

**Exercise Data Book  
for the  
General Hypothetical Facility  
and  
PTR Data**



# Table of Contents

<b>Lagassi</b> .....	<b>1</b>
<b>The City of Hashbakar</b> .....	<b>2</b>
<b>The Lagassi Nuclear Research Institute</b> .....	<b>3</b>
The PTR Research Reactor .....	3
The Waste Storage Site .....	3
<b>LNRI Hypothetical Facility</b> .....	<b>4</b>
<b>Physical and Environmental Conditions near the LNRI</b> .....	<b>5</b>
Topography.....	5
Vegetation.....	5
Wildlife .....	5
Background Noise.....	5
Climate/Weather .....	5
<b>PTR Research Reactor General Description</b> .....	<b>6</b>
Reactor Data.....	6
Cooling System.....	6
Irradiated Fuel Storage and Handling.....	7
Fresh Fuel Storage and Handling.....	7
Experiment Materials .....	7
<b>Nuclear Material Stored or In Use at the LNRI</b> .....	<b>8</b>
Intelligence Sources from the National Government.....	9
Crime Study .....	9
Professional Organizations .....	9
Site-Specific Data .....	10
<b>Response Force Data</b> .....	<b>11</b>
Types of Guard Force Personnel .....	11
Responsibilities of Institute Guards .....	11
Local Police Patrols.....	11
Military Tactical Response Team Members.....	11
Equipment.....	12
Training.....	12
Alarm Stations and Communication (P1).....	13
Response Force Staffing.....	14
Response Procedures.....	15
Average Response Performance Data.....	15
<b>Facility Entry Control Operations at LNRI Gates and Portals</b> .....	<b>16</b>
Institute Personnel Entrance (P2).....	16
Institute Vehicle Gate (P3) .....	16
Institute Delivery Vehicle Gate (P4).....	16

<b>Entry Control Procedures for the PTR Facility .....</b>	<b>17</b>
PTR Personnel and Vehicle Gates (P5) .....	17
PTR Building Personnel Portal (P6) .....	17
PTR Emergency Vehicle Portal (P8) .....	18
<b>PTR Research Reactor – Building Floor Plan .....</b>	<b>19</b>
<b>PTR Wall Thicknesses and Distances .....</b>	<b>20</b>
<b>PTR Interior Physical Protection Elements.....</b>	<b>22</b>
<b>PTR Access Control Plan (picture is incorrect).....</b>	<b>23</b>
<b>PTR Lighting Intensity Map .....</b>	<b>25</b>
<b>PTR Video Monitoring System .....</b>	<b>26</b>
<b>Probabilities of Detection (<math>P_D</math>) for Sensors.....</b>	<b>28</b>
<b>Entry Control and Contraband Detection Estimates.....</b>	<b>32</b>
<b>Access Delay Times – Fences .....</b>	<b>33</b>
<b>Access Delay Times – Gates and Turnstiles .....</b>	<b>34</b>
<b>Penetration Times- Walls.....</b>	<b>35</b>
<b>Penetration Times- Doors.....</b>	<b>38</b>
Cutting Rates for Reinforcement Bar - 1-Meter Boltcutters.....	41
Cutting Rates for Reinforcement Bar - Portable Cutting Torch .....	41
Cutting Rates for Mild Steel Sheet & Plate .....	43
Time Required to Set an Explosives Package.....	44
Adversary Running Rates .....	45
Vehicle Rates for Experienced Drivers .....	45
Sensors – Relative, Qualitative, Level of Detection .....	47
Sensors - Relative Susceptibility to Nuisance Alarms.....	48
Weather .....	48
Animals .....	48
Electrical Interference .....	48
<b>Appendix - Interior Sensors Suitable for Fixed-Site Applications .....</b>	<b>49</b>

