required for the Program is unprecedented in the Department's recent history.

Therefore, in order to ensure that the Program meets its requirements and achieves its mission, the Secretary established NP as a centralized program. NP serves as the focal point for the development of Program policy and directives, the identification, evaluation, and selection of options, and then implementation of the selected approach. All components of the NPR Program are defined and linked together in the Program Plan, which serves as an organizational and management tool for NP.

In addition to serving as a basis for centralized management of the NPR Program, the Office of New Production Reactors has responsibility for the entire Program from inception to delivery of the tested reactor to the operator. NP is now serving as the focus for the preliminary stages of selecting and planning a system of new reactors to meet the nation's tritium requirements. Once these plans are finalized, NP will then oversee the construction of the reactors. Later, NP will direct and monitor the introduction of these reactors into operational service. As the Program evolves, the organization and composition of NP will also evolve.

Requirements and implementation actions of the NPR Program are directly linked to national policy. As the NPR Program progresses, it is possible that the Executive and Legislative Branches will adopt new policies in light of changing conditions and priorities. As this occurs, the NPR Program Plan itself will be updated and, where necessary, modified to respond to these new directives.

3.0 PROGRAM OBJECTIVES AND REQUIREMENTS

Formal NPR Program objectives and requirements serve several purposes. First, they translate the general policy goals that guide the Program into specific tasks or operations. Second, these objectives and requirements serve as a benchmark for assessing the progress of the Program. Third, they provide a framework and basis for reaching decisions affecting different Program elements and simultaneously ensuring that any compromises in resolving conflicting requirements are consistent with established policies and priorities.

NP has developed design requirements for the NPR Program using existing DOE orders, NRC regulations, environmental requirements, other government regulations, and industry consensus standards. Ideally, design requirements for new production reactors would be prepared by referencing appropriate DOE Orders. However, many DOE Orders, and especially DOE's nuclear safety requirements, are undergoing revision and are not yet available for use in the NPR Program. Because of the urgent schedule of the new production reactors, it is unlikely that all new DOE-wide requirements will be issued within the time frame needed for preliminary design (Title I) of the new production reactors, which began in September 1990. The existing DOE orders have been supplemented with additional requirements in those cases in which current trends provide a reasonable definition of potential future delineation or tightening of requirements or increased demands on the facilities.

The NPR Program will meet the following four major objectives:

- ***Provide the production capacity to supply tritium and other nuclear materials reliably and on a timely schedule.***
- ***Provide a level of safety and of safety assurance that meets or exceeds that afforded to the public by modern commercial nuclear power plants.***
- ***Meet or exceed all applicable Federal, state, and local regulations or standards for environmental compliance.***
- ***Manage the Program in a cost effective manner.***

The following sections provide the specific requirements necessary for meeting these objectives. These requirements are programmatic in nature and apply to all new production reactors. These fundamental requirements are the baseline for configuration control of new production reactors, and are grouped as follows:

- Safety
- Environmental Protection
- Production
- Quality
- Safeguards, Security and Emergency Planning
- Operation and Training
- Design Guidance

Other fundamental requirements relating to management, facilities, administration and operations are contained in project management documents.

3.1 SAFETY

Safety is a paramount requirement for the NPR Program. General Safety Requirements Documents (GSRD) were prepared by NP for the Heavy Water Reactor and the Modular High-Temperature Gas-Cooled Reactor designs. These requirements were primarily derived from Title 10 of the Code of Federal Regulations (10CFR).

NP has followed a policy of minimal change in the requirements of 10CFR in developing NPR safety requirements. Changes have been made to increase safety, to anticipate future changes in safety requirements for nuclear power plants, or to adapt requirements that are not directly applicable to production reactors of the type that are being designed. NP will meet the requirements of 10CFR (as modified for new production reactors) except when good cause is indicated and documented. NP will follow Secretary of Energy Notice (SEN) 6B-90 in seeking approval within the Department of any exceptions from DOE policy and requirements.

NP has recorded and justified all differences between General Safety Requirements applied to new production reactors and the criteria in 10CFR which are applied by the NRC to nuclear power plants. NP will continue to follow this policy to provide a record of where extensions, additions, modifications, or deletions have occurred.

The NP Office of Safety and Quality has primary responsibility for defining minimum requirements for NPR safety. NP will also seek input from the Office of the Assistant Secretary for Defense Programs and from the site management and operations (M&O) contractors on the safety aspects of operations-related matters that can be addressed during design.

NPR Program safety-related requirements are as follows:

3.1.1 Priority of Safety in the New Production Reactors Program. Safety of the public, the worker, and protection of the environment shall be a primary consideration in the design, construction, start-up, and operation of the new production reactors.

3.1.2 Integration of Safety into the NPR Program. All new production reactors shall meet the General Safety Requirements of the NPR Program. This process of integrating safety shall be in addition to the separate review process implemented to verify independently that safety standards and criteria are met.

3.1.3 Formal Safety Review Process. The New Production Reactor Program shall implement a comprehensive safety review process, including reviews by the engineering technology offices, the safety self-assessment office, and external independent review groups.

3.1.4 Continuing Compliance With DOE-Wide Safety Requirements. NP will review new, DOE-wide nuclear safety requirements during their development and prior to publication for public comment and during any revisions that are made after public commentary. NP will comply with these requirements.

3.1.5 Incorporate Reactor Experience. New production reactors shall reflect the technology developments of government- and industry-sponsored programs and the significant lessons learned from the design and operation of research reactors, commercial and government-owned nuclear power plants, and DOE production reactors, including the accidents at Three Mile Island and Chernobyl. The designs shall demonstrate compliance with the applicable requirements for new commercial plants, and take into consideration all applicable NRC Unresolved Safety Issues, medium and high priority Generic Safety Issues, and severe accident research results.

3.1.6 Containment. New production reactors shall have a containment structure. The containment design shall consider a broad spectrum of challenges from severe accidents initiated by either internal or external events.

3.1.7 Accidental Radioactivity Releases. New production reactors shall be designed such that, after a design basis accident, potential exposure to radiation shall be within applicable guidelines of DOE Order 5480.6 and the applicable sections of 10CFR as specified by the General Safety Requirements Documents.

3.1.8 Occupational Exposure. Contractors shall address the protection of personnel, visitors and workers from the hazards associated with construction, operation and maintenance of the new production reactors. Occupational Safety and Health Administration (OSHA) requirements shall be met. The designs shall address industrial safety, industrial hygiene, fire protection, and radiation protection. The reactors shall be designed and operated to ensure that worker exposure during normal operations and anticipated operational occurrences shall not exceed DOE guidelines established in Order 5480.11 and the applicable sections of 10CFR as specified by the GSRD.

3.1.9 Severe Accidents. The new production reactors shall be designed, operated, and maintained so that the probability of severe accidents (i.e., those accidents that result in severe core damage and the potential for gross changes in core geometry and concurrent loss of coolability) occurring is very low. Systems shall be installed to mitigate the potential consequences of a broad spectrum of such events.

3.2 ENVIRONMENTAL PROTECTION

Minimizing environmental hazards has been a key concern since the inception of the NPR Program. The new production reactors are required to meet or exceed all applicable Federal, state, and local regulations or standards for environmental compliance. Moreover, NP has taken the approach that existing environmental protection regulations provide only a minimum objective for the NPR Program; new production reactors will be planned, designed, and constructed with adequate margins so that they should meet anticipated future environmental regulations and standards as well.

3.2.1 Full Compliance. All new production reactor facilities will be designed, constructed, and operated in full compliance with all applicable Federal, state, and local statutes and regulations, as well as DOE and Executive Orders for the protection of the environment and worker health and safety.

3.2.2 National Environmental Policy Act (NEPA). All new production reactor facilities will be designed, constructed, and operated in full compliance with the letter and spirit of the NEPA including specific environmental mitigation commitments.

3.2.3 Enhanced Environmental, Health and Safety Compliance and Monitoring. All new production facilities will, to the maximum extent practicable, be designed, constructed, operated, decontaminated and decommissioned to integrate the fundamental goals of 1) discharge of all pollutants to as low as reasonably achievable (ALARA) levels; 2) minimization of waste through source reduction and recycling; and 3) minimization of exposure to workers and the public to all radiological and non-radiological hazards, and, in addition, will be designed to utilize real time monitoring as a tool for minimizing environmental impacts.

3.3 PRODUCTION CAPACITY AND RELIABILITY

As indicated previously, current U.S. capabilities for meeting tritium requirements have declined to acute levels. The number of available production reactors is approximately one-fifth of the number available when U.S. capabilities were at their peak. Moreover, those reactors that are available have been required to operate at a fraction of their designed output, owing to questions concerning their reliability and their ability to achieve acceptable safety margins when operating at higher levels.

Key goals of the NPR Program related to production, therefore, include:

- Replacing existing tritium production capabilities on an urgent schedule;
- Providing production capabilities with redundancy and diversity to ensure against engineering failures, natural dangers, and hostile threats; and
- Providing production capabilities to meet currently documented requirements for tritium with sufficient reserve to meet anticipated surge capacity and currently unforeseen demands or requirements.

Experience during the past decade has demonstrated that overall capacity is only one factor that can severely constrain production; reliance on a single technology also poses significant risks. The use of single reactor technology has led to a generic failure in U.S. tritium production. To correct current deficiencies, it has been necessary to shut down all affected reactors or operate them at reduced capacity. The combined effect has been reduced tritium production significantly below levels required to maintain the existing weapons stockpile and ensure an adequate reserve for contingency requirements. In light of this experience, the NPR Program has adopted a requirement for technological diversity and siting redundancy.

The following requirements have been established to meet the NPR production capability goals:

3.3.1 Initial Operating Capability (IOC) of Tritium Production. The new reactors shall start tritium production within 10 years of the initiation of conceptual design.

3.3.2 NP Reactor Capacity Factor. The reactors shall be designed, constructed, and operated to produce the required product without exceeding the design margins and with realistic plant availability requirements.

3.3.3 Optimization for Tritium. The reactors shall be optimized for tritium production with the option to produce plutonium.

3.3.4 Production Assurance. To protect the investment and assure availability for production, the designs shall apply a high level of analysis, quality, and quality assurance to systems required for production. The design life of the plants shall be a minimum of 40 years.

3.3.5 System Redundancy. The NPR Program architecture shall be designed so that no single point of failure in a "most plausible case" would cause a loss of more than 50% of new production reactor capacity. Similarly, the temporary shutdown of a facility for non-routine maintenance shall not cause a loss of more than 50% of new production reactor capacity.

3.3.6 Technology Diversity. The NPR Program architecture shall be designed so that no single technology risk factor will cause a significant delay in the IOC of tritium production. The NPR Program architecture shall also be designed so that, once full operational capacity is achieved, no single technology risk factor will result in tritium production falling below 50% of new production reactor capacity.

3.4 QUALITY ASSURANCE

Quality Assurance programs in the commercial nuclear utility industry have been successful in varying degrees depending upon the importance placed on quality by management. NP has established a management program based on the fact that the achievement of quality is the responsibility of line management at all levels in the NPR Program and quality must be planned into all work activities by all NPR Program participants. The independent verification of quality is the responsibility of Quality Assurance. Quality, like safety, is a paramount requirement for the NPR Program.

The NPR QA Program is based on several key quality requirements. These include:

- Adoption of recognized national standards as the basis for development of the NPR QA Program;
- Establishment of additional standards and management controls over the adopted standards, whenever necessary to properly manage the NPR Program;
- Personnel trained in the QA Program and all procedures that they are to use in performing their job responsibilities;
- Independent audits, surveillances, reviews, and assessments used to provide management feedback on the achievement of quality by the line organization;
- Management controls assuring uniformity of activities by the implementation of controlling procedures with corresponding independent checks and balances through reviews, independent approvals, audits, surveillances, and assessments;
- Identification of problems through audits, surveillances, reviews, and assessments; and
- Timely correction of problems controlled by a detailed corrective action evaluation process.

3.4.1 QA Requirements. Quality Assurance measures shall be applied to all phases of the NPR Program to ensure that activities, structures, systems, and components important to safety and the Program mission meet their performance requirements with a high degree of confidence. The NPR Program shall meet requirements of ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities, ASME NQA-2-1989, Quality Assurance Requirements for Nuclear Power Plants, and applicable DOE orders. These requirements are further amplified in the Quality Assurance Requirements Document to include additional management controls felt to be necessary to support the NPR Program objective to provide a level of quality that meets or exceeds that afforded to the public by modern commercial nuclear power plants.

3.4.2 Configuration Management. A formal configuration management process shall be established and used throughout the new production reactors' life cycle to ensure that requirements are clearly defined and controlled and that the reactor systems and subsystems satisfy the technical, safety, and operational needs.

3.5 SAFEGUARDS, SECURITY AND EMERGENCY PLANNING

Public awareness of the need for emergency risk management and security in the construction and operation of nuclear reactors has increased greatly since the first production reactors were built four decades ago. Since then, experience has shown that effective emergency planning and security requires a comprehensive approach beginning with siting and technology selection, through design and construction, and into the development of operational procedures.

3.5.1 Safeguards and Security. The new production reactors shall incorporate measures necessary to prevent unauthorized access to nuclear material items, theft, diversions, hoaxes, and other malevolent acts, including sabotage intended to release radioactivity or disrupt operations, based on a specified year 2000 threat.

3.5.2 Emergency Planning. The new production reactors shall be designed with the goal to eliminate the need for offsite evacuation and sheltering. In addition, new production reactors features and information necessary to support effective site emergency response actions shall be included in the design and coordinated with the emergency planning of the respective DOE site.

3.6 OPERATION AND TRAINING

NPR Program requirements extend to operational procedures and the training required to implement them.

3.6.1 Maintenance. The new production reactors shall be designed for ease of maintenance, in-service inspection and surveillance testing; ready access to equipment; providing support equipment located and sized to facilitate work; assuring that systems and components have high reliability; use of automation when cost effective and safety enhancing; providing for mockups and training aimed at reducing radiological exposure; and easy replacement or repair of components.

3.6.2 Pre-Operational Testing. Pre-operational testing and start-up testing shall be planned and conducted to assure proper performance of components and subsystems individually and as part of the overall plant system performance. The plant shall be designed for ease of system and hardware checkout.

3.6.3 Staff Training. An operator training plan shall be implemented which meets DOE and commercial standards and which makes full use of a training simulator which itself is based on the plant dynamic model and Three Mile Island lessons learned. Retraining and recertification will be part of the operator training plan. Training of other reactor staff will also be conducted based on standards consistent with the importance of the function and complexity of the operations.

3.6.4 Minimize Operator Actions. The plants shall be designed to minimize the need and maximize the time for operator actions in response to operational transients, design basis events, severe accidents and other non-routine activities during normal operations, start-up, shutdown, and surveillance testing.

3.6.5 Instrumentation and Plant Controls. The design of the man-machine interface for operation and control of the reactors shall incorporate human factors engineering principles and operating experience to promote safety and high operational reliability. The design shall incorporate the appropriate instrumentation and controls to provide the operators with diagnostic and mitigation capability.

3.6.6 Technical Specifications. Technical specifications shall be used in the operation of the new production reactors. The technical specifications shall be developed during the design process to define safety limits; limiting safety system settings; and limiting conditions for operations, surveillance testing, and pre-operational testing and start-up.

3.7 DESIGN GUIDANCE

The Program will incorporate a design philosophy based upon a conservative approach that includes; defense in depth, so as to provide multiple and diverse barriers to the release of radioactivity; inherent and passive safety systems to the extent practicable; minimization of engineering and technology development where possible; and use of extensive analyses and tests for design confirmation.

The advancement of nuclear reactor technology is neither a mission nor an objective of the Program. However, there is a level of confirmatory engineering and technology development work that will be necessary to assure the designs will meet production requirements and will incorporate modern safety and environmental technology.

3.7.1 Safety First in Design. The NPR Program design process shall resolve competing interests in a manner which recognizes the following priorities: public and worker health and safety; environmental protection; production; and cost.

3.7.2 Design Integration. The design process shall recognize the close relationships and interactions among plant systems and safety, constructability, operability, and maintainability.

3.7.3 Inherent and Passive Safety Systems. To the extent practicable, the new production reactors designs shall incorporate inherent and passive safety systems and features.

3.7.4 Defense in Depth. The designs shall utilize the fundamental principles of defense in-depth (i.e., redundancy and diversity) to provide multiple levels of assurance that critical safety functions are achieved and multiple barriers to the release of radioactivity will be provided. Defense in depth shall be provided for normal operations, anticipated operational occurrences, and postulated accidents.

3.7.5 Simple Designs. The facility and systems designs shall be simplified to improve safety, reliability, constructability, operability, inspectability, and maintainability.

3.7.6 Development Support. The designs shall utilize existing technological advancements, thereby minimizing engineering and technology development. Activities requiring development support to successfully provide a viable design shall be planned and approved in advance.

3.7.7 Site-Related Hazards. The reactors shall be designed to accommodate seismic events, floods, winds, and other site-related hazards.

3.7.8 Deterministic and Probabilistic Analysis. The design method shall rely upon a conservative deterministic analytic approach that establishes operational and design limits for systems and equipment considering the most challenging "credible" circumstances. Probabilistic analysis shall be used to evaluate plant reliability and availability, to measure safety function reliability, to assist in systems optimization during design, to minimize the potential for operator error, and to characterize and manage the risks to the public and lost production associated with postulated accidents.

3.7.9 Design Confirmation. The design will make extensive use of analysis, prototype mock-ups, first article evaluations and tests to confirm the performance of key structures, systems, and components.

3.7.10 Design Capability. Where reliability goals exceed demonstrated capability of the design and it is necessary to ensure a greater reliability for safety or production, additional systems shall be provided to achieve the reliability goals. Diversity of system design and physical separation shall be practiced.

3.7.11 Decontamination and Decommissioning. The design of new production reactor facilities shall include features to enhance the safety and efficiency of decontamination and decommissioning as well as reduce the amount of material requiring offsite disposal.

3.8 TECHNOLOGY TRANSFER

The NPR Program has two important relationships with the existing technology base. First, the NPR Program will draw on this technology base to the maximum extent possible in order to ensure that the Program incorporates the "best available" features that have been developed in other reactor programs--both U.S. and foreign--to ensure safety, reliability, efficiency, and compliance with environmental requirements. Second, the NPR Program will make every attempt to ensure that innovations and "lessons learned" in the course of the Program flow back into this technology base.

3.8.1 "Best Available" Features. The NPR Program will develop and implement a plan for systematically identifying features and technologies developed in other U.S. and foreign reactor programs. These innovations and features will be used as appropriate to ensure and improve the safety, reliability, efficiency, and environmental compliance of NPR Program facilities.

3.8.2 Technology Flow-Back. Innovations, designs, operational approaches, and other forms of technology developed in the course of the NPR Program will be made available to the U.S. private sector to the maximum degree compatible with the ability of the Program to achieve its primary objective, i.e., providing safe and environmentally acceptable tritium production capacity. Special emphasis will be placed on technology related to efficiency, safety, and environmental protection. Provisions for technology transfer from the NPR Program will be consistent with Federal law encouraging such activities and, in particular, the Federal Technology Transfer Act of 1986.

These requirements are to be used as the basis for selecting among options for NPR design and operational plans. They will be periodically reviewed and revised as necessary along with the rest of the NPR Program Plan.

4.0 DESCRIPTION OF OPTIONS

The two main sets of options available to the NPR Program concerned the types of reactors to be selected for construction and where to build the reactors that were selected. This section describes the various technologies and sites that were available for consideration.

4.1 AVAILABLE NUCLEAR REACTOR TECHNOLOGIES

The Department of Energy had a number of nuclear reactor programs underway that the NPR Program was able to draw upon. These programs were divided into the following technologies:

- **Heavy Water Reactor (HWR)**
- **High-Temperature Gas-Cooled Reactor (HTGR)**
- **Light Water Reactor (LWR)**
- **Liquid Metal Reactor (LMR)**

For the most part, production reactors operate according to the same physical processes as any other nuclear reactor. At the heart of a nuclear reactor is the "core" where fissile material (i.e., elements that will split apart when struck by neutron, producing both heat and additional neutrons), such as uranium, is arranged in a manner designed to promote a "chain reaction." A single fission event in uranium will produce, on average, approximately 2.5 neutrons; each of these "second-generation" neutrons is then capable of producing another fission event, and so on, thus producing a chain reaction.

To properly control the chain reaction, additional systems and components are placed in the core. Because the neutrons produced during fission are high energy, or "fast" neutrons, and uranium fissions much more readily with "slow" neutrons; the speed of the neutrons must be reduced. This function is provided by what is called the moderator. To control the rate at which neutrons are produced within the core, and thus the rate at which the chain reaction proceeds, the core is provided with a means to absorb excess neutrons. This is normally performed with "control rods" constructed from neutron absorbing materials, such as boron.

Additional systems are also required to run a nuclear reactor. A cooling system is required to carry away the heat produced by nuclear fission, to avoid overheating the core. In the case of electricity-generating nuclear reactors, the coolant which carries away the core heat transfers that heat to secondary coolant, which then provides the motive force to power generation machinery. In many reactors, the coolant serves a dual function as moderator.

What is unique about a production reactor is that it is designed and controlled in such a manner that neutrons over and above those required to sustain the chain reaction, are produced. These neutrons react with specially constructed and placed "targets" in the core. These targets contain lithium which, when it reacts with the neutrons, produces tritium (and helium as a byproduct).

A variety of materials have been used as moderators and/or coolants, and this is one key feature that distinguishes the four reactor designs that were considered. The HWR uses heavy water (i.e., water composed largely of deuterium, rather than hydrogen) both as a coolant and a moderator. The HTGR uses a graphite moderator and an inert gas, helium, as a coolant. The LWR uses the common form of water, i.e., water composed of oxygen and hydrogen as the coolant and moderator. The LMR is cooled with liquid sodium.

In addition to the reactors listed above, the Department considered one other technology, not based on a nuclear reactor, as a means to produce tritium: the use of a linear accelerator. This technology uses an electro-magnetic system to accelerate protons and directs them with sufficient velocity into a lithium-bearing target array. Although the basic technology for linear accelerators is well understood, this approach has never been used to produce tritium or any other nuclear material in large quantities.

Each of the technological options listed above is described in greater detail in the following sections.

4.1.1 Heavy Water Reactor Technology Description. HWRs are currently used for tritium production; the U.S. heavy water production reactors now in operation are located at the Savannah River Site (SRS), where they have been in operation since 1954 and have compiled more than 130 reactor-years of operating experience.

A HWR operates at low temperature and pressure, utilizing highly enriched uranium fuel clad in aluminum, heavy water coolant and moderator, and thermal discharge to cooling water circulated through a cooling tower. Figure 4-1 provides a schematic of a HWR that is being considered for the NPR Program.

As the diagram shows, the reactor is designed around a core containing the fuel elements, target elements, and control and safety rods. The core is contained in a reactor vessel approximately 20 feet in diameter and 30 feet high. These components, in turn, are housed in a steel containment structure designed to contain any possible leakage of material from the reactor. Supporting systems, such as systems for monitoring and controlling the reactor may be located outside the containment structure.

The HWR reactor core, which is rated at 2,500 MWt, is a vertical flow-tube type. The core provides positions for 414 fuel and target tube assemblies, 61 hexafoil (control and primary shutdown rod) assemblies, 78 blanket assemblies, and 84 vacant spaces. Each assembly is surrounded by a flow tube which is mated with the upper and lower plenums. During operation, the heavy water in the core acts as the moderator. However, some acts as a coolant; the flow tubes separate the heavy water coolant from the

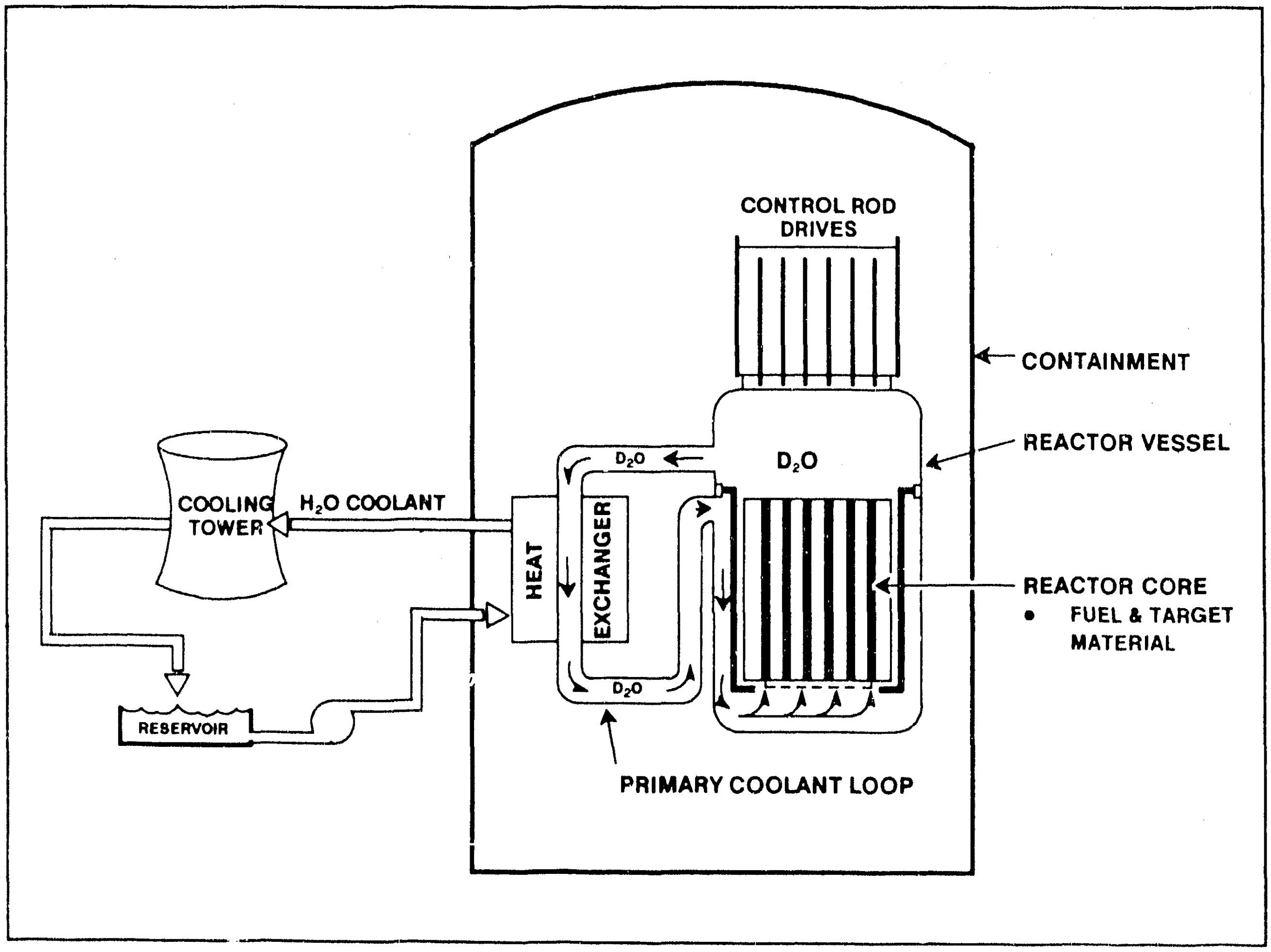

Figure 4-1
HWR Flow Diagram

bulk of the heavy water. The flow tubes are configured to permit the insertion and removal of the fuel, hexafoil, and blanket assemblies. In operation, the reactor's control rods are withdrawn from the core so that the fission reaction can proceed in a controlled manner. The coolant flow of heavy water into the reactor core is from the reactor pressure vessel inlet nozzles into the annulus between the vessel and the core barrel, then into the lower plenum and up through the core support plate, where the flow is distributed to both flow tubes and the moderator region. The coolant flows upward between the fuel and target assemblies. The moderator flows upward around the outside of flow tubes containing either fuel/target assemblies, blanket assemblies, or the control rod assemblies. The flow then passes into the upper plenum (where coolant and moderator are again mixed), leaving the reactor vessel through the outlet nozzles. The heat, generated in the core, is transferred by the reactor heavy water to a secondary coolant of ordinary water via heat exchangers and ultimately discharged into the environment via cooling towers.

