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**SAFEGUARDS AND SECURITY CONCEPT
FOR THE
SECURE AUTOMATED FABRICATION(SAF)
AND LIQUID METAL REACTOR (LMR)
FUEL CYCLE
SAF LINE TECHNICAL SUPPORT**

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ACRONYMS

ALARA	As Low as Reasonably Achievable
BOP	Balance of Plant
CAS	Control Alarm System
CB	Control Bldg.
CCP	Core Component Pots
CCTV	Closed Circuit Television
EI&C	Electrical Instrumentation & Control
ESF	Engineered Safety Facility
FCF	Fuel Cycle Facility
FHS	Fuel Handling System
FMEF	Fuels & Materials Examination Facility
FTS	Fuel Transfer Cell
GTB	Gas Turbine Bldg.
HW	High Level Waste
HVAC	Heat Ventilation & Air Conditioning
ICA	Item Control Area
IHE	Intermediate Heat Exchange
IHTS	Intermediate Heat Transport System
LMR	Liquid Metal Reactor
MBA	Material Balance Area
MOX	Mixed Oxide
NDA	Non-Destructive Assay
NI	Nuclear Island
NIMB	Nuclear Island Maintenance Bldg.
NRC	Nuclear Regulatory Commission
PAX	Private Automatic Exchange
PHIS	Primary Heat Transport System
QC	Quality Control
RCB	Reactor Containment Bldg.
RV	Reactor Vessel
SAF	Secure Automated Fabrication
SAS	Secondary Alarm System
SGB	Steam Generator Bldg.
SNM	Special Nuclear Material
UPS	Uninterruptible Power Source

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1.0 SUMMARY

1.1 OVERVIEW

This report is a safeguards and security concept for a secure automated fabrication (SAF) and national industrial metal reactor (LMR) fuel programs.

1.1.1 Plant Description

The SAF and LMR plant concept consists of independent power-generating units called Power Paks that are additions of these modular units and a fuel recycle or reprocessing facility combined with a fuel fabrication facility.

The plant is designed so that it is separated into two areas, referred to as the nuclear island (NI) protected area and the balance-of-plant (BOP) controlled area, respectively. The NI contains all safety-grade components and systems (including the fuel cycle facility), while all non-safety-grade components and systems are located in the owner-controlled area. This results in a "zoned" approach to security with fewer facilities and personnel within a small NI-protected area.

In addition, the reactor portion of the plant has inherent and unique operating characteristics and safety features that reduce the scope of the security system. These include:

- Physical separation of the NI from the BOP with no safety-related components and systems in the intermediate heat transport system (IHTS) or BOP controlled area
- An inherent, passive reactivity control device
- Multiple passive decay heat removal systems
- A long grace period before corrective action is needed.

The fuel recycle and fabrication facility is afforded increased protection by including additional within-plant access controls and by use of closed-circuit television monitoring within the facility

1.1.2 Security Design Concept

The SAF and LMR security system is designed to protect special nuclear material (SNM) and vital equipment in the most efficient way so that cost, operational impact, and security force size are all minimized. The design integrates the often competing objectives of ensuring nuclear plant safety and physical security while not adversely affecting the safety of plant personnel. Thus, the design reflects the interface between the safety and security requirements. The security design is based on a vulnerability study of the plant that shows there to be no apparent "windows" through which a credible adversary action might cause serious radiological consequences. The security system is designed to:

- Allow authorized personnel and material access to the facility
- Keep out all unauthorized personnel and material
- Detect and verify all unauthorized activities
- Delay unauthorized activities
- Deter potential adversary actions
- Prevent theft of SNM
- Prevent sabotage of vital equipment.

Although the plant is designed to permit incremental additions of modular units, operating units can maintain the required level of security during the construction of adjacent units and whenever outside contractors are necessary within the protected area.

The design basis threats established in 10 CFR 73.1 have determined the safeguards and security systems included in the plant design. In addition, the threat of assault by a vehicle carrying explosives has also been considered (although this is not required by current regulations).

The security design concept for **this** plant separates the site **into** four **increasingly** sensitive security zones, each **with its own** access control point, as follows:

- o Owner-controlled area
- o BOP-controlled area
- o NI-protected **area**
- FCF-protected area.

These areas are illustrated on **the** Site Security Zone Plan, Figure 1. **The** protected area boundary surrounds only the **NI** and the fuel cycle facility. This **approach** has several benefits:

- o Increased operating efficiency because **access** control requirements are matched to the appropriate Bevel of security
- o Reduced number of guards needed since **the** area to be protected is relatively small
- Reduced **number** of people requiring processing for entering or exiting the **NI** compared with the total plant population.

Within the **NI**, the following **systems** potentially require protection against sabotage or theft:

- Reactor **fuel** handling **and** storage
- Reactor coolant boundary
- Reactor shutdown
- Shutdown heat removal
- **Fuel** transport between the reactor and the fuel cycle facility (**FCF**)
- **FCF**.

Figure 1. Site Security Zone Plan

Each reactor system has redundant protection equipment or has inherent design features that contribute to or secure against the design threat.

1.1.3 Physical Security

The physical security system for the NI-protected area has the following primary components:

- Multiple perimeter barriers and isolation zones
- Redundant intrusion detection systems
- Surveillance and assessment equipment
- Hardened guardhouse facilities

- A computer-based card-key access control system
- Positive personnel identification **systems**
- e Central and secondary alarm stations
- e Redundant and uninterruptible power **systems**
- e Hardened, access-controlled boundaries for vital areas and equipment
- e On-site guard force backed by off-site response **forces**.

These **systems** provide detection, assessment and delay **of**, and response against **the** threats **of** radiological **sabotage** and theft. Detection is accomplished using sensors located at the **NI-protected** area boundary. Assessment of **sensor** alarms **is** remotely accomplished using a closed-circuit television (CCTV) **system**. A delay **to** intrusion **is** provided by the perimeter barriers to permit CCTV assessment. A **more** substantial delay to **allow** adequate time for **an effective** response **is** achieved at the exterior building envelope. Delay **times** and specific features **of** the barrier **system** depend **on** tradeoffs involving **the** response force, such as the **number of** guards and **the** time it takes for guards to **engage** the intruders.

1.1.4 Nuclear Materials Safeguards

The objectives **of** a safeguards **system** are to provide:

- A physical protection system that prevents theft of **SNM** and **that prevents** sabotage **of** vital equipment **whose** failure, destruction, or misuse could result in a radiological hazard to **the public**
- A materials control and **accounting system** to maintain records on the amount and location **of SNM in the plant and to monitor** the **SNM** to verify that it **has not been stolen or diverted**.

The material measurement and **accounting system encompasses the** procedures and system **used** to perform measurements, **maintain records, provide** reports, and perform data analyses to account for **SNM**. The accountability system

tracks and measures each batch or stream containing SNM as it enters or leaves the process and at internal process locations.

The reprocessing and fuel fabrication facilities are designed to include material balance control to provide an effective accountability system. To provide a total plant material balance, it is essential to measure the quantities of SNM entering and leaving the plant.

7.2 PLANT DESCRIPTION

The SAF and LMR plant consists of one or more independent power-generating units called Power Paks and a FCF. Each Power Pak consists of a sodium-cooled reactor system that transfers heat to a steam system that drives the turbine generator. The heart of the Power Pak is a compact, pool-type, sodium-cooled reactor. Primary pumps and intermediate heat exchangers (IHXs) circulate primary sodium within the reactor vessel and transfer reactor thermal power to independent IHTS loops. Superheated steam is generated by steam generators (one per intermediate loop). Heat is removed from the reactor by the primary heat transfer system (PHTS), transferred to the IHTS via the IHX, and then transferred to the turbine generator system via the steam generator system.

The reactor containment building (RCB) encloses the reactor vessel, the PHTS components, in-containment fuel handling system (FHS) equipment, and necessary electrical instrumentation and control (EI&C) equipment. The reactor guard vessel constitutes the containment envelope below the reactor closure.

The steam generator buildings (SGBs), located on the turbine side of the RCB, are conventional, corrugated-steel-sided buildings mounted on the basement. Auxiliary systems are shared to the maximum extent practical.

The PCF building is designed for the various functions associated with processing irradiated fuel from the LMR into new assemblies for return and reuse. It contains an area for irradiated fuel receiving, a fuel disassembly station, and a fuel reprocessing system that includes conversion stage, pellet fabrication, and pin/element assembly stages.

Recovered plutonium solutions are stored within the building until required for mixed oxide pellet fabrication at which time they are converted to oxide form. Recovered uranium solutions are stored as solutions which are converted to oxide as required for mixed oxide pellet fabrication. An excess of uranium over that required for plant operations will occur as the plant operation continues. It is expected that the plant will not generate more plutonium than is required to maintain reactor operation.

Replacement blanket fuel assemblies, for economic reasons, will be procured from outside vendors.

1.2.1 Nuclear Island Buildings and

All structures housing safety-related facilities and/or facilities containing radioactivity are included in this section. Most of these structures are seismic Category I and are designed to protect safety-related facilities from natural phenomena and to withstand design-basis and beyond-design-basis accidents. Some of these structures are Category II (not safety related but checked to ensure they cannot damage adjacent safety-related features under Category I design conditions), and some are Category III (nonnuclear design standards).

- Nuclear Island--The NI is a single structure consisting of a Category I concrete mat, concrete walls, and floor slabs at the lower and intermediate levels and Category II structural steel framing and metal siding at the upper elevations. It consists primarily of containment, the SGBs, and the auxiliary buildings.

The containment consists of the guard vessel surrounding the reactor vessel and of a carbon-steel-lined concrete box structure above the reactor vessel,

The auxiliary buildings adjacent to containment are of concrete construction. They house various reactor support systems and penetrations into containment.

The steam generator structures from one floor above the basemat are Category II structures of structural steel covered with metal siding.

Immediately adjacent to the NI is a buried concrete vault on a separate basemat containing the SWRPS/IHTS Na drain tank.

- o Nuclear Island Maintenance Building (NIMB)--The NIMB is a large, single-story building, designed and constructed to Category III requirements. It has concrete ground floor and foundations and a structural steel superstructure covered with metal siding. A large part of the floor system will be served by an overhead bridge crane.