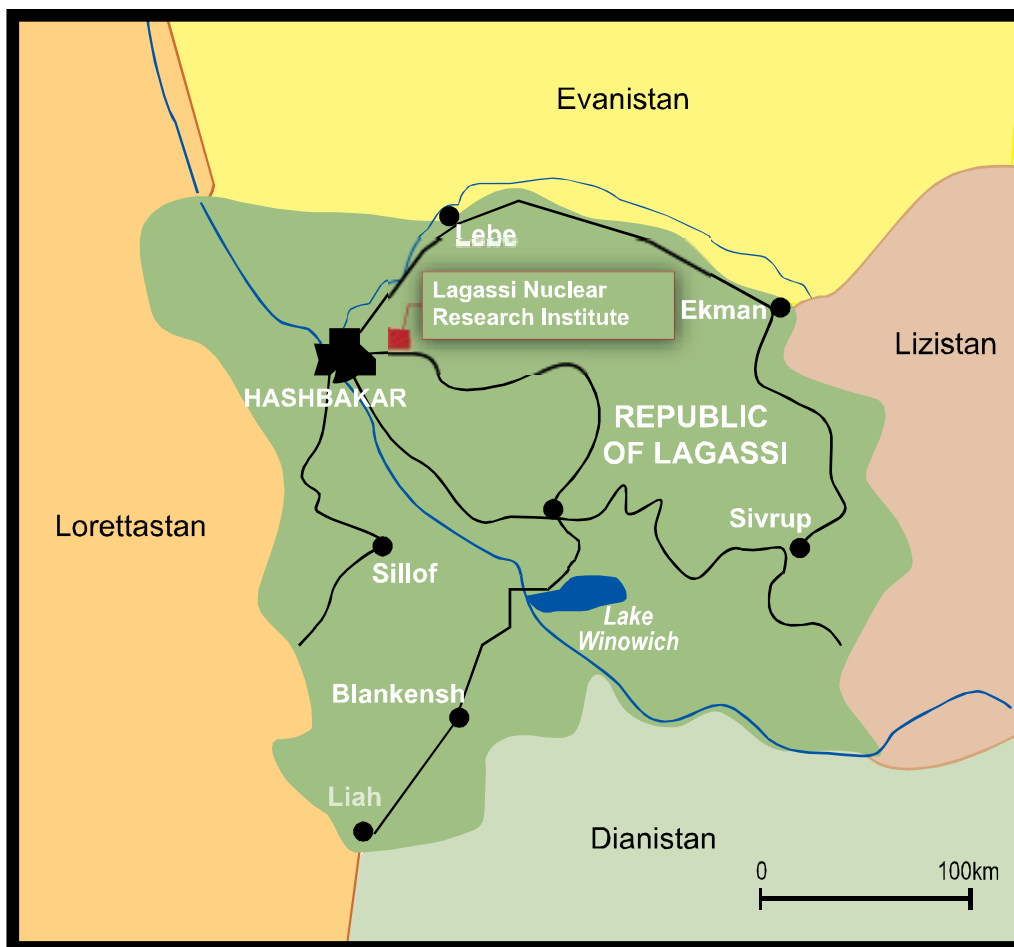




## Lagassi

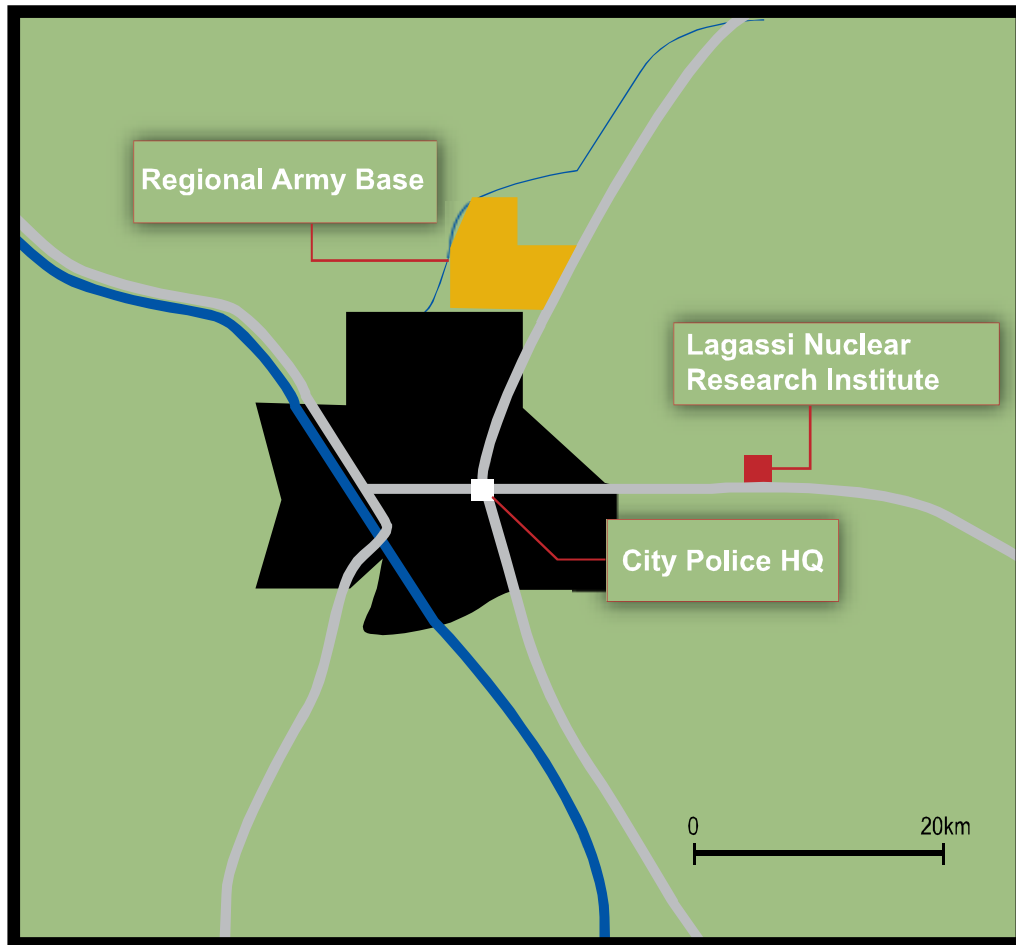
Lagassi, the smallest of the regional republics, possesses large fossil fuel reserves and plentiful supplies of other minerals and metals. It also has a large agricultural sector featuring livestock and grain. Lagassi's industrial sector rests on the extraction and processing of these natural resources 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***

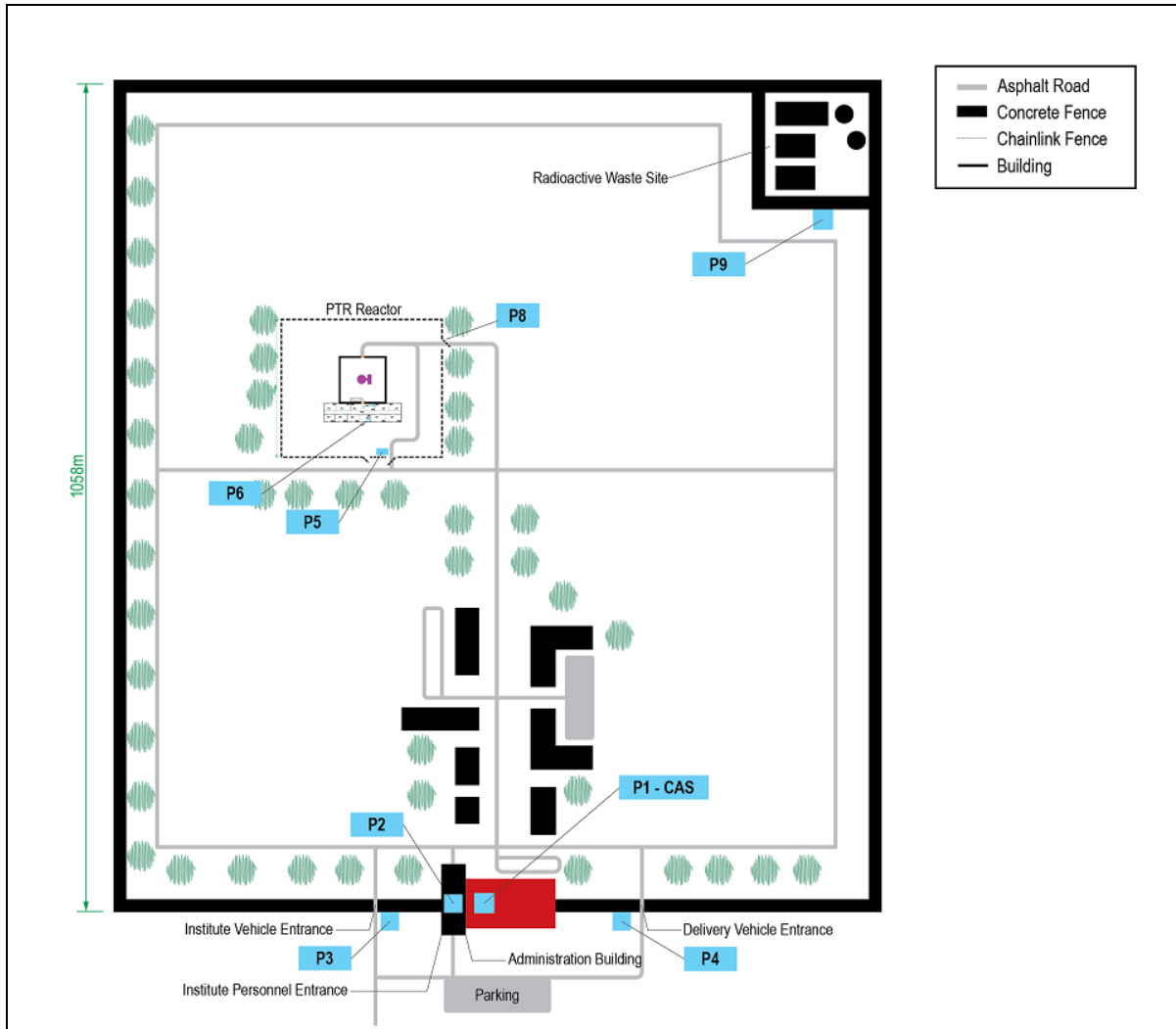
The PTR is a light-water moderated, highly enriched uranium (HEU)-fueled research reactor located within the LNRI. The reactor is used for research on advanced reactor components, special fuel assemblies, and production of radionuclides for the medical industry. Other experiments are performed to investigate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

The PTR Research Reactor employs a total of 32 people, plus the guard force. The reactor is not usually operated during the evening and off-shifts. During the off-shift periods, the gates and doors to the facility are locked and alarmed.

### ***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 Personnel Gate
- P6 = PTR Entry Control Portal and Secondary Alarm Station (SAS)
- P8 = PTR Emergency Gate
- 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 sparse 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 light-water moderated, highly enriched uranium (HEU)-fueled research reactor located within the Lagassi Nuclear Research Institute (LNRI), a hypothetical nuclear research center. The LNRI is located in the Republic of Lagassi, approximately 29 km (18 mi) east of the capital city of Hashbakar, the major population center.

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 PTR Research Reactor employs a total of 32 people. 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 pool-type research reactor is used in a steady-state operation of 2 MW. The continuous operation cycle is 14 days.
- The irradiation cavity is a 23 cm diameter dry tube in the center of the reactor.
- The annular core is formed by 236 cylindrical fuel elements arranged in a hexagonal grid around the central irradiation cavity.
- The reactor is controlled by seven fuel-followed control rods with rod drive motors accessible.
- At least five control rods must be removed for the reactor to go critical.
- Fuel material is BeO-UO<sub>2</sub>, 22 wt% UO<sub>2</sub>, 78 wt% BeO with uranium enriched to 36 percent.
- Each fuel element is approximately 1 meter long, 2 cm in diameter, and weighs a total of 2 kg.
- Each fuel element contains 103 grams of <sup>235</sup>U and is clad in stainless steel.
- Fuel rods are placed in a grid and may be removed with a rigid fuel-handling tool.
- Centerline fuel temperatures range up to 1,500°C.
- Water serves as coolant and moderator. The core is located in an open pool 3.1 meters in diameter and 8.5 meters deep.

