SAND2013-3215P

Exercise Data
for the
Insider Hypothetical Facility

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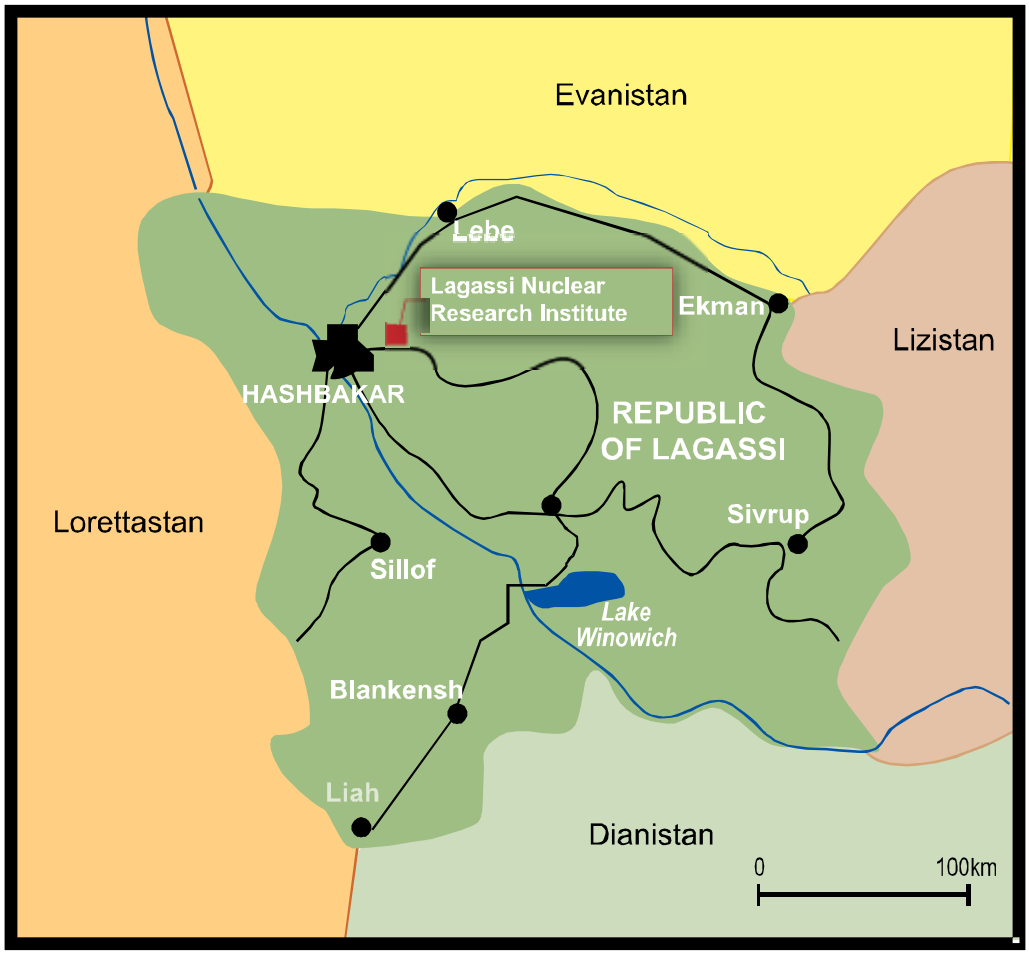
Lagassi

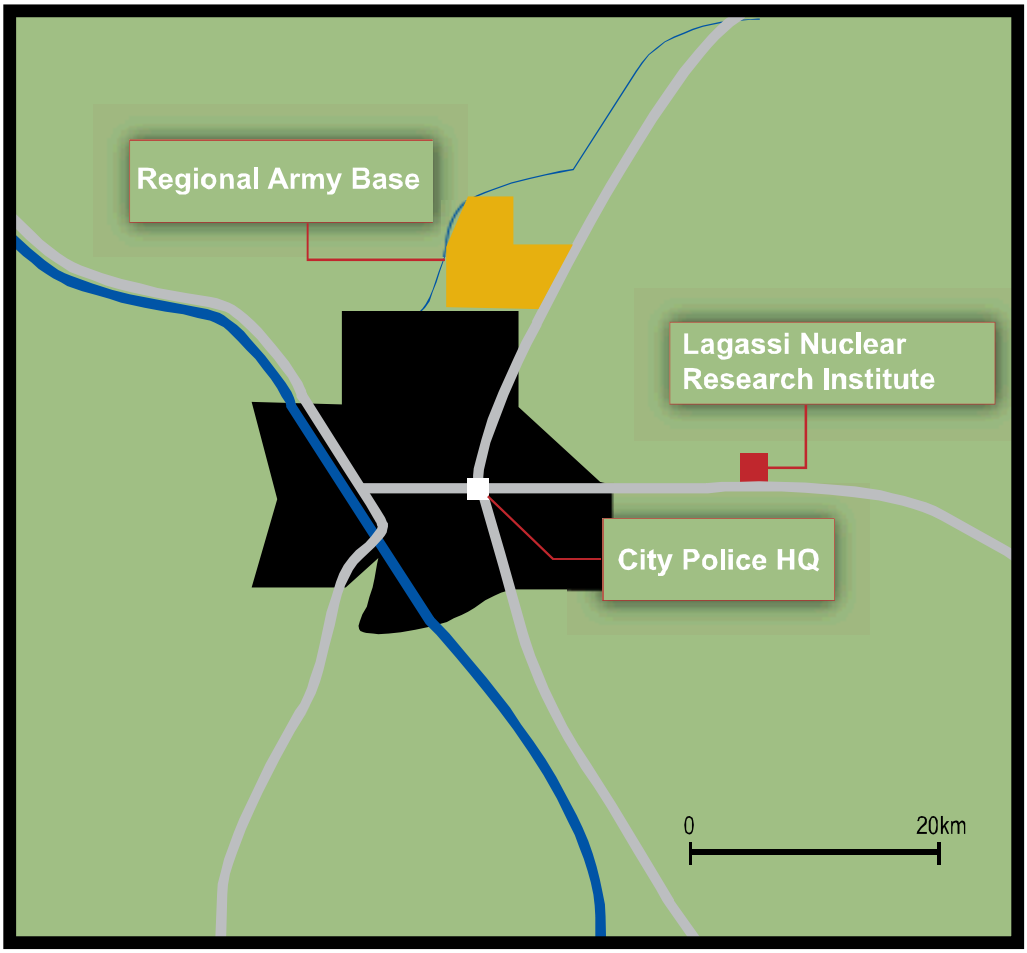
Lagassi, the smallest of the regional republics, possesses large fossil fuel reserves and plentiful supplies of other minerals and metals. It also has a large agricultural sector featuring livestock and grain. Lagassi's industrial sector rests on the extraction and processing of these natural resources and also on a growing machine-building sector that specializes in construction equipment, tractors, agricultural machinery, and some defense items. The country's solid 3.5% economic growth is largely due to its booming energy sector, but also to economic reform, good harvests, and foreign investment. In order to prevent overdependence on the oil sector, the country has embarked on an industrial policy designed to diversify the economy by developing light industry and a nuclear energy infrastructure.

Current issues include expanding the development of the country's emerging nuclear energy resources, achieving an export capacity of electrical energy to border countries, and strengthening relations with neighboring states and other foreign powers.



The City of Hashbakar

The capital of Lagassi, Hashbakar, is an ancient city that arose from the crossroads of early trading lanes. Today, the city is a modern metropolis of two million inhabitants. It contains a major roadway, a rail system, a private and military airport, and a limited waterway.



The Lagassi Nuclear Research Institute

The hypothetical nuclear research center, Lagassi Nuclear Research Institute (LNRI), was started in 1950 to serve as the nation's premier nuclear energy research facility. The Institute houses various research, administrative, and plant support facilities. The LNRI is located in the Republic of Lagassi, approximately 29 km (18 mi) east of Hashbakar.