The NIMB houses a radwaste processing facility as well as a process water treatment facility, both of which serve all on-site units and related facilities.

A part of the NIMB called the plant services building contains access control and related facilities to serve all personnel working in the radioactively controlled parts of the plant.

- o Control Building (CB)--The CB is a two-story, Category I concrete building. It houses the control room, the computer facilities, and the technical support center.
- o Engineered Safety Facility (ESF) Services Building--The ESF services building houses the essential chilled water chillers, safety-related batteries, and switchgear. It is a Category I, two-story, concrete building designed as structurally integral with the control building.
- o Gas Turbine Building (GTB)--The GTB is a Category I concrete structure that encloses safety-grade gas turbines and related facilities.
- o Fuel Cycle Facility (FCF)--The FCF building is a heavily shielded Category I concrete structure that processes spent fuel from all Power Paks onsite. The spent fuel is transported to this facility from each unit by a shielded cask transporter at grade.

1.3 SECURITY DESIGN CONCEPT

The design-basis threats established in **10 CFR 73.1** have determined the **safeguards** and security systems included **in the** plant **design**. In addition, the threat **of** assault by a vehicle carrying explosives has also been considered, though **not** required **by** current regulations.

The security concept **for** this plant separates **the** site into several security zones and locates the protected area boundary barrier around only the **NI** and the **FCF**. This approach:

- e Increases operating efficiency because access control requirements are matched to **the** appropriate level of security
- Reduces the number **of** guards needed since **the** area to be protected is relatively small
- Reduces substantially **the number of** people requiring processing for entering or exiting the **NI** compared **with** the total plant population.

The plant design has inherent and unique operating characteristics and safety features that reduce the scope **of** the security design. These include:

- Physical separation **of the NI from** the **BOP with no safety-** related components and systems in the **IHTS or BOP**
- o Physical separation **of the FCF from the** **LMR** within the **NI**
- e **An** inherent, passive reactivity reactor control device design
- o **LMR** designed with **multiple passive** decay heat removal systems
- o Long grace period **before LMR shutdown corrective action is** needed.

The following systems potentially require protection against sabotage or theft:

- LMR functions
 - Fuel handling and storage
 - Reactor coolant boundary
 - Reactor shutdown
 - Shutdown heat removal
- FCF facility
- Fuel transport system.

Each of the reactor systems has redundant protection equipment or inherent design features that contribute to the protection or secure the plant against the design threat.

The plant is designed to permit incremental additions of modular units. Operating units can maintain the required level of security during construction of adjacent units and whenever outside contractors are necessary within the protected area of an operating unit.

1.4 PHYSICAL SECURITY

The physical security concept focuses on providing differing levels of protection for the various areas of the plant site, with four levels, or zones, of access control measures corresponding to the level of security needed.

The owner-controlled-area boundary constitutes the first of these zones of access control with access limited to the warehouse, cooling towers, administration and training buildings, and parking lots. The second level of control allows access to the nonnuclear side of the plant (BOP), with employee identification badges and card-keys issued in the BOP guardhouse. The third level strictly limits access to those who have a need to enter the NI-protected area. The fourth and most restrictive level of access control is

for the FCF, which is designed to further limit or restrict personnel access and where exiting personnel are monitored for SNM. The FCF is located within the NI-protected area.

The primary components of the physical security system for the NI-protected area are as follows:

- o Multiple perimeter barriers and isolation zones
- o Redundant intrusion detection system,
- Surveillance and assessment equipment
- Hardened guardhouse facilities
- A computer-based card-key access control system
- o Positive personnel identification systems
- Central and secondary alarm stations
- o Redundant and uninterruptible power systems
- o Hardened, access-controlled boundaries for vital facilities and equipment
- o On-site guard force backed by off-site response forces.

7.5 NUCLEAR MATERIALS SAFEGUARDS

The nuclear materials safeguards and control concept focuses on establishing a control and accounting system that ensures current knowledge of the location and quantity of nuclear material in the plant and provides a means to obtain early detection of theft or diversion of such materials. The control and accounting system will be computerized to the extent possible and whenever possible will use recycle and fabrication facility on-line stations' information to continuously upgrade the records systems.

The physical security section describes the physical protection devices and systems designed to prevent theft or sabotage. The safeguards section describes the controls and accounting means used to detect theft or diversion and to determine rapidly the quantities involved.

The components of the safeguards control and accounting system are outlined in regulatory documents. Primary components consist of the following concepts :

- e Clearly delineated responsibilities for the control of nuclear materials
- e Specific assignment of personnel to nuclear material and accountability functions
- Integrating safeguards requirements with physical security concepts
- Developing and maintaining written safeguards procedures
- e Establishing clearly defined nuclear material control areas
- Establishing measurement criteria and measurement records
- Establishing and maintaining central accounting and subsidiary accounting systems
- e Establishing nuclear material inventory and inventory control system;
- Near-real-time location of fissile material in the FCF and the reactor areas
- Separated plutonium stored as aqueous nitrate solution
- e Plutonium and uranium mixed before conversion to mixed oxide for refabrication.

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2.0 PHYSICAL SECURITY

2.1 INTRODUCTION

This section describes the physical security **system** developed for the **SAF** and LMR program, reflecting its unique design characteristics and operating concept.

2.1.1 Objective

The objective **of** the security **system** is to provide physical protection to prevent the theft **of** special nuclear materials (SNM) and to prevent the sabotage of vital equipment such as the failure, destruction, or misuse of which could result in a radiological hazard to the public. This system is designed to achieve this objective as efficiently as possible **so** that cost, operational impact, and security force size are all minimized.

2.1.2 Functions

The functions of the security systems are **to**:

- o** Allow authorized personnel and material access to the facility
- Keep out all unauthorized personnel and material
- a** Detect and verify unauthorized activities
- a** Delay unauthorized activities
- Deter potential adversary actions
- a** Prevent theft **of** SNM
- o** Prevent sabotage **of** vital equipment.

2.1.3 Design-Basis Threats

The design-basis threats established in 10 CFR 73.1 determine the safeguards and security systems described in this report. Specific acts of sabotage and theft are discussed.

2.1.3.1 Radiological Sabotage

This is defined in 10 CFR 73.1 as:

- A determined violent external assault, attack by stealth, or deceptive actions of several persons with the following attributes, assistance, and equipment:
 - Well-trained (including military training and skills) and dedicated individuals
 - Inside assistance, which may include a knowledgeable individual who attempts to participate in a passive role (e.g., provide **information**), an active role (e.g., facilitate entrance and exit, disable alarms and communications, participate in violent attack), or both
 - Suitable weapons, up to and including hand-held automatic weapons, equipped with silencers and having effective long-range accuracy
 - Hand-carried equipment, including incapacitating agents and explosives for use as tools of entry or for otherwise destroying reactor facility, transporter, or container integrity or features of the safeguards system
- An internal threat of an insider, including an employee (in any position).

2.1.3.2 Theft or Diversion of Formula Quantities of Strategic Special Nuclear Material

This is defined in 10 CFR 73.1 as:

- A determined violent external assault, attack by stealth, or deceptive actions, by a small group with the following attributes, assistance, and equipment:
 - Well-trained (including military training and skills) and dedicated individuals
 - Inside assistance, which may include a knowledgeable individual who attempts to participate in a passive role (e.g., provide information), an active role (e.g., facilitate entrance and exit, disable alarms and communications, participate in violent attack), or both

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- Suitable weapons, up to and including hand-held automatic weapons, equipped **with** silencers and having effective long-range accuracy
- Hand-carried equipment, **including** incapacitating agents and explosives **for** use as tools of entry or for **otherwise** destroying reactor, facility, transporter, or container integrity or **features** of the safeguards **system**
- The ability to operate **as two or more teams**.
- An individual, **including** an **employee** (**in any** position)
- A conspiracy between individuals in any position who **may** have:
 - **Access** to and detailed **knowledge of** nuclear power plants or the facilities referred to in **10 CFR 73.20(a)**
 - **Items** that could facilitate theft of **SNM** (e.g., small tools, substitute materials, false documents, etc.)
 - Both **of** the above.

Recent worldwide acts **of** terrorism suggest that **it** would be prudent to add assault **by a** vehicle carrying explosives to the design-basis threat. This design addresses measures to protect against such acts, though not required **by** regulations.

2.2 DESIGN CHARACTERISTICS

This **section** describes the plant design and security components, A conceptual **site** plan **of** the plant is **shown** in **Figure 1** to illustrate the **design** characteristics **of** the **SAF** and **LMR** program.

2.2.1 Plant Design Concept and Special Features

The **SAF** and **LMR** program includes several innovative design concepts and special safety features, These are **summarized** below.

2.2.1 .1 Phased Modular Expansion

The SAF and LMR program consists of one to four independent power-generating units called Power Paks. The design permits incremental additions of these modular units. Operating units can maintain the required level of security during construction of adjacent units and whenever outside contractors are necessary within the protected area of an operating reactor unit.

2.2.1.2 Nuclear Island Protected Area

The plant is separated into nuclear and nonnuclear areas. This results in a "zoned" approach to security with fewer facilities and personnel within a reduced NI-protected area. The required level of security can be maintained with smaller guard facilities, fewer security forces and less security hardware.

2.2.1.3 Plant Safety Features

The plant design has inherent and unique operating characteristics and safety features that reduce the scope of the security system. These include:

- Physical separation of the NI from the BOP with no safety-related components and systems in the HIS or BOP-controlled area
- Physical separation of the LMR and the SAF within the nuclear island
- Inherent reactor safety control designs
 - , An inherent, passive reactivity control device
 - Multiple passive decay heat removal systems
 - Long grace period before corrective action is needed.

2.2.2 Security Concept

The SAF and LMR security design is based on a vulnerability review in which threats against system capabilities for both active and passive reactor shutdown and decay heat removal systems were assessed. The review showed that there are no apparent "windows" through which an adversary action might cause serious radiological consequences. The security design reflects this conclusion by providing differing levels of protection for the various parts of the plant, with four levels, or zones, of increasingly sensitive access control measures at four different points corresponding to the levels of security needed.