The HWR will have several features that enhance safety. The HWR will operate at moderate pressure and low temperature, and therefore have low stored energy. The normal operating temperatures will provide large margins against fuel damage in the event of reductions in core cooling or system pressure. In addition, the HWR will include safety protection systems as indicated below:

- **Redundant Means of Shutdown.** These include primary shutdown rods (the hexafoil assemblies), secondary shutdown rods, and a soluble neutron poison system utilizing gadolinium nitrate. Both the primary and the secondary shutdown rods are activated by gravity. The reactivity of the soluble neutron poison system is equal to that of the primary and secondary shutdown rods combined.

- **Containment.** The steel containment vessel has been designed to mitigate the challenges from a broad spectrum of severe accidents from both internal and external initiators. It and the concrete shield building surrounding the vessel provide substantial protection.

- **Passive Safety Features.** Wherever possible, the HWR will be designed to include passive safety features and human factors engineering. Specific safety features to be included are passive cooling design features, such as gravity feed and natural thermal circulation of cooling water, and the design of the containment structure steel shell and concrete external shell so that natural convection cooling occurs between the two structures in the event of an accident and loss of active cooling systems.

- **Additional Safety Features.** In addition, safety has been enhanced with such active systems as hydrogen igniters to prevent the accumulation of hydrogen within the containment structure in the highly unlikely event of a severe accident; a containment spray system to reduce contamination and pressure within the containment structure; an automatic containment structure isolation system; and a water injection system for core flooding and long term heat removal in the event of an accident.

4.1.2 High-Temperature Gas-Cooled Reactor Technology Description. The technology of the gas-cooled graphite-moderated reactor has its roots in the early history of nuclear reactor development. Commercial deployment of this reactor type began with the Magnox reactors built in the mid-1950s in Britain and France. Operations continued until the early 1970s. Beginning in the early 1970's, consideration was given to the next generation of gas-cooled reactors, the high temperature gas-cooled reactor (HTGR). These reactors all used helium as the primary coolant and a graphite and uranium based fuel.

The HTGR considered for use in the NPR Program uses a graphite moderator; a fuel using highly enriched uranium particles formed into fuel compacts; and helium coolant in the primary cooling loop. The graphite structure accommodates high coolant temperatures which provide heat to power a steam based electric power cycle. The HTGR fuel particle has been under development since the early 1970's and consists of a uranium kernel coated with pyrolytic carbon and silicon carbide to contain the fission products. The graphite block that moderates the neutrons also provides a massive thermally stable heat sink.

The current design for the NP MHTGR uses 660 fuel/target assemblies (Figure 4-2) arranged in a 10-block-high annular configuration within the reactor vessel which is connected to the steam generator. The plant consists of four reactor modules, each rated at 350 MWt. The components for each module (Figure 4-3) are contained within two steel vessels: a reactor vessel and a steam generator vessel, which are connected by a concentric cross-duct. The reactor vessel contains the core and targets, reflector, and associated support structures. Top-mounted standpipes contain the control rod drive mechanisms and the independent reserve shutdown systems. The standpipes are also used for refueling and retargeting. The steam generator vessel contains the helical coil steam generator and the main helium circulator.

In operation, the helium coolant flows downward through the core, where it absorbs heat from the graphite moderator that was generated by the nuclear reaction in the fuel particle compacts. The hot helium then exits the core and flows through the inner cross-duct and downward into the steam generator, where heat is transferred to the water contained in the generator coils to make steam. The cooled gas then flows upward through an annulus between the outside of the steam generator bundle and the inner surface of the vessel, is recompressed by the circulator and driven into the annulus between the inner and outer cross-duct. The cooling gas then enters the reactor vessel and flows up through the annulus between the core and the inner surface of the reactor vessel to the top of the core, completing the circuit.

In the secondary flow circuit, feedwater is transformed to superheated steam in the steam generator. Under current plans, the steam, after exiting the steam generator vessel, will be directed to a power conversion system incorporating steam turbine driven electric generators. The sale of electricity would reduce the life cycle costs of the plant. As a method to ensure a

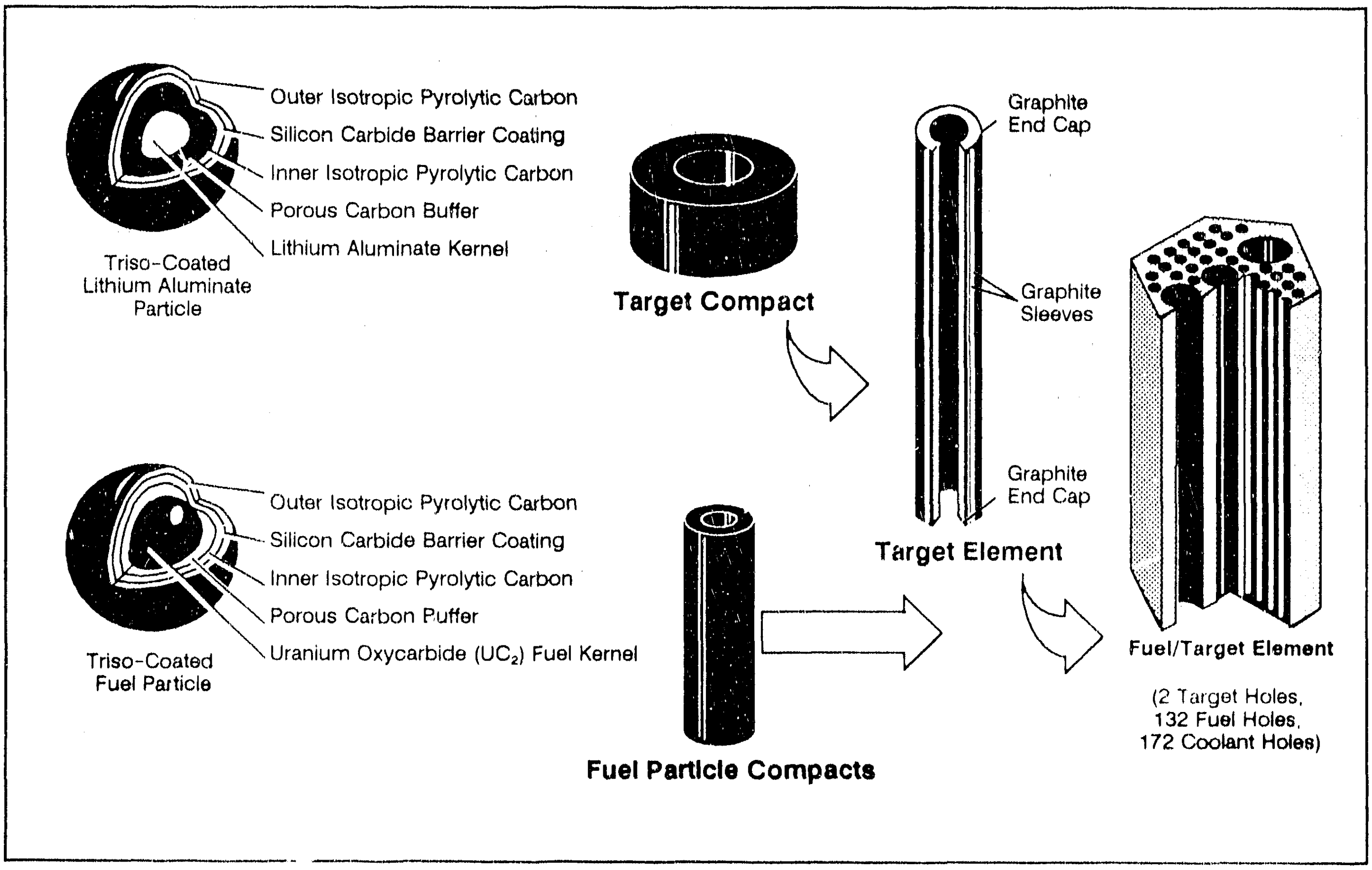

Figure 4-2
MHTGR Fuel/Target Assemblies

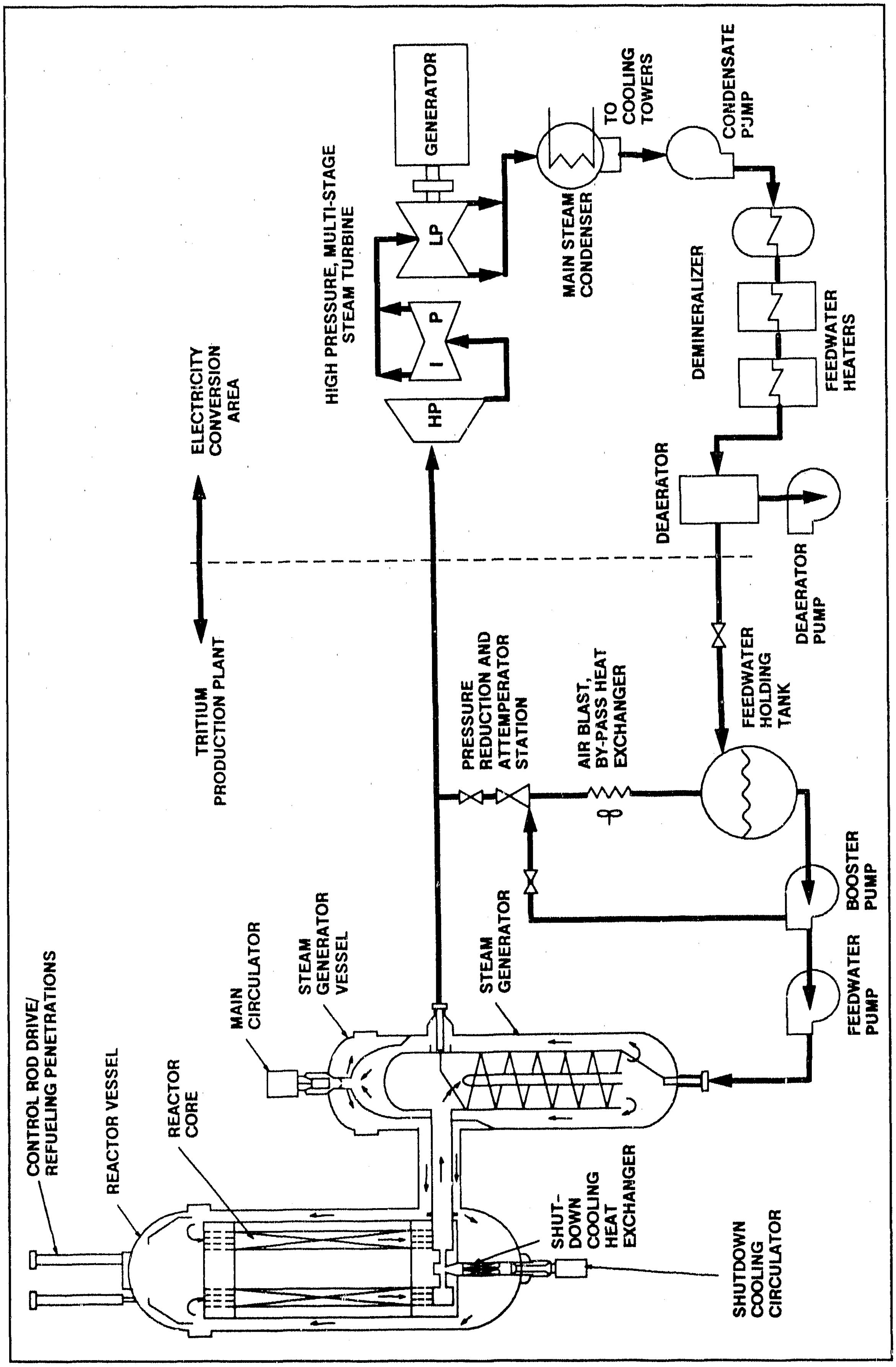

Figure 4-3
MHTGR Flow Diagram

constant and reliable means of tritium production, the steam can also be piped to an airblast heat exchanger, where the steam is condensed into water and returned to the steam generator through a condensate and feedwater system.

Consistent with the NPR Program requirements and the inherent characteristics of the MHTGR, passive features are incorporated in the MHTGR design with the objective of eliminating the need for active powered systems or operator actions to accomplish the safety functions. Specific features include:

- **Core Power and Power Density**: The maximum thermal output of the reactor core has been kept low to limit the amount of decay heat that must be dissipated during an accident--a key factor in enabling inherent safety.

- **Core Geometry, Reactor System:** The below grade containment, annular core geometry, large height to diameter ratio, and the uninsulated steel reactor vessel have been selected to ensure adequate decay heat removal from the core during a severe accident using only passive radiation and convection heat transfer from the reactor vessel to the metal containment structure. The ultimate heat sink is the surrounding earth that the containment structure is buried in. Fuel temperature would remain below the failure threshold.

- **Below Grade Containment Silo Installation** - The reactor module arrangement and installation below grade in a steel-lined containment silo reduces the seismic loading and provides containment of radionuclides in the event of fuel failure and leakage from the primary system.

- **Module Arrangement** - The reactor, crossduct and steam generator vessels are arranged to place the water sources below the core to limit the potential of water ingress.

In the preferred approach, the irradiated target element will be sent to an adjacent facility for extraction of the tritium which will be shipped to Savannah River for the final processing. Adjacent facilities will fabricate the fresh fuel and target kernels.

4.1.3 <u>Light Water Reactor Technology Description</u>. The LWR technology considered for the NPR Program is based on low enrichment uranium oxide fuel clad in zircaloy and cooled and moderated by ordinary water at high temperature and pressure. The LWR incorporates the most mature and widely used nuclear technology for power production available today in the United States and the world. At the present there are 111 LWR electric plants operating in the United States. The LWR technology includes extensive experience in design, licensing, equipment fabrication, construction, operation, and supporting infrastructure. Life-cycle costs of a light water production reactor could be reduced by the sale of steam or electricity.

The main technical gaps in the use of LWR technology as the basis of a production reactor are: 1) there is no U.S. experience in operating a LWR reactor for such a purpose; and 2) there is no U.S. experience in the construction or use of tritium targets in a LWR. The development of high-temperature targets for a LWR would present some technical and schedule risks. Irradiation testing of target elements in a LWR environment is being conducted to demonstrate the target technology.

One option that could be pursued if LWR technology is selected as the basis of a production reactor is the use of WNP-1, a partially constructed plant designed and planned for the Washington Public Power Supply System. WNP-1 is located on DOE's Hanford site near Richland, Washington. All of the main structures of the reactor are complete and all of the heavy equipment that have long lead times for design and procurement, including the turbogenerators, are on site or installed.

Construction was 63% complete when activities were suspended in 1982. The WNP-1 is being maintained under an NRC-approved preservation plan. The plant includes a Babcock and Wilcox 205 fuel assembly core rated at 3780 MWt, with a single turbine generator rated at 1250 MWe. There is no requirement to do any reactor design work for this technology prior to the Record of Decision.

The WNP-1 would use conventional LWR fuel in the form of uranium oxide pellets, enriched to 8-10 percent U-235. This approach uses well-established methods for LWR fuel fabrication, modified only to provide modest increases (to 8-10 percent) in the level of enrichment over that used in power reactors. The use of low enrichment fuel in the LWR was adopted in order to avoid safety issues that would have been raised if a highly enriched core were utilized and to make fuel reprocessing optional rather than required.

Modification of some existing components and development of target-related equipment would be required to use WNP-1 for tritium production. Safety and environmental aspects would be comparable to those of commercial LWRs. This option offers the possibility of a short schedule and low project cost, but it depends upon successful demonstration of the targets.

4.1.4 Liquid Metal Reactor Technology Description. The LMR technology that was initially considered for the NPR Program utilized highly enriched uranium metal fuel clad in stainless steel and cooled with liquid sodium. The neutron spectrum is epithermal since there is no moderator. The LMR is potentially a very efficient producer of tritium and high-grade plutonium, in terms of atoms per unit fission. The long-term operation of the Experimental Breeder Reactor-II (EBR-II) indicated that reliable core materials and fuel cycle operation could be achieved.

The LMR has no proven target technology or tritium target system. Essentially no target development has been initiated specifically for the LMR. Thus, there is greater uncertainty in the time and cost of LMR target development than for the other technology concepts. However, a number of promising target concepts exist, based partially on tests with other coolants. In the reference system presented for the LMR, the reactor operating temperature was reduced some 300°F from power reactor conditions to minimize target development uncertainties.

A lithium/aluminum (LiAl) intermetallic alloy was identified as a reference target material for the LMR. There is some metallurgical experience with this material from the advanced battery program. The extensive HWR experience with LiAl is only partially relevant because the LMR requires a much higher lithium content in its target, and is, therefore, a mechanically different alloy. The tritium recovery phase would be similar to the HWR process, except for decladding.

The fast neutron spectrum of the LMR requires lithium enriched with the lithium-6 isotope, and a high lithium inventory and throughput. A once-through lithium cycle is, therefore, impractical for the LMR. Development and qualification of a lithium recycle process would be required.

The general world-wide state of LMR technology is approaching commercial status. In the U.S., the EBR-II and Fast Flux Test Facility test reactors, both of moderate size, have operating records with high capacity factors and demonstrated safety features. Some difficulties have been experienced (world-wide) with steam generators; the lower operating temperature of a LMR production reactor would place less demand on the heat removal components than the reference power reactors. Nevertheless, extensive development, testing, and qualification work would be necessary to design and validate a NPR version of the LMR.

4.1.5 Production Via Linear Accelerator. DOE has also considered the use of linear particle accelerators to produce tritium. Under this approach, protons would be accelerated via a series of phased electromagnets to a sufficient velocity, and then directed at a lithium-bearing target array. The primary advantage of this approach is the elimination of the need to construct and operate a new reactor. By doing so, one would eliminate the problems associated with storing and disposing of radioactive waste resulting from the operation of nuclear reactors and would concurrently decrease the demand for enriched uranium. Some experts prefer tritium production with a linear accelerator because it is perceived to be inherently safer and have environmental advantages. A linear accelerator should present a lower risk to the public from radiation release or the release of toxic substances.

Tritium production using a linear accelerator has a number of significant disadvantages in that this option presents a high level of technological uncertainty and thus, a greater risk of failing to meet the schedule and operations requirements for tritium production capability. Linear accelerators have been in operation for many years, yet no one has attempted to adapt the technology to quantity production of nuclear materials. An accelerator designed for materials production would require much more power, beam strength, and much higher reliability than those currently in operation, which are used almost entirely for research purposes. Also, engineering details, such as system integration, support systems, and target design have not been worked out.

In addition, a linear accelerator used for tritium production would require significant electric power generation above existing capacity. DOE estimates that such an accelerator would require at least 900 megawatts of electricity. These requirements could be met currently, however the potential negative impact on near term economic growth and expansion have not been evaluated. Also, according to Energy Information Administration projections, by the year 2010 it is highly unlikely that the U.S. would have excess capacity of this magnitude available. Therefore, such an approach would require the planning, design, and construction of at least one additional power generating plant, which itself would present significant cost and environmental concerns.

As a result, use of a linear accelerator as proposed presents unacceptable risks in the areas of cost, assured production, and possibly other areas, such as environmental protection. Also, it is likely that, because of the requirements for additional engineering development, a linear accelerator designed for nuclear materials production would require more time to reach operational capacity than would a reactor. The delay in establishing an assured tritium supply is considered unacceptable.

4.2 SITING OPTIONS

The Department of Energy identified three DOE-owned sites that could be considered as candidate locations for new production reactors:

- The Savannah River Site, South Carolina
- The Idaho National Engineering Laboratory, Idaho
- The Hanford Reservation, Washington

Figure 4-4 shows the locations for these candidate sites.

4.2.1 Savannah River Site Description. The Savannah River Site is located on about 300 square miles along the Savannah River near Aiken, South Carolina. It is presently the Department's only active tritium production location.

HWR production reactors, producing plutonium as well as tritium, and one test reactor, have been operated at the site since it was established in 1950. Production reactor fuel and target materials are processed in two large facilities there, and a variety of spent fuel from research reactors is reprocessed at the site.

Existing and planned facilities at the Savannah River Site are adequate to support a production HWR without substantial additions or modifications. New facilities or modification of older ones for fabrication, processing, and development would be required for other technologies. A new Replacement Tritium Facility, currently under construction at the site, will be used for tritium loading regardless of where the NPRs are located. Waste management facilities are considered adequate, including the Defense Waste Processing Facility scheduled for start-up in the near future.

The Savannah River Site has been extensively studied during the preparation of several past and current environmental impact statements concerning various operations at the site. There are no apparent hydrologic, geologic, or meteorologic conditions that would preclude building a new production reactor at the site. Additionally, the site is sufficiently remote from population centers and public facilities to meet applicable siting criteria.

4.2.2 Idaho National Engineering Laboratory Site Description. The Idaho National Engineering Laboratory, located in the southeastern part of the state, is an area of about 890 square miles and is generally flat, dry, and extremely remote. The laboratory's principal mission for the past 35 years has been R&D associated with virtually all nuclear reactor technologies and supporting operations. A total of 52 reactors have been operated on site, of which 14 are currently operable.

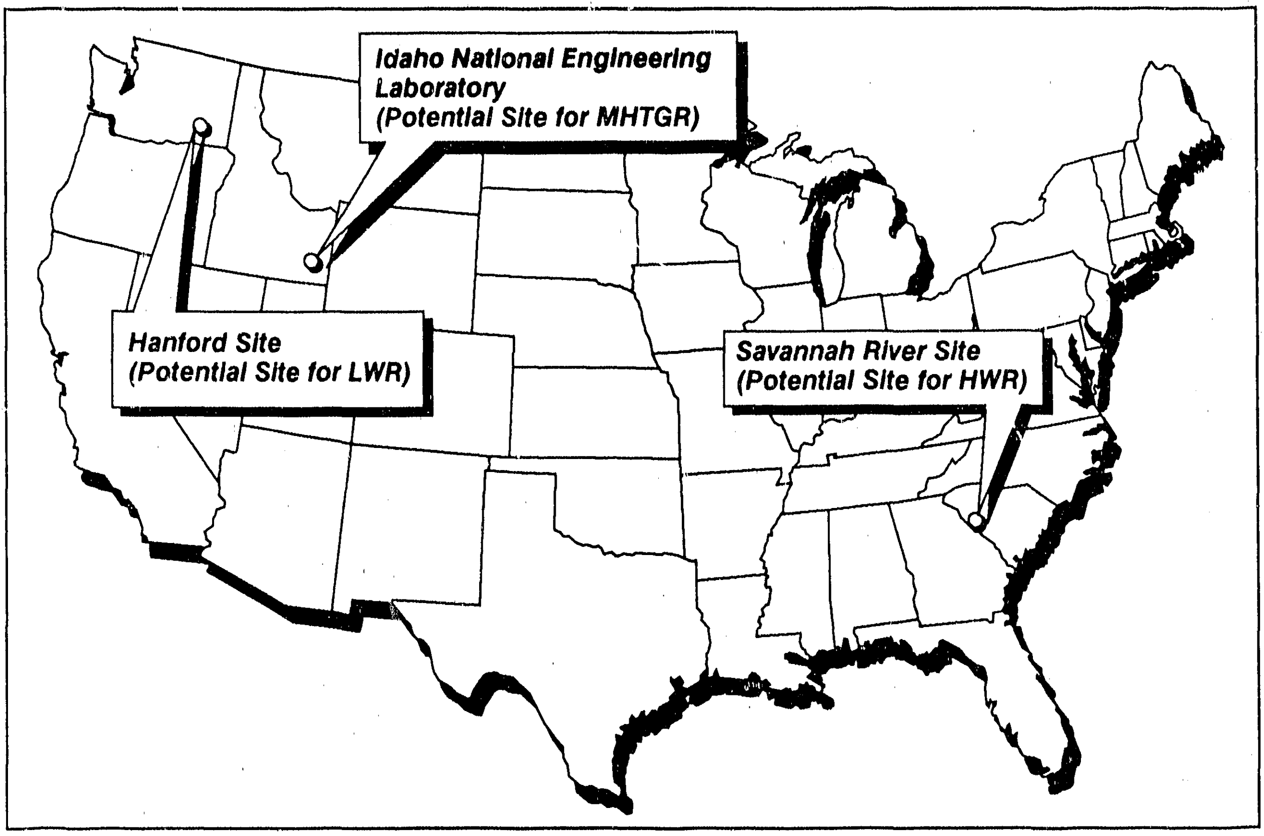

Figure 4-4
Candidate New Production Reactor Sites for DOE's Preferred Strategy

The Idaho National Engineering Laboratory has served as a DOE processing site for spent fuel from naval reactors. The site's tritium-related experience stems from R&D work associated with the MHTGR and LWR technologies. The Advanced Test Reactor and the Idaho Chemical Processing Plant, used for nuclear processing and related waste management operations, provide extensive operating experience that is important to tritium production operations.

The Idaho site would require new fuel and target fabrication facilities to support an NPR. Where possible, existing facilities, such as the waste management facilities, representing one of the most diverse, state-of-the-art, waste management capabilities in the DOE complex, would be sufficient to support a new production reactor.

The lab's operations have been subject to environmental monitoring since the site was established, and the reservation is environmentally well-characterized. There are no known geologic, hydrologic, or meteorologic conditions that would preclude construction and operation of a new production reactor plant at the site.