### ***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 resistivity 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 (5 full storage racks) in storage.

### ***Experiment Materials***

- Experiment materials include 3 kilograms total of highly radioactive medical radionuclides, including Cs, Am, and Sr<sup>90</sup>.
- 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<sup>239</sup>.
- 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	BeO-UO <sub>2</sub> Fuel Rods (236 in reactor)	67.5 kg U (36%)	24.3 kg <sup>235</sup> U	High >1 Gy/hr at 1m
	R090 Fresh Fuel Vault	BeO-UO <sub>2</sub> Fresh Fuel Rods (50 in storage)	14.3 kg U (36%)	5.2 kg <sup>235</sup> U	Low
	Irradiated Fuel Pool	BeO-UO <sub>2</sub> irradiated fuel Rods (100 in pool)	28.6 kg U (35%)	10.0 kg <sup>235</sup> U	High 0.2–0.3 Gy/hr at 1m
	R091 Product Vault	Pu Experiments HEU metal Other Sources	9.3 kg <sup>239</sup> PuO <sub>2</sub> (100%) 23 Kg U (95%) Cs, Am, Sr	8kg 22 Kg <sup>235</sup> U 3 kg total	Low Low High
Waste** Storage Facility	Vats (Large tanks for Liquids)	Liquid Mixture (4 vats, 1,000 liters ea)	Trace Amounts* of Pu (75%) and U (18%) Co, Cs	trace	High 0.5–1 Gy/hr at 1m
	Sheds	Solidified Waste (50 containers)	Trace Amounts* of Pu (31%) and U (12%)	trace	High <0.5 Gy/hr at 1m

*\*The term “trace amount” refers to an extremely small amount in quantities approaching the limit of detection for the analytical process used to characterize the material.*

*\*\* Waste is defined as radioactive material for which there is no further use. For Lagassi, this material is still under regulatory control and is protected according to prudent management practice.*

## *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 state that 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. [Note: the crime of robbery includes use of weapons.]
- Nationally, many thefts of highly valuable items have occurred. The crimes do not appear to be related to each other. National intelligence information indicates that, most likely, 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***

These security personnel are responsible for:

- Assessing alarms
- Performing administrative duties, such as access control and key service
- Staffing fixed posts and patrols
- Responding to all assessed intrusion alarms (non-confrontation)
- 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 each shift for the institute guards that conduct administrative duties and access control.

## ***Local Police Patrols***

Each local police patrol consists of two police officers in a patrol 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 random status checks with either the P2 or P3 guard a minimum of three times per day.
- responding to assessed intrusion to delay intruders until the military tactical response team arrives

They are not trained to enter the reactor buildings.

## ***Military Tactical Response Team Members***

There are two military tactical response teams at the military base 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 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***

### **Institute Guards**

All guards are equipped with:

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

### **Local Police Patrols**

The local police are equipped with:

- a standard patrol car, with radio
- 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
- hand held radio, for communication with the local police dispatcher

### **Military Tactical Response Team**

The military tactical response team members are equipped with:

- a military response vehicle, with radio communication with military response team dispatcher
- a 9mm semiautomatic handgun with a fully loaded magazine
- a 5.56 mm assault rifle with a 25-round magazine
- 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, for communication between response team members when deployed

Body armor is readily available in the response force building. In addition, at least one member of each team is a trained sniper carrying a 7.62 sniper rifle with scope.

## ***Training***

The guards receive training in the following areas:

- on-site safety
- access control procedures
- response procedures including chain of command and rules of engagement, non-confrontational, for the LNRI

- local target locations
- other administrative responsibilities, including safety procedures

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

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

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 including rules of engagement for the LNRI
- close quarters combat
- recapture and recovery of nuclear material/facilities

All personnel receive routine physical fitness training.

### ***Alarm Stations and Communication (P1)***

The Central Alarm Station (CAS) is located in P-1 and is staffed by a minimum of one guard at all times. This guard is responsible for assessment of alarms and when determined to be an intruder communicating to the local police dispatcher and military tactical response teams.

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 lower level of the reactor hall. Tests results indicate that guards inside the reactor hall are able to monitor transmissions from the CAS. However, transmissions from hand held radios in the reactor hall are not able to be received at the CAS.

All handheld radios and fixed posts are equipped with a duress switch that allows a covert signal to be sent to the CAS in case of unauthorized activity. When the CAS receives a duress alarm, the local police patrols and the military tactical commander are immediately notified to initiate a response.

During the day shift, the guard force supervisor is located in the CAS.

## Response Force Staffing

The response force posts and patrols are staffed as described in the following tables.

**Table 2. Guard Staffing Data**

Post No.	Description	Security Personnel Type	No. of Personnel	
			Day Shift	Nights and Weekends
P-1	CAS (includes commander)	Guard	2	1
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
		<b>Totals</b>	<b>9</b>	<b>5</b>

**Table 3. Police Patrol Staffing Data**

Post No.	Description	Security Personnel Type	No. of Personnel	
			Day Shift	Nights and Weekends
	Two-person patrols in local area	Police patrol units	4	4
		<b>Totals</b>	<b>4</b>	<b>4</b>

**Table 4. Military Tactical Response Staffing 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	10	10
		<b>Totals</b>	<b>10</b>	<b>10</b>

## **Response Procedures**

All alarms are received at the CAS. Upon receipt of an alarm, the CAS operator calls up the video from the PTR cameras. While doing so, the CAS operator immediately notifies the roving patrol (P-10) to also assess the cause of the alarm. If assessed as an intrusion, the CAS operator immediately notifies the local police dispatcher, who then notifies the local police patrols. The CAS operator then notifies 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 performing other actions that might obstruct the adversary (locking doors, disabling power, etc). Under no circumstances are the guards to approach or engage the adversaries.

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 building, they coordinate entry with the guards and deploy as a team and proceed to enter the PTR to ensure the protection of material and assets.

## **Average Response Performance Data**

The Institute has conducted extensive performance testing of the PPS in the areas of alarm assessment, alarm communication, preparation, travel, and deployment times at the PTR and the Waste Facility. The average communication and response times are listed in Table 5. All military tactical responders on duty are fully equipped with their duty gear with the exception of body armor and their rifles, which are kept in storage in the armory until needed.

**Table 5. Average Communication and Response Times**

<b>Description</b>	<b>Research Reactor</b>
Alarm communication time	1 second
Alarm assessment time	45 seconds
Communication time to guards, police, and military	25 seconds
Guard preparation time	30 seconds
Guard travel and deployment time to P6	45 seconds
Police Patrol preparation time	15 seconds
Military tactical response preparation time	90 seconds
Patrol travel time by vehicle to P6	150 seconds
Military tactical team response time to P6	600 seconds
On-site deployment time (after arrival)	90 seconds

## **Facility Entry Control Operations at LNRI Gates and Portals**

### ***Institute Personnel Entrance (P2)***

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

#### **Entry Procedures**

- Personnel form a single line and show the guard their badges as they enter.
- Personnel enter through the front door of the Administration Building and continue out the back of the building to go to other areas in the facility.
- The unarmed guard observes personnel for unusual behavior.

#### **Exit Procedures**

- Personnel form a line inside the Administration Building.
- The guard waves personnel to pass one at a time out the front door.
- The guard observes personnel for unusual behavior.

### ***Institute Vehicle Gate (P3)***

The gate is unlocked and open during normal working hours and locked during off-shifts. 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. The gate and associated traffic flow are controlled by a single guard.

#### **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.
- 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.

### ***Institute Delivery Vehicle Gate (P4)***

This gate is normally closed and locked with a high security padlock. A guard is not typically on post. The gate is used for special deliveries and emergency evacuations.

# Entry Control Procedures for the PTR Facility

## ***PTR Personnel and Vehicle Gates (P5)***

These gates are opened at 0600 and closed at 1800 and guard sare not present. A guard is required 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.