The owner-controlled area boundary constitutes the first of these zones of access control with access limited to the warehouse, administration and training buildings, cooling towers, and parking lots. The second level of control allows access to the nonnuclear side of the plant, the BOP-controlled area, with employee identification badges and card-keys issued in the BOP guardhouse. The third level strictly limits access to the NI-protected area to those who have a need to enter. The NI guardhouse also monitors exiting personnel for SNM. The fourth and most restrictive level of access control is for the FCF, which is located within the NI-protected area. The NI guardhouse controls access and egress from the FCF and monitors exiting personnel for SNM. FCF personnel badges will be keyed to permit only positive identification entry into specific areas of the FCF.

Thus, the security concept for this plant:

- Addresses an increased design-basis threat
- e Separates the site into several security zones
- Locates the protected area boundary barrier around only the NI and the FCF.

The benefits are as follows:

- Increased operating efficiency because access control requirements are matched to the appropriate level of security
- Reduced number of guards needed since the area to be protected is relatively small
- Greatly reduced number of people requiring processing for entering or exiting the NI compared to the total plant population.

2.2.3 Physical Security Components

The physical protection system provides early detection, assessment and delay of, and response to the threats of radiological sabotage and theft. Detection is accomplished using sensors located at the NI boundary. Assessing sensor alarms is remotely accomplished using a CCTV system. A delay to intrusion is provided at the perimeter fencing to permit CCTV assessment. A more substantial delay to allow adequate time for an effective response is achieved at the exterior building envelope. Delay times and specific features of the barrier system depend on tradeoffs involving the response force, such as the number of guards and the time it takes for guards to engage the intruders.

The components of the physical security system are discussed below.

2.2.3.1 Barriers, Protected Area

Barriers around the site boundary and the nonnuclear side of the plant will consist of standard chain link fence. For the NI-protected area, however, barriers will include dual chain link fences with barbed wire above, plus alarms and/or electrification; minimum 18-ft-high concrete or concrete unit masonry building walls without penetrations, and vehicle barriers to prevent crashing through the fencing. Figure 2 shows a detail of the double fence, vehicle barrier, and other security system components discussed below.

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Figure 2. Protected Area Perimeter-Section {Typical}

2.2.3.2 I Detection Systems

The areas between and around the dual fences will be equipped with electronic equipment that sense intrusion, such as:

- Ground-mounted microwave system; that alarm when their transmitted signals are interrupted
- e Fence or ground-mounted E-Field systems that alarm when their constant magnetic field is disturbed
- Motion-detection CCTV **systems** that alarm when movement takes place within their view
- Fence deflection **systems** that alarm when a fence is deformed or deflected to a predetermined degree.

Interior systems include area occupancy monitors that alarm when the air environment is disturbed and light detectors that sense changes in reflected light. **Also**, the CCTV motion-detection system will be used.

2.2.3.3 Surveillance and Assessment Systems

The CCTV system **is** the primary means of surveillance **and** assessment. The system will include a built-in time delay **so that** monitoring personnel will have time to focus their attention **on** the projection screen. In addition, the various ~~site-specific~~ alarms indicate the area penetrated, not simply that a penetration **has** occurred. Guard personnel will always be available to respond promptly to investigate alarms. All alarm **systems** will have monitors in both **the** central and secondary alarm stations.

2.2.3.4 Exterior Lighting

Illumination of the NI-protected area will be **no 'less** than **0.2** fc (**ft-candle**) with automatic switchover to the on-site standby power source.

2.2.3.5 Access Control and Positive Personnel Identification

A computer-based, card-key **access** control **system will** be used to control each employee's access to any secured area. Such **systems will be** linked to both central and secondary alarm stations for **monitoring** and keeping records of all entries to vital areas, **This system** will also provide positive identification of personnel entering **the** protected area **through** the use of equipment that compares and verifies hand geometry patterns, retinal eye patterns, or voice patterns with known parameters for each employee.

2.2.3.6 Response Capabilities

The guard force will **be** manned **so** that several guards are always immediately available **to** respond to alarms and **ensure** that the design threat adversary can be neutralized until off-site forces arrive.

2.2.3.7 Nuclear Island Guardhouse

The NI guardhouse is the single point of personnel and vehicle access control to the NI-protected area. It will **be** equipped with identification and detection equipment and provide search facilities to monitor all personnel and vehicles entering and exiting the NI-protected area. One of two alarm stations will **be** located in the NI guardhouse.

2.2.3.8 Power Sources

Power supplies will be provided with adequate capacity and access to on-site ac standby power sources. An uninterruptible power source (UPS) will provide power for security system electronics.

2.2.3.9 Central Alarm Station (CAS)

The central alarm station (CAS) is designated as a vital area and will be located within the NI-protected area. This station will contain:

- o Facilities for **communications** with each security guard on duty, the secondary alarm station, and all **off-site law-enforcement** authorities
- e Monitors and controls for **the CCTV** system
- Central **alarm and display panel** for the intrusion-detection systems console and printer **for** the card-key access control **system**
- o **Any** other special emergency alarms.

The **UPS system** will **be located** within **the** MI-protected area.

2.2.3.10 Secondary Alarm Station

The secondary alarm station (SAS) **is** located in **the** control building. **It** is designed to assume control **of** the security **system** should the **CAS be un-**available. **Control capability can be removed from** the **CAS by** activating **suitable controls at the SAS. Once this has occurred, the CAS will become** isolated from the remainder **of** the security **system.**

The **SAS** will contain:

- **An alarm panel for intrusion-detection systems**
- e **Electronic data** processing equipment necessary to operate the system
- e **Radio and telephone (PAX and commercial) communications with the CAS and off-site law-enforcement authorities**
- **Emergency exit alarms, and other alarm systems as required.**

It will **be possible to** monitor and control the **CCTV system** from **the SAS.**

2.2.3.11 Vital Areas

Vital areas are located within the NI-protected area and are protected by building walls, roofs, and **floors, which constitute a** second physical barrier. Vital equipment and facilities **are** isolated **from** nonvital equipment and facilities **where** feasible. The **second** physical barrier enclosing vital equipment will **be** capable of deterring intrusion by unauthorized persons and providing reasonable resistance to penetration.

2.2.3.12 Fuel Cycle Facility

The FCF is located inside its **own** "island" within the NI-protected area. It is surrounded by its own perimeter barriers with personnel entry and exit via an underground tunnel **from** the NI guardhouse. Vehicular and rail traffic must pass through guarded gates at **the** facility's perimeter.

2.3 PLANT OPERATING SYSTEM DESCRIPTION AND ASSESSMENT

2.3.1 Systems Requiring Protection

Normally, a system analysis of the facility would be made to identify and locate SNM and vital equipment and to determine the consequences of sabotage **of** the vital equipment; however, this cannot **be** done until **a more** detailed **plant design is available. While lacking such a design, it is still possible** to identify major plant **systems** that, if sabotaged, have the potential to result in an off-site release in excess **of** 10 CFR 100 limits. Vital equipment types and approximate locations can also be identified. The following systems potentially require protection:

- Fuel recycle **facility** (includes **the** fuel recycle and SAF areas)
- Fuel handling and storage
- Reactor coolant boundary
- Reactor shutdown

- e Reactor shutdown heat removal
- Fuel transportation between the LMR and FCF.

To maintain a reactor plant in a safe condition during a sabotage event, three essential functions must be met: shut down the reactivity, remove decay heat, and maintain the reactor coolant boundary.

For the reactor fuel transfer cell (FTC) and fuel transfer system, the essential functions are to prevent the fuel from overheating and to prevent the fuel cladding from breaking.

The essential function for the FCF is to confine the fuel, confine other radioactive materials, prevent sabotage, and detect and deter theft.

2.3.2 Reactor Fuel Handling and Storage

Vital areas and material access areas associated with the fuel handling and storage system include the spent fuel shielded transporter area, the fuel transfer and storage cell, and the reactor vessel (RV).

Fresh driver fuel consists of an enriched uranium and plutonium matrix of mixed oxides. Driver fuel is contained in large, heavy, welded assemblies. Each assembly will contain a significant amount of plutonium. The quantity of plutonium and uranium will be determined at the time the reactor design is completed. New fuel assemblies are transported on a specialized rail system from the FCF in a shielded transporter device. Conventional rail equipment cannot enter FCF or NI areas because of the rail specialization.

Newly refabricated driver fuel assemblies are remotely inspected at the FCF and are temporarily stored in sodium-filled core component pots (CCPs). New blanket assemblies and control assemblies, assuming they are fabricated elsewhere, also will be inspected at the FCF before being stored in CCPs. These core assemblies (driver, blanket, and control) are transferred singly in the shielded top-loading transporter by rail from the FCF to the power plant.

Movement of the shielded transporter unit (see Figure 3) is restricted to the NI-protected area. In the receiving and shipping area of the Power Pak, the shielded transporter is mated to an entry port in the fuel handling cell. In the inert atmosphere of the fuel handling cell, new fuel assemblies are placed into temporary storage. Spent driver fuel assemblies remain in the RV to decay for one year before being removed to the FTC. Decayed spent fuel is then moved through the FTC and deposited in FTC storage positions. After refueling and reactor start-up, spent fuel is moved over a period of several days from the fuel handling cell via the shielded cask transporter to the FCF.

The fuel assemblies in the sodium-filled CCPs are stored in cylindrical thimbles (see Figure 4) that form part of the fuel transfer cell inert gas boundary. Decay heat is removed by natural convection air flowing on the exterior of the cylindrical thimbles. The design consists of a single air inlet and a single exhaust stack for this cooling air flow. The inlet opening area is approximately 36 ft², located 30 ft above grade. The opening is protected against tornado missile damage by heavy steel louvers, backed by a heavy wire mesh protective screen against entry of small objects that may pass through the louver openings. The natural convection exhaust stack rises approximately 56 ft from the roof of the NI building. The exhaust openings are also protected with heavy duty steel louvers and heavy wire mesh screens.