4.2.3 Hanford Reservation Site Description. The Hanford reservation covers 560 square miles in the south central part of Washington and is generally flat, dry, and remote. Hanford has functioned as one of the nation's principal materials production sites since it was established over 40 years ago and, in recent years, has served as DOE's primary producer of plutonium. Currently, no plutonium is being produced in DOE's weapons complex. Tritium production was demonstrated at the site in the 1960s.

Over the years, nine production reactors and two test reactors have been operated at Hanford, including the N Reactor, a production reactor recently placed on standby, and the Fast Flux Test Facility, a liquid metal reactor. Within the Hanford Site is the Washington Public Power Supply System complex which includes WNP-1.

The Fuels and Materials Examination Facility at Hanford is a new, unused safety grade structure which was built to meet modern nuclear reactor design requirements and was specially designed to safely handle nuclear materials. It has been equipped for liquid metal reactor fuel fabrication and examination. It has ample space to house several support functions associated with an NPR and could be equipped for any of the candidate technologies. Technologies under consideration for an NPR would require new reprocessing facilities and modifications to existing fuel and target fabrication facilities.

Existing or planned waste facilities at Hanford would be adequate to support an NPR.

Through extensive environmental characterization, it has been determined that there are no geologic, hydrologic, or meteorologic conditions that would preclude construction or operation of a new production reactor at Hanford. The site is remote from population centers and public facilities. A draft environmental impact statement for the Hanford Site was prepared by the Nuclear Regulatory Commission for a previously proposed commercial reactor.

5.0 ASSESSMENT OF OPTIONS

The Department of Energy has developed its "preferred strategy" for the NPR Program. This strategy is a basic, no-frills approach. It requires no additional research and minimizes engineering development wherever possible. It is focused on meeting the immediate needs that define the mission of the NPR Program: providing assured tritium production capacity in a safe, environmentally responsible manner on an urgent schedule.

While the preferred strategy, as designed, achieves the objectives assigned to the NPR Program, it is also the minimum level of capability that can do so. Elimination or reduction of any of the major features of the preferred strategy would result in significant gaps in the ability of the Program to meet the requirements specified in Section 3.0.

A central concept underlying the preferred strategy is "duality." This means that the NPR Program is based on having two sites and two reactors, each using a different technology. Duality is essential assurity for meeting the Program requirements that have been defined. For example, two separate sites are necessary in order to provide the survivability of production capacity required against a hostile act or natural disaster. Similarly, the use of two distinctly different reactor technologies is necessary in order to avoid the threat of a generic technical issue leading to the shutdown of all U.S. production capacity should only a single technology be employed.

5.1 HOW THE PREFERRED STRATEGY WAS DEVELOPED

Studies concerning the safety, reliability, and capacity of U.S. production reactors have been carried out by DOE, other government agencies, and non-government organizations for at least a decade. The preferred strategy in this Program Plan, however, can be directly traced to the result of a 30-month process in which DOE:

- Assessed the demand for tritium necessary to support the production and maintenance of U.S. nuclear weapons;
- Assessed the current condition and capabilities of existing production reactors;
- Developed and analyzed a complete set of operational requirements for production capacity, public safety, environmental compliance, and worker safety; and
- Identified and analyzed all available reasonable options for the siting and technological basis of new production reactors.

In this process, a number of major studies were undertaken. These studies and their main findings are described in the following section.

5.1.1 Previous Studies and Assessments. In January 1988, the Secretary of Energy initiated two studies to support the planning of a new production reactor program. These studies were to address the two most important features of such a program: the technologies upon which the reactors would be based, and the sites at which the reactors would be built. These two factors are critical as they are the most important in determining the costs of the program and its performance characteristics.

5.1.1.1 Technology Assessment. The Secretary directed a review and assessment of reactor technologies being considered by DOE to be carried out by the Energy Research Advisory Board (ERAB), a standing independent advisory committee. ERAB convened a panel of 19 experts in the management of reactor facilities, nuclear engineering, engineering of large energy systems, safety and environmental concerns, and physics.

The reactor technologies considered in the ERAB evaluation process were heavy water reactor; modular high-temperature gas-cooled reactor; light water reactor; and liquid metal reactor. The Secretary also requested that the board review and assess the DOE-proposed selection criteria; the adequacy of each technology to meet the criteria; schedule, technical risks, benefits and costs of implementing a production reactor program with each technology; and the concept of multiple reactors using the same or diverse technologies at one or more sites.

Based on these objectives, the candidate reactor technologies were evaluated by the ERAB against the criteria in the areas of:

- Technology Base
- Safety and Environment
- Schedule
- Costs
- Industrial Base
- Institutional Acceptability

Criteria one and two were determined to be of equal and primary importance to successfully produce required quantities of tritium on a timely schedule and in a safe and environmentally sound manner. A brief description of the elements within each criterion follows.

- Technology Base. This criterion evaluated the maturity of the technology and addressed the technology base for the NPR. For each reactor concept under consideration, the current, and any required upgrading of the technology base were assessed. The status of the technology and required research and development was identified for tritium production; conversion to plutonium production if this option were to be exercised; reactor design, construction, and operation; fuel cycle facilities design, construction, and operation; and regulatory and safety activities. "Regulatory" was defined as those compliance activities stemming from regulations issued by NRC, DOE, EPA and other Federal, state and local agencies.

- Safety and Environmental. This criterion provided for the health and safety of the public and workers, and assured the ability of the technology to provide reactor safety and environmental protection at least equivalent to those for modern, commercial reactors and fuel cycle facilities. Safety-related factors considered included safety goals, inherent and enhanced safety features, external events, the potential for severe accidents, NRC regulatory requirements, safeguards and security, and target and fuel cycle safety. Environmental factors that relate to operating releases and waste management were addressed.

- Project Schedule. Project schedule combined the assurance of the availability of reactor fuel, target and processing technology for full-scale production on an urgent schedule with a high assurance of meeting that schedule. This criterion focused on bringing on line a reactor capable of producing required quantities of tritium and its supporting facilities as soon as practicable. Examples of major schedule factors addressed for each technology included 1) safety, environmental, and regulatory; 2) technology research and development; 3) design; 4) construction, and; 5) start-up and operation. Specific issues expected to be problems for the technology were highlighted and allowances in the schedule were made for the resolution of these issues.

- Project Costs. One of the project objectives was to produce, in a cost effective manner, required quantities of tritium with a high assurance of success. The principal factors related to the NPR complex addressed were the preoperational costs, capital facility costs, operating and maintenance costs, including fuel and target, potential offsetting revenues, and production rates. For the purposes of this evaluation, the NPR complex was defined to include the reactor (and, if appropriate, a steam or electrical power conversion capability), fuel fabrication, target fabrication, fuel reprocessing, tritium recovery, and target reprocessing capabilities.

- Industrial Base. This criterion defined the extent to which an industry and its infrastructure could mobilize personnel, material resources, and facilities to design, develop, manufacture, construct, and operate the NPR complex.

- Institutional Acceptability. Several institutional factors were considered before the NPR design concept was selected. For the purpose of this evaluation process, the major NPR institutional factors assessed included the potential for contributions to the advancement of nuclear (reactor, safety, environmental) technology, the implications of the duality of technology and sites, any public acceptance considerations relating to the reactor technology, and the impact of the sale of by-product steam or electric power.

5.1.1.2 Site Assessment. Similarly, the Secretary also directed the Assistant Secretary of Energy for Defense Programs to assemble a group of experts to evaluate alternate siting proposals for the new reactors. This group, the Site Evaluation Team (SET), was composed of senior DOE personnel and was mandated to identify and evaluate candidate sites. Three sites met the Department's screening requirements and were evaluated: the Idaho National Engineering Laboratory, Idaho Falls, Idaho; the Savannah River Plant, Aiken, South Carolina; and the Hanford Site, Richland, Washington. The team evaluated the sites on the following criteria:

- Experience Base: The site's capability and experience to manage and operate a production reactor and its associated facilities as well as to direct and manage the various processes and procedures required to design, construct and operate the NPR complex;

- Support Facilities: Specifically, the existence of facilities for fuel and target fabrication, processing, reprocessing, and handling; waste management; fuel and target technology; research and development; and analytical capacity associated with a production reactor; the availability, adequacy and remaining life of the support facilities;

- Environment, Safety and Health (ES&H): The potential for environment, safety and health effects from a new production reactor; physical characteristics of the site; the potential to meet criteria comparable to NRC siting criteria; and projected ability to comply with applicable ES&H requirements;

- Transportation: On-site and off-site transportation facilities and impacts as anticipated during construction and operation of an NPR;

- Cost and Schedule: Cost and schedule aspects of constructing and operating an NPR and its associated facilities, based on preliminary cost data;

- Safeguards and Security (S&S): Existing and projected S&S capabilities at each site and the extent of additional S&S resources that would be required for an NPR and its supporting facilities;

- Utilities: Availability of power and water to support construction and operation of a production reactor; and

- Socio-Economic Factors: The adequacy of public facilities, local services and infrastructure to support construction and operation of a production reactor.

Of these, the SET identified the first three--experience base, site support facilities, and environment, safety and health--as primary criteria and recommended that they be given relatively greater weight than the other criteria. Where appropriate, the evaluations were made on the basis of siting each of the candidate technologies at each candidate site.

5.1.1.3 Assessment of Option of Reliance on Existing Capacity. One option that will be included in the NPR Environmental Impact Statement (EIS) is not discussed in detail here: the option of prolonged reliance on existing reactors. NEPA requires this option to be considered as a starting point for assessing the effects of a new program on the environment. However, it appears that continued reliance on the existing nuclear materials production system will not fully satisfy the Program's safety, environmental protection, and long-term reliability requirements outlined in Section 3.0.

Today, most of the reactors the DOE has built over the last 40 years to produce nuclear materials are shut down, and although the remaining reactors capable of producing nuclear materials are undergoing safety and operational enhancements, they will not operate indefinitely. The reactors that have been used most recently to produce tritium, those at SRS, are over 35 years old and are experiencing aging effects that reduce their operational reliability. These effects are:

- Excessive effort and expenditures in order to meet the levels of safety currently achieved by modern nuclear power plants;

- Difficulty in meeting environmental standards, and questions as to whether future standards can be met in a cost effective manner; and

- Unacceptable long-term levels of reliability in meeting tritium requirements.

5.1.1.4 Results of the ERAB and SET Studies. The reports prepared by the ERAB and SET were issued in early July 1988. The results were reviewed by the Office of the Assistant Secretary for Defense Programs and the Department's Energy Systems Acquisition Advisory Board, a senior management panel chartered by the Under Secretary and charged to review the necessity, advisability, and soundness of major construction projects. In determining its proposed course of action, DOE also engaged in consultations with the Department of Defense, the Office of Science and Technology Policy, the National Security Council, the Nuclear Weapons Council, and the Office of Management and Budget (OMB). The principal topics of concern were the requirements for assured capacity for the production of tritium, the concept of multiple reactors at multiple sites to provide the necessary high level of production assurance, and costs.

In August 1988, DOE issued a report to Congress as required by the Continuing Appropriations Act, Fiscal Year 1988 (Public Law 100-202), announcing the Department's proposal for assuring future tritium production capacity through the building of new facilities. Specifically, the Department announced a preferred strategy that called for the construction of two new production reactors on an urgent schedule at different sites, using different technologies.

5.2 THE DOE PREFERRED STRATEGY

DOE's preferred strategy is to build a new, up-to-date heavy water reactor (the technology currently used for tritium production) and necessary support facilities at the Savannah River Site in South Carolina; and, at the same time, to proceed with the design and construction of a modular high-temperature gas-cooled reactor plant, which would consist of four small reactor modules with common support facilities, to be located at the Idaho National Engineering Laboratory in Idaho.

As a contingency and to ensure that all reasonable options are evaluated, DOE also is considering the use of light water reactor technology similar to that used commercially to generate electricity. In particular, the Department is developing a light water reactor tritium target for possible use in the partially completed WNP-1 reactor located on the Hanford Site, near Richland, Washington. The Department is working toward resolving a number of technical and institutional issues that would be associated with converting this facility for tritium production.

5.2.1 Rationale of the Preferred Strategy. This approach of building two reactors at separate sites, using two different reactor technologies, is termed "duality." This approach will assure that tritium capacity requirements are met should a problem develop at one of the reactor sites. Similarly, two reactors of different technologies provide redundancy and diversity, i.e. -- two independent sources of tritium and it also guards against the risk of a generic technical failure or concern (see Section 3.3) such as currently exists with the P, K, and L reactors at SRS.

DOE carefully balanced the reliability benefits of duality against the increased costs. The overwhelming conclusion from the many participants who were consulted in the development of the strategy was that the production assurance achieved through duality outweighs the increased costs. The major benefits of duality include:

- Much lower risk of simultaneous loss of all production capacity;
- Fewer interruptions in operations when units are down for refueling or maintenance;
- Inherent protection against natural events that might damage a particular site;
- Increased survivability against attack or disruptive events that could jeopardize production; and
- Better flexibility in managing operations and maintenance.

In addition to the general principle of duality, DOE found that a HWR at the Savannah River Site offers the following features:

- The HWR technology is the most mature with over 35 years of tritium and plutonium production;

- Preoperational and capital costs of a HWR facility sited at SRS are reduced because certain auxiliary facilities are already in place; and,

- The SRS HWR experience provides an extensive data base of successful materials production performance from which design and safety enhancements can be applied.

DOE found that a MHTGR at the Idaho National Engineering Laboratory offers the following features:

- MHTGR target technology development is at an advanced stage;

- The modular design, when coupled with the HWR, provides flexibility from phased expansion of individual units to special production tasks;

- The Idaho Site has been involved with gas-cooled reactors since the 1950s and possesses the Department's best MHTGR experience base; and,

- The Idaho Site possesses state-of-the-art reprocessing and waste management facilities that could reduce the cost of waste processing and high-level waste storage.

The preferred strategy provides for initial operations by a new production heavy water reactor at the Savannah River Site beginning around the year 2000. The schedule for a new production modular high-temperature gas-cooled reactor plant at Idaho depends on the construction and testing sequence of the four modules. The option with the least technical risk is based on constructing, loading, and testing the first module prior to building the remaining three modules. This option is the one presented by the Secretary to Congress in August 1988 and would produce tritium from the first module in the year 2000 and from all four modules by 2006.

Another MHTGR option, currently being evaluated, is to build all 4 modules in a sequential fashion that will allow work crews to move from one module to the next as a particular construction or equipment installation step is completed. This option has the potential for achieving tritium production capability from all four modules within a 10 to 12 year timeframe; although with some increased technical risk.

The Department is proceeding with the preparation of an environmental impact statement to assess the potential environmental impacts associated with the siting, construction, operation, and decommissioning of the new production reactor capacity. No final decision on sites or technologies will be made until that process has been completed, which will be in late 1991.

5.2.2 Description of an NPR Complex. Development of a new production reactor complex would include construction of a reactor, construction of cooling towers and other reactor-related support systems, and construction or modification of facilities for one or more of the following isotope production support activities: 1) reactor-fuel fabrication, 2) tritium target fabrication, 3) tritium extraction, and 4) fuel reprocessing.

Operations would include delivering to the NPR sites materials used to fabricate reactor fuel and targets. Materials for reactor fuel would be shipped to the site fuel-fabrication facility, where reactor fuel assemblies would be manufactured. Materials for targets would be shipped to the site target-fabrication facilities where tritium targets would be manufactured.

Both targets and fuel would be transported to an on-site area for assembly into fuel/target elements, and the elements would be placed into the reactor core. After a specified period of reactor operation, the fuel/target elements would be removed from the reactor core and separated into irradiated targets, spent nuclear fuel, reusable fuel, and scrap materials.

In the tritium-production mode, the tritium targets would be sent to the on-site tritium-extraction facilities, where the tritium would be removed and contained. The tritium would then be shipped to SRS, where it would be purified and loaded into warhead reservoirs. The spent fuel would be transported to an on-site storage facility or a reprocessing facility, where enriched uranium and weapons-grade plutonium might be recovered. Any enriched uranium not recycled to the fuel fabrication facility would be shipped to Oak Ridge to meet other reactor fuel requirements.

Any wastes generated by these activities would be segregated into high-level wastes, low-level wastes, transuranic wastes, mixed wastes, and hazardous wastes. Radioactive wastes would be treated on the site and either placed in interim storage for eventual disposal off the site (in the case of high-level and transuranic wastes) or disposed of on the site (in the case of low-level waste). Hazardous and mixed wastes would be disposed of in appropriate, approved facilities.

PART II
IMPLEMENTATION STRATEGY

The implementation strategy for the New Production Reactors Program has three functions:

- Linking the design, construction, operation, and maintenance of facilities to policies, requirements, and the process for selecting options. The development of an implementation strategy ensures that activities and procedures are consistent with the rationale and analysis underlying the Program.

- Organization of the Program. The strategy establishes plans, organizational structure, procedures, a budget, and a schedule for carrying out the Program. By doing so, the strategy ensures the clear assignment of responsibility and accountability.

- Management and monitoring of the Program. Finally, the strategy provides a basis for monitoring the Program so that technological, cost, and scheduling issues can be addressed when they arise as the Program proceeds.

To carry out these functions, the NPR Program implementation strategy consists of the following components:

- An Organization Plan, defining the overall structure of the NPR Program and the responsibilities of individual units within the Program organization.

- Acquisition and Technical Management Plans, defining the individual steps and ongoing procedures through which the NPR Program will be carried out and technically managed.

- Safety, Quality Assurance, Environmental Protection, and Security Strategies, explaining how the NPR Program will address these key concerns; and

- Program Schedule, Cost Analysis, and Staffing, describing how individual steps fit together, milestones for the Program and key decision points, an estimate of program costs and an explanation of the methodology used to make these estimates, and Program staffing requirements.

Like the rest of the Program Plan, the Implementation Strategy is a living document and will be periodically revised to reflect both progress made in the Program and adjustments in plans and policies as they are made.

6.0 ORGANIZATION PLAN

Because of the single mission focus, cost, complexity, and importance of the NPR Program, DOE established a centralized organization responsible for carrying out the Program. This organization provides clear lines of communication and authority, and integrates the many offices, agencies, laboratories, and contractors taking part.

NP is an organization devoted solely to the planning, design, construction, and initial operation of the required new production reactors. When the new production capacity is operating smoothly, the responsibility for operations will be turned over to the Assistant Secretary for Defense Programs. NP has a rank equal to that of the functionally specialized DOE organizations. As such, the NP Program Director reports directly to the Secretary. From the outset, the NP program management approach has been grounded in the following management principles:

- A vertical organization with clear lines of authority and responsibility;
- Sharp interface definition with unencumbered communications;
- Detailed program planning from conception-to-customer turnover, and time-phased technical, cost, and schedule baselines;
- Strong, centralized, and independent program control systems ensuring maximum visibility into program status; and
- Centralization to ensure effective integration of key program components.

The following sections describe the authority and responsibilities of each of the participant organizations in the NPR Program.

6.1 THE OFFICE OF NEW PRODUCTION REACTORS

The Office of New Production Reactors (NP) is directly responsible to the Secretary of Energy. NP consists of offices located in Washington, D.C. and Project Management Offices located at project sites. The organizational components of NP are illustrated in Figure 6-1.

Overall, the NP organization consists of:

- The Office of the Director;
- Three Engineering Technology Offices, one for each of the three preferred NPR technologies;
- Two oversight offices responsible for critical NPR review functions: The Office of Safety and Quality and the Office of Environment;
- The Office of Business Management which provides cross-cutting service functions for NP;
- Three Project Management Offices located at each of the preferred strategy sites; and
- Several advisory and consultative groups.

The roles, functions and responsibilities of the organizational elements are as follows:

- <u>The NP Director</u> is responsible and accountable to the Secretary of Energy for the successful conduct and completion of the New Production Reactor Program by defining program strategy and policy implementing technical and managerial control. The Director is supported by strategic planning and policy staff.
- <u>The NP Chief Engineer</u> is responsible for the systems engineering and configuration management of this NPR Program.
- <u>The NP Construction Manager</u> is responsible for reactor and support facilities construction.
- <u>The Advisory Committee on New Production Reactor Safety (ACNPRS)</u> provides the NP Director with an independent overview and audit capability on all aspects of safety. This organization also will evaluate all safety criteria and requirements established by NP staff organizations.

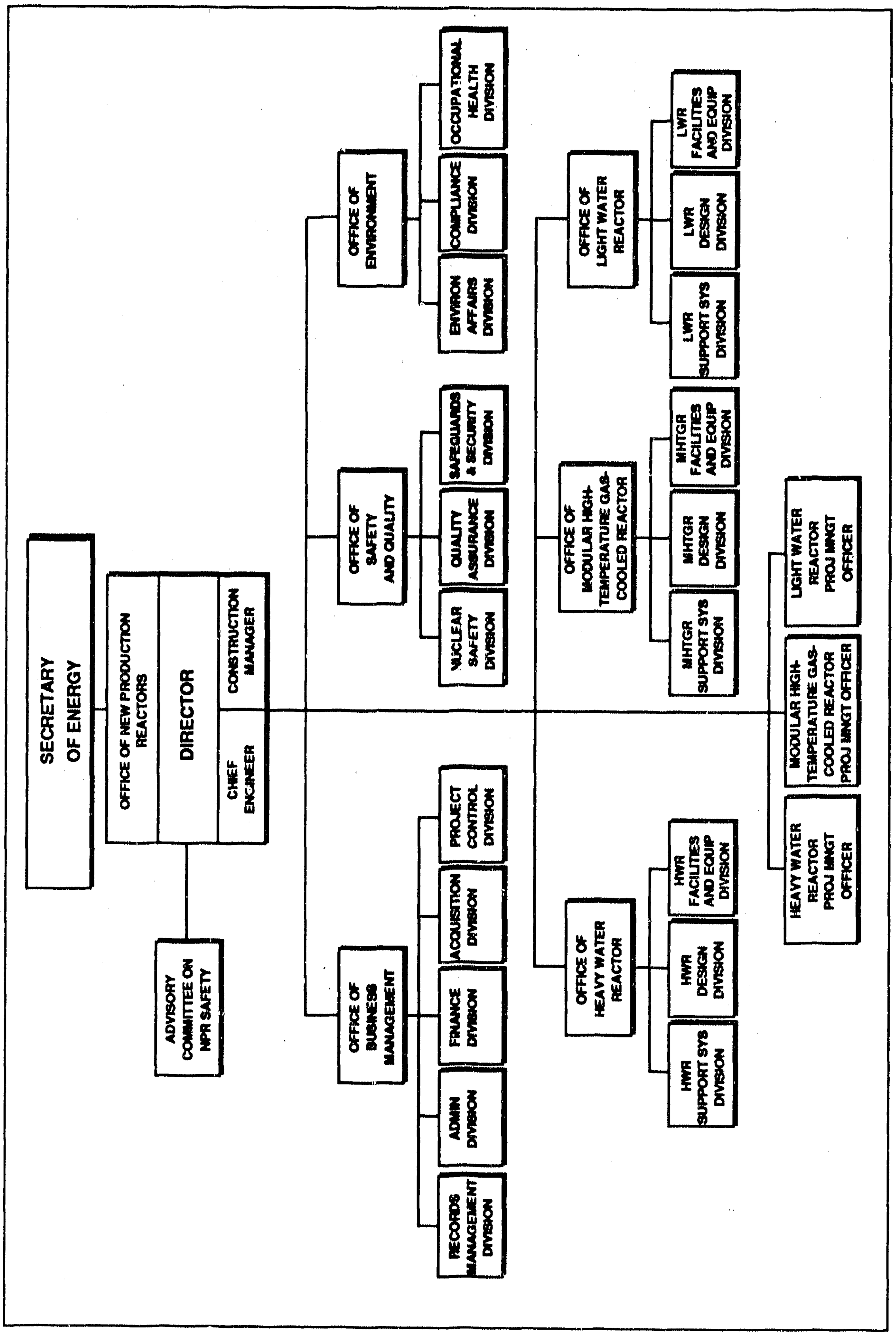

Figure 6-1
Organization for Office of New Production Reactors

- <u>An Engineering Technology Office (ETO)</u> has been established for each of the preferred new production reactor technologies: the Office of Heavy Water Reactor (HWR), the Office of Modular High-Temperature Gas-Cooled Reactor (MHTGR), and the Office of Light Water Reactor (LWR). The NP Director holds the respective ETO Directors responsible for the technical adequacy of their respective projects and associated activities. In particular, the ETO Directors are to:

  -- Be responsible for meeting the safety, quality, environmental, occupational health, and safeguards and security requirements during the design, construction, start-up, and operation of the new production reactors and support facilities.

  -- Maintain technical oversight and technical control of the projects throughout the life of the Program.

  -- Prepare the Technology Project Plan for approval by the NP Director.

  -- Concur on the Technology Project Management Plan which is approved by the Chief Engineer and Construction Manager.

  -- Ensure that the requirements and criteria are adequately established and documented in the basic requirements documents and subsequently in the systems descriptions documents.

  -- Ensure that the respective technical baselines are established and the configuration of the reactor and support facilities is controlled.

  -- Develop and monitor the performance of the project schedules and costs, and develop and control the work breakdown structure.

  -- Be responsible to the NP Director for technical management and control and serve as the Contracting Officer Representative (COR) for the conceptual, preliminary, and detailed designs, including direction to and control of the design contractors.

  -- Assume technical oversight for the design contracts for support facilities (Heavy Water Processing Facility, MHTGR Fuel and Target Fabrication Facility, etc.).

  -- Maintain technical coordination and liaison with other DOE elements, specifically with Defense Programs and Nuclear Energy, and with concerned technical research organizations and contractors.

  -- Oversee and approve the activities of the M&O contractor at the site at least through the preliminary design phase. This arrangement will be reviewed at the completion of the preliminary design.

  -- Plan for, manage, and ensure integration of engineering development and confirmatory tests by DOE National Laboratories, engineering laboratories, and M&O contractors, to the extent that these may be required, for all phases of the project.

  -- Ensure that design packages meet the basic requirements by arranging for and using the technical capabilities of the National Laboratories, the site M&O contractors, and the Utility Engineering Group.

  -- Provide for reviews of appropriate submissions by equipment contractors to ensure that they satisfy technical requirements.

  -- Provide for reviews of operational procedures to ensure that they meet technical requirements.

  In addition, the ETO Directors will conduct readiness reviews to ensure that requirements and procedures are in place, and that capabilities are adequate prior to initiation of project phases. Each of the ETO Offices has a Technical Director and three divisions -- Support Systems, Design, and Facilities and Equipment.