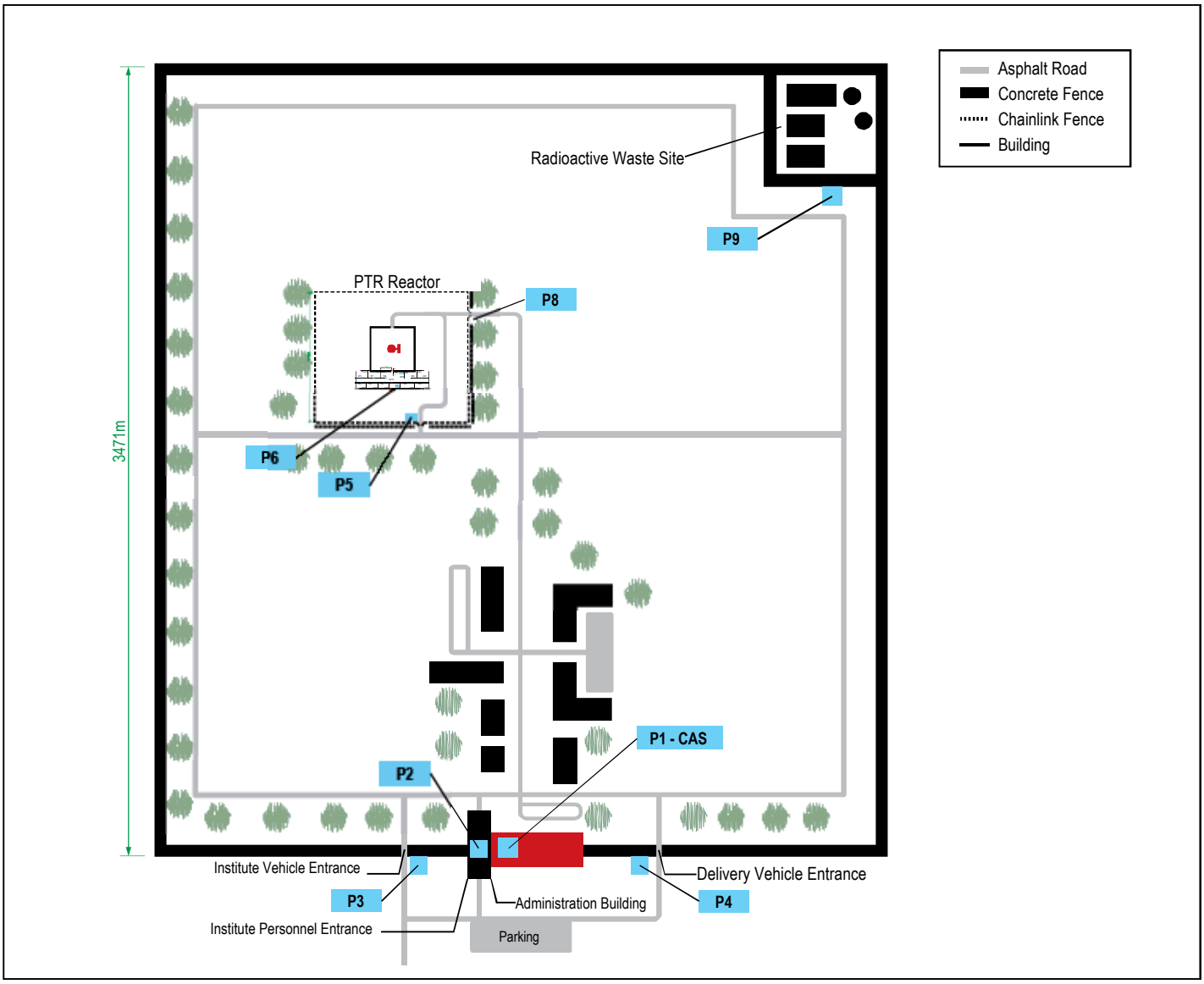
The PTR Research Reactor

The PTR is a light-water moderated, low-enriched uranium (LEU)-fueled research reactor located within the LNRI. The reactor is used for research on advanced reactor components, special fuel assemblies, and production of radionuclides for the medical industry. Other experiments are performed to investigate power reactor fuel when heated to the point of melting.

The Waste Storage Site

The Waste Storage Site is located at the northeast corner of the LNRI. The Waste Storage Site is an IAEA Category III site that is used for the storage of radioactive wastes from the PTR and other institute facilities. The site contains an unloading structure, a storage area for low-level liquid wastes, a burial area for wastes mixed with concrete, and storage buildings for medium-level and high-level wastes, isotopes, and metals. Because of recent theft attempts by local civilians and a group of students, all of whom were contaminated during these attempts, the site is now under 24-hour guard. The medium-level and high-level metals and isotopes are the main concern of the LNRI safety and health physics personnel.

LNRI Hypothetical Facility



Legend:

P1 = Central Alarm Station (CAS)
P2 = Institute Personnel Entrance
P3 = Institute Vehicle Gate
P4 = Institute Delivery Vehicle Gate
P5 = PTR Protected Area Personnel Gate
P6 = PTR Building Entry Control Portal
P9 = Radioactive Waste Site Guard Post

Physical and Environmental Conditions near the LNRI

Topography

The LNRI is located in a semi-arid environment.

Vegetation

Small shrubs, cacti, hardy desert trees, and grass are the only vegetation in the area.

Wildlife

Small animals such as rabbits, squirrels, prairie dogs, and coyotes inhabit the area. Birds of all sizes are also present.

Background Noise

Regional earthquakes cause seismic disturbances occasionally. Some noise may also occur because of heavy passenger vehicle traffic on nearby roads and low-flying aircraft.

Climate/Weather

The climate is a typical high-desert environment with approximately 300 clear days of bright sunshine per year. On cloudy days, there are areas with a high light-to-dark ratio because of moving cloud shadows. Rainfall is about 15 cm per year, with the majority occurring during seasonal thunderstorms in the late July–August rainy season. The spring is typically very windy for two to three months, with continuous winds of 2 to 5 km/hr and gusts up to 50 km/hr. Dry debris, dust, and dead vegetation are blown about during the windy season.

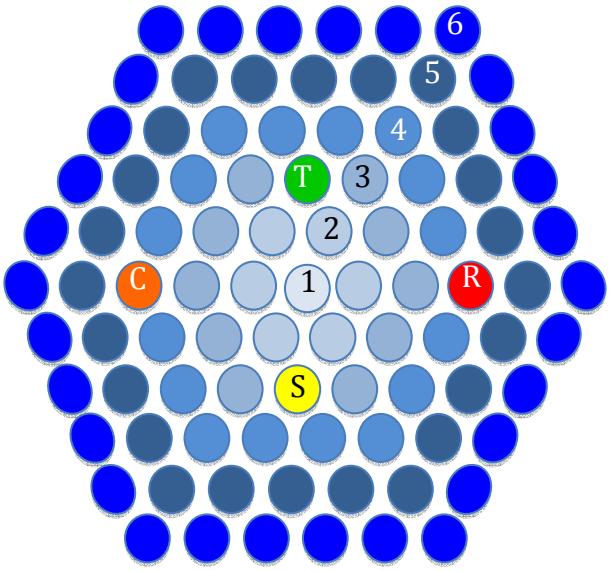
PTR Research Reactor General Description

The PTR, our hypothetical facility, is a TRIGA Mark II light-water moderated, highly enriched uranium (HEU)-fueled research reactor located within the Protected Area of the Lagassi Nuclear Research Institute (LNRI).

The reactor is used for research on advanced reactor components, special fuel assemblies, and production of radionuclides for the medical industry. Other experiments are performed to investigate power reactor fuel when heated to the point of melting. The reactor is not usually operated during the evening and off-shifts. During the off-shift periods, the gates and doors of the facility are locked and alarmed.

Reactor Data

- The TRIGA Mark II light-water reactor with an annual graphite reflector cooled by natural convection.
- The core is placed at the bottom of the 6.25m high open tank with a 2 m diameter.
- The core consists of 91 locations capped at the top and bottom to maintain the cylindrical configuration of the rods. Location 1 is normally filled with an empty irradiation tube made of aluminum. The remaining circular rows are designated 2-6.



S = Safety Rod
C = Shim
R = Regulating
T = Transient

- Each fuel element is a 1.5 inch diameter, cylindrical rod with stainless steel cladding, 28 inches in length. The actual fuel material in each element is 15 inches long and is a homogeneous mixture of uranium and zirconium hydride.
- Each rod contains 12 wt.% ^{235}U enriched to 19.9% for a total mass of 4.76 kg ^{235}U at 19.9% enrichment.
- Three 44-inch long, fuel-follower type rods are used in the reactor: Regulating (R), Shim(C), and safety (S). These rods each contain a mass of 26.9 g of ^{235}U at 19.9 % enrichment and have accessible drive motors.
- The 44-inch long, transient rod replaces the fuel part of the fueled-follower control rod with an absorber and air follower to reduce power peaking that could appear when the transient rods is in is fully withdrawn position.

- The transient rod is equipped with pneumatic system for rapid withdrawal.
- The reactor is equipped with 5 independent nuclear channels in the table below:

Channel Name	Detector Type	Range
Start	Fission counter	0.05mW-50W
Linear	Compensated ionization chamber	100mW-300kW
Logarithmic	Compensated ionization chamber	1W-1MW
Safety	Ionization chamber	100W-300kW
Pulse	Ionization chamber	10MW-2GW

- Fuel temperature is measured by thermocouples attached to two rods in the B-ring and up to 1,500°C.
- Fuel rods are placed in a grid and may be removed with a rigid fuel-handling tool.

Cooling System

- The pool contains 62.5 cubic meters of deionized water at a maximum temperature of 60°C.
- The core is cooled by natural convection in the water pool.
- The pool is constructed of stainless steel.
- A forced air/water heat exchanger is used to discharge the waste heat to the atmosphere.
- The heat exchanger is inside the reactor building with air ducts (and grids) through the building walls.
- The air ducts are mild steel, 0.3 cm thick, and has a grill that is #4 (13 mm) rebar on 15 cm centers.
- The reactor core is designed so that if a complete loss of water occurs after sustained 2-MW operation, air is sufficient for cooling. (However, natural circulation of air is essential.)
- Pumps are located below the reactor coolant level to ensure adequate Net Positive Suction Head.
- The cleanup loop flow rate of 1 to 2 liters/sec is used to:
  - remove impurities
  - maintain pH
  - maintain resistively within specifications
  - provide deionized makeup water

Irradiated Fuel Storage and Handling

- Irradiated fuel elements are transferred underwater to the spent fuel storage pools.
- The elements are transferred in storage racks using rigid handling tools.
- The dose rate of freshly discharged spent fuel is approximately 0.2–0.3 SV/hr. (20–30 rem/hr) at 1 meter.
- There are currently 100 irradiated fuel rods in the spent fuel storage pools.