There is considerable inherent theft protection in the fuel handling and storage system since the fuel assemblies are relatively heavy and are remotely handled. Theft of fresh driver fuel assemblies would appear to be an extremely time-consuming risk, requiring the use of special handling equipment and vehicles, as the assemblies must be handled remotely because of their inherent plutonium content and radiation field.

The primary sabotage concern would be in the FCF, where the irradiated assemblies have been reprocessed and consequently would be less radioactive than unprocessed assemblies.

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Figure 3. Fuel Transporter

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Figure 4. Sodium-Filled Transporter Thimble with Fuel Element

Protection against radiological sabotage **is** also inherent in the fuel handling and storage system. Throughout the fuel handling sequence, spent fuel **is** under sodium and **within inaccessible, inerted cells**.

When removing decay heat from the spent fuel temporarily stored in the FTC, the primary sabotage threat is blockage of the natural convection cooling air inlet or outlet openings by sabotage. The heavy steel plate louvers are designed to prevent significant loss **of flow area** caused **by** impacts from tornado missiles. The louvers would provide similar protection against sabotage threats. **In** addition, the small free area between individual louvers, together with the heavy wire **mesh** backing, prevents the entry **of** significant amounts **of** explosive materials. Blockage **of** both the inlet and outlet is further complicated **by** the location **of** the inlet 30 ft above grade and **the** outlet approximately 56 ft above the **roof line**. Even **if** the inlet and outlet **were** totally blocked, there would be approximately 36 h of **time available to** remove the blockage before sodium boiling would occur.

2.3.3 Fuel Cycle Facility

Spent fuel assemblies **and** spent blanket assemblies are transported from the reactor to the reprocessing facility in **sodium-filled** thimbles. These thimbles contain one element and are moved in a transporter on a dedicated rail line.

The fuel flow through the **FCF** is planned as a continuous process that processes material around the clock **in** 35-day campaigns (see Figure 5). It **is** then **shut down** for 2 months for the high-level waste handling, maintenance, and for nuclear material safeguards and accounting inventories. Plans call for reprocessing a number of spent fuel assemblies in series followed by reprocessing **a number of** spent blanket assemblies. A small spent fuel storage capability has been designed for the reprocessing plant.

The initial process will have the sodium-filled thimble containing the assembly brought into the receiving facility where the sodium is melted and

Figure 5. Generic Oxide Flow Diagram

the assembly removed. The assembly is first washed and then stored in a water-cooled pool.

Refabricated assemblies are transported back through the receiving facility. To accomplish this transfer, the refabricated assemblies are placed into the sodium-cooled thimbles, replaced back on the transporter, and transported back to the reactor for storage pending eventual insertion into the reactor.

2.3.3.1 Reprocessing

The spent assemblies are taken into the head-end cell and placed in the horizontal position. A laser is used to remove the ducting. The top hardware is placed in the intermediate solid waste containers. The remainder of the

assembly is moved to the **shear** where the fuel bundle is sheared into 2-in.-long pieces, which fall into a rotary **dissolution** drum. The remaining portion **of** the assembly containing the bottom hardware is transported to the intermediate-level waste container.

The uranium and plutonium contained in the 2-in. **slugs of** fuel in the rotary dissolver are dissolved in aqueous nitric acid. **The hulls** remaining in the drum are washed and placed in high-level solid waste disposal canisters. Empty drums are returned to the dissolver for collection of **more** sheared fuel **slugs**.

The vessel off-gas collected during shearing and dissolution operations contain the **volatile** fission **gases** and nitric acid fumes, which **must** be removed before release to the atmosphere. The **xenon** and krypton are separated **by** fluorocarbon adsorption and stored. The iodine is trapped in zeolite scrubbers, the ruthenium is recovered with absorbers and **the gas** is filtered to remove particulates. **The gas** is scrubbed to remove acid vapors and mixed with ventilation air before release to the atmosphere.

After digestion and centrifuging to **remove** particulates, the **acid** solution **is** sampled, analyzed, **and** adjusted to ensure proper valence **and** concentration **of** the dissolved heavy metals. The solution is fed near the center **of** a series **of** countercurrent centrifugal contactors where **it is** repeatedly mixed with and separated **from the** organic extractant. In these contactors the uranium and plutonium are complexed by tributyl phosphate and extracted into the organic phase. The fission products remain **in** the aqueous phase and, **thus**, are removed **from the** uranium and plutonium. The aqueous phase is scrubbed to remove traces **of heavy** metal remaining and transferred to high-level liquid waste storage.

After scrubbing to remove traces of fission products, the heavy metals are partitioned by reducing and back extracting the plutonium into an aqueous phase. **The** plutonium is purified through a **series** of contactors where **it is** repeatedly **extracted** into the organic phase **and** back extracted **in** the aqueous

phase. In this manner decontamination factors of 10^6 to 10^8 can be obtained. The purified plutonium is concentrated and transferred to storage where it is sampled and analyzed. The organic extractant is purified and recycled to the centrifugal contactor feed tanks.

The uranium is back extracted into the aqueous phase and reextracted into the organic and finally back extracted into the aqueous phase in a series of contactors. The purified uranium is then concentrated, sampled, analyzed, and placed in storage tanks. The solvent is washed, purified, and recycled.

Both the plutonium and uranium will be stored as aqueous nitrate solutions. These will be mixed in the required proportion before being converted to oxide. Sufficient storage is provided in a series of criticality safe slab tanks so that refabrication operations can be withdrawing from one series of tanks while reprocessing is feeding another series.

Sufficient uranium and plutonium in solution is withdrawn from the storage tanks to give the desired plutonium/uranium ratio in recycled fuel. These solutions are blended, mixed with additives, and thermally decomposed to the oxide. The oxide is reduced to the substoichiometric dioxide, granulated, pressed into pellets, and sintered. The pellets are inspected and the rejects are recycled. The MOX pellets are then loaded into magazines along with the appropriate number of off-site procured UO_2 blanket pellets.

The pellets are loaded into pins followed by the plenum tube and hold-down pins. The pins are capped, welded shut, and decontaminated. After inspection, the pins are wire wrapped, assembled into assemblies, and locked into place. The duct is placed over the assembly and welded. The top sub-assembly hardware is inserted into the other end of the duct and welded in place. The completed assemblies are given a final dimensional and straightness inspection and transferred to storage for subsequent transfer to the reactor.

Blanket assemblies are procured offsite and received into the receiving facility. They are placed in sodium-filled pots, which are in turn placed in the transporter for transfer to the reactor.

The high-level liquid waste (HLW) is vitrified, poured into disposal containers, sealed, and transferred to the HLW storage for ultimate transshipment to the HLW repository.

The foregoing process has the advantage of allowing a direct conversion of a mixture of plutonium and uranium solution to a mixed oxide that has the correct proportions of plutonium to uranium for fabrication into recycle fuel pellets. This eliminates the requirement for separate plutonium and uranium conversion to oxide steps, the subsequent reblending of the oxides to obtain the correct ratio for pellet production, and tends to simplify and reduce the number of accountability control and measurements steps.

This process will create an excess of removed uranium solution since, for economic reasons, it is more expedient to fabricate blanket assemblies offsite and transport these to the reactor site for storage and eventual insertion into the reactor. The excess uranium will be converted into an oxide for ultimate disposal.

2.3.4 Nuclear Island-Related Buildings

Most of these structures are seismic Category I and are designed to protect safety-related facilities from natural phenomena and to withstand design-basis and beyond-design-basis accidents. Some of these structures are Category II (not safety-related but checked to ensure they cannot damage adjacent safety-related features under Category I design conditions), and some are Category III (nonnuclear design standards). The other buildings associated with the plant are not critical for controlling radionuclides or preventing the theft of nuclear materials.

Each LMR is controlled from a main control room. Although the main control room is located within the NI-protected area, the LMR control and shutdown scheme **does** not rely on availability of the main control room to achieve a **safe**, monitored shutdown. The main control room does not contain safety-grade controls; these are located in remote shutdown rooms, one for each Power Pak.

Both the control room and the remote shutdown rooms are located in a seismic Category 1, tornado-hardened, reinforced-concrete structure. The remote shutdown rooms are provided with redundant safety-related heating, ventilation, and air conditioning (HVAC) systems to ensure continuous habitability in all postulated events.

The individual buildings are described below.

2.3.4.1 Nuclear Island--Reactor Building

The NI is a single structure consisting of a Category I concrete mat, concrete walls, and floor slabs at the lower and intermediate levels, with Category II structural steel framing and metal siding at the upper elevations. It consists primarily of containment, the steam generator buildings, and the auxiliary buildings. The containment consists of the guard vessel surrounding the reactor vessel and of a carbon-steel-lined concrete box structure above the reactor vessel. The auxiliary buildings adjacent to containment are of concrete construction. These buildings house various reactor support systems and penetrations into containment. The steam generator structures from one floor above the basemat are Category XI structures of structural steel covered with metal siding.

2.3.4.2 Fuel Cycle Facility

The oxide FCF is a hardened structure designed to meet all NRC inclement weather and seismic regulations. It is designed to the same specification as the FMEF building. It is a four-story structure with two floors below grade

and two floors above grade. The main processing and pin fabrication cells are located on the bottom underground floor. Grade level, where the spent fuel enters the facility, is the third floor of the building.

Two high-bay areas above each other are along one side of the facility. The reprocessing cell is located in the bottom high-bay area, and the maintenance cell is located in the top high-bay area above it. Across a central corridor is located the conversion, pelletizing, and pin fabrication cells on the bottom level. The pin inspection and final assembly areas are located in the second level of the facility above pelletizing and pin fabrications. The final assembly area is also a two-story high-bay area to facilitate handling the long thin fuel assemblies.

Auxiliary systems such as laboratory cells, waste handling and storage cell;, maintenance and shop areas are located along either end of the facility at various floor levels.