- <u>The Office of Safety and Quality (OSQ)</u> was established as a separate office in order to help define and ensure compliance with the NPR Program's high standards under which the new production reactor capacity will be designed, constructed, and operated. It serves as NP's independent nuclear self-assessment office, as required under the Secretary of Energy Notice (SEN) 6B-90. OSQ performs independent safety reviews, provides certification data, establishes safety and quality requirements and criteria, oversees the quality assurance program and accompanying audit process, and coordinates with safety oversight and advisory groups. In addition, OSQ has the oversight responsibility for safeguards and security. The OSQ Director has a Technical Director and three divisions -- Nuclear Safety, Quality Assurance, and Safeguards and Security.

- The Office of Environment (OE) is primarily responsible for ensuring compliance with all environmental and occupational health and safety statutes throughout the Program. OE carries out three key functions: assuring compliance with NEPA; assuring compliance with applicable environmental and health and safety statutes and regulations, including waste minimization; and involving the public in its review of the environmental consequences of the NPR Program. The office will initially focus on preparing the Environmental Impact Statement (the primary NEPA document).

  With regard to the Project Management Offices and the Operations Offices, OE provides guidance and oversight for the planning and implementation of site environmental compliance activities, reviews site compliance planning and scheduling, assists in determining and planning for site environmental requirements that must be complied with, and participates in the site's regulatory process.

  Two key committees assist the Office of Environment: the Environmental Steering Committee, a group of senior DOE managers chaired by the NP Director, which considers environmental policy issues related to the Program; and the Environmental Coordinating Committee, a forum for coordinating NPR Program environmental activities. The OE Director is supported by a Technical Director and three divisions -- Environmental Affairs, Compliance, and Occupational Health.

- The Office of Business Management ensures the efficient and responsible operation of NP by defining and fulfilling reporting requirements, preparing budgets, developing and implementing program controls and performance measurements, implementing an acquisition strategy, developing and managing the NPR Program Records Management System, and providing administrative and personnel services. The Office of Business Management coordinates with the Office of Management and Budget (OMB) on program status and budgets. The Director is supported by a Chief Financial Officer and five divisions -- Administrative, Finance, Acquisition, Project Control, and Records Management.

- NP Project Management Offices to manage project activities at the sites are a distinctive feature of the NPR Program. Each PMO is headed by a Project Officer who reports to the NP Director and all PMO personnel are part of the NP organization. The PMOs serve as the focal point of all project site activities. PMOs are currently in place at each of the three sites contained in DOE's preferred strategy: Barnwell County (Savannah River site), Butte County (Idaho site), and Benton County (Richland site). The relationship between the NP elements and the NP major contractors is shown in Figure 6-2.

  The use of Project Officers reporting directly to a Program Director establishes a clear, unambiguous line of authority for all project site decisions. While it avoids multiple lines of reporting, effective coordination and communication with the local DOE Operations Office will be maintained.

  The Project Officer for each project has the following specific responsibilities:

  - Represent the NP Director, commensurate with responsibilities set out and specified by charter and in a memorandum of agreement with the site Operations Office.

  - Advise the NP Director and the ETO Office Director on the status of the project and any matters of concern.

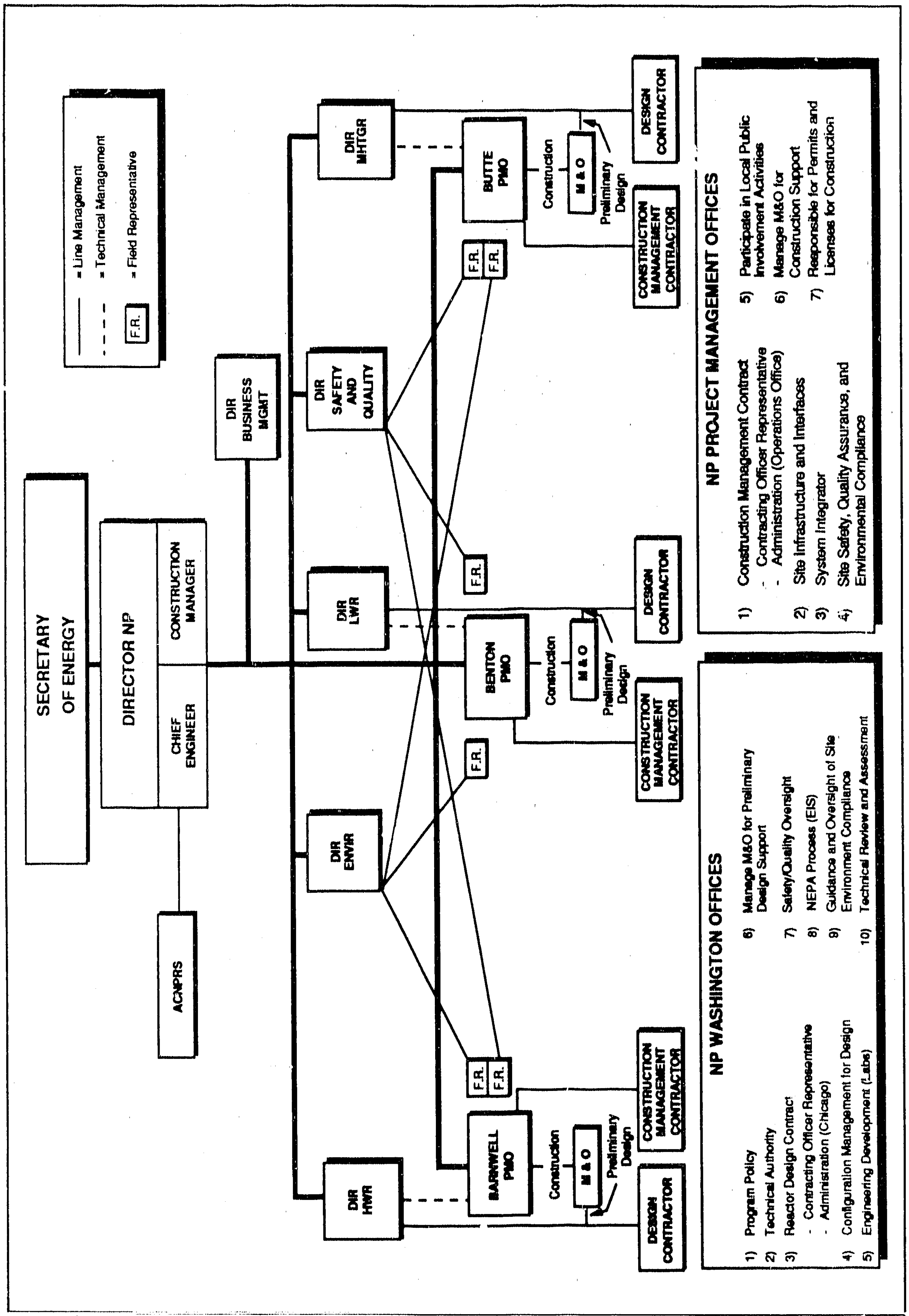

Figure 6-2
NP Elements and Contractor Relationships

- Prepare the Technology Project Management Plan and its implementing documents. The plan will be concurred with by the ETO Director and approved by the Chief Engineer and Construction Manager.

- Through preliminary design, concur on the Management Plans and Implementing Plans prepared by the M&O Contractor and approved by the ETO.

- Be responsible for constructability, operability, and maintainability assessments of the reactor and support facilities designs and for integration of the design contractors specifications and requirements with the construction management contractor's acquisition, construction, installation, testing and start-up, and operations assignments.

- Serve as the Contract Officer Representative (COR) for the construction management contract which will be let by the Operations Office.

- Approve the construction management contractor's Management Plan, with concurrence by the Construction Manager.

- Serve as the systems integrator for the design, construction, and testing and start-up of the NPR facilities.

- Be responsible for the NPR site infrastructure (roads, utilities, etc.) design and integration, including site interfaces, and the integration and modification of existing facilities.

- Oversee the construction management contractor activities supporting the development of site infrastructure to accommodate the NPR facilities.

- Be responsible for site safety, environmental matters, and security.

- Be responsible for the quality assurance of all contracts under the PMO's cognizance.

- Be accountable and responsible to the NP Director for ensuring that all Federal, state, and local permits and licenses necessary for the construction and operation of the NPR and all NPR support facilities are obtained on schedule. Sign as the owner, all environmental and regulatory documentation for those activities to be performed within the NPR site. Where necessary, ensure that the Operations Office obtains modifications to existing permits for existing facilities to be utilized in the NPR Program.

- Prepare the actual permit and license applications. The PMO will provide direction to and participate with the Operations Office who has the lead in 1) filing the permit applications, 2) negotiating and interfacing with state and local agencies, and 3) obtaining state and local agency signatures on permits.

- Within areas of assigned responsibilities, review and monitor project budgets and schedules, and initiate corrective action as necessary to maintain a viable performance measurement baseline and ensure that project objectives can be met.

- Within agreed-upon levels of the work breakdown structure, approve proposed changes to designs, schedules, and budgets that do not impact the project mission, thresholds of total estimated costs, HQ-controlled milestones or designated technical requirements.

- Implement a QA program in coordination with the Engineering Technology Office and the Safety and Quality Office that conforms with the NP QAR for the plant design, procurement, construction, testing and start-up, and operations, including ensuring its proper implementation by all appropriate contractors and subcontractors.

- Ensure full compliance with all DOE orders including DOE Order 4700.1, Project Management System, DOE Order 1332.1.A, Uniform Reporting System and DOE Order 2250.1C, Cost and Schedule Control Systems Criteria.

The Project Officer is supported by a Deputy and, in the case of the HWR and MHTGR PMOs, four divisions -- Environmental, Safety, and Quality; Engineering; Construction; and Business Management.

- **Field Representatives** assist the Office of Safety and Quality and the Office of Environment in exercising their oversight responsibility for ensuring safety, quality and environmental standards. The Offices each have one or two Field Representatives at each of the reactor sites. These Field Representatives are located with the PMOs yet they report directly to their respective Offices. Thus, Field Representatives provide an extra level of oversight at the sites. The Field Representatives have the following responsibilities:
  - Make independent assessments of QA Program effectiveness and provide input to audits regarding contractors' conformance to approved procedures.
  - During construction, assist in determining if the facility is being constructed as specified in the design, safety, and environmental documents.
  - Ensure that configuration control is rigorously applied and that the quality assurance programs are aggressively maintained throughout the entire project.

6.2 DOE OPERATIONS OFFICES

The Operations Offices have assigned dedicated personnel to support each PMO and ETO and provide appropriate facilities, equipment, and other support. The Savannah River Operations Office serves Barnwell County PMO, the Idaho Operations Office serves the Butte County PMO, and the Richland Operations Office serves the Benton County PMO.

For each site, a formal Memorandum of Agreement (MOA) has been prepared and signed by the NP Director, the Manager of the Operations Office, and the Project Officer. This MOA delineates the roles and responsibilities of the respective parties in carrying out the NPR Program. The Operations Office at each site is responsible for the following activities:

- Executing the Contracting Officer responsibility and contract administration for the construction management contract.
- Incorporating NP personal property requirements into existing Operations Office systems and providing assessment and oversight of the NP contractors and property management systems in accordance with DOE standards. The Operations Office is also to assist the NP Project Officer in coordinating a real estate management program in accordance with Federal standards, and consistent with contractual requirements and sound business practices.
- Performing liaison among the NP, the NP contractors, the Operations Office, and outside groups representing the General Accounting Office and the Office of the Inspector General. The Operations Office is to include the NP contractors and the PMO in the Operations Office audit follow-up and resolution system.
- Establishing and administering activities for the PMO in accordance with DOE standards in the following areas: printing, in-house data processing, word processing, automated office support systems, mail distribution, supplies and services, space utilization, communication and computer operations, telecommunications, small purchases, travel services, relocations, utilities service, and other administrative areas consistent with NP goals and objectives and Operations Office policies. Additionally, as requested by the PMO, the Operations Office is to provide lead services in the execution of public affairs, external relations, and legal services.
- Filing the required applications for Federal, state, and local permits and approvals for construction and operations. In addition, the Operations Office will take the lead in permit negotiations and resolution with state and local agencies and obtain state and local agency signatures on permits in a manner consistent with Program schedules and designs. These efforts will be performed in conjunction with the PMO and other appropriate NP Offices.
- Administering Federal personnel programs for employee relations, training, and develop-

ment, and labor-management relations as required and defined by the PMO.

- Advising, assisting, and supporting the NP Project Officer on the internal NP Project and Contractor security programs to ensure conformance with DOE Orders, including such areas as personnel security, computer security, and operations security.

- Providing security services (e.g., trained security officers) to support the NP security plan. The Operations Office is also to consult with the NP Director and the Project Officer on the development of site-wide policies (e.g., site access procedures).

6.3 DOE NATIONAL LABORATORIES

Eight DOE laboratories support the NPR Program; they have accepted tasks for specific areas and are described in Table 6-1.

To support the NPR Program's urgent schedule and to ensure focused and coordinated efforts, each laboratory has been directed to structure their NPR workforce in the form of dedicated, full-time employees that are collocated in a single building.

The National Laboratories will also provide specific technical assistance to the Engineering Technology Offices in the review of the conceptual and preliminary design deliverables provided by the design contractors. The extensive network of scientific and engineering support provided by the National Laboratories will help to maintain technical excellence throughout the Program.

6.4 CONTRACTORS

6.4.1 Primary On-Site Contractors. Each PMO has three primary contractors on site: the reactor designer, the construction management, and the M&O. These contractors will support the design, construction, testing, and initial operation of the new production reactor capacity. In addition, there are design contractors for NP support facilities, such as the Heavy Water Process Facility and the Fuel and Target Fabrication Facility for the MHTGR. The responsibilities of the three major contractors are as follows:

The reactor designer, under a prime contract to DOE, will provide conceptual, preliminary, and detailed designs, and engineering and inspection

Laboratory	Responsibility
Savannah River Laboratory	HWR technology
Idaho National Engineering Laboratory	MHTGR technology
Pacific Northwest Laboratory	LWR technology
Los Alamos National Laboratory	Independent safety review and documentation
Argonne National Laboratory	Draft EIS, transient fuel behavior
Oak Ridge National Laboratory	Cost estimates, materials, materials codes and standards
Lawrence Livermore National Laboratory	Reactor survivability from external events
Sandia National Laboratories	Containment and equipment survivability, severe accidents

Table 6-1
DOE National Laboratories and Responsibilities

services during construction. The initial contract was issued for the conceptual design with options for the preliminary design (Title I), detailed design (Title II), inspection services (Title III), reactor and supply, and engineering support during initial operations.

A construction management contractor, brought on board during the preliminary design phase, will carry out the construction of the reactor, supporting facilities, site infrastructure, and any other construction activities within the fence surrounding the NP site. The construction manager will accomplish most of the construction through firm fixed-priced competitive-bid subcontracts.

The site M&O contractor will provide support at each site under existing DOE Operations Offices M&O contracts, but with NP exercising control over support provided to NP. The NP ETOs will oversee the activities of the M&O contractors at least through completion of the preliminary design. An exception is M&O activities supporting the PMO. The respective memorandum of agreements between NP and the Operations Offices includes provisions for the services of the M&O contractors. As the eventual reactor operator, the M&O contractors share a common interest with DOE in the engineering and construction of an effective, safe, and environmentally sound facility; thus, they have been assigned continuing roles and responsibilities in all phases of the respective reactor project. These include:

- Reviewing the construction and procurement of components and equipment to ensure that operational requirements are met and that appropriate documentation is made available to support operational planning, procedures development, training, and operations.

- Assisting NP in reviewing plant requirements, designs, analyses, and equipment to ensure that the requirements are sufficient and are met from an operator's point of view. Specific M&O tasks in this area include:

  -- Reviewing designs with respect to operability, reliability, availability, maintainability, inspectability, fire protection, environmental requirements, waste minimization, OSHA, ALARA, human factors, and Institute of Nuclear Power Operations (INPO) good practices. This may involve locating M&O engineering personnel at the design offices.

  -- Maintaining the plant design and configuration database after turnover of the reactor design.

  -- Advising and participating in the development of spare parts requirements.

- Assisting the ETO in the coordination and definition of engineering development activities as required. When plans are approved and funded by the ETO, the M&O will coordinate, status, and advise the ETO on needed changes to plans, budgets, and schedules.

- Assisting in the review of the Integrated Safety Analysis Report submitted by the design contractor.

- Providing engineering and technical services to support the PMO management of construction. The M&O will participate in "as-built" plant walkdowns to ensure that the plant is built in accordance with approved drawings. The M&O will have significant involvement in review and/or development of plant logistics planning to include coordination with the site's ongoing operations.

- Developing the training program and implementation procedures, coursework, exams, and training support materials to meet requirements of DOE's "Performance Based" accredited training, retraining, and qualification and certification efforts. Management and personnel in the areas of operations, maintenance, technical support, and administrative support are included in these activities. The M&O contractor will also develop and check out plant simulator training and ensure compatibility with the development of plant operating procedures.

- Taking the lead role in developing plant, system, subsystem, and component test and acceptance plans, with close involvement of the design contractor and construction management contractor.

- Reviewing and concurring in the construction management contractor's turnover plan and procedures, and participating in Title III inspection and closure of non-conformance items.

- Accepting responsibility for maintenance of components, systems, and facilities after completion of construction activities and turnover.
- Reviewing the safety documentation and designs for incorporation of lessons learned from commercial and DOE nuclear facilities experience.
- Reviewing the design contractor's response to the Integrated Safety Evaluation Report and advising the ETO on the adequacy of the response.
- Preparation of testing and start-up procedures, including the Surveillance Test Plan, which is part of the Plant Technical Specifications.
- Providing engineering and technical services to conduct specified plant system testing and initial start-up activities.
- Performing and participating in system evaluations to determine whether acceptance criteria have been met, and certifying those results.
- Supporting, as requested by the PMO, the obtaining of Federal, state, and local permits and approvals for construction and operation, and signing these permits as the plant operator.

6.4.2 Support Contractors. Support contractors will be used to furnish technical and administrative support to NP Offices including, possibly, the PMOs. Support will be provided through existing or new contracts. No support prime contractor will be used by more than one of the NP Offices. In most cases, contracts will be structured to last for the duration of the Program, i.e., 10 years.

6.4.3 Procurement by Contractors. Contractors will have responsibility for procuring certain equipment and material for the NPR Program. For purposes of acquisition planning, equipment and material have been broken into four categories:

- Engineered and process equipment (e.g., reactor vessel, demineralized water unit);
- Standard equipment (e.g., chillers, standard valves);
- Safety-related construction material and components (e.g., stainless steel piping, electrical cables); and,
- Standard construction material and components (e.g., standard door units, concrete).

Most procurements will be contracted through the construction management contractor; some specialized components (e.g., MHTGR circulators) may be procured by the design contractor; and some may be procured by the M&O contractor, for the convenience of the government.

6.5 ADVISORY GROUPS

The NPR Program has relied and will continue to rely on outside experts to advise management on all aspects of the new production reactor capacity. The Program will draw upon the best available information from experts in a variety of fields such as nuclear engineering, reactor safety, environmental sciences, systems engineering, nuclear physics, and nuclear plant management. This arrangement ensures that the Program takes advantage of current knowledge as well as previous reactor operating experience, particularly in the area of reactor safety.

Since the creation of the NP Office, a variety of groups have been identified or created that will oversee, review, or advise Program activities. Of particular concern is thorough review of the safety and environmental activities. In these areas, no fewer than six separate groups will be used to oversee and review Program activities in addition to the Federal, state, and local groups and the public that will take part in the NEPA process.

Every effort will be taken to ensure that the activities and recommendations of the advisory groups will be integrated and considered in maintaining the Program schedule. However, all decisions or actions that could potentially affect Program technical, safety and quality, and environmental requirements or performance will be thoroughly reviewed and evaluated prior to implementation or change. By enlisting the views of these groups early in the design process, it will be possible to ensure the performance of critical safety systems and the integrity and reliability of the reactor design. The principal groups providing ongoing oversight are:

- Defense Nuclear Facility Safety Board (DNFSB). Chartered in its enabling legislation (Public Law 100-456) to serve as an independent body to provide recommendations in matters important to safety regarding DOE defense nuclear facilities. Reviews and evaluates the content and implementation of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities of the Department of Energy and recommends to the Secretary those specific measures that should be adopted to ensure that public health and safety are adequately protected.

- DOE Office of Nuclear Safety. Created by SEN 6A in September 1989, reports directly to the Office of the Secretary and advises the Secretary of whether line management and its self-assessment functions are adequately assuring nuclear safety. This office has broad responsibilities to monitor and audit all aspects of nuclear safety, including site office and contractor performance, through the review of safety documentation, Program office and site reports, and through observing on-site activities.

- Advisory Committee on New Production Reactor Safety. An external group that assesses the quality and depth of the safety reviews and provides expert, independent, technical review and advice to the NP Director on matters of safety.

- Environmental Steering Committee. An internal group of senior DOE management, chaired by the NP Director, that will focus on environmental policy issues affecting the new production reactor capacity.

- Environmental Coordinating Committee. A forum, chaired by the Director of the Office of Environment, established for the coordination of NPR Program environmental activities among the different NP Offices, the Operations Offices, and NP support contractors.

- Utility Engineering Group. Duke Engineering, a utility engineering company with extensive experience in building and operating commercial nuclear plants, was selected in May 1989 to provide technical and management expertise to the New Production Reactors Program.

7.0 ACQUISITION AND TECHNICAL MANAGEMENT STRATEGIES

This section describes the approach DOE is following in acquiring new production reactor capacity by defining each stage in the process, describing what takes place in each of these stages, the NPR Program procurement management approach, and the approach to the technical management of the project. This section will also make explicit the technical management responsibilities within the NPR Program, the actual process for technical management, the methodology and implementation of a project management technique called Configuration Management, and a description of the NPR Program Control System and NPR Program Records Management System.

7.1 NP APPROACH TO SYSTEMS ACQUISITION

As noted in Part I of the Program Plan, the Department's preferred acquisition strategy calls for the design and construction of two new production reactor facilities--a heavy water reactor plant to be located at the Savannah River Site and a four module, high-temperature gas-cooled reactor plant to be located at the Idaho National Engineering Laboratory. In addition, a light water reactor target is being developed for possible use in the WNP-1 reactor located at DOE's Hanford Site. DOE will turn to the nuclear vendor industry, primarily the private sector, for design and construction of the new production facilities. Wherever practical, competitive procurement will be used in accordance with both Federal and DOE acquisition regulations.

7.1.1 Steps in the DOE Acquisition Process. The process for DOE major acquisitions is governed by DOE Order 4700.1, Project Management System. Each major NPR project will proceed in accordance with this DOE Order and follow the six distinct sequential phases and five Key Decision (KD) points that are presented in Figure 7-1.

- **Conceptual Design** - The objectives of the conceptual design phase are to develop a project scope that satisfies Program needs and requirements; validate project feasibility and measurement of performance levels to identify and quantify risks; and develop a reasonable cost estimate and performance schedule. Separate conceptual designs have been performed for the MHTGR and HWR.

  Conceptual design proceeds from existing point designs and includes such activities as trade-off studies and evaluations; detailed assessments of major concept issues; identification of required development work; identification of overall management (management systems) requirements; preliminary costs and

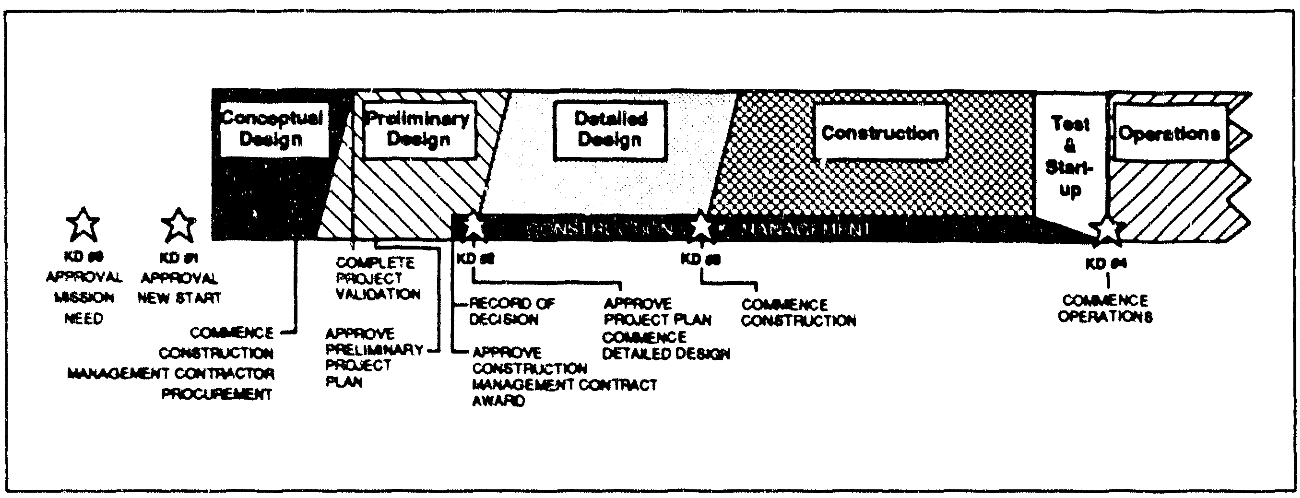

Figure 7-1
DOE Acquisition Phases

schedule information; the initial identification of long-lead procurement items; and a formal conceptual design developed and published as a Conceptual Design Report. This phase also incorporates such activities as expansion of the Project Summary Work Breakdown Structure, development of requirements and interface matrices, definition of project system design descriptions (SDDs), and development of conceptual SDDs and an overall conceptual plant design description.

- Preliminary Design (Title I) - This phase covers architect/engineering (A/E) Title I activities which include preliminary design and project planning activities utilizing conceptual design and project design criteria. Topographical and subsurface data are developed and the requirements and criteria, including NEPA findings, which will govern the detailed design are determined. Activities include preparation of preliminary planning and engineering studies, preliminary drawings and outline specifications, life-cycle cost analysis, improved cost estimates, more detailed identification of long-lead procurement items, initiation of construction and environmental permitting activities, initiation of labor agreement negotiations, completion of more detailed project SDDs, and associated safety analyses and scheduling for project completion.

- Detailed Design (Title II) - This phase covers A/E Title II and reactor manufacturer's (RM) final design activities, including preparation of design details necessary for construction, procurement, fabrication, assembly, installation, testing, and operation of the respective project. Final working drawings, specifications, bidding documents, and cost estimates are prepared, including associated safety reports. Through coordination of all parties which might affect the project, firm construction and procurement schedules and final technical data for permits are developed. Long lead procurements are initiated when necessary to comply with project schedules.