### **Entry Procedures**

1. The employees enter through the unlocked outer door one at a time.
2. Each person presents his picture badge to the guard.
3. If the picture on the badge and the person's face match, the guard directs the person through the metal detector.
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 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.
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.
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 staffed by response force staff only in times of emergency or special use.

#### **Entry Procedures**

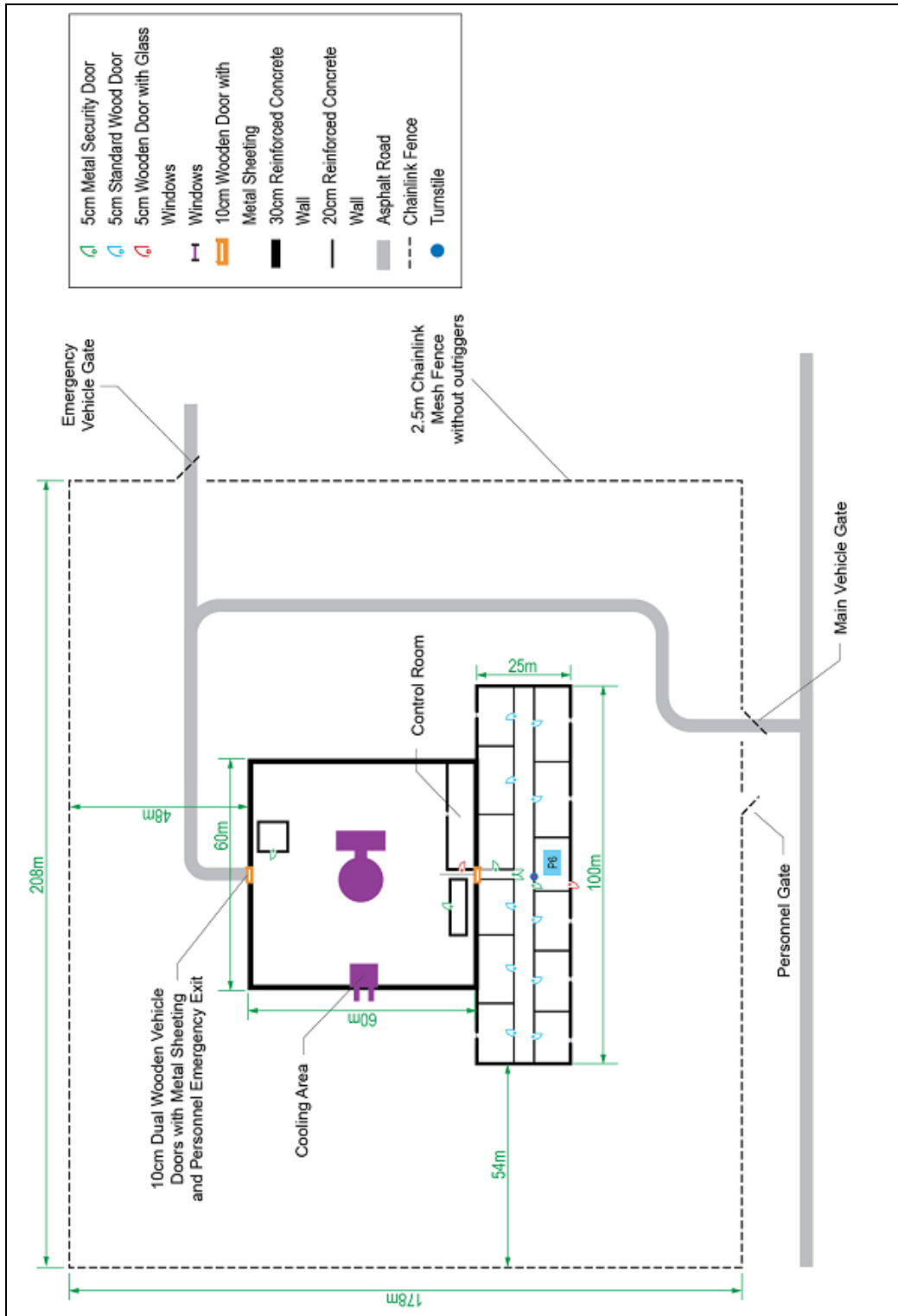
1. The CAS operator provides vehicle information to the guard.
2. Under direction from the CAS, a guard unlocks and manually opens the gate.
3. The vehicle drivers slow as they approach the gate.
4. The guard observes the approach of the vehicle for type, speed and suspicious actions. The vehicles must 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**

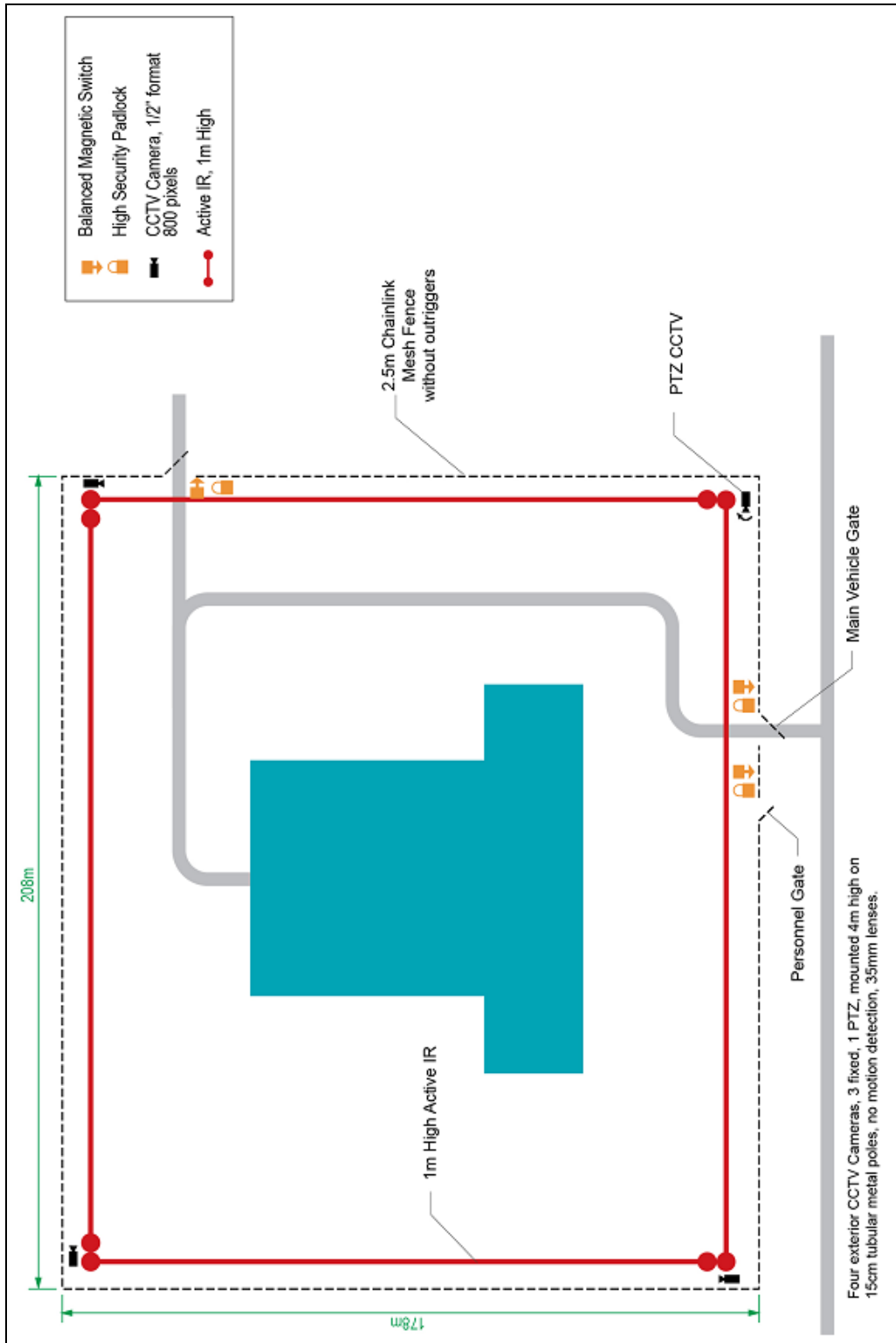
1. The CAS operator provides vehicle information to the guard.
2. Under direction from the CAS, a guard unlocks and manually opens the gate.
3. The guard observes the approach of the vehicle for type, speed and suspicious actions. The vehicles must match the description from the CAS.
4. Under the direction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