Fresh Fuel Storage and Handling

- Fuel rods arrive in shipping containers.
- Fuel rods are stored in a reinforced concrete storage vault, R090, in the reactor building.
- Fuel storage racks capable of holding 10 fuel rods are used to transfer new fuel rods into the reactor pool.
- The storage vault can hold five storage racks.
- Cotton gloves are worn when directly handling the fuel elements.
- A rigid fuel-handling tool is used to transfer the fuel element to its intended position once in the reactor pool.
- There are currently 50 fresh fuel rods in storage.

Experiment Materials

- Experimental fuel rods are assembled in the R091 Vault. Experiment materials include 3 kilograms total of highly radioactive medical radionuclides, including Cs, Am, and Sr^{90}.
- A maximum of one assembly of mixed oxide fuel rods is in the reactor core at any one time and no more than four are located on site at one time. Each MOX assembly weighs a total of 3 kg and each contains 2 kg of plutonium^{239}.
- Targets are used in other irradiation and activation experiments.

Nuclear Material Stored or In Use at the LNRI

Table 1. LNRI Nuclear Material

Facility	Location	Form of Material	Amount of Material On Site (wt% enrichment)	Total Isotope Amounts	Level of Radiation
PTR Research Reactor	Reactor	U-ZrH Fuel Rods (86 in reactor)	23.9 kg U (19.9%)	4.8 kg ^{235}U	High >1 Sv/hr at 1m
	R090 Fresh Fuel Vault	U-ZrH Fresh Fuel Rods (50 in storage)	13.9 kg U (36%)	2.8 kg ^{235}U	Low
	Irradiated Fuel Pool	U-ZrH irradiated fuel Rods (30 in pool)	8.3 kg U (35%)	1.7 kg ^{235}U	High 0.2–0.3 Sv/hr at 1m
	R091 Product Vault	Pu Experiments HEU metal Other Sources	9.3 kg $^{239}PuO_2$ 23 Kg U (95%) Cs, Am, Sr	8kg 22 Kg ^{235}U 3 kg total	Low Low High
Waste Storage Facility	Vats	Liquid Mixture (4 vats, 1,000 liters ea)	Trace Amounts of Pu (75%) and U (18%) Co, Cs	trace	High 0.5–1 Sv/hr at 1m
	Sheds	Solidified Waste (50 containers)	Trace Amounts of Pu (31%) and U (12%)	trace	High <0.5 Sv/hr at 1m

Threat Data

Intelligence Sources from the National Government

- Items were recently confiscated from a political terrorist group's hiding place, which was located less than 200 km from the LNRI. The items included internal engineering drawings of the LNRI with circles drawn around the PTR Reactor and the waste storage; various weapons, including automatic weapons; some explosives; and evidence of correspondence and communication with a foreign terrorist group. Interviews with property owners and residents indicated the group consisted of three to five men.
- Surveillance of several members of the terrorist group shows extensive travels in and out of the country.
- The economic and civil strife in a neighboring country has caused many refugees, some of which are suspected terrorists, to enter Lagassi illegally.
- Plans by a political terrorist group to attack shipments of nuclear material in a neighboring country were discovered.
- The local police intelligence reports several Special Forces members had been offered large cash payments to provide special training to unidentified individuals.
- The national intelligence organization reports terrorist groups are operating in cells of four to six individuals and compartmentalizing information.
- A group of international terrorists made threats that they have the ability (skilled members and weapons) to take over or create a radiological release of a foreign nuclear facility. They demanded the release of several political prisoners. Investigation proved that they do have the weapons and equipment they claimed they have.

Crime Study

An analysis of crime incidents leads to the following conclusions:

- A major bank robbery was committed in the capital two months ago. Four robbers escaped with a large amount of money. Investigation shows the bank vault was breached by the sophisticated use of high explosives stolen from the local army base.
- Nationally, many thefts of highly valuable items have occurred. The crimes do not appear to be related to each other. It is speculated that several groups committed the crimes. Organized crime may be involved.

Professional Organizations

- A recent meeting of the Lagassi Atomic Energy Ministry included a special session on analysis of threat to nuclear facilities and material. No substantiated data on threat were available. However, the general feeling among members was that a threat to nuclear facilities does exist.
- During a meeting of the Industrialists Society, some corporate managers expressed concern that some of their employees had been approached by unnamed groups to help them carry out theft of valuable equipment and materials from the corporations. The employees had been offered large amounts of money.

Site-Specific Data

- An analysis of the backgrounds of the employees of LNRI and of the population of the community did not provide any information that would suggest a concern of threat to the Institute.
- There have been no serious disputes over labor issues at the Institute in the past five years.
- Local news media publicized that the security system at the LNRI was the latest in modern security system design with full IAEA compliance.
- A recent news feature raised the question of the potential risk to public health of the many radiological isotopes present in the LNRI.
- An Institute employee was recently caught stealing equipment and was terminated from the facility.
- A site-wide inventory recently discovered that several controlled site drawings were missing.

Response Force Data

Types of Guard Force Personnel

The guard force consists of three types of security personnel:

- unarmed institute guards
- local armed police patrols
- military tactical response teams

Responsibilities of Institute Guards

Personnel

These security personnel are responsible for:

- assessing alarms
- performing administrative duties, such as access control and key service
- patrolling and staffing fixed posts
- responding to all assessed intrusion alarms
- observing adversary actions and communicating them to the alarm station

All posts and patrols have defined policies and procedures with which the security personnel must comply.

A supervisor is present for all shifts.

Equipment

All guards are equipped with:

- a straight baton
- one set of handcuffs
- a small flashlight
- a handheld radio with duress button

Training

The guards receive training in the following areas:

- on-site safety
- access control procedures
- rules of engagement and proper use of force
- facility target locations
- response procedures
- chain of command
- other administrative responsibilities

Local Police Patrols

Personnel

Each local police patrol consists of two police officers in a squad car. They are responsible for protecting the neighborhood around the LNRI, including the facility. There are two patrols in the area 24 hours a day. They are responsible for:

- performing periodic checks with local guard force (three times per day)
- responding to assessed intrusion to delay intruders until the military tactical response team arrives

Equipment

The local police are equipped with:

- a standard police car
- a 9mm semiautomatic handgun with a fully loaded magazine
- a spare magazine of 8 rounds
- one 5.56mm semiautomatic rifle per squad car with 50 rounds

Training

The members of the Local Police Firearms receive training in the following areas:

- legal basis for search and seizure
- rules of engagement and proper use of force
- facility response locations
- local statutes and laws
- firearms qualification training (four times per year)

They are not trained to enter the reactor buildings.

Military Tactical Response

There are two military tactical response teams in the city on 24-hour alert. The teams have five members each. All members are trained in hostage situations and close-quarters combat, and have the authority and training to enter target locations to ensure the safety of critical assets and target material. However, they have never entered the PTR facility, nor do they have keys or breaching equipment to do so.

Equipment

The military tactical response team members are equipped with:

- a 9mm semiautomatic handgun with a fully loaded magazine
- a 5.56 mm assault rifle with a 25-round magazine
- one member of each team carries a 7.62 sniper rifle with scope
- two spare magazines of ammunition for each weapon. Both weapons are carried with a fully loaded magazine but without a round in the chamber.
- a straight baton

- one set of handcuffs
- a flashlight
- a handheld radio

All military tactical responders are response ready except for rifles and body armor, which is readily available in the response force building.

Training

The members of the Military Tactical Response Team receive training in the following areas:

- firearms qualification training (12 times per year)
- standard military combat training
- close quarters combat
- facility target locations
- recapture and recovery of nuclear material/facilities

All personnel receive routine physical fitness training when in the training mode.

Deployment of Response Force

The response is deployed as described in the following tables. All fixed posts are equipped with a duress switch that allows a covert signal to be sent to the CAS in case of unauthorized activity.

Table 2. Guard Deployment Data

Post No.	Description	Security Personnel Type	No. of Personnel	
			Day Shift	Nights and Weekends
P-1	CAS (includes supervisor)	Guard	3	2
P-2	Institute Personnel Entrance	Guard	2	1
P-3	Vehicle Entrance (Main Gate)	Guard	1	0
P-4	Delivery vehicle entrance (Main Gate)	Guard	Unmanned	Unmanned
P-5	PTR Personnel and vehicle gate	Guard	Unmanned	Unmanned
P-6	PTR Building Personnel Portal	Guard	1	0
P-8	PTR Emergency Vehicle Portal	Guard	Unmanned	Unmanned
P-9	Radioactive Waste Site entrance	Guard	1	1
P-10	Random two-man patrol of Institute	Guard	2	2
		Totals	**10**	**6**

Table 3. Police Deployment Data

Post No.	Description	Security Personnel Type	No. of Personnel	
			Day Shift	Nights and Weekends
	Patrols in local area	Police patrol units	2*2	2*2
		Totals	**4**	**4**

Table 4. Military Tactical Response Deployment Data

Post No.	Description	Security Personnel Type	No. of Personnel	
			Day Shift	Nights and Weekends
	Military tactical response teams (two teams of five personnel each)	Tactical Teams	2*5	2*5
		Totals	**10**	**10**

Alarm Stations and Communication (P1)

The Central Alarm Station (CAS) is located in P-1 and is staffed by a minimum of one guard and a supervisor at all times. The CAS monitors intrusion alarms, periodically communicates with all posts and patrols, and dispatches patrols for key service or other administrative duty.