- Construction - This phase covers construction activities including engineering, preparation of bid packages, procurement, erection, installation, assembly, and fabrication efforts involved in creating a new facility or modifying an existing facility. It also includes A/E Title III inspection services, RM engineering services, and construction management. This phase begins with site preparation and ends with a formal testing and start-up phase. Safety-related construction will start after a review of the Integrated Safety Analysis Report (ISAR) and the granting of construction authorization.

- Testing and Start-up - The testing and start-up phase will begin during the later stages of construction with acceptance and pre-operational testing. Testing and acceptance of equipment, subsystems, and systems will occur over time in a phased manner. When an operational authorization is granted, integrated testing will begin. Fuel loading and initial criticality will be separately controlled activities and will depend on readiness reviews and approvals by the cognizant safety boards and the Program Director. Activities in this phase are prescribed by formal Test Procedures prepared to approved Operating Specifications. This phase begins with "Construction Turnover" and ends with formal "Plant Acceptance" by DOE. At completion of this phase, the Plant Operator is in place.

- Operations - Commencement of this phase by DOE and the operating contractor signifies the beginning of operations. The Prime Contractors and principal subcontractors generally remain in place for approximately one year or until the reactor is considered to be completely functional. NP will remain involved through the first prototypic production run.

A breakdown of the DOE acquisition process and the tasks to be undertaken in order to complete each of the NP acquisition phases is provided on the following page in Figure 7-2.

7.1.2 Key Decision Points. There are five Key Decision (KD) points in the acquisition plan. Key Decisions require approval of the Secretary and provide top-level oversight to ensure that the project is performing acceptably and should be continued. KD #0 and KD #1 establish the need and approve the start of a new project. These were made by the Secretary when he gave authority to proceed with the New Production Reactors Program in August 1988.

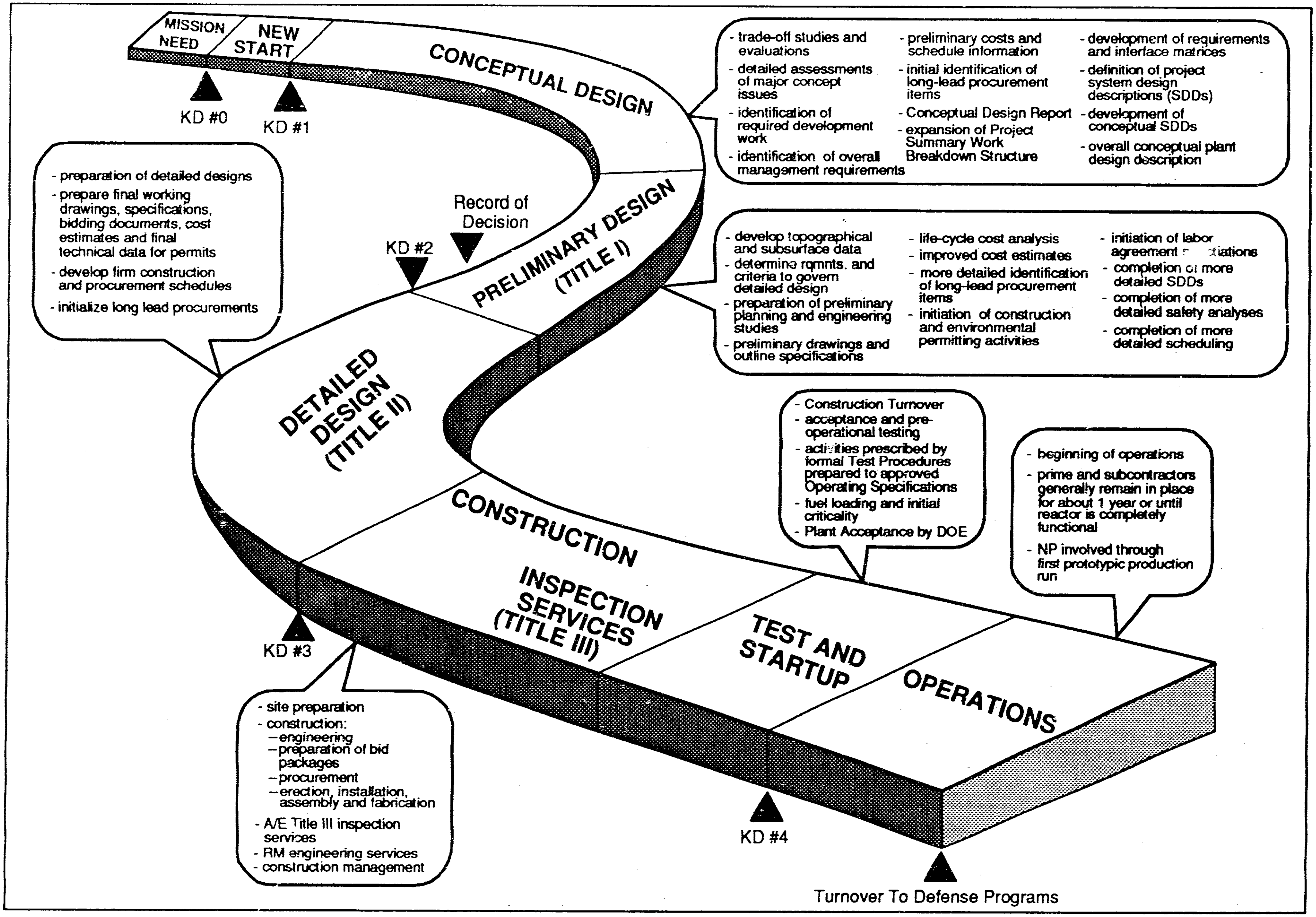

Figure 7-2
DOE Acquisition Process

KD #2 occurs prior to the initiation of the detailed design phase (Title II). KD #3 follows detailed design and gives the authority to begin construction. KD #4 follows construction and testing and authorizes the facility to commence operations.

To keep the Program on an urgent schedule, the preparation of the EIS will be performed concurrently with confirmatory development and project design activities for the HWR and MHTGR and those light water reactor tasks necessary for informed decision-making. Once the Record of Decision is released, the final technologies and sites selected will proceed with detailed design and the remaining acquisition phases as previously described.

The NPR Program acquisition plan focuses on the two primary aspects of providing the reactor capacity required by its mission: the procurement process for providing the specified facilities, equipment, and support systems; and the technical management of planning and designing the new production reactors. The following sections describe the Program's approach to procurement and technical management.

7.2 NPR PROGRAM PROCUREMENT MANAGEMENT APPROACH

Both technical and administrative management of the primary design contract efforts, including engineering development, conceptual design, preliminary design (Title I), and detailed design (Title II) will be the responsibility of the NP Engineering Technology Offices. These offices will, in fact, retain the role of providing policy guidance and full technical oversight and control during the life of the projects.

The construction management contract will be awarded by the DOE Site Operations Office during the preliminary design phase and the PMO will serve as the Contracting Officer Representative.

Contracts will be awarded and managed such that they support a single area of effort or a single office. This ensures clear accountability and avoids conflict over resources. All acquisitions will be approved by NP prior to initiation of a Request for Proposal. This approval will provide for control of programmatic requirements, an affirmation of the necessity for the work, a determination that funds are available, and an overview to prevent a personal or organizational conflict of interest situation that might be unknown to the initiating office. During the conceptual design phase and well into preliminary design (Title I), acquisitions of $1,000,000 or more will require the approval of the NP Director.

7.2.1 Procurement Status

7.2.1.1 Heavy Water Reactor: The HWR technology has been used by the Department of Energy and its predecessors for production of nuclear materials since the early 1950s; however, no new HWRs have been built in the United States since that time. Based upon the Department's commitment to safety and environmental concerns, NP is obtaining new designs to incorporate technical and engineering advances to ensure the desired levels of safety and environmental compliance.

To shorten the schedule, a procurement strategy for the design contract was developed which provided for the design team to stay intact through the life of the project. The contract was competitively awarded for conceptual design with options for preliminary design (Title I), detailed design (Title II), engineering and inspection services (Title III), reactor supply, and engineering support during initial operations. It was determined that an Operations Office with experience in large, design, and construction procurement would be able to complete this effort in the most efficient and timely manner; consequently the Chicago Operations Office was chosen and assigned the task.

In August 1989, DOE issued a request for architect/engineering services for the design of the HWR. Three contractor consortia expressed interest and a decision was made that the Program would be best served by a design competition between two of them. On November 1, 1989, contracts were awarded to Ebasco Services, leading a team which included Babcock and Wilcox, Combustion Engineering, Rockwell International, and Battelle; and to the National Production Reactor Group, consisting of Westinghouse and Bechtel. The first contractor conceptual design deliverables were submitted on December 1, 1989 and the final deliverables were provided June 1, 1990. The proposed designs were reviewed by DOE, and on August 10 the down-selection decision was announced to award the preliminary design contract to the team of Ebasco Services.

Concurrently, Westinghouse Savannah River Corporation, the current Savannah River Site management and operations (M&O) contractor, was requested to prepare a conceptual design for the Heavy Water Processing Facility (HWPF) necessary to support the HWR. Preliminary design is scheduled to begin in the third quarter of FY 1991. Once the preliminary design is completed and if the HWR technology is selected as a result of the Record of Decision, a decision will be made on the procurement approach for further design and construction of the HWPF.

On August 3, 1990, the Savannah River Operations Office issued a Request for Proposal (RFP) for the construction management contractor at the HWR site. The contract is scheduled for award during the third quarter of FY 1991.

7.2.1.2 Modular High-Temperature Gas-Cooled Reactor: The Department has had a substantial commercial high-temperature gas-cooled reactor (HTGR) program under the Assistant Secretary for Nuclear Energy for many years. The two commercial HTGR plants; Peach Bottom 1 and Fort St. Vrain, have provided valuable experience for design of the new production reactor, including current safety criteria.

The same overall procurement strategy described for the HWR is being used for the MHTGR; however, only one design consortium responded to the August 1989 DOE request for design of the MHTGR. On November 27, 1989, the Chicago Operations Office awarded a contract to CEGA, a joint company consisting of Combustion Engineering and General Atomics supported by Stone and Webster and Burns and Roe. The MHTGR conceptual design was completed on May 1, 1990. The decision to proceed with preliminary design was announced on August 10.

Concurrently, a competitive contract for the design of fuel and target fabrication facilities necessary to support the MHTGR was awarded to Fluor-Daniel in January 1990. The contract is for conceptual design with options for preliminary design, detailed design, and engineering services. The conceptual design was completed in November 1990, at which point preliminary design began.

On August 15, 1990, the Idaho Operations Office issued an RFP for the construction management contractor at the MHTGR site. The contract is scheduled for award during the third quarter of FY 1991.

7.2.1.3 Light Water Reactor: Since LWR technology is more advanced and the WNP-1 reactor on the Hanford Site is 63 percent complete, there is not a requirement to do any reactor design work for this technology prior to the Record of Decision. If the decision is to proceed with the WNP-1, contracts for design modifications and construction completion would be procured by the PMO. Questions related to the acquisition of WNP-1 are included in the LWR Technical Question Data Bank. A number of options have been evaluated and the actual process would be determined after ROD and after Congressional authorization to acquire the facility was obtained. If a LWR at another site is selected, then the PMO at that site would be responsible for procuring design and construction contracts.

7.2.2 Engineering and Technology Development Requirements. Each of the candidate reactor technologies will require some modest engineering and technology development to ensure that the new production capacity meets performance, safety, and, environmental requirements. The management strategy for the development efforts is to utilize the readily available expertise of the DOE National Laboratories and existing facilities to address and resolve technical issues essential to success of the NPR Program. It is, however, the intent of NP to utilize existing proven technology and off-the-shelf materials whenever possible.

NP has identified and matched development requirements to capabilities of specific laboratories and reached agreements with the labs on priorities, schedules, and funding. The assignment of tasks to specific laboratories was based on a selection process in which a panel of DOE engineers reviewed laboratory proposals on the basis of the following criteria:

- History of prior work and availability of existing technology base;

- Need to develop technology base at the preferred site;
- Availability of experienced personnel to perform tasks;
- Availability of experimental and related support facilities;
- Readiness of facilities to proceed;
- Estimated cost (manpower, facility modifications, other); and
- Estimated schedule.

Five-year technology development plans are being prepared for the HWR and MHTGR technologies. These plans include considerations of safety and design support development needs identified in the ERAB technology evaluation process (because of substantial experience that already exists for LWR power reactors, the only LWR technology development being pursued is the tritium target). The development tasks have been assigned to one or more of the following categories:

- Technology Development--Development work needed to solve a feasibility problem or to provide reasonable confidence of the performance capability of a component or feature;
- Confirmatory Development--Development work directed by DOE aimed at developing and confirming the technology base required to verify fundamental design and safety decisions; to develop review criteria and define design requirements, and to perform developmental long-lead-time tasks to facilitate the design and safety analysis schedule;
- Design Proof-of-Principle Development--Development work aimed at direct support of the designs including generic characteristic studies, design feature development and testing, and integral performance testing (including facilities). This work will be initially directed by DOE with longer-term direction including the designer's input; and
- Contractor-Supported Development--Development work proposed by the design contractor or DOE but which is considered design-specific and should be funded and directed by the design contractor.

7.2.2.1 HWR Development Requirements. The development plan for the HWR mainly concerns updating the HWR design for safety and environmental requirements. The HWR design will include features such as:

- Coolant upflow;
- Separated moderator and coolant;
- A low-leakage LWR-like containment;
- State-of-the-art instrumentation and control and human factors design.

In addition, current safety concepts require consideration of severe accidents in design and safety review, and increased reliance on passive performance of safety systems; these are also included in the development program. The HWR design will use modern technology to avoid problems which have arisen with the present HWR production reactors. Finally, a general review and upgrading of analysis methods, the supporting data, and associated quality assurance is being implemented.

The HWR confirmatory development efforts include:

- Reactor plant safety evaluations including severe accidents;
- Reactor plant and component systems analysis and evaluations;
- Severe accident and transient fuel behavior tests; and
- Thermal-hydraulic testing of the fuel-target assembly.

The HWR design proof-of-principle development efforts include:

- Control rod drive reliability;
- Natural circulation shutdown cooling;
- Charge-discharge fuel/target machine;
- Flow testing and instrumentation;

- Heat exchanger materials; and
- Canned motor pump bearings.

7.2.2.2 MHTGR Development Requirements. The experience gained from design and operation of gas cooled reactors both in the United States and Europe will be factored into the new production reactor design. Additional technical support to the development of the new production MHTGR technology comes from the Civilian Reactor Development Program in DOE's Office of Nuclear Energy. The commercial reactor program is a development and demonstration effort with the objective of proving the advanced MHTGR technology and economics to the extent that the utility industry will be willing to build MHTGR electric generating plants. The commercial design has progressed through the conceptual design stage and has been in the preliminary design stage for approximately three years. Although there are some significant differences between the commercial and defense MHTGRs, the existing conceptual design for the commercial unit served as a technical base for proceeding with the new production MHTGR.

There are both unique as well as common technical development efforts for the commercial and the MHTGR new production reactor. Since the NPR Program is structured to build one-of-a-kind government-owned reactors for producing nuclear weapons materials on an urgent schedule, it will conduct all unique and schedule-driven common technology development necessary to support its mission. To avoid any duplication and to ensure technical completeness and consistency, development activities between the commercial and defense programs are closely coordinated, including a formal Memorandum of Understanding between NP and DOE's Office of Nuclear Energy.

The NP MHTGR technology development efforts include:

- Tritium target fabrication, performance, and processing; and
- Highly enriched fuel performance and fabrication (as compared to low enriched with thorium in existing MHTGR).

The confirmatory development efforts include:

- Safety evaluations including severe accidents; and
- Reactor plant and component evaluations.

The design proof-of-principle development efforts include:

- Neutronic analysis;
- Control and shutdown;
- Containment;
- Steam Generator;
- Circulator; and
- Fission product transport.

7.2.2.3 LWR Development Requirements. The main features of power LWRs, especially the use of elevated coolant temperatures, have been retained to permit production of steam and/or electric power as a marketable by-product of the tritium production process. The lithium-bearing targets that are used in these reactors must, therefore, retain their integrity at elevated temperatures (typically 600 degrees Fahrenheit). Target development and qualification will require extensive testing of the target concepts. Sufficient testing has been completed to demonstrate the feasibility of at least one target system for tritium production and performance demonstrations are being conducted in support of the Record of Decision. This system is based on lithium aluminate contained within a stainless steel tube with a tritium diffusion barrier of aluminum and a zirconium "getter" to retain the tritium over the irradiation time of the target.

The LWR technology development efforts include:

- Tritium target development.

The LWR confirmatory development efforts include:

- Safety reviews including severe accidents; and
- Reactor plant evaluations.

7.2.3 Technology Transfer and Tasks for the National Laboratories. The technology transfer between the National Labs and the private sector depends upon the assignment of specific tasks by the NP Director, and is governed by five-year technology development plans that are currently being developed.

As stipulated in the Program requirements, the results of these development efforts will be made available to the private sector wherever it is possible to do so without compromising the ability of the NPR Program to carry out its mission. Possible areas for such technology transfer might obviously include new approaches to reactor design and operations, but may also include technologies not exclusively related to reactors. Some examples of technologies that could be made available to the private sector include isotope production, radiation monitoring and control systems, and reactor control and safety systems.

7.3 NPR PROGRAM APPROACH TO TECHNICAL MANAGEMENT

In order to achieve the NPR Program mission, management responsibilities must be explicit. The overall strategy for the technical management of the HWR and MHTGR technologies is to:

- Define reactor plants whose safety, environmental, technical and operational designs meet the goals and objectives specified by the Secretary and the NP Director;
- Ensure that design and development of the reactor components, systems, and plants meet the stated objectives;
- Oversee the design, acquisition, construction, testing, and startup of the reactor plants, to ensure requirements for new production capacity are met on schedule and within budget;
- Provide the NP Director with life-cycle support over the new production reactors, ensuring that technical controls are in place for all phases of each project, from conception to turnover; and
- Ensure that the necessary technical support and plant documentation are in place to provide a smooth transition to the M&O contractor at the start of production operations, and that there is continued technical support throughout the plant life-cycle.

7.3.1 Technical Management Responsibilities Within the NPR Program. The NP Director is ultimately responsible for all NPR Program technical decisions. Under him, individuals and components within the NPR Program have been assigned specific responsibilities for technical management. These responsibilities are as follows:

- Chief Engineer. The Chief Engineer of the NPR Program coordinates the efforts of the three Engineering Technology Offices and is responsible for the systems engineering and configuration management of the Program.
- NP Engineering Technology Offices. The ETO Directors define and specify the requirements for each of the reactor subsystems and critical interfaces between subsystems. In this respect, it is the function of the ETO Technical Directors to develop the policies and procedures necessary to carry out the requirements. This integrating function and oversight of the subsystems are documented in the NP Requirements Document (RD). The RD defines operational capabilities, operating environments, and specific requirements for reactor system performance, including objectives for reliability, safety, quality, and environmental compliance.
- ETO Contractors. The contractors for the ETOs are a critical part of the NP management team. They are ultimately responsible to the NP Director for the execution of their designated project development activities. This is a critical distinction in NP program management; though the ETO Directors define requirements and are responsible for ensuring their implementation by the contractors, it is the NP Director who ultimately determines product acceptance.

7.3.2 Process for Technical Management. The process for technical management is set out in the NP Systems Engineering Management Plans. DOE Order 4700.1, Project Management System, defines systems engineering as follows:

"Systems engineering encompasses management of the engineering and technical effort required to transform the objectives into an operational system. It includes the engineering required to define the system performance parameters and the configuration to best satisfy the project objectives. It also includes the planning and control of technical tasks, integration of the engineering specialties, and the management of a totally integrated design effort to meet cost, schedule, and technical objectives of systems engineering."

This "systems engineering process" reflects the highly interactive nature of the process of developing final plant specifications. Each of the NP projects will evolve from point designs through conceptual designs, preliminary designs, and detailed designs. Each design represents the translation of functional needs and performance requirements into an operating "system". The finished plant, in turn, is the integrated composite of these "systems". DOE Order 4700.1 defines the systems engineering process in terms of seven steps. These steps, and their interactive nature, are illustrated in Figure 7-3. The NP Systems Engineering Management Process will be established in accordance with DOE Order 4700.1 to manage, integrate, and document all aspects of the NP projects' life cycles, which encompass establishment of requirements, confirmatory development, testing, design, fabrication, construction, operation, maintenance, modification, decommissioning, and other related activities. The NP Systems Engineering Management Plans (SEMP) will define the approach to integrate and coordinate all these activities, with appropriate control to ensure the proper balance of technical, schedule and cost factors in the final systems configuration. The NP ETOs have the responsibility for ensuring that the Systems Engineering Process defined by the SEMPs is appropriately and effectively implemented.

In addition, the NP Director has established several other groups that assist in implementing the Program and maintaining technical oversight. These include:

- <u>Senior Management Group</u>. The Senior Management Group (SMG) is comprised of the NP Director, the Chief Engineer, the Construction Manager, the Directors of all NP Offices including the heads of the Project Mangement Offices, the senior policy analyst, and the senior strategic planner. The SMG meets weekly to discuss policy, issues of concern to the Program, and progress that has been made.

- <u>Technical Directors Workshop.</u> The Technical Directors meet regularly to address issues and problems that cut across the NP Offices. The meetings provide a forum for resolving the difficult interfaces associated with ensuring that safety, quality, environmental performance, schedule, and cost requirements are integrated and balanced. The group additionally resolves specific issues identified by the NP Director, Chief Engineer, and the Construction Manager.

- <u>Division Directors Roundtable</u>. The Director of NP has established regular monthly meetings at which he and all NP division heads gather in an informal session to discuss the Program. These meetings complement the normal lines of communication by providing the division heads direct access to the Director, thus allowing them to raise issues of concern that the Director might otherwise miss. Also, by meeting with the individuals who work with specific parts of the Program on a day-to-day basis, the Director is able to acquire a more concrete understanding of the Program implementation and progress. The Roundtable also provides a unique setting in which the middle-level managers of the Program can meet with their peers. In this setting, these managers gain a greater appreciation for the other components of the NPR Program and the concerns of other working-level personnel. By creating personal relationships at this level, these managers will be able to anticipate difficulties that might arise in other parts of the Program and take steps to respond.

- <u>Progress Measurement Staff</u>. Independent measurement is incorporated into the NPR Program through the use of a Progress Measurement Staff, which is located within the Project Control Division in the Office of Business Management. This form of performance measurement provides directly to the NP Director at the SMG weekly meeting, an independent status check of contractor and

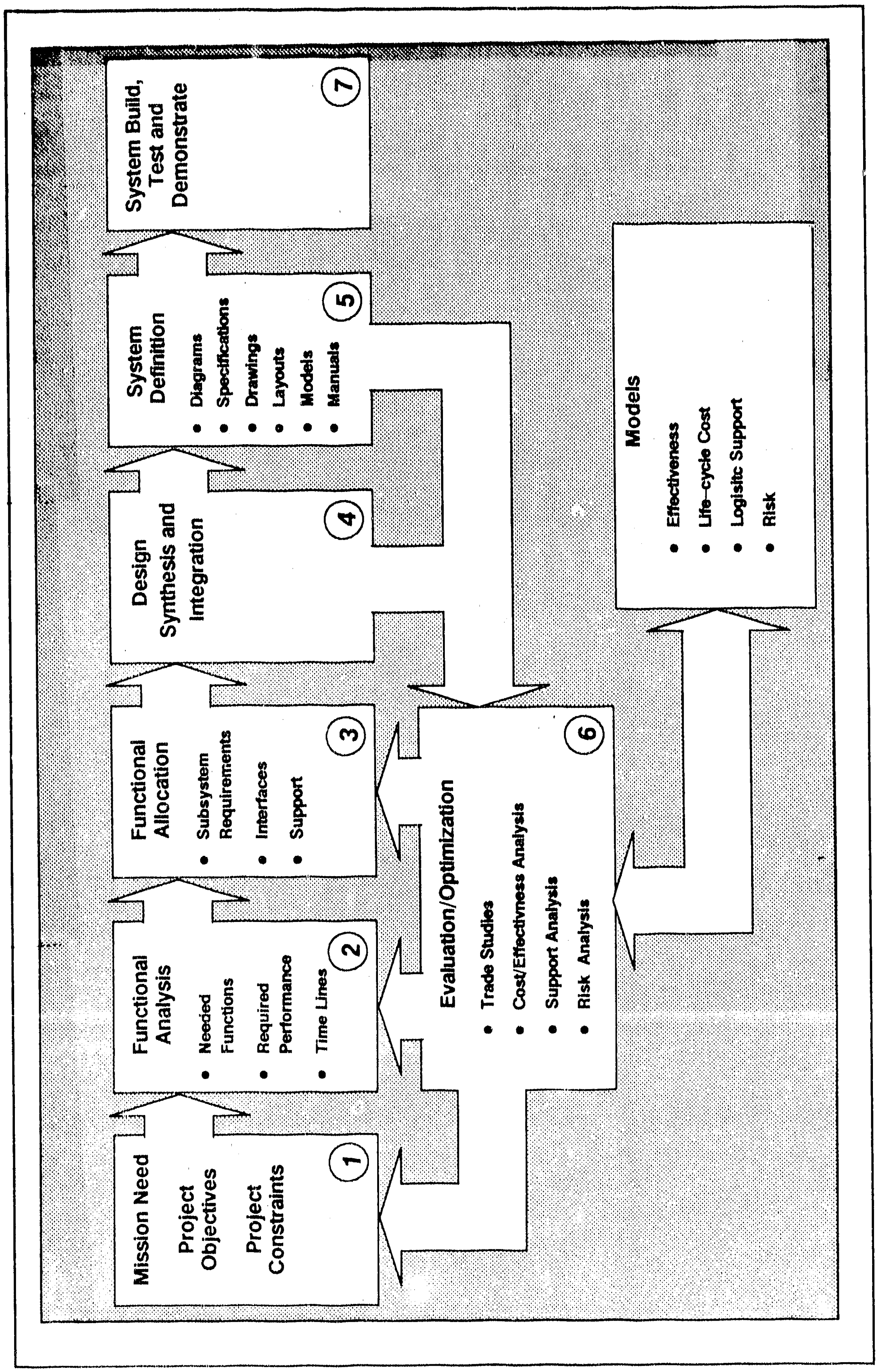

Figure 7-3
Systems Engineering Process

supplier progress against Program goals. The staff is authorized to visit any of the Program's external participant organizations to gather information indicating Program progress. Part of the purpose of this separate communication network is to keep the NP Director informed and to provide him an additional source of information from that of the line personnel responsible for carrying out the Program.