The layout of the main processing bottom floor is shown in Figure 6. Spent fuel is received two stories above and placed in storage or brought down into the head-end cell. The fuel is disassembled, chopped, and dissolved in the head-end cell and decontaminated and partitioned in the adjacent process cell. After purification and concentration, the uranium and plutonium stream are taken across the corridor to the uranium conversion and mixed oxide (MOX) blending and conversion cells. Here the pure uranium and blended uranium-plutonium solutions are thermally converted to oxide. The MOX is stored in the vault area until it is fabricated into fuel. The MOX is transferred to the powder and pellet processing area where it is granulated, pressed into pellets, and sintered. The pellets are placed into loading magazines along with axial UO_2 blanket pellets procured offsite. The pellets are loaded into pins that are capped, welded shut, and decontaminated in the fuel pin loading area. The pins are transferred to the floor above for inspection and final assembly into fuel assemblies.

Figure 6. Oxide Processing Floor Layout

On the main processing floor, the high-radiation level materials such as spent fuel *storage* and *handling*, *fuel* disassembly, high-level waste storage and processing area are located together behind 6-ft-thick shielding walls. As the radiation level of the fuel *is* decreased as it progresses through the processing and fabrication areas, the shielding thickness of the cell walls is decreased. Thus, the processing floor layout not only facilitates operations and maintenance but also minimizes construction costs while maintaining as low as reasonably achievable (ALARA) personnel exposure criteria.

The layout of the remaining floors of the facility are given in documents prepared by Oak Ridge National Laboratory and the Westinghouse Hanford Company. In these documents the design criteria and facility design features are presented. Figure 6 is taken directly from this documentation.

2.4 PHYSICAL PROTECTION SYSTEM DESCRIPTION

This section of the report describes the physical protection system that provides detection, assessment and delay of, and response to the threats of radiological sabotage and theft. The SAF and LMF program design has four different security zones, each with a different level of security, as described below.

2.4.1 Owner-Controlled Area

The initial level of security is provided at the site boundary where a 6-ft-high chain link fence with the appropriate warning signs will be erected along with a manned guardhouse at the entrance of the main access road into the site. The purpose of this barrier is to keep out animals and casual unauthorized persons and to observe approaching vehicles. No intrusion detection sensors will be provided along the fencing, and no patrolling would be required under normal circumstances, although a boundary road will be provided for patrol during a period of threat warning and for fire fighting. Persons entering would have access to the administration and training buildings, parking lots, the warehouse, and the cooling towers.

A guardhouse that is located at the entrance of the main access road into the site is the initial control point for vehicles and persons entering the site. It is manned during normal working hours, temporary badges are issued to visitors, and persons being visited are notified by the attendant guard. A phone link with the NI guardhouse is provided for persons requiring access when this guardhouse is unattended.

2.4.2 BOP-Controlled Area

The second level of security is provided around the nonnuclear side of the plant (BOP). This area is surrounded by a 6-ft-high chain link fence with three strands of barbed wire mounted on a single outward-facing 45° outrigger. This is intended as a standard industrial security fence and no intrusion detection sensors are provided. However, an inner boundary road is available for patrol. A determined adversary would be delayed only minimally at this barrier. Only one entry point is provided, and all personnel and vehicles enter there. Employee identification badges and card-keys are issued in the BOP guardhouse. These card-keys permit access to specific buildings as necessary for the performance of the employee's assigned duties. Exiting personnel are monitored for SNM. Outside contractor forces enter the BOP through this guardhouse. The facility is not hardened.

2.4.3 NI-Protected Area

The third level of security is provided around and within the NI-protected area where several penetration detection systems, assessment systems, and physical barriers are provided, as described below.

2.4.3.1 Perimeter

The perimeter protection system consists of a vehicle barrier, two chain link fences, and inner and outer isolation zones plus detection and assessment sensors (see Figure 2).

The outer fence is 6 ft high with three strands of barbed wire mounted on single, outward-facing outriggers. Outside this outer fence is a 20-ft isolation zone, which includes a vehicle barrier intended to prevent penetration of the perimeter by a vehicle.

The inner fence is 7 ft high with 12 in. of barbed tape concertina mounted on dual outriggers. Between the two fences is a 25-ft-wide clear zone containing detection equipment **such** as microwave and fence-deflection sensors.

Inside **the** inner fence is another 20-ft isolation zone, which contains an E-field system. A 24-ft-wide perimeter patrol road is provided inside the inner fence. Solid reinforced-concrete building walls form part of the inner boundary (see security site plan, Figure 2).

The perimeter detection system is to be configured into sectors **so** as to locate intrusion attempts, facilitate assessment of sensor alarms, and direct on-site response forces to specific areas.

2.4.3.2 Perimeter Intrusion Detection and Assessment

Each sector in the perimeter has three types of sensors, such as a microwave transmitter and receiver pair, a free-standing E-field unit, and a motion detection system. These are representative sensors. Actual sensor types will be dependent on environmental conditions, such **as** heavy precipitation, electrical storms, or high winds, that would prevent detection of **an** unauthorized intrusion into the isolation zone. At least **one of** these sensors will operate effectively during **most** environmental conditions. If conditions become **too** severe or if breakdown of a sector processor occurs, the perimeter must be patrolled by a guard **to** satisfy detection requirements.

CCTV cameras and the requisite lighting provide the assessment elements within the sector. Cameras and light poles are situated **just** inside the inner fence and positioned on extended mounts that **project** outward over the inner fence. Thus, the poles do not obstruct viewing or lighting **of** the isolation zone.

Video coverage extends **from** the outer edge **of** the outer isolation zone to the inner edge of the inner isolation zone. Thus, there **is** CCTV coverage for all sensors in the sector.

Because the alarm center operator may be unable to observe and assess the cause of the alarm in real time, a CCTV recording capability is provided that is triggered by the alarm signal. It requires 1 to 2 s to activate the recorder and store the first video frames. Approximately 4 to 5 s of CCTV recorded video are sufficient for assessment purposes. Thus, a nominal 6-s delay, as provided by the inner chain link fence, is an adequate perimeter delay to record an attempted intrusion.

Alarm signals from the sensors are relayed to both alarm stations. Appropriate controls are activated to alert the operator of the alarm and to initiate the assessment process.

Lighting is provided so that assessments can be made during periods of darkness. Lights must be positioned so that a minimum of 1.0-fc illumination is provided within the assessment area. Furthermore, light/dark ratios over the area should not exceed 6/1 to prevent unacceptable degradation in the quality of the CCTV imagery. Continuous illumination is automatically provided during cloudy or dark conditions. Manual lighting switches are provided at both control centers.

In some cases, there may be occasions when heavy fog or precipitation prevents CCTV assessment of an alarm. Procedures will be established to provide supplementary local assessment by security personnel whenever CCTV assessment cannot be accomplished. Security personnel must be on station or readily available for dispatch to assess alarms during periods of restricted visibility.

2.4.3.3 Personnel and Vehicle Access Control

The access control system is located in the MI guardhouse and includes the personnel portal and vehicle gate. Employee identification badges and card-keys are issued here. As on the nonnuclear side, these card-keys permit access only to specific buildings and spaces as necessary for the performance of the employees' assigned duties.

Positive personnel identification of persons passing through the perimeter will be provided by verifying hand geometry patterns, retinal eye patterns, or voice patterns. Packages and vehicles will be manually searched to protect against explosives and other contraband being brought into the protected area. Random pat-down searches may be conducted to deter persons from attempting to bring in contraband material.

The perimeter personnel portal is a multilane, man-assisted system. Functional operation is controlled by a security guard, located in a protected guard station, through the entry control console. This guard also monitors the turnstiles to ensure that proper passage procedures are followed.

The portal exterior is hardened, and the guard station has bullet-resisting walls and glass. When not in operation, the portal can be secured. Door microswitches are provided for this purpose. If forcible entry attempts should occur, alarms are relayed to the alarm centers in the same manner that sector alarms are relayed. Likewise, CCTV cameras are provided in the portal for assessment purposes.

The vehicle gate consists of motor-operated gates, gate locks and closure switches, and microwave sensors. The gates are operated by the personnel portal operator and have an automatic override that prevents the simultaneous opening of both gates. An access door from the personnel portal guard station is provided so that a guard can inspect vehicles before they enter or leave the protected area. A vehicle radiation monitor, CCTV cameras, and portal lighting equipment are also provided for the vehicle portal.

Normally, all sensors in the vehicle and rail portals are active, and alarm signals are relayed to the alarm stations in the same manner as the perimeter sector alarms. When the vehicle portal is to be used, sensors are placed in an access mode by the alarm station operator. The outer gate is opened to allow the vehicle to enter and the driver and any passengers to leave the vehicle and exit the portal through the open gate. The gate is closed and the vehicle is inspected while the driver and passengers are

cleared through the personnel portal. If all checks are satisfied, the inner gate is opened, and the driver and passengers return to the vehicle and exit the portal. The portal is then returned to its secure active state.

2.4.3.4 Building Barriers

The areas identified in Section 2.3 provide a substantial barrier at the building exterior to provide enough delay against determined adversaries so that the on-site response force can be alerted and deployed. A barrier at the exterior would delay adversaries outside the building in the open, thereby allowing the response force to neutralize them outside the building rather than within.

A building barrier is integrated into the reactor building design. Building exterior walls have a hardened construction equivalent to at least 8 in. of reinforced concrete. Penetrations (e.g., portals, doors, ducts, vents) are also hardened to yield a comparable delay.

The hardened building walls are constructed to a height of no less than 18 ft above ground level. These hardened walls encompass the entire building. Penetrations through the hardened surface are kept to a minimum.

Normal personnel access through the hardened surface would be at the building personnel portal, where positive personnel recognition is required. Other potential access portals are secured to guard against unauthorized entry.

2.4.4 Fuel Cycle Facility

The fourth and highest level of security is provided at the FCF. As shown in Figure 1, this facility lies entirely within the NI and benefits from the previously described NI security features. In addition, the facility is surrounded by its own 7-ft chain link fence with three strands of barbed wire mounted on dual outriggers. A vehicle barrier is provided between the NI vehicle gate and the facility. Normal personnel access is via a below-grade

tunnel that begins in the basement of the NI guardhouse and daylight inside the facility's boundary fence. Vehicle and rail access are through gates and require escort and observation by guards.