Employees and contractors are trained to contact the CAS for security related questions.

The CAS is equipped with:

- 100-watt radios that can communicate to all posts and patrols within the boundaries of the Institute
- a telephone line that provides non-dedicated access to all guard posts, the local police dispatcher, and the military tactical team dispatcher

Extensive testing of the communication system has shown that the radio communications are good throughout the office area of the PTR Building. Tests have determined that the handheld radios within the Reactor Hall are able to receive transmissions from the CAS. However, the CAS is unable to receive transmissions from handheld radios within the Reactor Hall

When the CAS receives a duress alarm from a post, the local police patrols and the military tactical commander are notified to initiate a response. The CAS then alerts institute guards at posts and patrols individually via telephone starting with the closest post to the duress signal.

Response Procedures

All intrusion detection alarms are received at the CAS. When video assessment is available, the CAS operator assesses the alarm. When video assessment is not available, the CAS operator immediately dispatches the roving guard patrol to assess the cause of the alarm.

If assessed as an intrusion, the CAS immediately notifies the Local Police Dispatcher, who then notifies the local police patrols and the Commander of the military tactical response unit in order for the appropriate tactical team to begin preparations for deployment. The CAS then notifies the guards to initiate actions designed to protect employees by warning them, evacuating them when appropriate, and other actions that might obstruct the adversary (locking doors, disabling power, etc).

When the first patrol arrives, the police officers receive a quick briefing from the guard supervisor, and then begin to tactically assess the situation. Upon arrival of the second patrol, the two patrols deploy to *contain* the adversary and prevent employees from becoming injured.

Once the members of a military tactical team arrive at the research reactor, they deploy as a team and proceed to enter the PTR and ensure the protection of material and assets.

Average Response Performance Data

The Institute has conducted extensive performance testing of the institute guards, police patrols and military tactical response teams in the areas of alarm assessment, alarm communication, preparation, travel, and deployment times to alarms at the PTR Research Reactor and the Waste Facility. The average communication and response times for the

response forces to the designated response locations are provided in Table 5 below. Response times include average communication, preparation, and travel time.

Table 5. Average Response Times

Description	Research Reactor	Waste Facility
Alarm assessment time (non video – by institute guards)	45 seconds	45 seconds
Institute guards	95 seconds	105 seconds
Local Police Patrol	165 seconds	190 seconds
Military tactical response	690 seconds	715 seconds
Military Tactical response deployment time (after arrival)	90 seconds	90 seconds

Entry Control Operations at Lagassi Nuclear Research Institute Gates and Portals

Institute Personnel Entrance (P2)

During normal working hours entrance is controlled by two guards. One guard is inside the front guard postat all times. The personnel entrance is locked with one guard present during off-shifts.

Entry Procedures

- Personnel form a line and, one at time, enter the portal area and show the guard their badges as they enter.
- Visitors are checked against a visitor log. If on the list, the visitor is directed to the badging office to receive a visitor badge. If the visitor is not on the list, the second guard contacts the facility contact to determine if expected. No unannounced visitors are permitted entry.
- The unarmed guard observes personnel for unusual behavior.
- Personnel exit through the rear door of the Administration Building to go to other areas in the facility.

Exit Procedures

- Personnel form a line just inside the portal area.
- The guard waves personnel to pass one at a time out the front door.
- The guard observes personnel for unusual behavior and collects visitor badges.

Institute Vehicle Gate (P3)

The gate is unlocked and open during normal working hours and locked during off-shifts.

The gate and associated traffic flow are controlled by a single guard.

During normal working hours, site vehicles (designated by special markings on vehicle) and the automobiles of authorized employees (designated by special marking on personnel badge) are allowed entry through the gate.

Entry Procedures

- Drivers form a single line, approach the vehicle gate slowly, then stop to show the guard their badges as they enter.
- The guard verifies the vehicle and driver is approved into the facility by checking markings and badges of all passengers, if authorized, the unarmed guard waves the driver to pass into the facility one at a time. If not approved into the facility, the driver is directed to park and enter through the pedestrian portal to obtain a visitor badge.
- The unarmed guard observes the drivers and passengers for unusual behavior. **Exit Procedures**

- Drivers form a line inside the facility and when directed by the guard, slowly approach the vehicle gate.
- The guard waves drivers to pass one at a time out of the facility
- The guard observes drivers and passengers for unusual behavior. The guard collects any visitor badges.

Institute Delivery Vehicle Gate (P4)

This gate is normally closed and locked with a high security padlock. A guard is not typically on post. A guard is dispatched to open the gate for pre-announced special deliveries and for emergency evacuations.

PTR Protected Area Personnel and Vehicle Gates (P5)

An institute guard opens the gates at 0600 and closes them at 1800. They are not continuously manned. The CAS dispatches a security guard to open the gates after hours.

PTR Building Personnel Portal (P6)

The Building Personnel Portal is staffed by one guard during normal working hours. During off-shift hours, the doors are locked and the guards are not present. The CAS dispatches a security guard to open the gates after hours.

Entry Procedures

1. The employees enter through the unlocked outer door one at a time. Employees escorting visitors, enter with the visitor.
2. The employee and, when applicable the visitor, presents his picture badge to the guard.
3. If the picture on the badge and the employee's face match, the guard directs the employee through the metal detector.
4. If the either the employee or visitor is carrying or transporting a package, the guard observes the package.
5. If the package looks suspicious, the guard inspects the package.
6. Under the observation of the guard, each person, with any packages, walks through the metal detector.
7. If there is an alarm, the guard performs an inspection of the person and package.
8. If there is no alarm or the person and package is cleared by the guard, the person continues to enter the building.
9. Once past the metal detector, the employee scans his badge and enters his personal identification number (PIN).
10. If the PIN is correct, the turnstile becomes operable and allows entry into the building. If the employee is escorting a visitor, the employee allows the visitor to enter and repeats the process to enter himself.
11. The guard allows the next employee to enter.

Exit Procedures

1. The employees line up to enter the portal through the locked door one at a time.
2. The first person scans his badge and enters his PIN.
3. If the PIN is correct, the door opens, allowing him to enter the portal. Employees escorting a visitor exit with the visitor.
4. If the person is carrying or transporting a package, the guard observes the package.
5. If the package looks suspicious, the guard inspects the package.
6. Under the observation of the guard, the person, with any packages, walks through the metal detector.
7. If there is an alarm, the guard performs an inspection of the person and package.
8. If there is no alarm or the person and package is cleared by the guard, the person exits the portal.

PTR Emergency Vehicle Portal (P8)

The Emergency Vehicle Portal is not normally staffed. The CAS dispatches an institute guard to unlock the gate for special deliveries or emergency response.