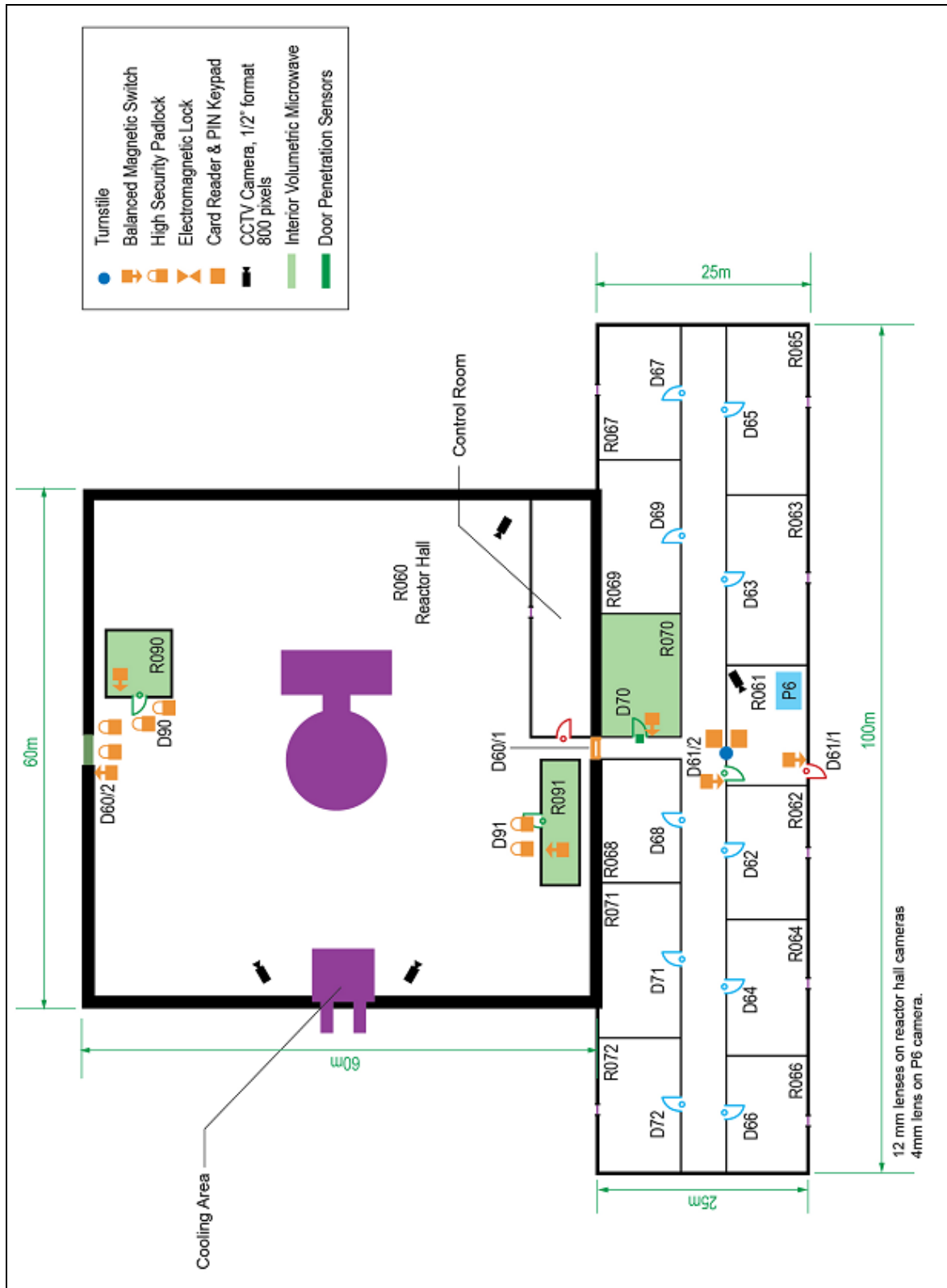
# PTR Wall Thicknesses and Distances



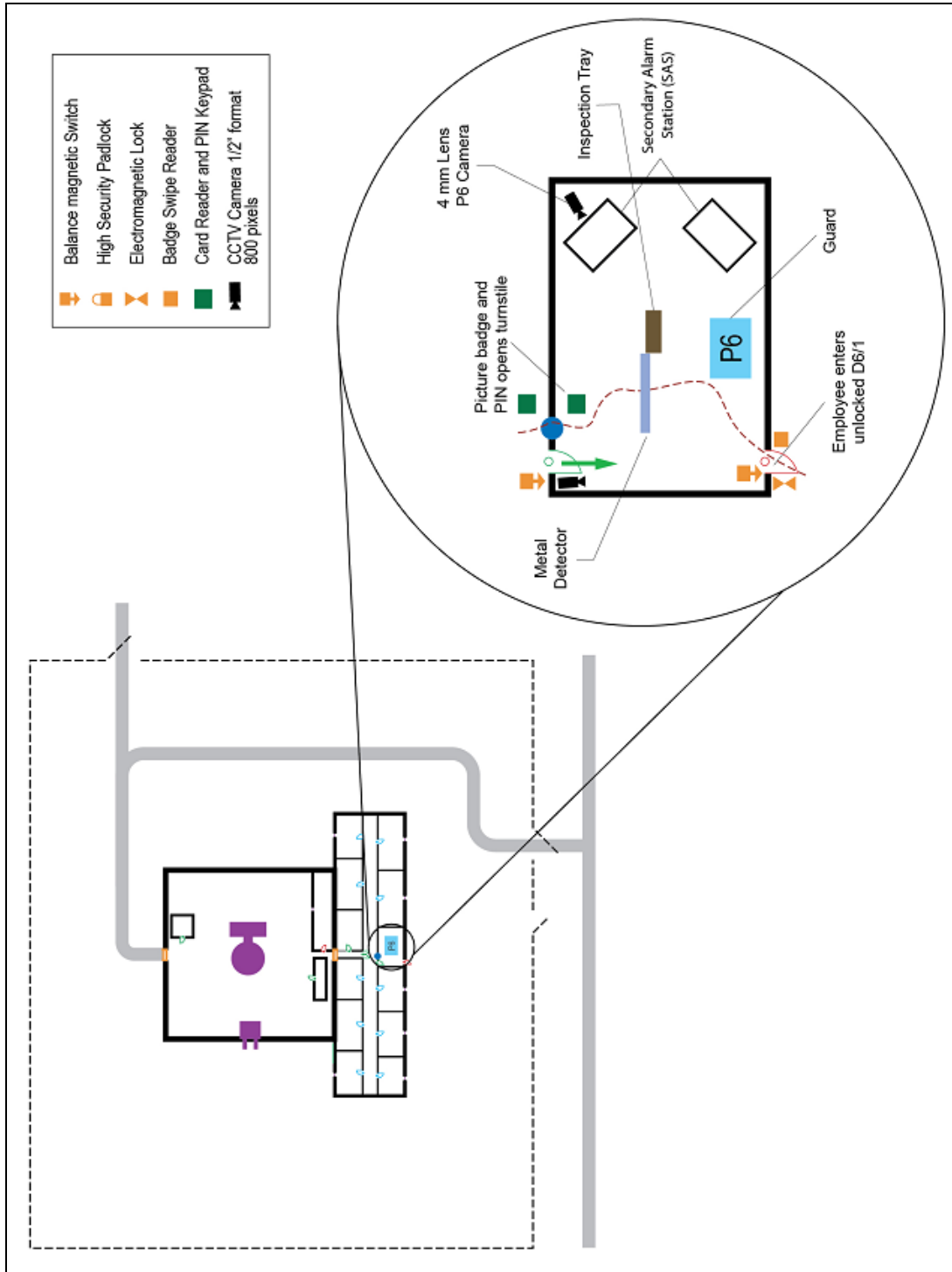
# PTR Exterior Physical Protection Elements