2.4.5 Security force

2.4.5.1 Organization

A security organization that reports to management is required to ensure that overall direction of physical security operations is provided at all times. Procedures that establish the order of responsibility for security and detail the duties of the security forces are also required.

2.4.5.2 On-Site Guards

The on-site security force is used for alarm station operations and communications, escort and patrol duties, assessment, and limited response. The size of the force has not been determined but will reflect the minimized NI-protected area and subsequent reduction in numbers of operating personnel within the NI.

2.4.5.3 Off-Site Response Forces

Off-site forces are used for response and adversary neutralization. The size and deployment capability of the off-site response force will depend on the location of the facility and on the capabilities of the local law-enforcement agency. Actual force size, facility coordination plans, deployment routes, and neutralization tactics are site dependent.

2.4.6 Security Communications

2.4.6.1 Alarm Station--Security Force Communications

Communications among the alarm stations **and** the *on-site* security personnel **will be by a two-way mobile radio system that provides total coverage of the entire owner-controlled area, Guards will carry radio units that have** antijam and authentication features **to** ensure that guard messages are neither counterfeited nor masked.

A handset microphone and speaker connected **to** the security force radio transceiver **will be** located **in** the access control area **of the** NI guardhouse, central and secondary alarm stations, and **the security supervisor's** office. Base station radio transmitters and antennas **will be** located within the protected area.

A dedicated intercom communication **system will** be provided between security-related locations.

2.4.6.2 Duress Alarms

The personnel **radios** carried **by** the guards **will have** an emergency **signal that can be activated to transmit a signal to the** central **and** secondary alarm stations **if the guard is under coercion or duress. A similar feature is to be** incorporated in the control centers **so that** a duress signal can **be sent** to the off-site response **headquarters.**

2.4.6.3 Alarm Station--Off-Site Communications

Both telephone and radio frequency channels **will be used to communicate among the** central and secondary **alarm** stations and the off-site response force alarm station. The radio frequency link **is to be** a spread-spectrum system that **uses** a pseudorandom sequence, frequency-hopping carrier. This results **in**

a highly jam resistant and secure **system** #at minimizes couser interference. An alarm signal will **be** generated at the **off-site** station if jamming or transmission failure occurs.

These **systems** will **be** located in the central and **secondary** alarm stations and will have a minimum of two-channel transmission and reception capability.

2.4.6.4 Normal Communications

Private automatic exchange (**PAX**) and commercial telephones will be provided in the access control area of the NI guardhouse, central and secondary alarm stations, and the security supervisor's office.

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3.0 PLANT SAFEGUARDS NUCLEAR MATERIAL CONTROL PLAN

3.1 SAFEGUARDS ORGANIZATION

3.1.1 Plant Organization Structure

The organizational structure for establishing nuclear materials safeguards control and accountability functions for the nuclear reactor should follow the guidelines established by ANSI-N15-8-1974. Fabrication plant guidelines should follow pertinent sections of NRC Regulatory Guide 5.45, "Standard Format and Content for a Special Nuclear Material Control and Accounting Section of a Special Nuclear Material License," and Regulatory Guide 5.52, "Standard Format and Content of a Licensee Physical Protection Plan for Strategic Special Nuclear Material at Fixed Sites.

Title 10 Part 70, "Domestic Licensing of Special Nuclear Materials," and Part 73, "Physical Protection of Plants and Materials," are the regulations that must be met to satisfy NRC criteria for the safeguards and control of SNM.

The assignment of material control functions is such that the activities of one person or unit serve as a control over and a check of the activities of other persons or units. Specific assignments of responsibilities are prescribed for all facets of the nuclear material control system. Material control functional and Organizational relationships are set forth in writing in organizational directives, instructions, procedure manuals, or other documents. Such documentation includes position qualification requirements and definitions of authority, responsibilities, and duties. Delegating material control responsibilities and authority always are in writing.

3.1.1.1 Plant Super

The plant superintendent at each nuclear SAF and LMR plant has overall physical control and physical surveillance responsibilities for nuclear materials at the plant site. The plant superintendent's responsibilities include

appointing a nuclear materials custodian for each material balance area (MBA)/item control area (ICA) within each reactor plant.

3.1.2 Nuclear Control Structure

3.1.2.1 Nuclear Materials Manager

The plant supervisor appoints a nuclear materials manager who has the overall responsibility for implementing the nuclear material control system. The nuclear materials manager's position, to be effective, must be independent of plant operating personnel. The nuclear materials manager's duties include establishing a central material control and accounting office under his direction. This office will maintain the material control records for nuclear materials in the plant's possession.

3.1.2.2 Staffing

The nuclear materials manager is provided a staff of personnel or, depending on staffing arrangements, has personnel available who can provide nuclear material control expertise in such fields as computer programming, quality assurance, statistics, reactor fuel burnup evaluation/calculation, and nuclear material accounting.

3.1.2.3 Nuclear Materials Custodian

The nuclear materials custodians at each plant are responsible for the performance of the functions that relate to the control of nuclear materials at each plant site. Custodians are selected by the responsible manager of the operating area and appointed by the plant supervisor. Each assignment is approved in writing by the nuclear materials manager. An individual can be named custodian of more than one control area provided that he does not transfer material from an area for which he has custodial responsibilities to another area for which he also has custodial responsibilities, and that his dual custodial responsibilities are effectively discharged. All nuclear

material transfers are signed by two authorized Individuals, one from the shipping function area and one from the receiving function area. MBA/ICA custodians should physically witness transfers.

3.1.2.4 Job Descriptions

3.1.2.4.1 Nuclear Materials Management

. The nuclear materials manager should report to the plant superintendent. He is responsible for establishing and maintaining a program to control and to account for all source and SNM for the plant in accordance with the pertinent federal, state, and local regulations. In addition, he acts as the utility representative for contacts with federal, state, and regulatory agencies in matters pertaining to source and SNM.

Authority and resources to accomplish his assigned responsibilities are to be ensured by the plant superintendent.

Minimum qualifications for holding this position include a bachelor's degree or equivalent in one of the physical sciences or engineering disciplines, with 3 to 5 years' experience in the area of nuclear materials management functions. The individual in this position must be able to demonstrate the management and technical capabilities to coordinate, develop, and implement management systems as required to implement corporate and government policies and regulations.

The bachelor's degree requirements may be waived with explicit review by the plant manager. In waiving academic requirements, specific consideration may be given to the potential appointee's formal education and demonstrated capability and performance in job assignments associated with and/or related to the position.

3.1.2.4.2 Nuclear Material Custodians

Minimum qualifications for nuclear material control custodian is satisfactory completion of SNM management training and demonstrated capability to perform the particular activity involved.

3.1.2.4.3 Staff

Key positions within the plant for nuclear material control functions are those in the fields of computer programing, quality assurance, statistics, reactor burnup calculations, and nuclear material accounting. Minimum requirements for these positions include a bachelor's degree or equivalent in one of the applicable engineering, science, or business administration fields with demonstrated capability to perform all functions required of a particular staff position.

3.1.3 Security Structure for Safeguards

The on-site physical protection system and security organization are structured to provide assurance that activities involving SNM meet the protection requirements for common defense and security and do not constitute an unreasonable risk to public health and safety. The security organization and system, including guards, is designed to protect the facility against radiological sabotage and to prevent theft or diversion of nuclear material.

The security system is structured so that at least one full-time member who has the authority to direct the physical protection activities will be on site at all times.

3.7.4 Separation of Functions

The nuclear material management function as well as the security force function is to be organizationally independent from other plant management organizations and other supporting functions. Thus, it can have complete

independence for objective performance in establishing criteria and procedures that ensure the effective achievement of nuclear material management goals. Appropriate interface relations are established by plant standard operating policies to provide for the uniform application of nuclear material safeguards and accountability controls.

3.2 NUCLEAR MATERIAL CONTROL PROCEDURES

3.2.1 Responsibilities and Authorities

The basic responsibility for nuclear materials management and control is assigned to the plant superintendent. The nuclear material manager is responsible for planning, procedures, coordination, and administration of SNM control and accounting functions. The nuclear material manager forms his functions within the following framework of procedures:

- Plant standard operating policies
- Fundamental materials controls established by the nuclear materials manager
- The detailed procedures established in a nuclear materials management manual for basic control and accountability of SNM
- The nuclear safety analysis for the reactor, for the fuel storage areas, and the fuel recycle facility
- Regulatory agency requirements.

3.2.2 ICA/MBA Designations

The nuclear materials manager is responsible for maintaining overall custody and control of SNM for the plant. The primary method used to evaluate source and SNM control is to balance receipts and removals against inventories. To accomplish this control, facilities using such material may be divided into smaller units of MBAs or ICAs around which balances can be drawn. The nuclear materials manager is responsible for designating control

areas to serve **as** subsidiary accountability stations for materials in **use** in **the** reactor core for materials **assigned to a** specific storage area within the plant, **and** for the various recycle and **reprocessing** phases in the **fuel** recycle facility.

Material control areas and subsidiary **accountability** stations are **used** to determine the location and quantity **of** nuclear materials in the facility. **Three** basic functions are performed:

- e Data collection, including **measurements** and maintenance **of the** data **base**
- Data analysis for **loss** detection
- Data dissemination and **reporting**,

3.2.2.1 Selection Criteria

The basic criterion for establishing **an MBA** or **ICA** is **a** uniquely defined, geographical area under the cognizance **of a** specifically assigned organizational entity in which all inputs and releases **of** material **can** be individually **and** completely controlled. **This** disallows the establishment **of** MBAs/ICAs that have overlapping geographical areas and hence would have **the** potential for dual responsibility **for** the material.

In establishing **MBAs** and **ICAs**, consideration is given to individual processes, process **steps**, geographical areas, organizational control, health and safety control, security control, and any applicable state or federal regulatory requirements.

3.2.2.2 Reactor Area Controls

Each reactor unit **is** to be **designated** as **a** single **ICA** **with** subsidiary accountability stations assigned within the **ICA**. **Using this system**, movements **of assemblies, or elements, within a reactor unit** are documented within the

subsidiary accountability **system**; ~~movements between,~~ **out** of, or **into** reactor units can **be** documented as ICA transfers.