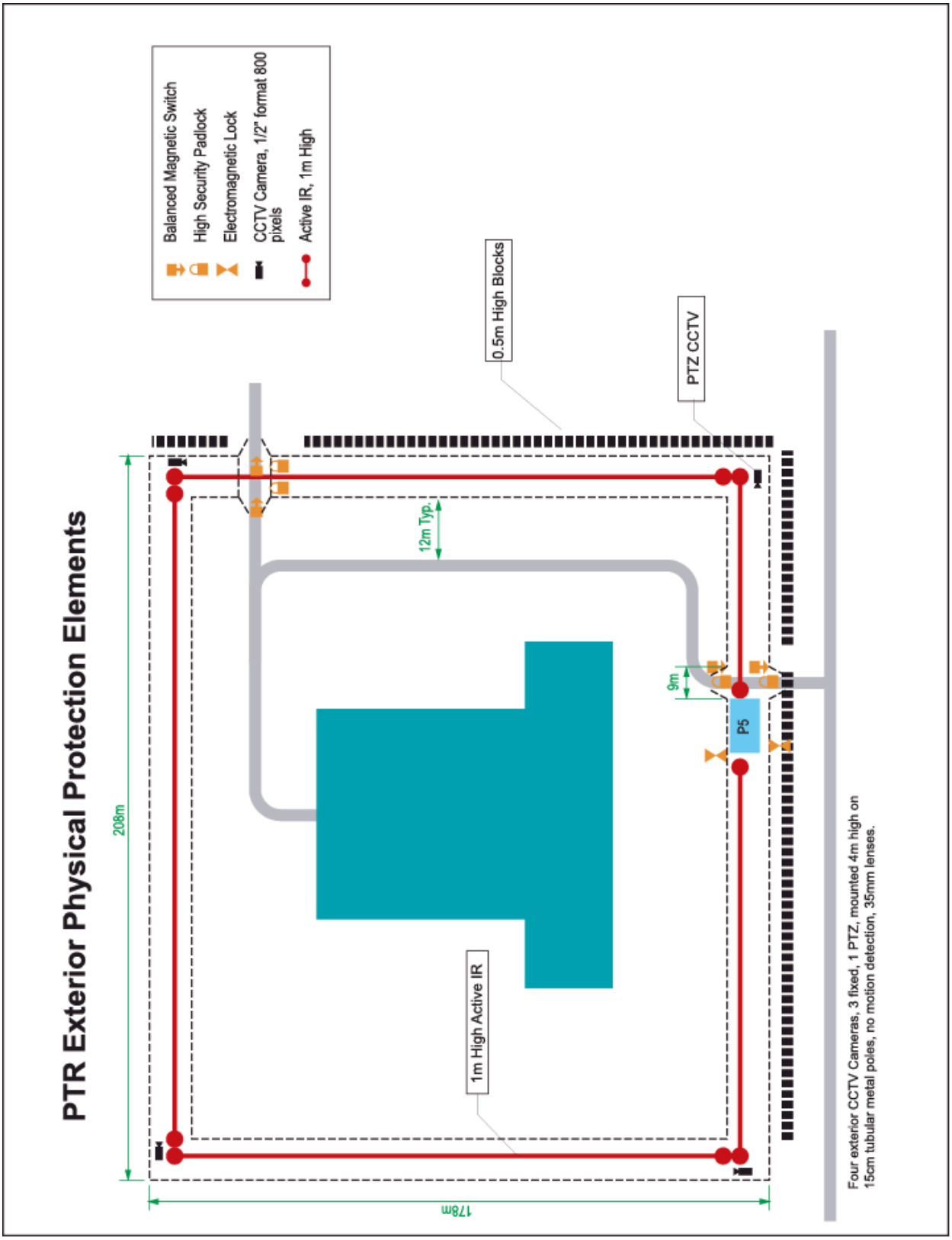
Entry Procedures

1. The CAS operator provides vehicle information to the guard.
2. Under direction from the CAS, a guard unlocks and manually opens the gate.
3. The vehicle drivers slow as they approach the gate.
4. The guard observes the approach of the vehicle for type, speed and suspicious actions. The vehicles must match the description from the CAS.
5. Under the direction and observation of the guard, the driver proceeds through the gate to the PTR building.
6. The guard shuts and locks the gate and remains at the gate for vehicle exit.

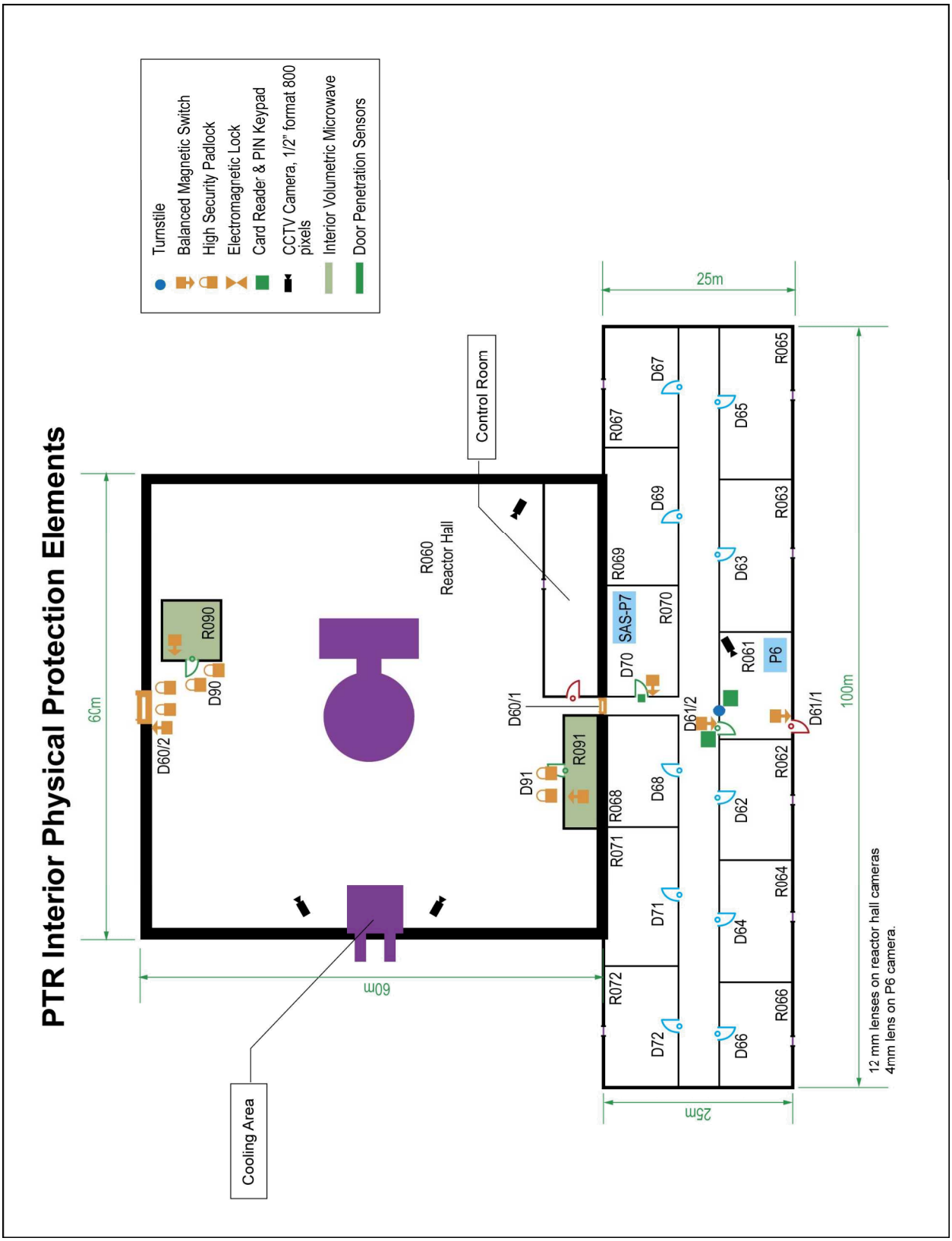
Exit Procedures

1. The CAS operator provides vehicle information to the guard.
2. Under direction from the CAS, a guard unlocks and manually opens the gate.
3. The guard observes the approach of the vehicle for type, speed and suspicious actions. The vehicles must match the description from the CAS.
4. Under the direction and observation of the guard, the driver exits through the gate.
5. The guard shuts and locks the gate.

PTR Exterior Physical Protection Elements



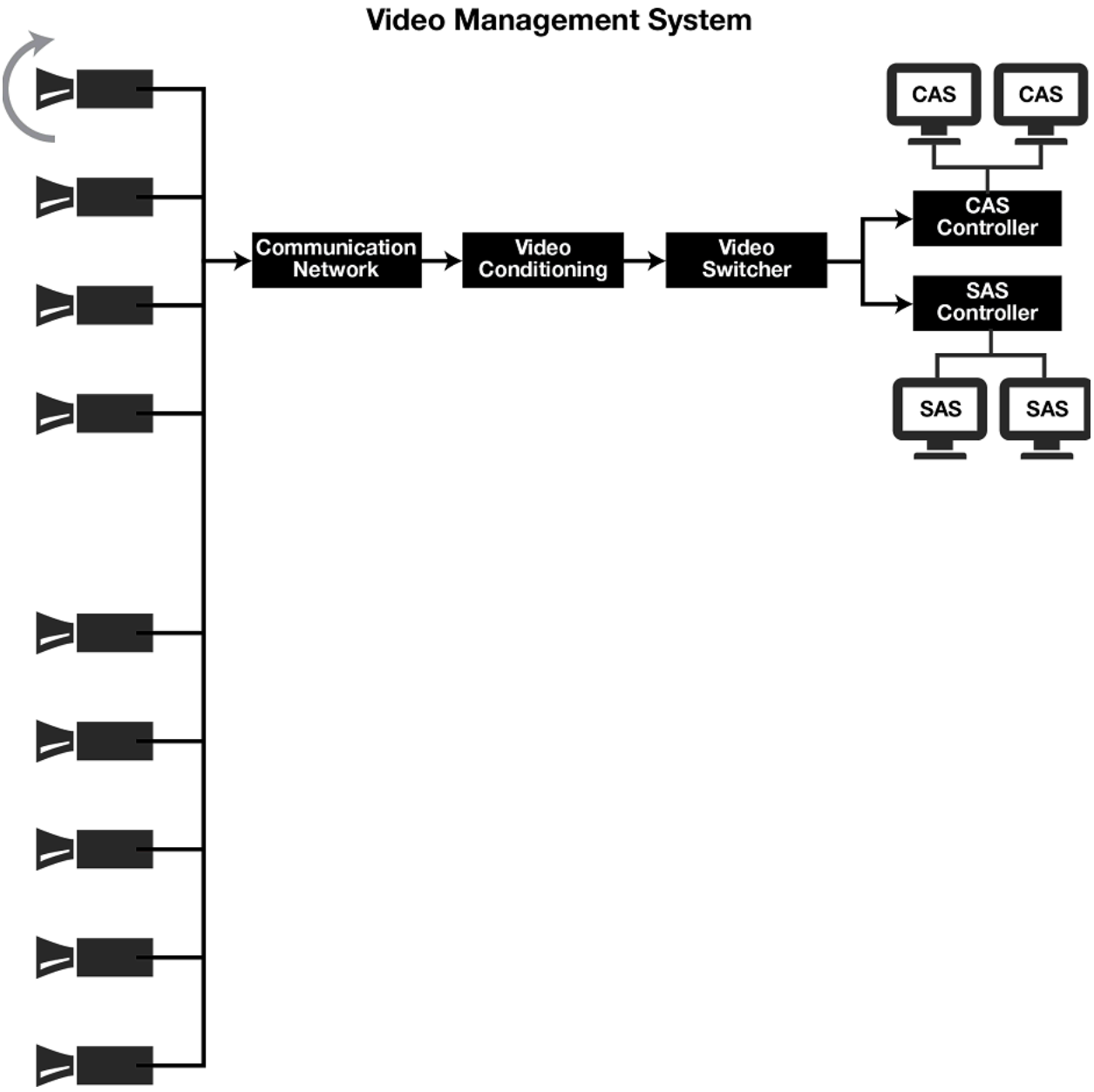
PTR Interior Physical Protection Elements