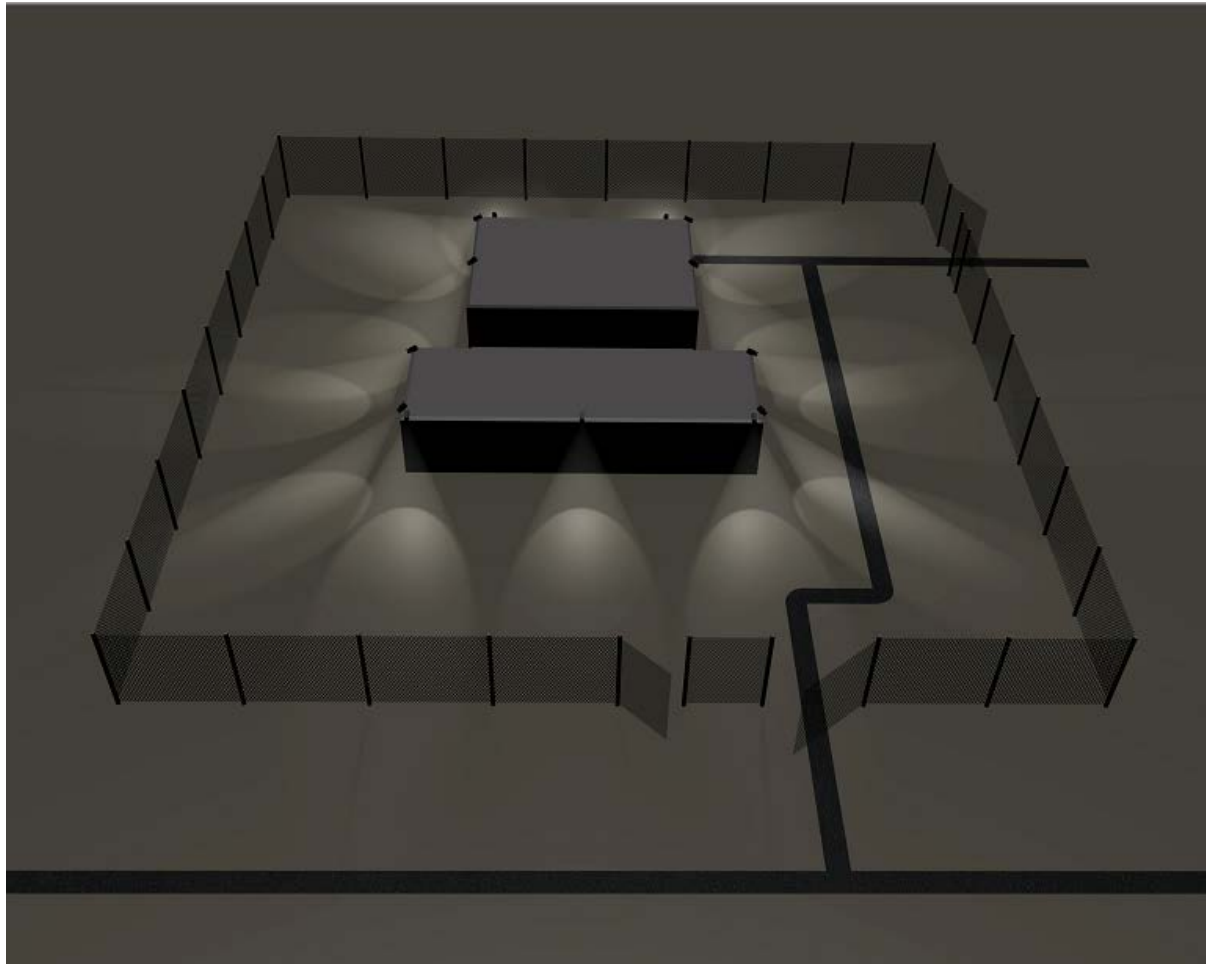
# PTR Interior Physical Protection Elements



# PTR Access Control Plan (picture is incorrect)



## PTR Lighting

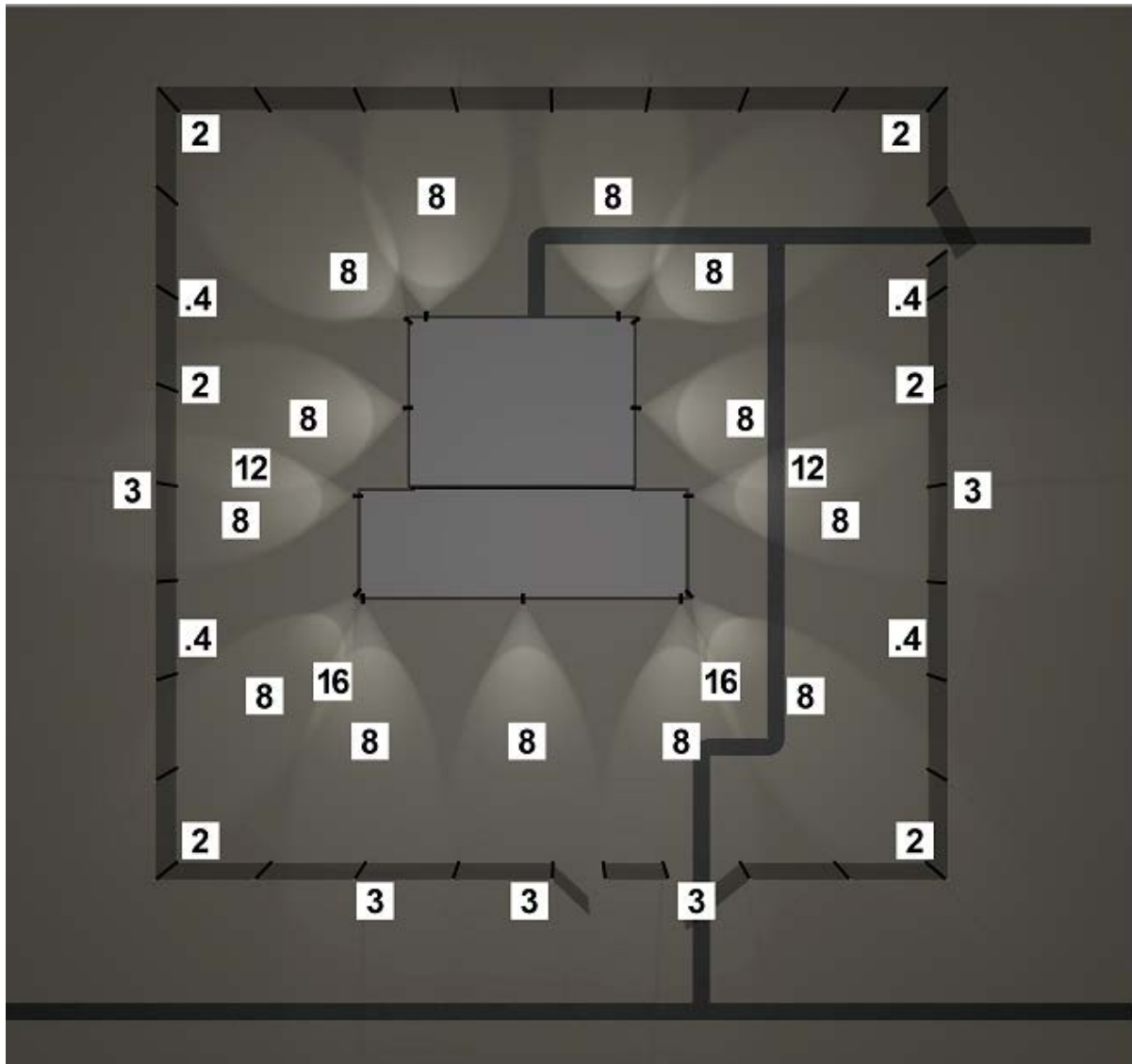


The PTR lighting involves the following:

- Thirteen 1000-watt incandescent floodlights are mounted on the PTR building at 6 meters high.
- The beam half-angle is 26 degrees.
- The ground surface within the intrusion detection area has low reflectivity dark gravel with some small vegetation.
- Lights turn on when an alarm is received by the exterior IR sensors. The lights will automatically turn off after 10 minutes.
- The CAS operator also has the ability to turn on and off the lights.