Within an ICA, a minimum **af** three subsidiary accountability stations **should** be established:

- o** **Fresh** assemblies
- In-cooling assemblies
- o** Reactor vessel assemblies,

The basic unit **of** control for nuclear material **is** the nuclear **fuel** assembly. Each nuclear fuel assembly will **be** identified in **the** material control records **by its** serial number and location. Nuclear material contained in **fuel** elements, not part **of** an assembly, **will be** separately identified on all **mate-**rial control records.

Each ICA and each subsidiary accountability station within the ICA must be an identifiable physical area **such** that the nuclear fuel assemblies or fuel **elements** being **moved** into or out **of the** ICA or subsidiary accountability **sta-**tion can **be** counted and identified.

3.2.2.3 Number of Control Areas

Sufficient **ICAs**, with subsidiary accountability stations, must be **estab-**lished **so** that nuclear materials components can be **localized, identified,** inventoried, and controlled.

Sufficient **MBAs**, with subsidiary accountability stations, **must** be **estab-**lished **so** nuclear material recycle and fabrication operations throughput can be controlled, holdups established, **in-process balances** can be determined, product and waste stream contents established, and **so** that inventory differ-ences **can** be determined and controlled. **The FCF** should be divided into a minimum **of** two **MBAs**, one for the receiving and processing **of** fuel **from** the reactor, **and** one for fuel fabrication and assembly. A third for plutonium and **uranium** should be considered.

3.2.2.4 Method of Control

Control into and out of ICAs and associated subsidiary accountability stations is by item identity and previously determined nuclear material quantities contained in each item,

Control within MBAs and associated subsidiary accountability stations is based on measurements. Measurements at some of the associated subsidiary accountability stations will be on a volume or weight basis, other stations will require sampling for elemental and isotopic content, as well as weight or volume measurements. Certain stations (i.e., storage areas) can operate as an ICA accountability station provided material is controlled in accord with regulatory criteria. Waste streams can be controlled for safeguard purposes by application of nondestructive measurement techniques.

3.2.3 Measurements Criteria

Measurement procedures are prepared and qualified for each type of measurement used. Performance qualification is required of individuals responsible for conducting SNM measurements. Procedure and performance qualification criteria are "consistent measurement results within the measurement limit of error for three consecutive measurements of unlike known standards." SNM measurements, which are used as source data for SNM accounting purposes, are performed in accordance with procedures of proven validity by personnel who have demonstrable competence in the conduct of the procedure.

3.2.4 Measurement Requirements

3.2.4.7 Reactor Fuel Measurements

The liquid-metal reactor units have no capabilities for operations involving source and SNM other than handling reactor fuel assemblies and fuel elements; therefore, the materials management accounting system is based on assembly or element item accounting. For each reactor area, an assembly

and/or element record is maintained. **SNM** content **is** assigned and controlled based on original manufacturing **data** as certified by the vendor or by **FCF** operations. For each **ICA** and each accountability **control** area, **a book** inventory **is** maintained. All records are periodically adjusted for fuel burnup and generation in accordance with regulatory criteria.

3.2.4.2 Element/Assembly Record

A record is maintained for each assembly. **As a** minimum, this record **consists of the** following data points:

- Assembly serial **number**
- Element serial number and assembly location
- Element average **bulk** weight
- Element average nonfuel constituent **weights**
- Fabricator's element and/or assembly **fuel** chemical composition
- Fabricator's element **and/or** assembly source **and** **SNM** content (e.g., net, uranium, ²³⁵U, plutonium)
- **Assembly weight**, including average weights of assembly constituents
- Reactor **site** receipt date
- **New** assembly storage **location**
- Date into core
- Core position(s)
- **Assembly** core discharge date
- **Spent** assembly storage position
- Burnup calculations
 - **By reactor core**
 - **By assembly**

- o Discharged assembly source and SNM content
- e Off-site/recycle reprocessor shipment date
- e Shipment date, cask number, canister number, and transfer document.

3.2.4.3 FCF Fuel Measurements

The fuel recycle facility operation will require measurements to be made at several steps in the reprocessing/recycle operation. Primary measurement requirements within a generic plant are as follows:

- e Fuel Receipt from LMR and Storage—Item control should be used. Accountability is maintained by fuel assembly serial number. SNM content is calculated based on the fuel assembly manufacturing data as adjusted by reactor burnup/transmutation calculations.
- Disassembly/Reprocessing/Concentration/Partition--Once elements have been dissolved, partitioned, and the solutions stored, sampling and measurement of the solutions is required, unless the operation is continuous through conversion to oxide.
- o Major plutonium and uranium storage is planned to consist of materials in the aqueous stage stored in criticality safe slab tanks. Solutions stored as an interim production line item require that a weight or volumetric determination be obtained against each tank or storage unit. Three samples from each unit for a total element and for isotopic analysis should be considered the minimum for basic safeguards accountability control purposes. Accountability records can be balanced by comparing input based on reactor burnup calculations against dissolution values.
- o Conversion—If conversion is continuous, i.e., minimal solution storage, then a solution measurement may not be required other than for solutions remaining at the end of a campaign or at an inventory period. Converted MOX powder or uranium oxide or plutonium oxide powders should be blended and then weighed and sampled to determine uranium and plutonium content and the respective isotopic distributions. Again, three independent samples from each conversion lot are to be considered the minimum for safeguards accountability control. More sampling may be required if a conversion lot is fairly large and proves not to be relatively homogeneous.

- **Storage**--This is an item control area. Containers should be maintained under tamper-safing conditions, and safeguards accountability should be based on unique container identification control with weight and analysis values obtained during the conversion cycle.
- **Pellet Production**--Incoming MOX powder accountability should be based on data obtained from the storage records that have been based on weight and analysis determinations obtained during the conversion process. A weight check should be made on each container to minimize record errors that might have occurred in previous steps.

During this stage, the MOX will be jet milled, moved to the collector and storage hopper, and then apportioned to the blender where a binder is added and the material is blended. The resulting mixture is then pressed into slugs, which are then granulated before being pressed into pellets. Each container of granulated MOX should be identified and a weight determination made for safeguards accountability purposes.

MOX granules are fabricated in a blender and then transferred to a press feed hopper to where green pellets are manufactured. Green pellets are transferred to boats for transfer to a debinder furnace and then to a sintering furnace. A weight must be obtained for all containers of sintered pellets. Depending on production quality control measurement statistics, uranium, plutonium, and isotopic values for a lot of MOX pellets might be determined by application of incoming MOX powder analysis. To use this system, it must be shown that all binder and lubricant is driven off during the debinder sintering cycle and that pellet production controls are such that pellet manufacturing is identifiable to measured incoming container (i.e., semibatch control through the process to assure that batches differing in plutonium, uranium, and isotopes are not intermixed).

If the foregoing controls are not feasible, then three pellet samples, representing each batch of lubricated MOX granules, are to be selected from the boats of sintered pellets for uranium, plutonium, and isotopic determination to meet the safeguard accountability requirements.

In addition to the above, all sidestream materials also must be measured for safeguards accountability purposes. Depending on the usefulness of the sidestream material, processing of material to a measurable state may be required (e.g., MOX granules, green pellets, reject sintered pellets). Extremely low-level material may be measurable by nondestructive techniques that will meet safeguard accountability criteria.

- Pin Assembly--Pellets loaded into pins will be weighed. Separate weighings for MOX pellets and other pellets are to be considered. In addition, all components of a pin assembly should be recorded for weight, composition, and dimensions to assist in burnup/transmutation calculations, curie generation, and associated isotopes, and future recycle safeguards accountability evaluations. Element and isotopic values can be based on previously determined analyses values and as-loaded pellet weight determinations.
- Pins/Elements--From this point, all safeguards and accountability controls should be based on pin and element serial identification numbers.

The material management accounting system, physical security safeguards system, and containment/surveillance system ensure inspection authorities of continued assembly or element security.

3.2.5 Fuel Supplier Certification

For nuclear material furnished by a fuel supplier, the reactor utility or its representative will establish the validity of the supplier's certification by appropriate quality assurance checks and audits of the supplier's processes.

3.2.5.1 Supplier Audits

For nuclear material furnished by a fuel supplier, the reactor utility or its representative is to:

- Review the adequacy of the supplier's material control system used in establishing the quantities and assays of nuclear material
- Audit the implementation of the fuel supplier's material control system
- Audit the fuel supplier's measurements, analyses, computations, and rework affecting the determination of nuclear material quantities and assays
- e Perform or require the performance of NDA measurements on fuel elements to confirm the validity of supplier's measurement data and to confirm the fuel element source and SNM content.

If there is a significant discrepancy between the fuel supplier's values for nuclear material quantities and **assays** and those determined by audit, the cause of such discrepancies will be investigated with the fuel supplier and the differences reconciled expeditiously.

3.2.6 Statistics

3.2.6.1 Fresh Fuel

Statistical evaluation of the measurements establishing the **SNM** content of fuel elements/assemblies is required of the **vendor**. **Records of these** determinations are maintained by the nuclear materials manager.

3.2.6.2 Irradiated Fuel

On discharge from the reactor, the calculated burnup values are calculated. This evaluation includes the development of confidence intervals for the remaining **SNM** content of each fuel assembly as well as for material transmitted/generated and burnup quantities.

3.2.6.3 NDA Measurements

NDA techniques (gross **gamma**, **gamma** spectra, passive neutron, and active neutron interrogation) can be used as attribute checks and to identify the fissile content of **fresh** fuel. **These** checks normally are conducted before the fuel elements are delivered to the reactor units.

3.2.6.4 Recycle Processes

Measurements on standards are **used** to determine the confidence intervals for the measurement technique and also for the determination of differences between analysts. The variability of analyses obtained against the independent batch/process samples will be used to calculate the confidence interval around each batch/process.