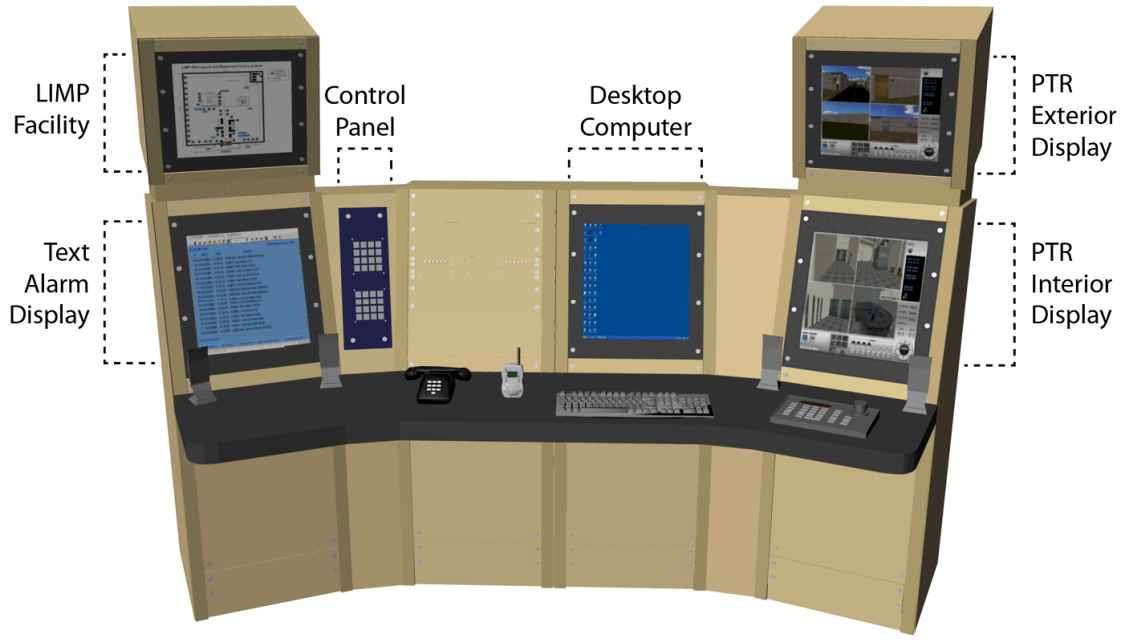
PTR Research Reactor – Fuel Assembly Vault, R091

PTR Video Monitoring System

- The PTR CCTV assessment system consists of four external and four internal cameras.
- One external camera, located at the Pan View SE corner of the perimeter, has pan-tilt-zoom capability. All others are fixed cameras.
- The system has no automatic alarm-to-video display capability and no motion detection capability.
- When an alarm occurs, the console operator must operate the controller manually to assess the alarm.



PTR Alarm and Camera Display Console



Central Alarm Station (CAS)
The alarm system equipment is located in a room in P1, the CAS and uses a hybrid star/bus network topology for communication throughout the LNRI facility. Alarms annunciate both visibly and audibly at both the CAS. The CAS operator can silence the alarm during assessment.

Video Management System:
The PTR building is the only facility with cameras. Video system controls and displays are located in both the CAS.

The Alarm Station Operator assesses most alarms by using the video system controller to manually display the video for the alarm. Alarms without video must be assessed by dispatching an institute guard.

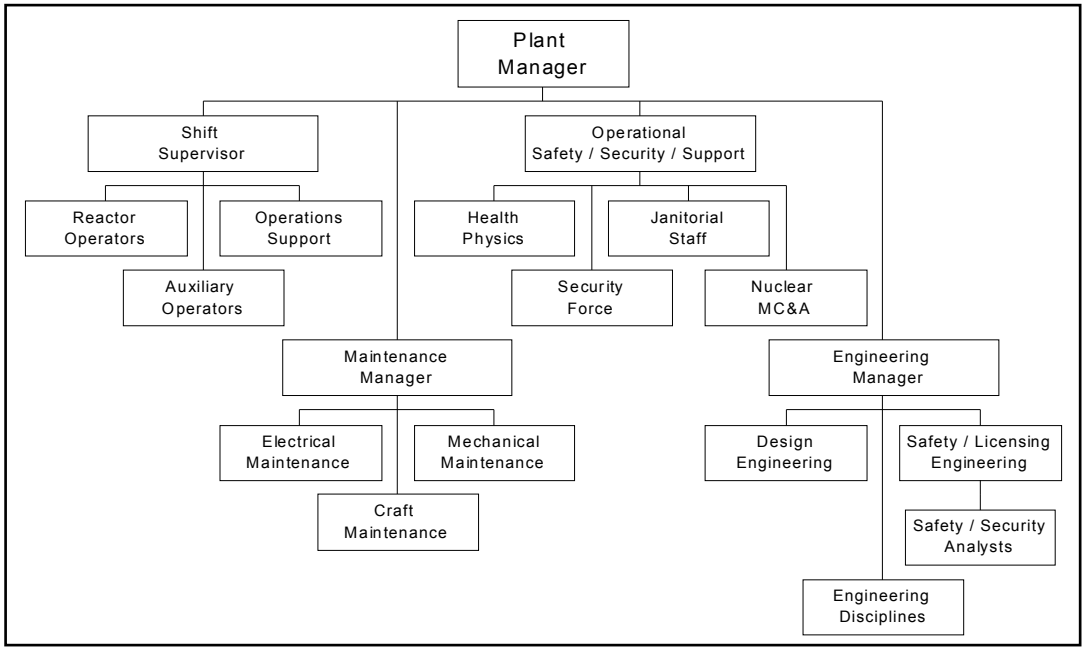
The video system is an analog system that uses coaxial cable and a star type communication between the cameras and the video system equipment. Communication to the CAS is by a dedicated fiber communication links, one for the controls and two for the displays. The communication links for the video system are shown in section 16.

***Entry Control System**:*
The entry control system equipment is collocated with the badging station in the Administrative Building.

There is no entry control system workstation at either the CAS, therefore, the system is not monitored and doors in the secure area cannot be remotely locked and unlocked for access control.

Organization and Staffing

This section discusses the organization and staffing levels at LNRI and the PTR. The figure below describes the LNRI overall organizational structure. The facility only operates between 8 am and 5 pm Monday through Friday. During weekends and off-hours, only institute guards are present at the site. While over 200 employees work at LNRI, only 59 employees have access to the PTR.



The following table gives a list of personnel types and their accesses to various areas of the PTR facility.

PTR Personnel Access List

X means unrestricted access. E means escorted access only. N is no access.

Personnel Type		# of Staff	PTR Protected Area & P6	Reactor Hall	R090	R091	Control Room
1	Plant manager	1	X	X	E	E	E
2	Reactor Supervisor	1	X	X	N	N	X
3	Senior Reactor Operator	1	X	X	N	N	E
4	Reactor Operator	2	X	X	N	N	X
5	Auxiliary Operator	2	X	X	N	N	X
6	Control Room Support Personnel	5	X	X	N	N	X
7	Operations Support	2	X	X	E	N	E
8	Maintenance Manager	1	X	X	N	N	X
9	Electrical Maintenance	1	X	X	N	N	X
10	Mechanical Maintenance	1	X	X	N	N	N
11	Craft Maintenance	1	X	X	E	E	N
12	Administrative Support	2	X	N	N	N	N
13	Health Physics Technicians	1	X	X	E	E	N
14	Guard Supervisor	1	X	X	N	N	N
15	Alarm Station Operators	2	N	N	N	N	N
16	Patrol Guards	2	X	X	N	N	N
17	Post Guards	3	X	E	E	E	E
18	Janitorial Staff	1	X	E	N	N	E
19	Material Balance Area Custodians	3	X	X	X	X	N
20	Nuclear Material Technicians	6	X	X	X	X	N
21	Nuclear Material Accounting Technicians	2	X	X	X	X	N
22	Engineering Support	1	E	E	N	N	N
23	Design Engineers	5	E	E	N	N	N
24	Safety	3	E	E	N	N	E
25	Scientists	6	X	X	E	E	N
26	Analysts	3	X	N	N	N	N
27	Vendors		E	N	N	N	N
28	State Safety Inspectors		E	E	E	E	E
29	State Security Inspectors		E	E	N	N	N
30	IAEA Inspectors		E	E	E	E	E