7.3.3 Configuration Management. Configuration Management (CM) is an integrated management process that identifies and documents the physical and functional characteristics of facilities, structures, systems, components, and computer software and firmware. The objective of the CM process is to ensure that these characteristics are properly identified, developed, assessed, approved, issued, implemented, verified, recorded, and incorporated into the associated technical documentation. Also, the CM process ensures that changes in the design or function of any part of the NPR configuration are properly evaluated, recorded, and implemented.

CM uses a technique called "baseline management" to ensure that technical requirements are clearly defined and controlled throughout the design, procurement, construction, testing and start-up, and operational lifetime. Baseline management also ensures that all products that are acquired satisfy technical and operational requirements. The baseline consists of a specified set of performance or design requirements that are formally designated and approved as the technical baseline. The current NP technical baseline is the Requirements Document, which also serves as the basis of Section 3.0 of the Program Plan.

In accordance with the Department of Energy directive that provides instructions for the management of DOE projects (DOE 4700.1, Project Management System), baseline management will also be used to control project costs and schedules. Cost and schedule impacts due to proposed changes to the technical baselines will be identified, evaluated, and controlled in accordance with the requirements of a CM Plan and approved change control procedures.

7.3.3.1 Responsibilities for CM Implementation. NPR Program CM responsibilities are as follows:

- The NP Chief Engineer is responsible for establishing and directing the implementation of a comprehensive and consistent NPR CM process, and coordinating the activities of the NP Offices, PMOs, and NP Program participants in order to accomplish the necessary programmatic commonality.

- The Office of Business Management will provide distribution of controlled documents, records management, and NP Program management control system support.

- CM training will be conducted by the appropriate organizations to ensure that all NP Program participants are familiar with the guidelines and requirements of the NP configuration management process.

- The Division of Quality Assurance shall conduct periodic audits of the CM process to ensure compliance with the NP CM Program Directive and the NP Configuration Management Plan.

Moreover, all NP participants will have the following CM responsibilities:

- Implementing CM in their area of responsibility, in accordance with the approved CM Policy and Requirements Document, the NP CM Plan, and their approved CM Plan.

- Preparing the required detailed plans and procedures to support the implementation of the NP CM Plan; these procedures will be made available to NP Offices and other participants, as applicable, for use in implementing the NP CM process.

- Generation, retention, and control of all records necessary for satisfying NPR Program CM requirements. In particular, all participants will control their CM documents so that only approved versions are used.

- Reporting deficiencies in the CM process and in accordance with applicable QA procedures or engineering procedures.

While the CM process will satisfy the requirements of DOE Order 4700.1, it will also be based in part on government and industry standards. Implementation of the CM process will be in accordance with the approved NP CM Plan and CM procedures and standards.

7.3.3.2 Implementation of CM. Figure 7-4 provides an overview of the NPR Program CM process. There are four elements to configuration management: configuration identification, configuration control, status accounting, and configuration verification.

- Configuration identification - The process and methods of identifying: 1) the plant site, structures, systems, components, and computer software and firmware configuration items (CIs); 2) the supporting documentation which identifies and defines the functional and physical characteristics of the CIs; and 3) the numbers and other identifiers affixed to the items and documents.

- Configuration control - The process of managing proposed changes to the CIs and technical documentation which ensures that proposed changes to the technical baselines are accurately described, systematically reviewed and evaluated for impact, properly implemented upon approval, and completely closed out. CM for the NPR Program employs a three-level change control process as shown in Figure 7-5.

- Configuration status accounting - The process of recording and reporting the current status of CIs, technical documentation, and all proposed and approved changes throughout the life cycle of the NPR Program.

- Configuration verification - This process ensures that the technical baselines satisfy the design requirements, that the physical and functional characteristics of CIs conform to the technical baselines, that approved changes have been properly incorporated into the technical baselines, that the "as-built" configuration conforms to the approved technical baselines, and that the entire process functions in accordance with approval plans and procedures.

7.3.3.3 Computer Software CM. Computer software is essential to nearly all aspects of the design, development, construction, and operation

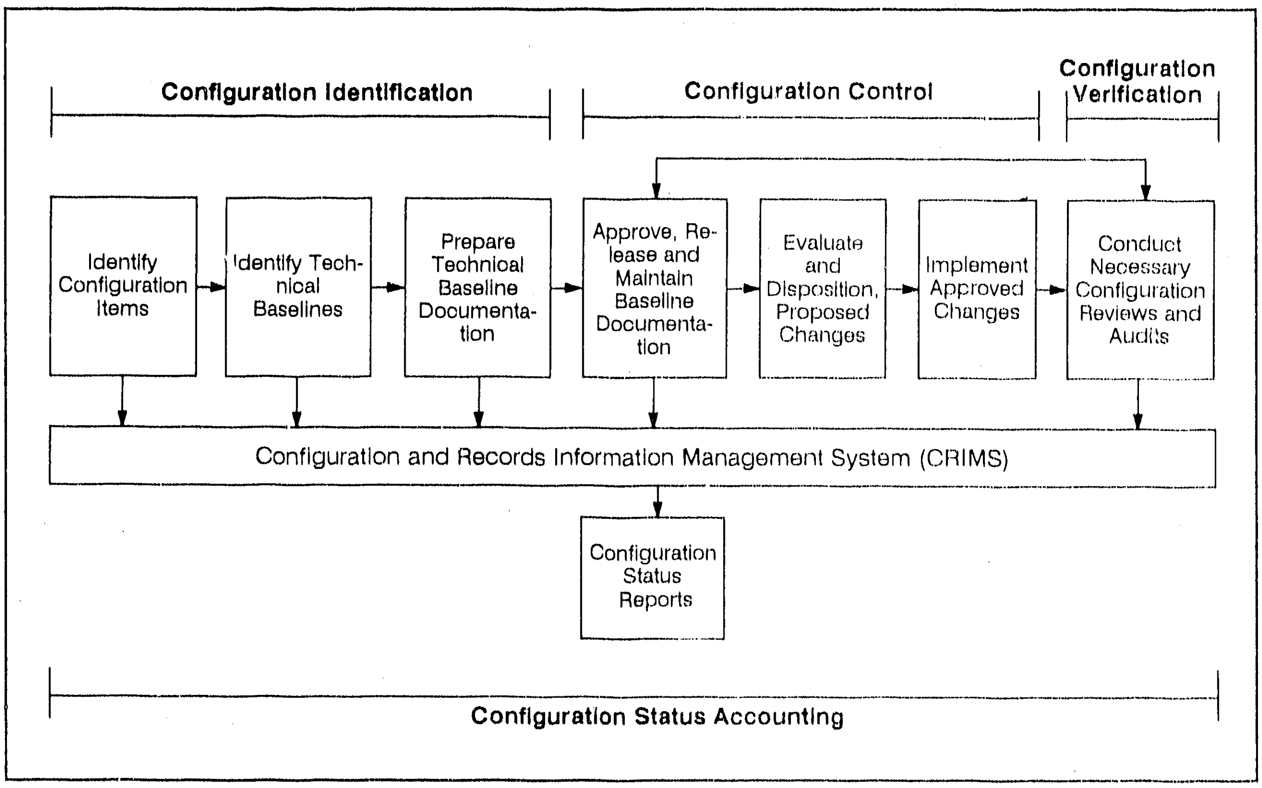

Figure 7-4
NP CM Process Overview

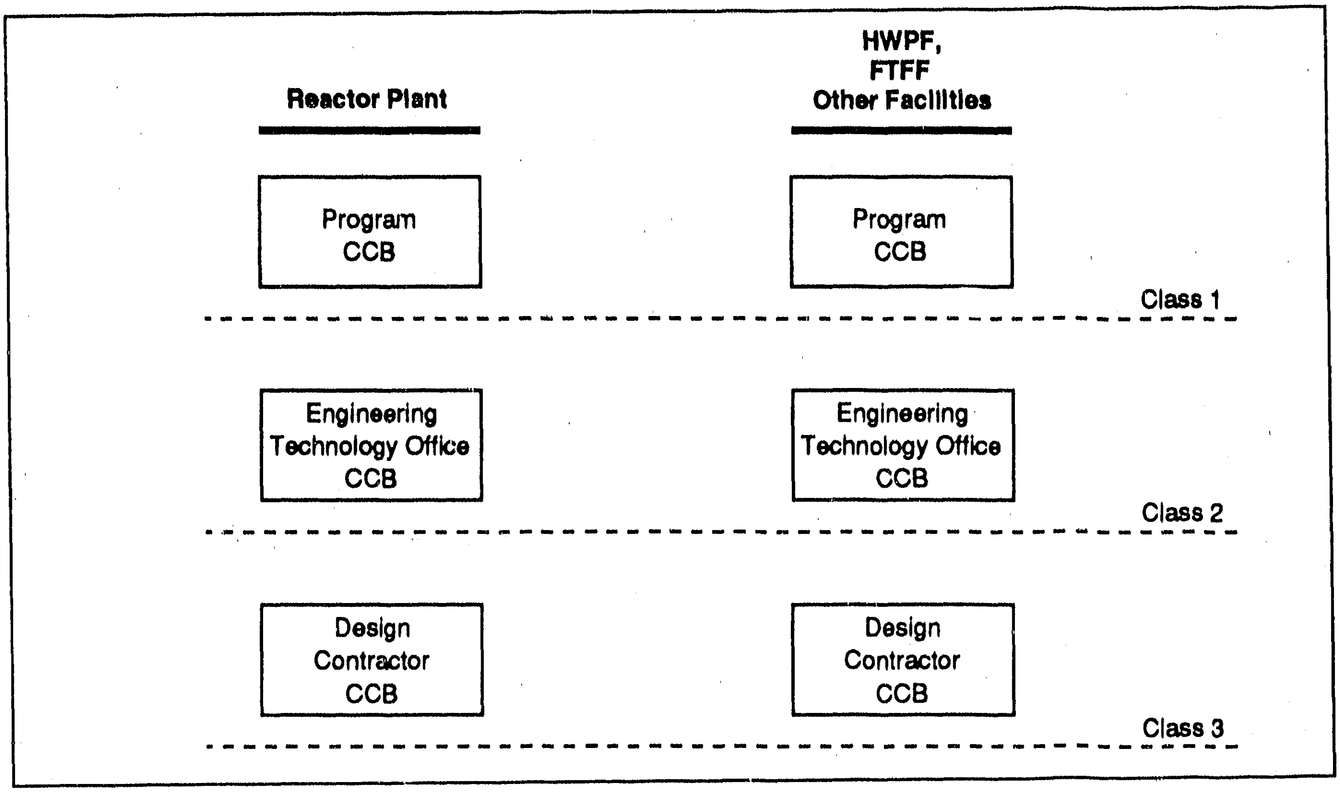

Figure 7-5
Change Control Hierarchy

of the new production reactors. Computer software used in the NPR Program will be managed and controlled over its entire life cycle in a manner consistent with the requirements of the NPR Program CM Plan and Part 2.7 of NQA-2. The computer software covered by the CM Plan includes software used for:

- Operations and process control;
- Protection systems;
- Plant or engineering development, design analyses, evaluation, and assessment;
- Simulator systems;
- Database or document registers when used as the source of information for operations and process control; protection systems; plant development, design, or construction; and simulator systems;
- Computer aided design (CAD);
- Computer aided manufacturing (CAM);
- Computer aided engineering (CAE); and
- Any other computerized mathematical model used to design, operate, or maintain any operational software within the NPR Program.

All software will be developed in a traceable, planned, and orderly manner. NPR participants who develop computer software will have an established process to manage and control the software development in accordance with the NPR Standard for Software Management. This process will ensure that the development, including documentation, verification, and validation and changes are appropriately implemented, executed, and controlled.

Documentation requirements for software used in the NPR Program are specified in the NPR CM Plan. This software documentation will be part of the approved technical baseline. Like other systems maintained under a technical baseline, management of software will comply with the requirements of the CM Plan. The requirement applies both to software that was acquired from outside and software developed under the NPR Program.

Software that was not developed under a formal documented program meeting the requirements of the NPR Standard for Software Management will be verified and validated or show documented evidence of verification and validation prior to its use. Once established, this baseline will be controlled, and applicable documentation will be prepared to support its use. Verification and validation of the software is also required after any change to the approved baseline.

7.3.4 **Program Control System**. To ensure that the NPR Program remains on schedule and within cost, NP has adopted a Program Control System. The objectives of this system are to:

- Provide assurance that all work has been planned and considered in developing the Program cost and schedule baselines;
- Identify the necessary procedures and organizational measures required for effective, timely management of the effort;
- Ensure that these measures are implemented and that the resulting information accurately reflects the status of the Program; and
- Establish a review and decision-making process that provides for the effective guidance of Program dynamics.

Under the Program Control System, integrated cost, schedule, and supporting baselines have been developed. The performance of NP elements and supporting organizations (contractors, National Laboratories, etc.) in completing their assigned tasks is measured against these baselines and reported to their managing organizations so that action can be taken if the baselines and actual performance diverge significantly.

Elements of the Program Control System are as follows:

7.3.4.1 **Management Control System and Reporting Requirements**. To ensure that NP elements and supporting organizations meet the objectives of the Program Control System, NP has adopted DOE's Cost and Schedule Control Systems Criteria (CSCSC). These criteria provide the standards by which NPR Program participants provide viable and credible cost and schedule management information. The CSCSC are sufficiently general to permit their use on almost any type of NP contract. Various NP participants will comply with the CSCSC when their contracts meet requirements defined by DOE Order 2250.1C and as specified by the Office of Business Management in the CSCSC Implementation Plan.

In addition, NP will use the DOE's Uniform Reporting System, DOE Order 1332.1A, to assist in the management and control of participants. The Uniform Reporting System addresses the reporting requirements specified in contracts. The plans and reports provide the data essential to project management and for reporting to higher level management. In general, there is a basic process by which reporting requirements are identified and specified by NP and plans and reports provided by the contractor.

7.3.4.2 **Program Summary Work Breakdown Structure**. Evaluating the current status of the NPR Program requires a clear definition of work to be accomplished and how it relates to the total mission. The NPR Program uses a structured framework, the Program Summary Work Breakdown Structure (PSWBS), for establishing those relationships. The PSWBS enables NP to divide large, complex elements of work into smaller elements until manageable units have been defined. Use of the work breakdown structure also ensures that no required element of work necessary for completion of the Program is overlooked.

Once these elements are identified, they are assigned to responsible performing organizations for planning, scheduling, budgeting, tracking, and reporting. The framework used by the NPR Program for specifying such organizational responsibilities is the Organizational Breakdown Structure (OBS). Contractors divide their assigned work into elements using Contract Work Breakdown Structures (CWBS) which are extensions of the PSWBS. Each element includes a defined technical content, work statement, assumptions, definition of interfaces, resource requirements, costs, milestones, and schedules.

The PSWBS consists of the following levels and elements:

- Level 0 -- Program;
- Level 1 -- Project;
- Level 2 -- Systems; and
- Level 3 -- Subsystems.

Each element within a level may be separately planned, scheduled, budgeted, and assigned to a responsible performing organization. The PSWBS provides a framework for establishing Program planning and reporting levels, Annual Operating Plans, status reports, and other specified planning and reporting requirements.

The sum of the elements for which an organizational unit is responsible equal that unit's entire responsibility to the Program. Responsibility for a work element may not be assigned to more than one unit. If more than one unit is working on a task, the work is subdivided into unique pieces, one for each performing unit.

Budgeting assignments within the NPR Program are based on work elements defined within the PSWBS. Initial planning, budgeting, and scheduling is carried out at the higher levels of the PSWBS and supporting CWBS. Eventually all budgets will be detailed to specific cost accounts. Budgets assigned to cost accounts and work packages are time-phased in accordance with the schedule for performing that work. These time-phased budgets constitute the Program cost baseline used in the measurement of performance.

7.3.5 Records Management (RM) System. The NPR Program manages and maintains its records and documentation in accordance with DOE Order 1324.5, other DOE orders, and ASME NQA-1-1989. Quality assurance records for the NPR Program will be identified on an approved Record Retention Schedule (RRS), and turned over to NP in accordance with approved procedures. Wherever possible, NP uses existing DOE records management processes (e.g., procurement, personnel, financial, and similar administrative records). NP records will be:

- Stored and maintained in accordance with approved procedures;
- Accounted for and controlled to protect against loss or unauthorized access; and
- Easily and readily retrievable.

NP procedures will ensure that approved versions of controlled Program documents are available for performing Program activities, and are disposed of in accordance with applicable NP plans, procedures, and originating organization approvals.

The RM System applies to records as defined by Title 44 of the U.S. Code, and encompasses the records generated or collected during the development, design, construction, operation and decommission of NP facilities. These requirements extend to all NPR Program participants including NP Offices, contractors and subcontractors, National Laboratories, consultants, and other government agencies providing services or products that require the delivery of records through contractual agreements in accordance with approved turnover procedures.

The NPR Program will develop an RM Plan to implement the RM System. This plan will define an integrated approach and methodology for records identification, records control, document control, record turnover, and records disposition. The RM Plan will also list the necessary required procedures to implement the RM System. The RM Plan will include the following functions:

- **Records Identification**. The process of selecting and categorizing the information to be controlled by the RM System;
- **Records Control**. A function for managing the receipt, verification, preparation, indexing, filing, storage, and retrieval of approved NPR Program documents. All records will be indexed in a control records database;
- **Document Control**. A function for managing the receipt, reproduction, distribution, accountability, vendor manual control, change control tracking and distribution, void issue control, and disposition of designated controlled Program documents; and
- **Records Disposition**. A function for managing the process of disposing of records or permanently retaining records in archive. The disposal of technical, safety, environmental, and quality assurance records will require concurrence of the appropriate NP

organization and the Chief Engineer or Construction Manager. Other records authorized for disposal will be retained until completion, clearance, or settlement of any pending litigation, audits, investigations, inspections, Congressional requests, and Freedom Of Information Act requests. Those records requiring permanent retention will be so designated in the RRS based on approval by the organization and the National Archives and Records Administration.

The RM System will be applicable during the period from development through facility decommissioning. RM training will be developed and conducted to ensure that all NPR Program participants understand and comply with the requirements of the RM System. Responsibilities for records management are as follows:

- The Office of Business Management is responsible for the oversight and implementation of the RM System;
- The NP Records Manager is responsible for developing and maintaining the RM System in accordance with the RM Plan;
- Designated NPR Program participants will establish consistent and compatible RM procedures in accordance with NP directives; and
- OSQ has the responsibility for performing surveillance and audits of the RM System.

8.0 SAFETY, QUALITY ASSURANCE, ENVIRONMENTAL COMPLIANCE, AND SECURITY STRATEGIES

As noted in Section 3.0, NP has established specific requirements in the areas of safety, quality, environmental protection, and security. To respond to these requirements, the NPR Program has taken steps to ensure they are addressed and carefully monitored in the planning, design, construction, and operation of the new production reactors. This section describes the NPR Program's strategies for each of the following areas:

- Public safety assurance--how hazards and risks to the public will be identified, assessed, and controlled;
- Employee safety assurance--how hazards and risks to workers building or operating the new production reactors will be identified, assessed, and controlled;
- Quality assurance--how standards of design and construction will be monitored and maintained;
- Environmental compliance--how the Program will ensure that the construction and operations of the new production reactors meet legal environmental protection standards; and
- Security--how the production reactors will be protected against sabotage or attack, and how the materials they produce will be protected against theft or diversion.

8.1 SAFETY ASSURANCE

The NPR Program is committed to the highest safety principles in accomplishing its mission to provide tritium production capacity for the nation's defense. As noted in Section 3.0, safety is a "paramount requirement" for the Program. DOE intends that the new production reactor capacity will provide a level of safety and of safety assurance that meets or exceeds that offered by modern commercial nuclear power plants.

The new generation of production reactor capacity being proposed will adopt advances in nuclear technology that have been developed in the nuclear industry over the past 30 years. The reactor designs will incorporate advanced safety, instrumentation, and control systems that will simplify operations and reduce the potential for accidents. These designs will also include features such as containment to mitigate the release of radioactive materials into the environment. In addition, the designs will incorporate the use of "passive" systems that rely on natural forces, such as convection or gravity, minimizing the need for operator action or external power in order to safely respond to accident situations. The lessons we have learned from past experiences, including Three Mile Island and Chernobyl, have proven valuable to DOE in this process.

8.1.1 The NPR Safety Assurance Approach.

Safety principles are fully incorporated in all Program planning and will be strictly adhered to in the design, construction, and operation of the new reactor capacity. All government and contractor managers are held accountable for achieving safety and reliability. Safety will be built into the components and operating procedures of the reactors. This is accomplished by careful planning of reactor systems, exacting design of reactor components, meticulous construction, complete operator training, and impeccable operating practices. The three NP Engineering Technology Offices are responsible for achieving safety through proper design, construction, and testing. They will develop models and perform analyses to uncover potential safety hazards in the reactor designs and make appropriate adjustments.

Management and oversight of safety are accomplished by two independent, but complementary approaches:

- First, the NP Office of Safety and Quality (OSQ) serves as the focal point for independent safety review, planning, implementation, and verification. This organization reports directly to the NP Director and is held accountable for independently verifying all nuclear safety aspects of the new production reactor capacity.

OSQ is responsible for verifying, through independent safety reviews and inspections, that the engineering organizations have achieved an adequate level of safety. This verification is provided to the NP Director and the Secretary of Energy for their use in decision-making. OSQ prepares safety and quality requirements subject to review and concurrence by the engineering organizations and approval by the NP Director, performs safety evaluations and inspections, helps maintain safety vigilance throughout the Program, and helps maintain strong interfaces between NP and other safety advisory and oversight organizations. OSQ directs the preparation and issuance of certain safety documents, including Integrated Safety Evaluation Reports (ISERs), and is the NP Director's nuclear safety self-assessment office. The OSQ Director will establish a safety Field Representative at each project site.

- Second, all safety-related activities are reviewed and confirmed by a variety of advisory and oversight panels. Three groups, the Defense Nuclear Facilities Safety Board (DNFSB), the DOE Office of Nuclear Safety, and the Advisory Committee on NPR Safety (ACNPRS), have special advisory functions. As previously discussed, the DNFSB reviews and evaluates all DOE defense nuclear facilities and recommends to the Secretary specific measures that should be adopted to ensure adequate protection of the public.

The DOE Office of Nuclear Safety advises the Secretary of whether DOE line management and its self-assessment functions are assuring adequate nuclear safety. The ACNPRS advises the NP Director on all matters of safety specific to the new production reactor capacity. Use of these advisory groups ensures the Program will benefit from the combined insights of the best safety experts and from lessons learned from all past reactor experience. In addition, the Assistant Secretary for Nuclear Energy has been assigned the responsibility for developing and coordinating Departmental policy for nuclear reactor and non-reactor nuclear facility safety. The relationships of the organizations involved in the new production reactor capacity safety activities are shown in Figure 8-1.

8.1.2 <u>Safety Review Process</u>. The Safety Review Process provides the umbrella for independent safety review activities of the Program. It is the blueprint for confirming that safety is integrated into the design, construction, testing, and operation of the new production reactor capacity. The Safety Review Process may be described as both an operating philosophy for the Program as well as a series of Program documents and reviews used to confirm compliance with safety requirements and procedures. Rather than waiting to conduct safety reviews on the fully-designed reactors, safety issues will be identified and resolved during the design phases of the Program.

The Safety Review Process is structured to meet the following objectives: 1) early and continued consideration of safety and quality in all Program phases; 2) development of and compliance with safety goals and requirements, that will provide a level of safety and of safety assurance that meets or exceeds that afforded to the public by modern commercial nuclear power plants; 3) completion of required safety reviews in a controlled, timely, and efficient manner, synchronized with the evolution of the design and construction activities; and 4) provision for external oversight.

The Safety Review Process is implemented using four major Program documents that will define the protocol for verifying safety for the new production reactor capacity. These documents are the:

- <u>Safety Review Process Document</u>, which outlines the independent safety review strategy;
- <u>General Safety Requirements Document</u>, which provides the general safety requirements for the NPR Program;
- <u>Integrated Safety Analysis Report (ISAR)</u>, which analyzes and demonstrates how the design complies with safety requirements; and
- <u>Integrated Safety Evaluation Report (ISER)</u>, which provides an independent evaluation of the ISAR.

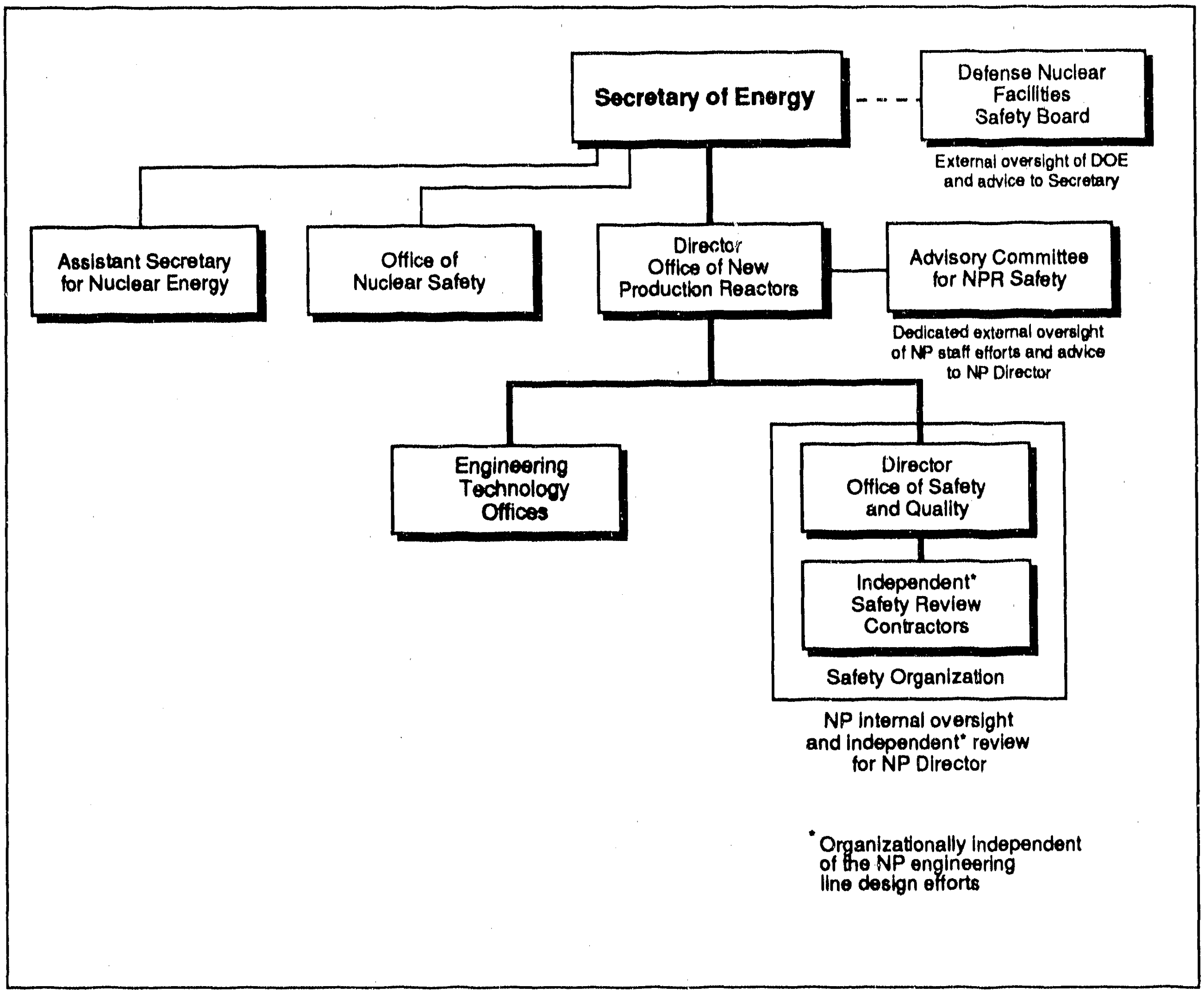

Figure 8-1
NPR Program Safety Review Organizations

The development and application of these documents, in conjunction with the extensive safety advisory functions, constitutes a dependable safety review process encompassing the full scope of NPR Program activities.