3.3 TRAINING

3.3.1 Facilities

The plant site includes facilities to conduct group training. *The training area contains equipment for using vugraphs, video tapes, film, and slides for individual and/or group training.*

3.3.2 Requirements

Reactor plant operating policy requires that individuals performing tasks involving control or handling of SNM have skill levels consistent with the task requirements. To ensure continued maintenance of competency commensurate with respective positions, documented programs of instruction and training will be established. The plant supervisor, in cooperation with the nuclear materials manager, the security manager, and operating departments, will establish training programs covering the aspects of physical security and SNM control. Assigned individuals will be instructed in sufficient depth to ensure functional competency in their assignments.

The program is designed to provide for an annual course of instruction that includes the requirements of federal regulations, license conditions, and SNM control procedures. The course is designed to be given in incremental portions, if desired. Attendance records will be kept and will be available for inspection for a period of 2 years.

Personnel responsible for plant physical security will undergo periodic training in accordance with the precepts outlined in 10 CFR 73, Appendix B.

3.4 MBA/ICA ACCOUNTABILITY PLAN

MBA and ICA definitions are covered in 10 CFR 70.58 and Regulatory Guide 5.26. MBAs and ICAs must be established in accordance with the regulations. These areas must be physically definable areas and must be of such

size that inventory **differences, losses, or thefts** can **be** identified and localized.

The reactor facility **is** considered **to** be a single ICA. However, the **FCF** should **be** divided into several **MBAs**, each of which relate to **specific** operational functions. **As** a minimum, one **MBA** should consist **of** the fuel receipt from the reactor and the **disassembly/reprocessing** areas. Consideration should **be** given to making the solution 'storage process **and** area into another **MBA**, although this function **might** **be** considered **as** part **of** the **disassembly/reprocessing** operation.

MOX processing and **pellet** processing through pellet storage **should** **be** considered **as** a separate **MBA** while pin fabrication through **element assembly** can either **be** a separate **MBA** or **be** part **of** the pellet processing function.

MBAs can **be** defined more appropriately **when** processes and process layouts **become** finalized. A basic process **and** inventory control system will include detailed nuclear material operational steps, measurement requirements, and structural evaluations based on "accountability station" control concepts. This system concept **allows** the site nuclear materials **manager** to **localize** losses 'and holdups **by** providing sub-MBA processing records and **by** providing near-real-time inventory data.

Tables 1 and **2** define the **accountability station** nuclear **material** management control points. These should **be** considered to **be** the minimum number required to afford adequate plant nuclear material controls.

TABLE 1
REACTOR ACCOUNTABILITY STATIONS

Operation	Accountability Station	Description
Recycle and new assembly storage	Fresh assemblies	New assemblies as received from the FCF or from offsite
In-cooling assembly storage	In-cooling assemblies	Assemblies stored in-cooling and waiting to be moved to the FCF or to be reinserted into the reactor
Reactor	Reactor vessel assemblies	Assemblies located within the reactor vessel

TABLE 2
FCF ACCOUNTABILITY STATIONS
(Sheet 1 of 3)

Operation	Accountability Station	Description
Fuel receiving	Fuel receiving	Receive fuel at FCF. Mate transporter to receive flange. Open transporter, remove assembly in Na-filled pot. Place in sodium melter . Melt sodium and remove assembly. Wash assembly and place in storage. Place refabricated assembly in sodium pot . Place assembly and pat in transporter. Unmate transporter for return to the reactor.
Disassembly/ reprocessing	Dissolution and partitioning	<p>Obtain assembly from storage and transfer to disassembly. Laser cut ducting and hardware from assembly, transfer hardware and duct to TRU waste. Shear assembly pins into 2-in. slugs that fall into rotary dissolver drum.</p> <p>Dissolve fuel in hot nitric acid. Transfer acid solution to feed adjustment and accountability tank, wash, and package hulls as TRU waste.</p> <p>Feed acid solution to decontamination and partitioning systems. Decontaminate and partition U/Pu. Transfer U and Pu separately to cleanup and concentration systems. Transfer solvent to solvent cleanup and recycle. Collect HLLW for vitrification.</p>
Solution storage	Concentrate storage	Send concentrated solutions to conversion storage.
Conversion	Conversion	Pump plutonium nitrate solution and appropriate amount of uranium nitrate solution from storage to converter . Add additives, mix, and thermally convert nitrates to oxide . Sample, QC, and press and sinter test samples periodically.

TABLE 2
FCF ACCOUNTABILITY STATIONS
(Sheet 2 of 3)

Operation	Accountability Station	Description
Oxide storage	Oxide storage	Can MOX powder and transfer to vault storage. Convert extra uranium nitrate solution to UO₃ powder in separate thermal converter. Transfer UO₃ powder to UO₃ storage.
Prepare fuel and preparation of pellets/pins	Pellet fabrication	Obtain MOX powder from vault storage and transfer to jet mill hopper. Mill mixed oxides and convey MOX to collection/storage hopper. Convey MOX to blender hopper. Add binder to blender hopper. Blend MOX and binder. Transfer to press feed hopper and press slugs. Granulate slugs and classify granules. Recycle off-spec granules and transfer on-spec granules to tube blender. Blend MOX granules with lubricant. Transfer to press feed hopper, press green pellets and recycle off-spec. Transfer green pellets to boats. Transfer boats to debinder furnace. Debind green pellets. Transfer boats to continuous sintering furnace. Sinter pellets.
Pellet storage	Pellet storage	Transfer to inspection. Analyze and quality control (QC). Prepare accountability documents. Transfer pellets to storage. Recycle rejects.
Fabrication of clad/end cap sub-assembly and pin fabrication	Pin fabrication	Receive, clean, inspect, and store components (clad tubes, bottom-end caps, top-end caps, springs, plenum tubes, driver sleeves, etc.). Assign and fix serial numbers to clad tubes. Assemble and weld bottom end cap to clad tube. Inspect weld and sample. Ultrasonic test clad/end cap sub-assembly . Transfer rejects to scrap. Transfer subassemblies to storage.

TABLE 2
FCF ACCOUNTABILITY STATIONS
(Sheet 3 of 3)

Operation	Accountability Station	Description
Fabrication of clad/end cap sub- assembly and pin fabrication (continued)		<p>Receive clad/end cap subassembly. Receive and stack MOX pellets.</p> <p>Receive and stack axial blanket pellets. Stack blanket and MOX pellets in magazine.</p> <p>Attach clad subassembly to magazine, load pellets into clad subassembly. Detach magazine and decon clad end. Evacuate clad,, backfill and insert plenum tube, spring, top plug, and compression weld.</p> <p>Decontaminate pin, QC, ultrasonically test weld, transfer rejects to recycle. Wire wrap, spat weld, and inspect pins.</p>
Fabricate assembly	Element/assem- bly fabrica- tion (Note: Pin and assembly fabrication may be com- bined into a single accountability station .	<p>Receive duct subassembly and components [retainers, wire wrap, attachment rails, shield inlet assembly, locking bars, and piston rings).</p> <p>Assemble strip layers with attachment mils and inspect. Assemble pins, strip layers, and shield assembly. Install locking bars. Inspect pin bundle subassembly. Assemble duct sub-assembly over pin bundle subassembly. Install retainer, weld, and inspect.</p> <p>Install piston rings, QC inspect.</p> <p>Final dimensional inspection (length, wear pad centerline), check decon. Transfer assembly to storage.</p>

4.0 CONCLUSIONS

The zoned physical security aspect enhances the protection of nuclear fuel by reducing the number of plant individuals having direct access to fuel processing, storage, and handling areas. It reduces the guard force requirements because of the nuclear material control functions having been localized into a small physical area.

Protection from internal threats and possible diversion is met by meeting Regulatory Agency Control requirements as noted in 10 CFR 70, 10 CFR 73, and 10 CFR 74 by having an independent organization overseeing and controlling nuclear material movements and transfers. Additional controls are instituted by implementing "accountability station" controls to localize and define process step anomalies.

IAEA goals as noted in 10 CFR 75 for early detection of a loss are met by the accountability station system that also provides a near-real-time plant nuclear inventory,

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5.0 REFERENCES

A list of the applicable regulatory documents used to derive this safeguards and security concept is given below.

5.1 DOE ORDERS

- 5630.1 Control and Accountability of Nuclear Materials
- 5630.2 Control and Accountability of Nuclear Materials, Basic Principles
- 5630.9A Nuclear Materials Reporting and Data Submissions Procedure Manual
- 5632.1 Physical Protection of Classified Matter
- 5632.2 Physical Protection of Special Nuclear Materials
- 5632.3 Operating Security

5.2 NRC CRITERIA

- 10 CFR 50 Domestic Licensing of Production and Utilization Facilities
- 10 CFR 70 Domestic Licensing of Special Nuclear Material
- 10 CFR 73 Physical Protection of Plants and Materials
- 10 CFR 74 Material Control and Accounting of Special Nuclear Material
- 10 CFR 75 Safeguards on Nuclear Material--Implementation of US/IAEA Agreement
- 10 CFR 95 Security Facility Approval and Safeguarding of National Security Information and Restricted Data

5.3 NRC REGULATORY GUIDES

- 1.8 Personnel Selection and Training 5/77
- 1.17 Protection of Nuclear Plants Against Industrial Sabotage 6/73

1.134	Medical Evaluation of Nuclear Power Plant Personnel Requiring Operators License	3/79
3.39	Standard Format and Content of License Applications for Plutonium Processing and Fuel Fabrication Plants	
5.10	Selection and Use of Pressure Sensitive Seals on Containers for Onsite Storage of Special Nuclear Material	7/73
5.12	General Use of Locks in the Protection and Control of Facilities and Special Nuclear Materials	11/73
5.14	Use of Observation (Visual Surveillance) Techniques in Material Access Areas	5/80
5.75	Security Seals for the Protection and Control of Special Nuclear Material	1/74
5.20	Training, Equipping and Qualifying of Guards and Watchmen	1/74
5.24	Analysis and Use of Process Data for the Protection of Special Nuclear Material	6/74
5.29	Nuclear Material Control System of Nuclear Power Plants	6/75
5.43	Plant Security Force Duties	1/75
5.44	Perimeter Intrusion Alarm System	5/80
5.45	Standard Format and Content for the Special Nuclear Material and Accounting Section of a Special Nuclear Material License Application	12/74