PTR Staffing Authority and Knowledge

Personnel Type	Routine Authority/Responsibility	Knowledge
Plant manager	Overall direction; not authorized to direct detailed facility operations	General knowledge of plant operation, lacks detailed understanding of facility
Reactor Operations Shift Supervisor	Detailed direction of all facility activities. Approves all work orders.	Extensive, detailed knowledge about all aspects of facility design, layout, and operation.
Senior Reactor operator	Detailed direction of all reactor operations.	Extensive, detailed knowledge about all aspects of reactor design, layout, and operation.
Reactor operator	Detailed direction of all reactor operations.	Extensive, detailed knowledge about all aspects of reactor design, layout, and operation.
Auxiliary Operator	Detailed direction of all reactor operations.	Extensive, detailed knowledge about all aspects of reactor design, layout, and operation.
Control Room Support Personnel	Perform specific operations tasks under direction of the reactor operator and shift supervisor	Specialized knowledge related to their duties. Narrow knowledge of complete facility systems.
Operations Support	Perform specific operations tasks under direction of the reactor operator and shift supervisor	Specialized knowledge related to their duties. Narrow knowledge of complete facility systems.
Maintenance Manager	Overall direction to maintenance personnel.	General knowledge of plant operations.
Electrical Maintenance	Perform activities on specific systems pursuant to work orders and the plan of the day	Specialized knowledge related to their duties. Narrow knowledge of complete facility systems.
Mechanical Maintenance	Perform activities on specific systems pursuant to work orders and the plan of the day	Specialized knowledge related to their duties. Narrow knowledge of complete facility systems.
Craft Maintenance	Perform activities on specific systems pursuant to work orders and the plan of the day	Specialized knowledge related to their duties. Narrow knowledge of complete facility systems.
Administrative Support	Administrative support	No working knowledge of facility systems.
Health Physics Technicians	Monitor radiological conditions. Not permitted to work on plant equipment	Specialized knowledge related to their duties. Narrow knowledge of facility systems.
Guard Supervisor	Direct activities of security force	No knowledge of facility systems, but knowledgeable about plant security systems and security procedures

Personnel Type	Routine Authority/Responsibility	Knowledge
Alarm Station Operators	Testing and Calibration of Physical Protection Equipment	Specialized knowledge of the physical protection system (technology) and security procedures. No knowledge of facility systems
Patrol Guards	Monitor alarms and direct response under the direction of the Guard Supervisor	No knowledge of facility systems, but knowledgeable about plant security systems and security operational procedures
Post Guards	Routine patrol of PAs and non-radiological vital areas and respond to plant alarms	No knowledge of facility systems, but knowledgeable about plant security systems and security operational procedures
Janitorial Staff	Staff access control and other security posts and respond to plant alarms	No knowledge of plant safety / operational systems or plant response to abnormal conditions, but knowledgeable about security operational procedures
Material Balance Area Custodians	Cleaning and housekeeping	No knowledge of plant systems or security measures
Nuclear Material Technicians	Direct nuclear material inventories, authorize transfers	Knowledgeable about nuclear material status and inventory procedures, but no knowledge of facility systems
Nuclear Material Accounting Technicians	Perform nuclear material operations and inventories at the direction of Material Balance Area (MBA) custodians	Knowledgeable about nuclear material status and inventory procedures, but no knowledge of facility systems
Engineering Support	Maintain paper accountability system and generate required nuclear material status, transfer, and inventory reports	Knowledgeable about nuclear material status and inventory procedures, but no knowledge of facility systems
Design Engineers	Support plant engineering activities	Specialized knowledge related to their duties
Safety	Perform design activities and review performance and status of specific systems	Specialized knowledge related to design and performance of specific plant systems, moderate knowledge of complete facility systems
Scientists	Analyze safety and impacts of proposed changes, develop / review procedures and procedure revisions, prepare documents for State regulator	General knowledge of performance and roles of facility systems, but no detailed knowledge of operation of complete facility systems
Analysts	Perform security analysis activities and review performance and status of specific systems	Specialized knowledge related to design and performance of security systems

Interior Sensors Suitable for Fixed-Site Applications

Application	Operating Principle	Detection Capabilities					Factors That Cause Unreliable Detection	Typical Defeat Methods	Major Causes of Nuisance Alarms									
		Portal Opening	Break through Wall/Floor\Ceiling	Radial Motion	Transverse Motion	Touching Object			Humidity/Temp/ Velocity (wind)	Localized Heating (sunlight)	Movement Greater than 0.025 m/sec	Movement Outside Area (Vibration)	Fluorescent Lights	Loose-Fitting Doors	Mount Vibration	Ambient Acoustic Noise (lightning/thunder)	Animals	RFI-radio transmitter
Boundary Penetration	Balanced Magnetic	X					Improper installation	Stay behind intruder or enter through unprotected area						X				
	Vibration		X									X			X			
	Continuity		X															
	Infrasonic	X	X						X				X					
Motion	Sonic	X		X	X		Acoustic background	Disable electronics	X		X			X	X	X		
	Ultrasonic	X		X			Air movement	Cover when sensor is in access	X		X			X	X	X		
	Microwave	X		X			RFI				X	X	X		X		X	X
	Infrared				X		Unstable thermal background			X					X		X	X
Proximity	Capacitance					X	Gross changes in relative humidity, temperature, or pressure	Disable electronics	X								X	
	Strain					X											X	
	Pressure Pad					X											X	

Probabilities of Detection for Contraband and SNM Detection Measures

		Material Detection					
Component Type	**Component Description**	**Hand Tools P(D)**	**Power Tools P(D)**	**High Explosives P(D)**	**Metal Contraband P(D)**	**Small Arms P(D)**	**Radioactive Contraband P(D)**
Explosives Detector	Animal Olfaction			0.1			
	Handheld vapor collection			0.45			
	Thermal Neutron			0.25			
	Vapor Collection			0.35			
Handheld Metal Detector	Ferrous materials and all forms of lead	0.85	0.75		0.25	0.5	
Item Search	Cursory	0.1	0.1	0.1	0.1	0.1	0.1
	Rigorous	0.75	0.75	0.45	0.75	0.75	0.65
Personnel Search	Pat down	0.9	0.9	0.3	0.9	0.9	0.9
	Strip inspection	0.9	0.9	0.9	0.9	0.9	0.9
Portal Metal Detector	Ferrous materials and all forms of lead	0.9	0.9		0.8	0.6	
Vehicle Search	Cursory	0.1	0.1	0.1			0.1
	Rigorous including cargo	0.5	0.5	0.25			0.4
X-Ray Inspection	Standard	0	0.9	0.9	0.6	0.6	0.6

Radiation Detection Estimates	**Probability of Detection**
Vehicle	0.5
Personnel using Portal	0.85
Personnel using handheld device	0.75

Probabilities of Human Surveillance Detection

Component Type	Component Description	No Equipment P(D)	Small Arms P(D)	Light Antitank Weapons (LAW) P(D)	Independent of threat attribute P(D)
SO at Post Observation	Duress, LAW protected	0.8	0.8	0.8	
	Duress, small arms protected	0.8	0.8	0.45	
	Duress, small arms protected: LAW protected on alert	0.8	0.8	0.45	
	Duress, unprotected	0.8	0.45	0.45	
	Duress, unprotected: LAW protected position on alert	0.8	0.45	0.45	
	Duress, unprotected: small arms protected position on alert	0.8	0.45	0.45	
	No duress, LAW protected	0.8	0.8	0.45	
	No duress, small arms protected	0.8	0.45	0.45	
	No duress, small arms protected: LAW protected position on alert	0.8	0.45	0.45	
	No duress, unprotected	0.8	0	0	
	No duress, unprotected: LAW protected position on alert	0.8	0	0	
	No duress, unprotected: small arms protected on alert	0.8	0	0	
SO in Tower Observation	LAW resistant tower	0.05	0.05	0.02	
	Small arms resistant	0.05	0.05	0.02	
SO on Patrol	Random				0.02
	Scheduled				0.01
General Observation	Personnel always in vicinity				0.02
	Personnel generally in vicinity				0.01

Probabilities of Detection for Access Control Measures

Component Type	Component Description	Independent P(D)	Land Vehicle P(D)
ID Verification	Casual Recognition	0.02	
	Credential	0.05	
	Credential and PIN	0.35	
	Picture Badge	0.1	
	Picture Badge and PIN	0.6	
	Exchange picture badge	0.5	
	Exchange picture badge and PIN	0.8	
	Retinal scan and PIN	0.99	
	Hand geometry and PIN	0.95	
	Speech pattern and PIN	0.95	
	Signature dynamics and PIN	0.95	
	Fingerprint and PIN	0.95	
Personnel Access Authorization Check	General observation of authorization	0.1	
	Authorization verification each time location is accessed	0.6	
Two Person Rule	Presence in area	0	
	Within sight	0.1	
	Dedicated observation	0.5	
	Dedicated observation with alarm	0.95	
Vehicle Authorization Check	Authorization from check		0.35
	Serial number verification		0.45
	Visual check of insignia/ license plate		0.15

Fuel Movement and Storage Procedures

Planning and Coordination

A. The Reactor operator shall verity the Reactor Supervisor and a qualified Nuclear Material Technician are within the PTR PA and notify them prior to moving fuel elements.
B. Satisfactory completion of each step in this procedure shall be indicated by the initial of the individual performing that step, marking boxes or by recording the requested variable.
C. The completed operations checklist shall be place in the PTR Operation Log

Safety Requirements

A. Visually inspect material storage racks for integrity of the geometric array spacing and arrangement in R90 prior to movement of any materials.
B. Verify that the reactor and storage pool levels are adequate to ensure adequate shielding of personnel.
C. Verify that the water resistivity is greater than or equal to 0.5MΩ-cm in both the reactor pool and the storage pool.