Each of the NP Engineering Technology Offices and their design contractors will analyze its reactor design for compliance with safety requirements, and collate their findings into a single document, the ISAR. OSQ will perform an independent safety review of the reactor designs and review the ISAR. OSQ's safety evaluation reports of individual design segments will be incorporated into the ISER. Prompt corrective action will be expected to resolve any open safety issues. Final authorization to proceed with the project will be given following these reviews and after the ISER has been completed. Both the ISAR and the ISER are expected to receive considerable review by the external oversight groups.

The Engineering Technology Offices and OSQ are expected to have resolved open issues before the construction phase. Even so, during construction, safety reviews will be held as each design segment is built. The entire collection of reviews must be favorable before the reactor may go into operation. Any open issues that develop during the review of individual design segments will be tracked through a Safety Verification Plan. Solutions that are mutually acceptable to the OSQ and the Engineering

Technology Offices will be identified to resolve these issues and any alterations to the design must be reviewed and documented in this publication and incorporated into the ISAR and ISER. The key features of the safety review process are shown in schematic form in Figure 8-2.

8.1.3 Key Safety Decision Points. The DOE Safety Review Process for both the HWR and MHTGR plants is similar to the process used for commercial reactors. Prior to the start of substantial construction, a comprehensive safety review of the design and supporting analyses will be conducted (similar to the Preliminary Safety Analysis Report (PSAR) stage in a commercial licensing process, except that the new production reactor designs are expected to be more advanced at this stage than has been the case for most commercial plants). A formal readiness review process will form a part of the basis for the Secretary of Energy to determine if the project should proceed into the construction phase.

A decision will be made prior to operation based on additional comprehensive safety reviews considering the finalized safety analyses and the as-built plant conditions. This second decision (similar to issuance of an operating license at the Final Safety Analysis Report (FSAR) stage in a commercial plant) will be based on the readiness of the physical plant, the procedures, and the operators to initiate operations.

The nomenclature of the NPR documents used to support these decisions is somewhat different than that for commercial plants. The documented basis for the first review is the ISAR which is developed in preparation for the start of construction. This document is comparable to a PSAR for a commercial plant. The additional reviews to be conducted after the start of construction will be based on amended and updated versions of the ISAR. The final documentation will be reviewed against the same types of requirements applicable to a FSAR. The reviews at both the construction and the operation stages will be documented in the ISER.

8.2 OCCUPATIONAL SAFETY & HEALTH

In general, occupational safety and health (OS&H) encompasses the protection of personnel, visitors and workers from the hazards associated with the construction, operation, and maintenance of a facility. The Occupational Safety and Health Administration (OSHA) has established requirements to ensure this protection.

The Department of Energy has adopted specific policies to incorporate the OSHA requirements--as well as other Federal requirements and industry standards related to occupational safety and health--into the basic guidelines for the development of DOE operations. DOE policy and NP directives stipulate that safety measures will be designed into the facilities and systems to protect the occupants, personnel adjacent to the facility, and the public prior to approval to begin construction of the new production reactors and the supporting facilities. The OS&H approach that has been adopted by NP addresses the following areas of concern:

- Industrial Safety, mainly involving the interaction of the worker and equipment used in performing work;
- Industrial Hygiene, concerning the non-radiological hazardous and toxic substances that may be encountered in the workplace;
- Fire Protection, including both fire prevention and fire protection systems; and
- Radiation Protection, concerning methods for minimizing and tracking personnel exposure to ionizing radiation in the workplace.

In addition to these areas of concern, DOE policy requires the development and implementation of emergency procedures to mitigate the impact of an accident which threatens the health and safety of the facility occupants, personnel in the immediate surrounding area of the facility, or other individuals.

8.2.1 Organizational Responsibility. The NP Director is ultimately responsible for ensuring that all facilities in the NPR Program provide a safe work environment. He has assigned responsibility for the actual development and implementation of OS&H efforts that meet DOE requirements to the Directors of the Engineering Technology Offices. The Engineering Technology Offices will carry out this assignment in step with each phase of the overall NP schedule (e.g., design, construction, testing, and operation).

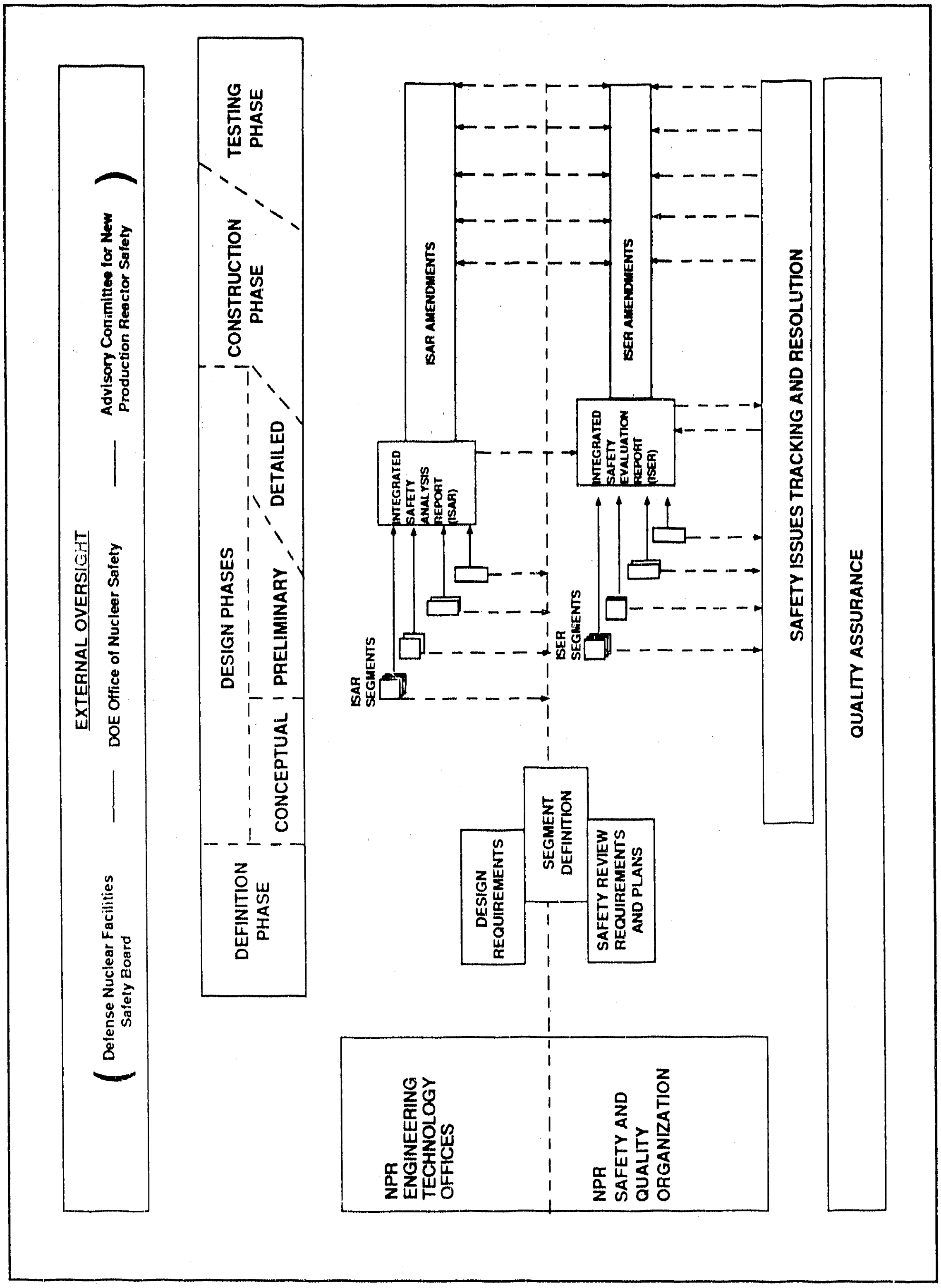

Figure 8-2
NPR Program Safety Review Process Schematic

The Office of Environment (OE) is responsible for oversight of the NP OS&H efforts to ensure that it meets the DOE requirements. OE carries out this oversight function through a systematic, documented process providing for the review of:

- Design documents;
- Safety analysis reports;
- Safety implementation plans; and
- Construction and plant operations.

8.2.2 Implementation of the OS&H Process. Implementation of OS&H is fully integrated into the overall NPR Program. OS&H requirements to be carried out in step with specific phases or milestones are described below.

- **Environmental Impact Statement**. Preparation of the EIS is the responsibility of OE. In addressing OS&H, the EIS will include radiological impacts to NPR Program workers due to normal operations and potential accidents. In addition, operational supplies of hazardous chemicals will be identified as part of addressing chemical hazards due to potential accidents that could impact workers located outside the NPR plant but within the site boundaries.

- **Design Documents**. The Engineering Technology Offices will include OE in the review process for all phases of design documents. The OE reviews will evaluate and approve the adequacy of the following measures at each level of design:

  - Conceptual Design - Provides references to basic OS&H design requirements in the appropriate sections;

  - Preliminary Design (Title I) - Delineates actual OS&H requirements based on facility specifics: shielding, ventilation, fire protection systems and barriers, ergonomics, remote maintenance, contamination control, chemical controls, emergency systems; and,

  - Detailed Design (Title II) - Provides details of OS&H hardware and systems.

- **Construction**. The Project Management Office in conjunction with the Operations Office will provide basic OS&H needs including fire department response, ambulance service, medical program (routine and emergency), and worker safety training, and provide general OS&H overview to ensure compliance with site specific requirements.

  The PMO, with input from OE, will approve the construction contractor's OS&H plans and, with OE oversight, will ensure OS&H systems are incorporated as specified in the designs.

- **Operations**. The PMO, in conjunction with the Operations Office and the M&O contractor will ensure that basic OS&H needs (fire department response, ambulance service, routine and emergency medical program, worker safety training, radiation dosimetry) are provided prior to initiation of operations. The PMO will also ensure that general OS&H monitoring to ensure compliance with site specific requirements is in place and, with input from OE, will approve the M&O OS&H Plan and Emergency Preparedness Plan.

8.3 QUALITY ASSURANCE

Quality achievement is a continuing responsibility of line management at all levels in the NPR Program. Well defined quality assurance (QA) programs describing the set of management controls needed to achieve Program objectives have been established and are effectively being implemented by all Program participants. These participants include the Office of New Production Reactors, contractors, subcontractors, National Laboratories, and other agencies performing activities affecting quality.

8.3.1 Quality Assurance Requirements. Quality assurance is based on the NP Quality Assurance Requirements (QAR) Document, which incorporates the requirements of DOE Orders 4700.1 and 5700.6B, the nuclear industry standard ASME NQA-1-1989, and applicable portions of ASME NQA-2-1989. NQA-1 has been chosen as the basic document because DOE Order 5700.6B, Quality Assurance, has endorsed it as the preferred standard for nuclear facilities. Figure 8-3 reflects the importance of the QAR in governing the NP QA Program.

The NP QAR governs all work performed by NPR Program participants during the design, construction, equipment procurement, and start-up phases of the Program. Line management is fully responsible for the quality and safety of the new production reactor capacity. Through issuance of the QAR, the NP Director has established the following:

- A definition of responsibilities and authorities for quality assurance activities in the Program.
- The requirement that a quality assurance program at least as effective as that in the commercial nuclear power industry be implemented by DOE contractor organizations, other government agencies, and National Laboratories participating in the Program.
- The requirement that corrective actions be taken by responsible organizations in response to identified quality assurance-related issues and problems.
- A process whereby each participant's QA Program will comply with the applicable Federal codes, standards, and regulations.

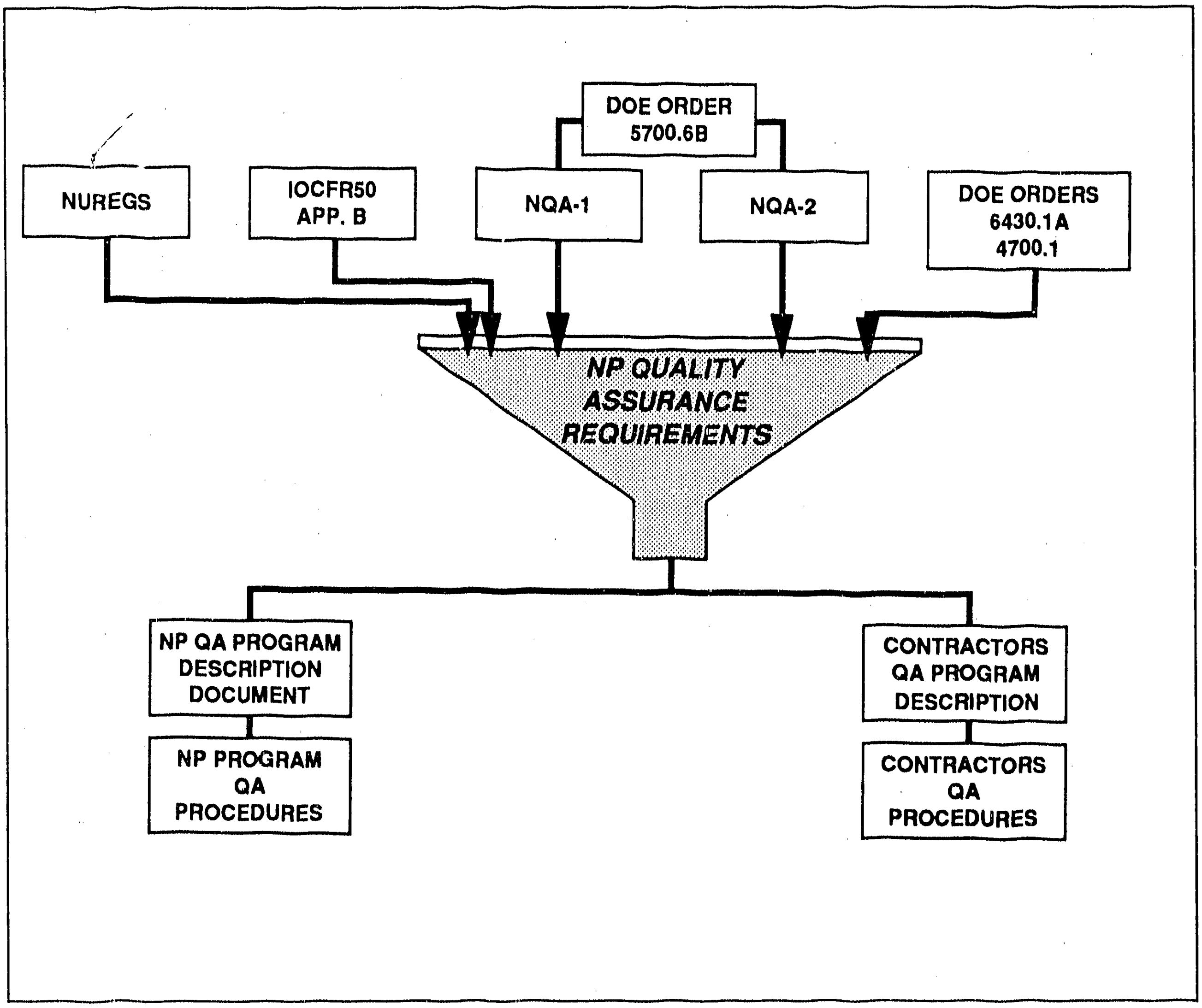

Figure 8-3
NPR Quality Assurance Program Documents

The QAR addresses quality assurance in the areas shown in Table 8-1.

8.3.2 The NPR Program Approach to Quality Assurance. The QA Program is based on the following fundamental principles:

- The achievement of quality is a line responsibility wherein each performer and supervisor is accountable for the quality of the work assigned to them. This applies to all persons responsible for design, construction, testing and start-up, and operations.
- The Quality Assurance Division maintains oversight of work to give additional assurance that specified requirements are met. This oversight is carried out through audits, surveillance, reviews, and assessments of activities affecting quality. An immediate debrief of each QA audit is given by the lead auditor to the NP Senior Management Group once the audit is complete.
- Quality assurance criteria should be determined according to the importance of a structure, system, or component to the safety and success of the Program; using this approach, these criteria should yield a "graded" quality assurance program, in which the more important structures, systems, and components are given greater attention and assigned more stringent requirements.
- The review and approval of Quality Assurance Program Descriptions (QAPDs), quality assurance administrative procedures, and quality categories will be at a management level commensurate with importance of the structures, systems, and components involved.

The Office of Safety and Quality (OSQ) is establishing minimal QA requirements for all NP systems and projects. The Quality Assurance Division within OSQ is establishing a quality assurance strategy and program including an effective independent audit process.

The NP Quality Assurance Program is organized such that plant structures, systems, and components are graded or classified into the three following quality categories.

Category	Generic Description
S	Safety-related, important to safety, regulatory-related
M	Mission related, reliability related, production systems
G	Plant support, non-critical support facilities

The assignment of a facility, system, or piece of equipment to a category depends on its impor-

- Engineering Development
- Reporting and Tracking of Quality Assurance Information
- Nuclear Facilities Interfaces
- Audits
- Design Control
- Instructions, Procedures, and Drawings
- Quality Assurance Records
- Control of Processes
- Test Control
- Handling, Storage, and Shipping
- Identification and Control of Items
- Corrective Action
- Computer Software Control
- Independent Management Quality Assessments
- Readiness Reviews
- Surveillances
- Procurement Document Control
- Document Control
- Control of Purchased Items and Services
- Inspection
- Control of Measuring and Test Equipment
- Inspection, Test, and Operating Status
- Control of Nonconforming Items

Table 8-1
QAR Quality Assurance Areas

tance and, hence, the level of confidence needed in ensuring that the requisite quality is achieved.

The OSQ Director will establish a Field Representative at each of the project sites. Program participants are developing and implementing QA programs to ensure that applicable management controls reflected in the QAR are applied to work performed in the Program.

8.4 ENVIRONMENTAL COMPLIANCE

DOE is committed to environmental protection in all of its activities. As part of this commitment, the New Production Reactors Program will be conducted in compliance with all applicable Federal, state, and local environmental statutes, regulations, and standards.

To meet environment protection requirements, the NPR Program has adopted a general "as low as reasonably achievable" (ALARA) approach to the design, construction and operation of the new production reactors. Under this approach, normal operations of the Program will produce environmental impacts at or below regulatory thresholds. This approach will simplify the compliance process and provide ample margins for compliance to future environmental protection requirements. In addition, all NPR facilities will be designed to minimize waste through source reduction and recycling, and to minimize the exposure of workers and the public to all radiological and non-radiological hazards.

8.4.1 Meeting the Environmental Impact Statement Requirement. The new production reactor capacity acquisition is being reviewed under NEPA which requires Federal agencies to prepare an EIS for every major Federal action that may significantly affect the quality of the human environment. Accordingly, the Department is evaluating all reasonable alternative technologies and sites, including the "no action" alternative. As per NEPA, no final decision on technologies or sites will be made until DOE publishes a Record of Decision following the completion of the final EIS which is expected in late 1991.

To keep the program on an urgent schedule, the preparation of the EIS will be performed concurrently with confirmatory development and project design activities for the HWR and MHTGR and those LWR tasks necessary for informed decision-making. Once the Record of Decision is released, the final technologies and site selections will proceed with detailed design and the remaining acquisition phases as previously described.

The new production capacity EIS will provide a full and comparative discussion of the potential environmental impacts associated with siting, constructing, operating, and decommissioning each of the technologies, including support facilities being considered at each of the candidate sites. It will describe in detail the proposed action, facilities, and affected environment, as well as address public and occupational safety, water resources, air quality, regulatory compliance, and other environmental issues. It will also evaluate the environmental consequences of the "no action" alternative, which assumes that no new production capacity is developed. Under this condition, DOE may continue to rely on existing production reactors for production of tritium.

8.4.2 Public Involvement in the EIS Process. Beginning with an announcement in the Federal Register in September 1988, DOE initiated the EIS process by inviting comments from all interested parties. Thirteen "scoping" meetings were held in five states to provide the public an opportunity to participate early in the process by identifying environmental issues to be addressed in the EIS and the level of detail in which they will be covered. More than 1000 members of the public took part in those meetings. In addition, approximately 6000 people submitted their comments in writing. In all, more than 9000 comments were received and are being considered in the preparation of the EIS.

The EIS process will provide additional opportunities for public involvement. Once the draft EIS is issued in early 1991, a public comment period will be announced in the Federal Register. Comments received on the draft will be considered by DOE in preparing the final EIS, which is expected in November 1991.

After the final EIS is released, the Department will publish a Record of Decision (ROD) in the Federal Register. That notice will announce the selected technology(ies) and site(s) for new production capacity, if any, discuss the alternatives that were considered, and describe the measures selected to avoid or minimize environmental impacts.

8.4.3 EIS Schedule. Table 8-2 shows the schedule for the EIS process and includes completed activities and estimated dates for upcoming activities.

8.4.4 Administration and Monitoring of Environmental Compliance. A separate Office of Environment (OE) was created within NP to manage and coordinate all environmental aspects of the Program and ensure compliance with all applicable requirements. OE will develop an Environmental Management Plan along with a supporting Environmental Compliance Requirements Document to assist it in carrying out its mission effectively.

In addition to ensuring compliance with these requirements, OE will address environmental efforts for construction, start-up, and operation of the reactor capacity. Field Representatives at each Project Management Office, who report directly to OE, will be used to ensure proper adherence to sound environmental practices at each site. OE, in fulfilling its oversight and planning responsibilities, will:

- Provide for necessary NEPA documentation and requirements;
- Assist the PMO in determining environmental requirements and in coordinating the respective planning efforts and participate, to the extent requested, in the regulatory process;
- Provide guidance and oversight for planning and implementation of PMO compliance activities. The PMO is responsible and accountable to the NP Director for obtaining all permits and licenses necessary for the construction and operation of the NPR and all support facilities;
- Provide oversight to ensure compliance with all applicable environmental, human health, and safety statutes, standards, and regulations;
- Develop and implement a construction and pre-operations environmental health and safety strategy for workers and the public; and
- Develop environmental, health, safety, and waste minimization strategies for NP operations.

SCOPING PERIOD	September 16 - December 15, 1988
Notice of Intent Published	September 16, 1988
Revised Notice of Intent Published	October 25 and November 17, 1988
Scoping Meetings Conducted	November 10 - December 8, 1988
IMPLEMENTATION PLAN RELEASED	January 31, 1990
DRAFT EIS RELEASED	April 1991
FINAL EIS RELEASED	November 1991
RECORD OF DECISION PUBLISHED	No sooner than 30 days following release of Final EIS

Table 8-2
Environmental Impact Statement Schedule

In addressing these functional areas, it will be necessary to coordinate with Federal, state, and local regulatory agencies and respond to public and organizational interests and concerns. OE will participate with the Operations Offices and the PMOs in these activities.

The Office of Environment receives expert guidance and oversight from two separate environmental committees created to anticipate and resolve environmental issues affecting the Program. The Environmental Steering Committee, consisting of senior DOE managers and chaired by the NP Director, focuses on DOE environmental policy issues affecting new production capacity. The Environmental Coordinating Committee, a forum chaired by the Director of the Office of Environment, coordinates NPR environmental activities among the NP Offices, Operations Offices, and NP support contractors. Together, these groups constitute an integrated approach for implementing a conscientious environmental strategy.

8.5 SAFEGUARDS AND SECURITY

Safeguards and Security (S&S) are important aspects of any nuclear facility and must receive consideration at the earliest phase of the design and at every subsequent phase. There are three elements to safeguards and security: physical protection, material control, and material accountability. The safeguards and security system for NP, its supporting fuel cycle, and its target processing facilities will provide protection against the DOE-defined generic threat for all applicable categories of potential inside and outside adversaries, or combinations of insiders and outsiders. This includes:

- Physical protection against acts of theft of Special Nuclear Materials/Other Nuclear Materials (SNM/ONM) and acts for creating a radiological incident which might endanger employees or public health and safety (radiological sabotage) or industrial sabotage that interrupts production activities thus adversely impacting national security; and,
- Materials and personnel control systems and material accountability systems for protection of SNM/ONM from adversarial acts involving the unauthorized movement of SNM/ONM within a facility (diversion) or the unauthorized removal of SNM/ONM from a facility (theft).

The new production reactor projects will comply with the applicable requirements (as defined in DOE Orders 5632 and 5633) to provide an effective integrated safeguards system with respect to design and operations of the plants. The safeguards and security requirements for the HWR, MHTGR, and LWR are set out in the NP Requirements Document and will apply to all participants and contractors.

Each NP site will have a Physical Protection Plan, a Vulnerability Analysis, and a Material Control and Accountability Plan. Also, each facility will be based on a design that meets the NPR Program safeguards and security requirements. Each facility's compliance with these requirements will be monitored through the design, construction, and operation of the project.

8.5.1 Organizational Responsibilities. In general, each NP organization is required to develop and implement a security plan for its area of responsibility. During the conceptual, preliminary, and detailed design period, the NP Director will hold the respective Engineering Technology Office Directors (HWR, MHTGR and LWR) responsible for directing the design contractors and implementing the S&S requirements. That responsibility will transfer to the respective PMO prior to start of construction and will remain there through start-up.