Testing has been performed on the lighting levels around the PTR. The results of the tests are provided, in LUX, in the diagram below.

## PTR Lighting Intensity Map



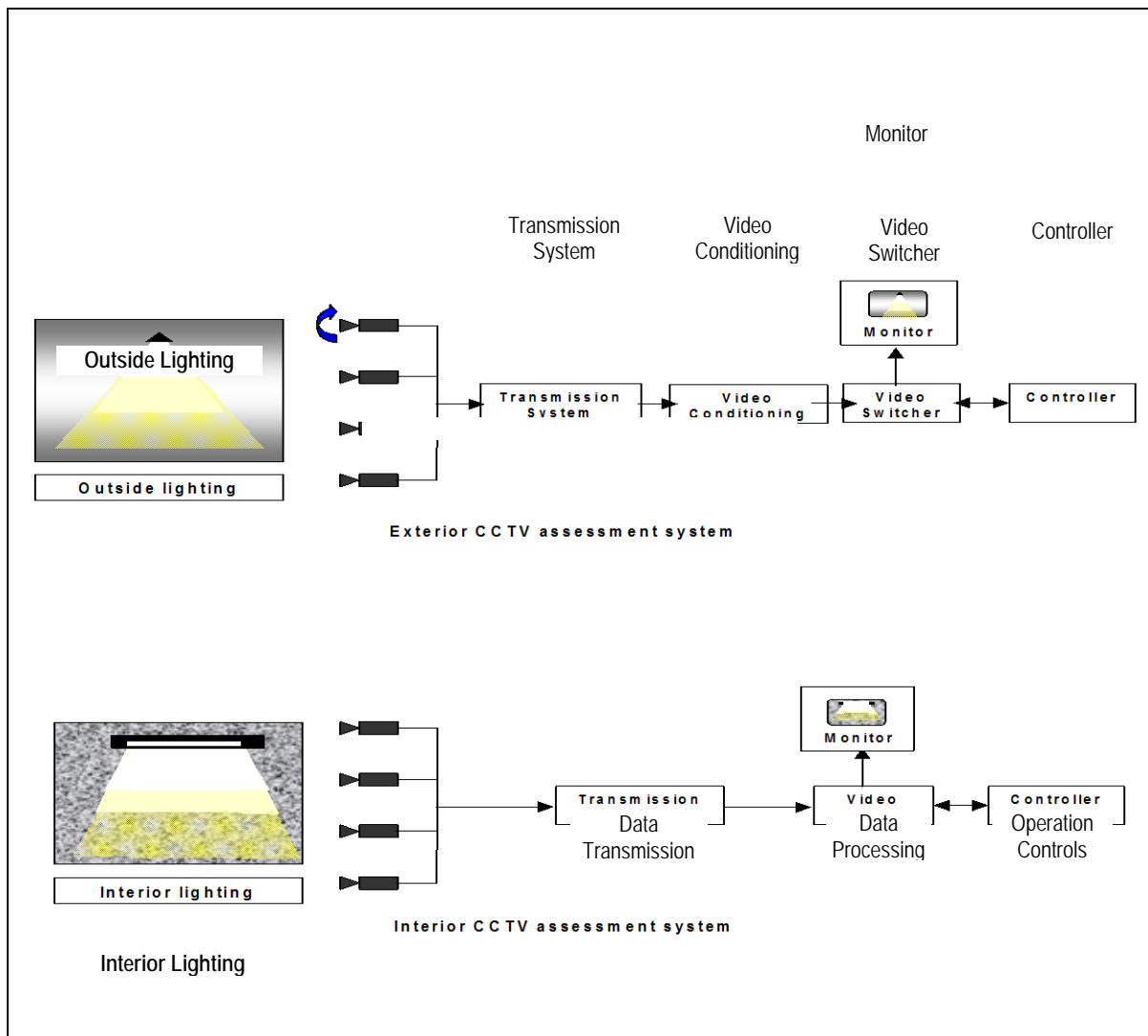
Note: 10 LUX=1 footcandle

Approximate center-line illumination from each fixture is as follows:

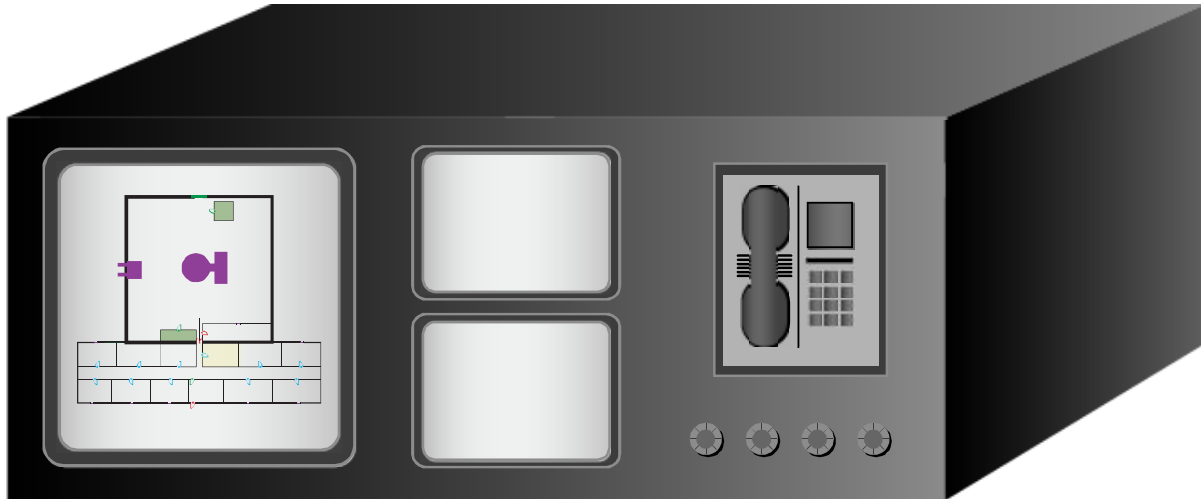
Meters:	25	50	75	100
LUX:	8	2	1	0.5

## PTR Video Monitoring System

- The PTR CCTV assessment system consists of four external and four internal cameras.
- One external camera, located at the SE corner of the perimeter, has pan-tilt-zoom (PTZ) 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 call up the camera view manually to assess the alarm. Assessment requires an average of 45 seconds.



## PTR Alarm and Camera Display Console at Central Alarm Station



The console consists of a graphics panel with status indicating lights, two 9-inch black and white video monitors, an intercom/phone handset, and operator controls.

- The top video monitor displays the video from any of the four interior cameras. The camera displayed on this monitor is manually selected by the operator.
- The bottom video monitor displays the video from any of the four exterior cameras. The camera displayed on this monitor is manually selected by the operator. One of the cameras has pan-tilt-zoom capabilities that are controlled from this panel.
- A panel light corresponding to the active sensors and cameras give the operator a visual indication of overall system status.
- An audible tone is generated when a sensor first goes into alarm state.
- The operator can acknowledge the alarm with a console control button. This also silences the audible tone.
- The turnstile and exit door in P6 can be remotely controlled from this console.