Administrative Limits for Storage Racks

A. Racks shall not be stacked and can be arranged in one-high arrays.
B. A rack shall not be lifted or moved with more than 15 fuel elements in it.
C. Pneumatic tools or other devices that could potentially introduce air voids into a fuel storage rack are forbidden in the vicinity of the racks.
D. Modified or damaged racks (e.g. sever corrosion, dents, or missing parts) shall not be used without a criticality safety review and approval.

Loading of Reactor Core 90-Element Rack

A. The 90-element rack may be used in either the reactor pool or the storage pool.
B. Loading of the 90-element rack shall be performed with the rack located on the level plate or on the floor of the pool. Stability of the rack will be confirmed prior to use.
C. The 90-element rack shall not be lifted or moved with fuel elements within the rack.
D. The 90-element rack within the reactor shall have a separation between any portion of the rack and any fuel elements in the outer row of the core of at least 10cm.
E. Use of any other moveable fuel element handling racks in the reactor pool is prohibited while there are elements in the 90-element rack.
F. Pneumatic tools or other devices that could potentially introduce air voids into a fuel storage rack are forbidden in the vicinity of the racks.

Administrative Controls on R90

A. Fissile materials up to 500 g ^{235}U, 250g ^{239}Pu, or 250g combination of ^{235}U, and ^{239}Pu are allowed in the vault.
B. Fissile material in transit may be temporarily held in from of the vault while it is being opened.

Surveillance Requirements

A. Visually inspect material storage racks for integrity of the geometric array spacing and arrangement in R90 prior to movement of any materials.
B. Verify that the reactor and storage pool levels are adequate to ensure adequate shielding of personnel DAILY.
C. Measure and record the storage and reactor pool water resistivity MONTHLY.
D. Check the radioisotopic analysis of the water from the storage and reactor pools for indication of a fuel leak MONTHLY.

Lagassi PTR Facility Fuel Storage Log Sheet

Month _____

Daily Pool Level Measurements

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Storage Pool																															
Reactor Pool																															

Monthly Water Measurements

Storage Pool Water Resistivity (≥0.5MΩ-cm)_____

Reactor Pool Water Resistivity (≥0.5MΩ-cm)_____

Storage Pool Radioisotopic Analysis Completed_____

Reactor Pool Radioiosotopic Analysis Completed_____

Fuel Handling Procedure

Safety Notes:

1. The PTR pool water and spent fuel storage pool water should be considered contaminated and all items coming in contact with the water must be handled as potentially contaminated until released by Nuclear Material Technician.
2. The reactor shall remain in shutdown mode throughout this procedure.

Operational Notes:

1. When conducting a complete core unloading, the fuel should be removed one complete row at a time starting with the outer rows or as defined in activity specific procedures or plans.
2. When conducting a complete core loading, the fuel should be installed one complete row at a time starting with the inner rows.
3. The fuel handling tools use a cable-type release system. Accidental snagging of this cable can result in inadvertently dropping a fuel element.
4. The overall length of the fuel-followed reactivity control elements requires extra caution when rigging them out of the reactor or spent fuel pool or other storage location. Crane movement should be made in small increments to minimize swing of the fuel-followed reactivity control element when suspended.

Approval and Notifications

Reactor Operators

1. Handle the fuel elements and fuel-followed reactivity control elements in accordance with this procedure.
2. Use a reader-worker team approach to double check each other when possible to ensure proper performance of each procedure step.

Reactor Supervisor

1. Authorize fuel handling operations.
2. Review the completed Fuel Transfer Log sheets for accuracy and completeness.
3. Ensure the Fuel Element Database is updated.

Procedure - *Fuel element*

1. Attach the fuel handling tool to the fuel element and ensure the element is securely attached.
2. Record the position of the fuel element in the Fuel Transfer Log. If practical, visually check the serial number stamped on the fuel element.

3. Move the fuel element to the new location and visually confirm the element is properly positioned.
4. Record the new position of the fuel element in the Fuel Transfer Log and initial the log sheet.
5. Update the
6. Fuel Element Database as soon as practical following the fuel element transfer(s).

Procedure - ***Fuel-Followed Reactivity Control Element (FFRCE)***

1. Attach rigging to the FFRCE and ensure the element is securely attached.
2. Record the position of the FFRCE in the Fuel Transfer Log.
3. Move the FFRCE to the new location and visually confirm the FFRCE is properly positioned.
4. Record the new position of the FFRCE in the Fuel Transfer Log and initial the log sheet.
5. Update the appropriate fuel database as soon as practical following the FFRCE transfer(s).

Movement of Facility Nuclear Materials

The Onsite Transfer Checklist shall be used for onsite transfer of radioactive material.

The Experimental Materials Worksheet and Facility Radioactive Materials Inventory shall be completed before material is accepted into the reactor.

Onsite Transfer Operations

1. Use the Onsite Transfer Checklist to record the onsite transfer of radiological material between R90 and the reactor.
2. Verify that the radiation protection requirements have been reviewed and enter the Technical Work Document (TWD) and Radiological Work Permit numbers on the checklist.
3. Specify the remaining information on the Onsite Transfer Checklist.
4. If the transfer involves vehicles, verify the quantity of fuel available in the vehicles is minimized and that material containers are securely fastened to the vehicle.
5. Restrict the pathway or route to be taken during the onsite transfer operations.

Transfer of Experimental Materials

1. Identify the types and quantities of experimental material to be brought from R91.
2. List each experimental item associated with the experiment on the Experimental Materials Worksheet including the type of material/radionuclide and quantity.
3. Multiply the quantity of each material/radionuclide by the ^{239}Pu equivalent conversion factor listed on the worksheet. Enter the value in the ^{239}Pu eq. column.

4. If the material is best described as “metal/ceramic”, the sum the values in the ^{239}Pu eq. column to determine the total ^{239}Pu equivalent.

Facility Material Inventory

1. Obtain the total ^{239}Pu equivalent from the completed Experimental Materials Worksheet.
2. Enter a unique identify (e.g., Experiment Plan Number, Pakage serial number, etic.) and the total grams of ^{239}Pu equivalent.

Fuel Transfer Log for the Lagassi PTR

Date: _____ Page _____ of _____

Purpose of Transfer(s): _____

Precautions Checklist:

- ☐ The reactor is in shutdown mode
- ☐ Certified reactor supervisor (RS) is within the PTR Protected Area
- ☐ Certified reactor operator (RO) is directly supervising the fuel handling operation
- ☐ Qualified Nuclear Material Technician is within the PTR Protected Area

_____Concurrence from Reactor Supervisor

_____Concurrence from Nuclear Material Technician

Action #	Element Number	Transferred From	Transferred To	Verified by (RO/RS)	Database Updated
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

ONSITE TRANSFER CHECKLIST

Onsite Transfer Subject/Title: _____

Review radiation protection requirements for the transfer TWD# _____

RWP# _____

Review the criticality safety requirements for the transfer CSA# _____

Specify means for moving the material _____
(e.g. via truck, forklift, hand cart, hand carry etc.)

Specify material container requirements _____

Specify hoisting and rigging requirements _____

Specify means by which the material containers are secured _____
(e.g. tie downs)

Specify training, qualification, and certification requirements _____
of the personnel executing the transfer

Material containers are secured to the vehicle _____

Combustible materials minimized _____

Quantity of fuel available in transfer vehicles minimized _____

Weather conditions and external events acceptable _____

Visually inspect approved storage locations _____

Pathway or route to be taken restricted. Only personnel and vehicles _____
necessary to execute the transfer SHALL be allowed in the area of the transfer.

Completed by:

_____ _____

Person-in-Charge (PIC)/Designated Leader (DL) Date

EXPERIMENTAL MAR WORKSHEET

EXPERIMENT PLAN NUMBER: _____

Item	Material/ Radionuclide	Quantity	Conversion Factor	Pu-239 eq. [grams]	Comments

Total Pu-239 eq. (metal/ceramic): _____ g (≤9600 g)

Total Pu-239 eq. (when vaporization is credible): _____ g (≤10 g)

Total Experimental Gaseous Tritium: _____ Ci (≤500 Ci)

For operations involving dosimetry fission foils:

Total fissile mass of dosimetry fission foils irradiated in a single operation: _____ (≤ 5 g Pu-239 eq.)

For each operation: _____ nvt (≤ 5×10^{15} nvt [>10 keV])

For all pulse/TRW reactor operations:

Total fissions produced: _____ ≤ $1x10^{17}$

For Category D steady-state experiments:

Total fission power: _____ kW (≤ 50 kW)

COMPLETED BY: _____ DATE: _____

VERIFIED BY: _____ DATE: _____

FACILITY MATERIAL INVENTORY

EP #, Unique Identifier [e.g., package serial number]	Pu-239 eq. [grams]	Comments

Total Pu-239 eq. metal/ceramic: _____ g (≤20.6 kg)

Total Pu-239 eq. contiguous with explosives: _____ g (≤1 g)

Total Gaseous Experimental Tritium: _____ Ci (≤500 Ci)

COMPLETED BY: _____ DATE: _____

VERIFIED BY: _____ DATE: _____