The NP Office of Safety and Quality will independently verify that safeguards and security requirements are fulfilled by performing evaluations, inspections, and/or audits. These findings will be reported to NP management and any shortcomings will be tracked until resolved.

8.5.2 Implementation Procedures. In order to meet the identified security requirements, the NPR Program will be required to carry out initial planning during the conceptual design, detailed planning during the preliminary design, and implementation during the detailed design, construction, and start up phases. The series of steps and achievements necessary in this process are outlined below.

Each NP site will prepare a physical protection plan. The key elements of the approach to assure the physical protection of SNM/ONM and vital equipment are:

- A vulnerability analysis to determine the expected performance of the S&S system to detect various malevolent acts; this should include an identification of specific security requirements, based on the series of DOE Orders 5632 and 5633;

- Provisions for site security which usually include plans for fences, intrusion detection devices, guard force and weaponry, central alarm authorities, backup power for security functions, access control for people and vehicles, protection during SNM/ONM transfers, and protection during radiological, fire, or toxic gas emergencies;

- Protection against possible violent external assault, attack by stealth or deception, and sabotage, including the potential participation of one or more employees; and,

- Provisions for interfaces with existing site services and existing site plans and organizations.

To provide these key elements, each NP Project Management Office will:

- Document the S&S plan and design for its area of responsibility, delineating the safeguards system objectives, and identifying the specific requirements in the DOE S&S Orders (Physical Protection and Material Control and Accountability (MCA) series) that the safeguards system will meet;

- Prepare a preliminary Master Safeguards and Security Agreement and describe in the site S&S planning documents how the S&S activities for NP may impact (or be impacted by) the other S&S activities at the site;

- Ensure that the detailed design of the S&S system is completed as part of the detailed engineering phase of the project and evaluate and demonstrate that the planned S&S system fully meets the S&S design basis;

- Ensure that procurement and construction activities are monitored to demonstrate that the S&S system was constructed as designed; and,

- Implement a change control system for any changes in the S&S system design; evaluate the effectiveness of proposed changes, and obtain appropriate approvals for changes.

The respective design contractors will accomplish sufficient S&S planning during the conceptual design to establish the need for and conceptual cost of the required physical features.

The design contractors will document the S&S design basis during the preliminary design. During that period, they will also complete the Physical Protection Plan, continue the Vulnerability Analysis and the MCA Plan. The design contractors will develop a preliminary Master Safeguards and Security Agreement in close concert with the respective M&O contractor and PMO who will coordinate the work with the site Operations Office.

NP will prepare and validate the procedures required for S&S during operations and will participate in training operations up to the point of turnover.

8.5.2.1 Requirements for the Physical Plant. The designs of the reactor and other structures containing SNM/ONM will recognize the requirements for nuclear material control and will ensure that the S&S system includes:

- Continuous monitoring of operations;

- Surveillance of personnel movements;

- Surveillance and containment of nuclear materials within the facilities;

- Near real-time estimation of material quantities; and,

- Monitoring health, safety, and production information of safeguards significance.

8.5.2.2 Accounting and Control Requirements for Materials. Each NP project will have an MCA Plan as set out in the NP Requirements Document. The S&S system design will include:

- High accuracy measurements of nuclear material transfers and inventories;

- Accounting record systems by material balance areas;
- Estimates of the limits of error for inventory difference for the proposed MCA systems; and,
- Analysis and investigation and resolution of material balance inventory differences.

9.0 PRELIMINARY PROGRAM SCHEDU' E, COSTS, AND STAFFING

9.1 PRELIMINARY SCHEDULES

The schedules and milestones supporting the New Production Reactors Program are divided into a multi-tier hierarchical structure consisting of the Program Master Schedule, Program Summary Schedules, Project Intermediate Schedules, and Project Detailed Schedules. This structure, shown in Figure 9-1, provides the framework for vertical and horizontal integration among organizations, participants, and technologies.

At this time, all of the New Production Reactors Program schedules and milestones are preliminary. At completion of the conceptual designs for the HWR and the MHTGR, the contractors delivered budget quality cost estimates and schedules. Following review, the Department will be in a position to develop updated government estimates of the costs and schedules for each design. The LWR cost and schedule estimate is also being updated. Total program cost estimates will remain preliminary until final selection of the technology(ies) and site(s) for new production capacity at the time of the Record of Decision in December 1991.

9.1.1 Preliminary Program Master Schedule. The Preliminary Program Master Schedule is the uppermost tier of the scheduling system and provides a capsule summary of the overall target schedule, including all Secretary Key Decision milestones and other controlled milestones. This schedule outlines the target start and completion dates for all subprograms and major phases for the DOE preferred strategy and provides a basis for development of all lower level schedules. It is shown as a Gantt chart displaying progress toward achieving each milestone, and providing narratives appropriate for program level management. The focus of this schedule is on overall Program policy, planning and development, budget preparation, and broad Program direction. Figure 9-2 depicts the current Preliminary Program Master Schedule developed to provide the Program logic consistent with the preferred strategy.

9.1.2 Preliminary Program Summary Schedules. The Program Summary Schedules are second-tier schedules for the entire Program or a time segment of the Program, e.g., start of Program authorization through Record of

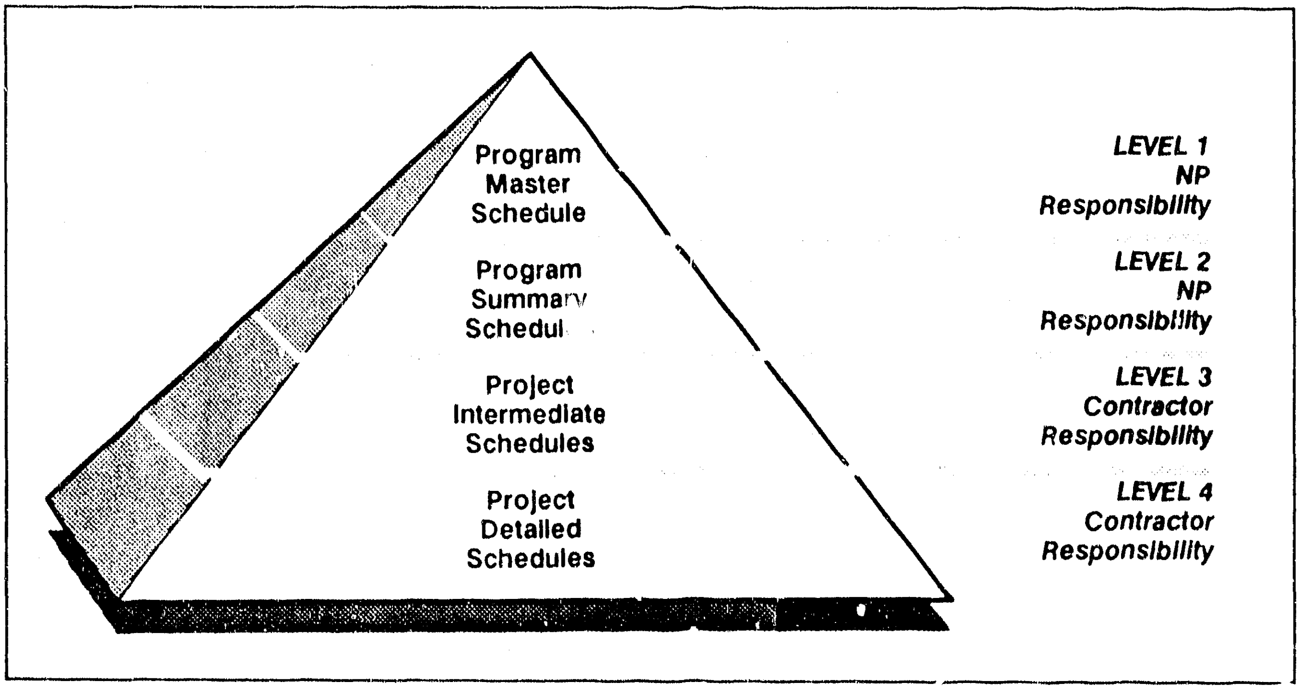

Figure 9-1
NPR Program Schedule Hierarchy

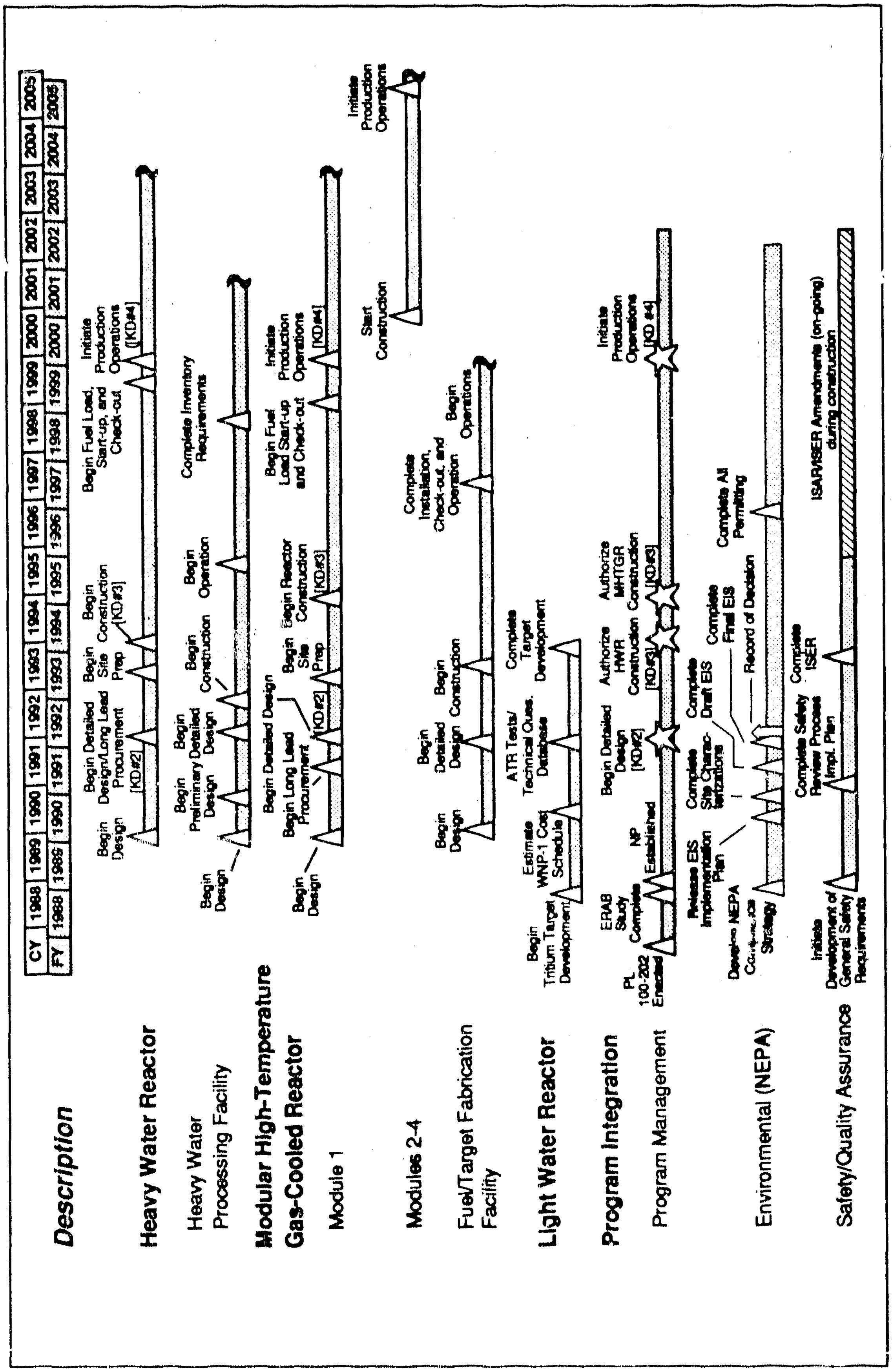

Figure 9-2
NPR Program Preliminary Master Schedule

Decision. These schedules provide a logical flow from the Program Master Schedule down to the Intermediate and Detailed Schedules. The Program Summary Schedules display the scope of the Program by project, phase, system, or areas and include design, procurement, construction, testing, and interfacing maintenance and operations activities. All DOE controlled milestones are indicated on these schedules and are the basis by which overall progress of the Program can be measured. These schedules are developed by NP during the conceptual and preliminary design phases and updated as required. The Program Summary Schedules will be Critical Path Method (CPM) networks. In addition, Gantt charts will be produced from the logic networks to display status. Figure 9-3 is a current Program Summary Schedule developed to provide the program logic from the New Production Reactors Program authorization through FY 1995. As the Program moves through each project's design phases, better cost and schedule estimates will be generated. This will require continuous updating of plans, schedules, and budgets as more precise projections become available.

9.2 PRELIMINARY PROGRAM COST ESTIMATES

The only cost projections to date for the New Production Reactors Program are based on data provided by industrial proponents for the reactor technologies at the request of the ERAB in 1988. Better, budget quality cost data were generated as contractor deliverables at completion of the HWR and MHTGR conceptual designs. These cost estimates are currently under NP review and will be validated through DOE independent cost estimating procedures. These conceptual design-based cost estimates are expected to be completed by February 1991. The accuracy of the cost projections will continue to improve as each phase of the design progresses. The LWR cost estimate will be based on firm fixed price bids to complete WNP-1 as a commercial power plant, adjusted to reflect the modifications to the plant necessary to satisfy the NPR Program requirements.

9.2.1 ERAB Cost Estimates. The January 1988 ERAB review and assessment of candidate technologies for new production capacity included project costs as one of the evaluation criteria. The ERAB sought data from private sector firms (proponents) with expertise in the various reactor technologies under consideration. A Cost Evaluation Technical Support Group (CETSG) was established to review this project cost data. Their report, NPR Capacity Cost Evaluation (DOE/DP-0052), was issued in July 1988 and provided estimated project costs as obtained from the proponents and modified by the CETSG.

The CETSG modified the proponents' estimates in two ways - standardization and addition of other factors. Although ERAB cost guidelines were issued to the proponents, they were not always followed or complied with consistently. After discussions with the proponents, estimates were adjusted to ensure comparability and consistency. The CETSG provided the following cost data:

- Materials and services such as heavy water, uranium enrichment, uranium ore, and lithium.
- Site support.
- Capital upgrade.
- Decontamination and decommissioning.
- Proponent contingencies were replaced with CETSG estimates.

Actual calculation of life cycle costs was done by the CETSG.

The CETSG figures served as the basis for determining the estimated cost of the DOE preferred strategy of a heavy water reactor at the Savannah River Site, a four module, high-temperature gas-cooled reactor plant at the Idaho National Engineering Laboratory, and the development of a light water reactor target as a contingency. Table 9-1 summarizes the aggregated life cycle project costs (not total DOE Program costs) for the DOE preferred strategy based on the CETSG data.

It is important to recognize that the CETSG life-cycle cost estimates included costs that would be incurred following completion of the NPR Program. The operation and maintenance costs over a 40 year period as well as decontamination and decommissioning costs were necessary to

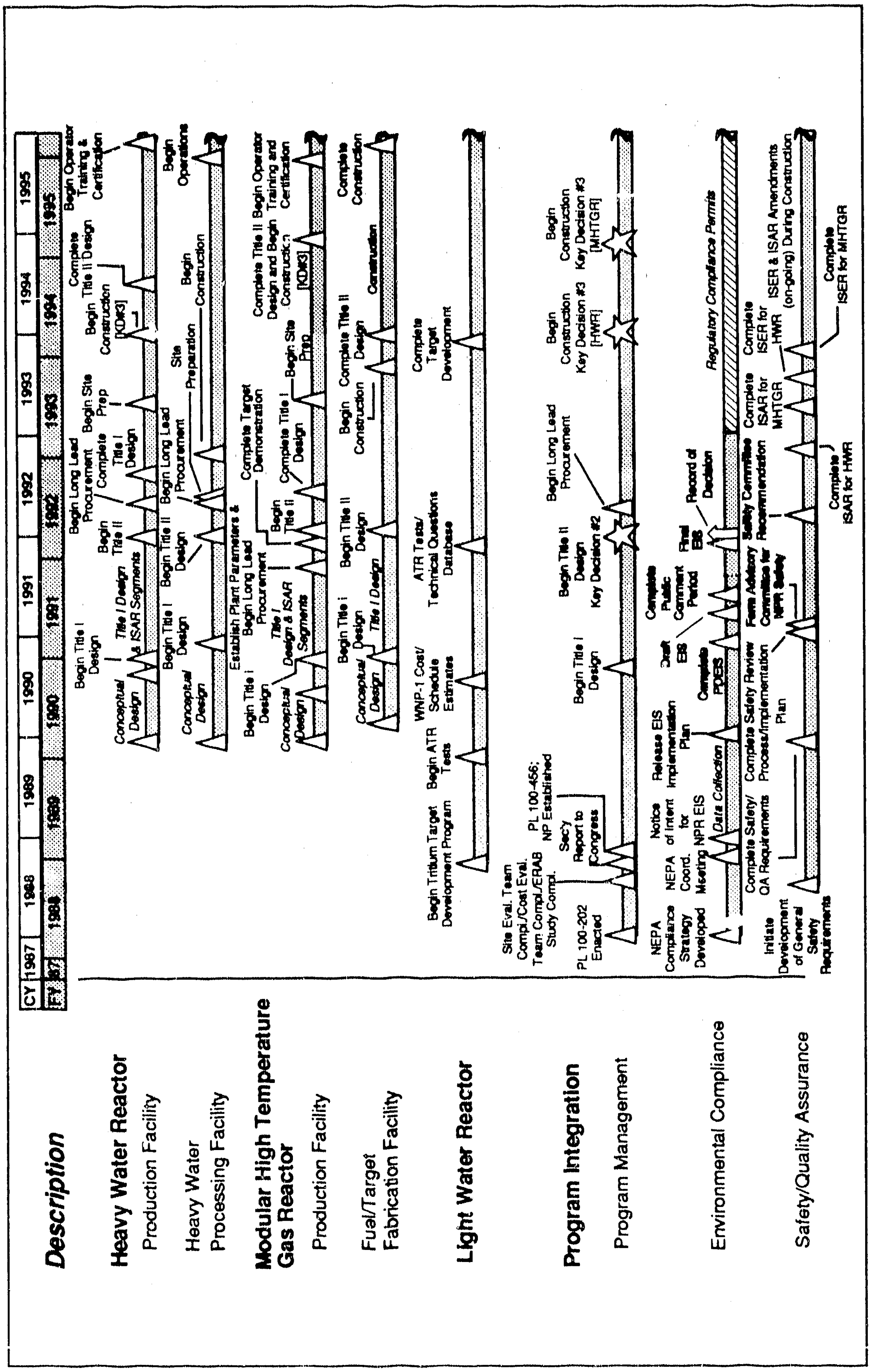

Figure 9-3
NPR Program Preliminary Program Schedule Summary

(1988 Dollars in Billions: Undiscounted)

Project	Preoperations and Capital	O&M	Steam Revenues	Life Cycle Costs
HWR @ SR	3.2	16.5		19.7
MHTGR @ ID	3.6*	18.4	(-)3.4	18.6
LWR Target R&D	0.1			0.1
Project Totals	6.9	34.9	(-)3.4	38.4

* MHTGR Target Development Included

Table 9-1
CETSG Modified Proponents' Life Cycle Costs
For DOE Preferred Strategy

provide decision makers with a complete understanding of the proposals. However, the mission of the NPR Program is to develop, design, construct, and turn over the new operational capacity. Therefore, the Program's total cost should only encompass the costs associated with these activities.

These preliminary estimates, based upon proponent data, are highly tentative. They were reviewed by the General Accounting Office (GAO) which questioned the methodology used for scaling the MHTGR for an eight module plant to a four module plant and the handling of the MHTGR schedule stretch out. GAO also noted in their report, Better Information Needed for Selection of New Production Reactor (GAO/RCED-89-206, September 1989), that "DOE's proposed two-reactor strategy has the uncertainty of not yet having detailed reactor designs, without which it becomes very difficult to develop a firm estimate". The New Production Reactors Program agrees fully that any estimates developed prior to design are not budget quality.

9.2.2 Initial Program Funding Requirements. The initial NP Program funding requirements are based on the preoperations and construction project costs estimated by the proponents with the addition of Program management data including independent safety review and oversight, environmental activities such as preparation of the EIS, and Program direction costs for the Office of New Production Reactors such as salaries and independent technical reviews. Table 9-2 shows the actual NP funding from Program authorization for FY 1988 through FY 1991 and the projected funding requirements through FY 1996 for the Department's preferred strategy projects based upon proponents' cost estimates.

9.3 PROGRAM STAFFING.

Currently projected Federal manning levels for this Program include: 428 for FY 1991; 548 for FY 1992; and 610 for FY 1993. These numbers reflect end-of-year positions and also include personnel to be located at the PMOs. The PMOs are a part of NP and therefore, NP controls all manpower for these organizations.

To meet the requirements expected of this Program, there has been, and will continue to be, an aggressive effort to recruit and retain a sufficient number of highly qualified personnel with the correct mixture of necessary skills. Recruiting efforts will center around technical

(Dollars in Millions)

	FY 1988 (actual)	FY 1989 (actual)	FY 1990 (actual)	FY 1991 (actual)	FY 1992 (est.)	FY 1993 (est.)	FY 1994 (est.)	FY 1995 (est.)	FY 1996 (est.)
Operations	10.0	60.0	200.4	134.9	152.3	133.6	120.0	184.0	190.0
Capital Equipment	0.0	0.0	0.0	8.8	11.2	15.0	25.0	25.0	25.0
Construction	0.0	0.0	98.5*	231.3*	524.1	871.0	1,220.0	1,366.0	1,145.0
Total	10.0	60.0	298.9	375.0	687.6	1019.6	1,365.0	1,575.0	1,360.0

*Construction Funds are for preliminary and detailed design prior to actual construction.

FY 1992-1996 figures are estimates only. Administration budget requests for those years will depend upon program decisions made during the normal budget cycle and on the choice of reactor technology(ies) and site(s) made in the *Record of Decision*.

Table 9-2
Initial Program Funding Requirements
For DOE Preferred Strategy
(Based on Proponent's Project Cost Estimate)

personnel, such as engineers and other highly specialized technicians and in recruiting managerial and business staff.

To support the vast areas of responsibility encompassed within this Program, NP employees are supplemented by the National Laboratories, a Utility Engineering Group (UEG), the M&O contractor, and when necessary, outside consultants. The National Laboratories provide a readily available source of highly specialized scientific and technical expertise. Duke Engineering Services, Inc., the UEG for NP, will supplement our efforts in design and construction by bringing years of commercial sector nuclear engineering and operations experience. And finally, special consultants will be hired on an "as needed" basis for highly specialized efforts.

Because the NPR Program is a new operating approach for DOE, careful attention has been paid to planning the recruitment, training, and development of NP personnel. An NP Staffing Plan has been developed and includes the following elements:

9.3.1 Recruitment Initiatives

9.3.1.2 Technical Intern Initiative. This initiative is designed to provide a continuing source of highly qualified entry level engineers and scientists to help NP fulfill its mission. The initiative consists of three years of training which includes orientation, formal training, work experience with rotational assignments to the project sites, and a year spent in graduate level education. The process will be administered by the Office of Business Management staff with the advice and support of the Technical Directors.

9.3.1.2 College Recruitment Initiative. This initiative is designed to provide attractive career opportunities and incentives in order to recruit college graduates with outstanding qualifications and academic records, particularly in the areas of engineering and health physics. It will offer internships, direct hire, accelerated promotion opportunities, opportunities for rotational work assignments and graduate study, and support for participation in scientific and technical societies.

9.3.2 Training Initiatives

9.3.2.1 NP University and Nuclear Facility Training. This initiative is intended to provide training and improve the proficiency of NP technical staff by providing for work or study in a cooperating university and a commercial nuclear power company which has the facilities and equipment for hands-on training.

9.3.2.2 Graduate Studies. Under this initiative, NP is facilitating graduate studies by NP personnel at the Masters, Doctoral and Post-Doctoral level. It will include three areas of activity:

- Courses intended to upgrade a specific knowledge or skill through the study of a new or emerging technology;
- Advanced degree coursework designed to raise the general skill level of professional employees; and
- NP-sponsored seminars and colloquia with leading technical experts.

In addition, graduate exchange opportunities may be developed to include working assignments of university faculty at NP Offices including project sites and joint NP and university-sponsored projects to support science, mathematics and engineering education.

9.3.3 Personnel Development Initiatives

9.3.3.1 Management Development. The management development initiative is intended to ensure that managers have the skill, knowledge, and confidence required to provide competent management of high risk activities and to foster disciplined, safety-conscious conduct of operations. It will be designed to eliminate discrepancies between required and actual performance in both management and technical skills. Based on the review and analysis of performance, and considering future work assignments, NP managers will develop annual plans for each subordinate manager. Plans may include formal training and structured work experiences in other organizations, site visits, attendance at professional conferences, or one-on-one training by senior academic or scientific personnel.

NP will develop a core management curriculum designed specifically for the technical, oversight and audit management functions of its managers. The core effort will be augmented by additional training to meet the needs of individual managers. Academic and experience-based learning will be continuously updated to reflect the changing nature of the NP mission.

9.3.3.2 Training and Development Needs Analysis Evaluations. The evolving nature of NP technical responsibilities requires an unprecedented level of attention to training needs and evaluation. NP will assess and evaluate technical and management training requirements on a continuing basis.

The first step in this process will be a comprehensive NP training needs analysis. Each year the analysis will include new technical requirements as the NP mission unfolds. The inventory will produce a comprehensive documentation of the mission skills required for effective performance of the full range of NP responsibilities.

Universities and the nuclear industry will be systematically utilized to provide insight into evolving technical training requirements that would not be revealed by standard analysis methods. Training needs information from all sources will then be consolidated and incorporated into an annual training plan. Success in meeting training objectives will be evaluated on the basis of demonstrated skills back on the job.

9.3.3.3 Fast Track Retraining. To accommodate the various skills and experience levels of safety and project personnel who will be assigned to NP site locations, short-term retraining courses will be conducted at Duke Engineering Services. Incoming safety and project personnel will attend Duke Engineering's two week course, Nuclear Systems Overview. In addition, incoming personnel will attend an NP orientation course to acquaint them with NP roots, culture and goals.

Attendance at these courses will serve three major objectives:

- To update knowledge of the whole spectrum of nuclear plant operations and safety;
- To assure that all incoming personnel have a mutual set of basic engineering concepts and vocabulary; and
- To provide an opportunity for course managers to conduct searching analysis of individual strengths and weaknesses. This latter information will then be used to schedule any required additional training on a case-by-case basis.

END

DATE FILMED

01 / 17 / 91