## Probabilities of Detection ( $P_D$ ) for Sensors

Sensor	$P_D$ for Threat Attribute		
	No Equipment	Hand Tools	Land Vehicle
<b>Exterior Sensors</b>			
Seismic Buried Cable	0.5	0.5	0.9
Electric field	0.5	0.3	0.9
Infrared	0.8	0.4	0.8
Microwave	0.8	0.7	0.9
Video motion	0.8	0.6	0.9
<b>Interior Sensors</b>			
Sonic	0.5	0.5	N/A
Capacitance	0.5	0.5	N/A
Video Motion	0.5	0.5	N/A
Infrared	0.5	0.5	N/A
Ultrasonic	0.5	0.5	N/A
Microwave	0.5	0.5	N/A
<b>Position Sensors</b>			
Position Switch	0.5	0.2	N/A
Magnetic Switch	0.4	0.1	N/A
Balanced Magnetic Switch	0.8	0.8	N/A
<b>Fence Sensors</b>			
Taut Wire	0.5	0.25	0.85
Vibration	0.5	0.1	0.85
Strain	0.1	0.1	0.9
Electric Field	0.5	0.4	0.9
<b>Barrier Sensors</b>			
Vibration	0.9	0.4	N/A
Glass Breakage	0.9	0.6	N/A
Conducting Tape	0.8	0.2	N/A
Grid Mesh	0.9	0.6	N/A

## Probabilities of Detection for Access Control Measures

Component Type	Component Description	Independent P(D)	Land Vehicle P(D)
<b>ID Verification</b>	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	
<b>Personnel Access Authorization Check</b>	General observation of authorization	0.1	
	Authorization verification each time location is accessed	0.6	
<b>Two Person Rule</b>	Presence in area	0	
	Within sight	0.1	
	Dedicated observation	0.5	
	Dedicated observation with alarm	0.95	
<b>Vehicle Authorization Check</b>	Authorization from check		0.35
	Serial number verification		0.45
	Visual check of insignia/ license plate		0.15

## Probabilities of Detection ( $P_D$ ) by Human Surveillance Detection

Component Attribute		$P_D$ for Threat Attribute			
Component Type	Component Description	No Equipment	Small Arms	Light Antitank Weapons (LAW)	Independent of threat attribute
<b>Guard at Post Observation</b>	Duress, unprotected	0.8	0.45	0.45	
	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, LAWs protected	0.8	0.8	0.8	
	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	
	<b>Guard in Tower Observation</b>	LAW resistant tower	0.05	0.05	0.02
Small arms resistant		0.05	0.05	0.02	
<b>Guard on Patrol</b>	Random				0.02
	Scheduled				0.01
<b>General Observation</b>	Personnel always in vicinity				0.02
	Personnel generally in vicinity				0.01

## Probabilities of Detection ( $P_D$ ) Contraband and SNM Detection

Component Type	Component Description	$P_D$ for Threat Attribute						
		No Equipment	Hand Tools	Power Tools	High Explosives	Metal Contraband	Small Arms P(D)	Radioactive Contraband
<b>Explosives Detector</b>	Canine	0			0.1			
	Handheld vapor collection	0			0.45			
	Thermal Neutron	0			0.25			
	Vapor Collection	0			0.35			
<b>Handheld Metal Detector</b>	Ferrous and solid lead materials	0	0.85	0.75		0.25	0.5	
	Ferrous materials and all forms of lead	0	0.85	0.75		0.25	0.5	
	Ferrous materials only	0	0.85	0.75		0.25	0.5	
<b>Manual Item Search</b>	Cursory	0	0.1	0.1	0.1			0.1
	Rigorous	0	0.75	0.75	0.45			0.65
<b>Personnel Search</b>	Pat down	0	0.9	0.9	0.3			0.9
	Strip inspection	0	0.9	0.9	0.9			0.9
<b>Portal Metal Detector</b>	Ferrous and solid lead materials	0	0.9	0.9		0.8	0.6	
	Ferrous materials and all forms of lead	0	0.9	0.9		0.8	0.6	
	Ferrous materials only	0	0.9	0.9		0.8	0.6	
<b>Vehicle Search</b>	Cursory	0	0.1	0.1	0.1			0.1
	Rigorous including cargo	0	0.5	0.5	0.25			0.4
<b>X-Ray Inspection</b>	Standard	0	0.9	0.9			0.6	0.9

Component Type	Component Description	P <sub>D</sub> for Threat Attribute						
		No Equipment	Hand Tools	Power Tools	High Explosives	Metal Contraband	Small Arms P(D)	Radioactive Contraband
Drive thru SNM Monitor	Plastic Scintillator *	0						0.5
	Sodium Iodide Scintillator*	0						0.5
Handheld SNM Monitor	Plastic Scintillator *	0						0.75
	Sodium Iodide Scintillator*	0						0.75
Portal SNM Monitor	Plastic Scintillator *	0						0.85
	Sodium Iodide Scintillator*	0						0.85

## Entry Control and Contraband Detection Estimates

	Probability of Detection	Delay Time
Visual ID Check (ID)	0.5	5 sec
Metal Detector (ME)	0.9	5 sec
Explosives Detector (EX)	0.1	5 sec
Special Nuclear Materials (SNM) Detector (Personnel)	0.9	5 sec
Special Nuclear Materials (SNM) Detector (Vehicles)	0.5	5 sec
Guard at Post	0.5	30 sec

## Access Delay Times – Fences

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
2.5-m chain-link mesh with outriggers 4-mm x 50-mm mesh	Ladder	5.0	12
	Tarpaulin	2.0	12
	Pliers	1.0	120
	Manual Boltcutters	3.0	60
	Circular Saw	10	60
	Manual Boltcutters (larger opening)	3.5	90
	Circular Saw (larger opening)	11	90
	Gloves	0.5	12
2.5-m Vinyl-coated chain-link mesh with outriggers 3-mm x 50-mm mesh	Ladder	5.0	12
	Manual Boltcutters	3.0	60
	Pliers	1.0	120
	Circular Saw	11.0	90
2.5-m chain-link mesh without outriggers, Vinyl-coated, 1.8-mm x 50-mm mesh	Ladder	3.0	12
	No equipment	0.0	6
	Manual Boltcutters	3.0	60
	Pliers	0.5	120
	Vise grip pliers	0.5	36
2.5-m Welded wire fabric fence 3-mm wire	Ladder	3.0	12
	Manual Boltcutters	3.0	60
	Circular Saw	11.0	90
2.5-m concrete panel wall	Ladder	3.0	12
	Sledgehammer	5.0	90
	No equipment	0.0	9

## Access Delay Times – Gates and Turnstiles

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
Vehicle gate Chain-link mesh pipe gate 2.4-m high x 4-m wide chain-link gate on metal pipe frame, chained and padlocked	Ladder	5.0	12
	Pliers	1.0	120
	Truck	1500	6
Pedestrian gate Chain-link mesh pipe gate 2.4-m high by 1.2-m wide 3-mm wire x 5 cm mesh on 4.8-cm metal pipe frame, chained and padlocked	Sledgehammer	5.0	60
	1.8 m pry bar	10	120
	Boltcutters	3.0	90
	Hacksaw	0.2	120
Steel Turnstile	Circular Saw	10	18
	Hand tools	3	75
High security padlock	Hand tools	3	90
	Power saw	4	60
	Explosives (1Kg)	1	30

## Penetration Times- Walls

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
Concrete-10cm Thick 210 kg/cm <sup>2</sup> one layer 6.4-mm dia. 15-cm x 15-cm mesh	Sledgehammer, hand boltcutters	8.0	240
	Sledgehammer, cutting torch	30	300
	Sledgehammer, Circular saw	15	516
	Rotohammer, chisel, punch, sledgehammer, hand boltcutters, generator	50	384
	Explosives (1.0 Kg), sledgehammer, hand boltcutters	9	210
	Explosives (3.0 Kg), hand boltcutters	6	150
	Explosives (5.0 Kg), hand boltcutters	8	140
	Explosives (10.0 Kg),	10	120
	Sledgehammer, hand hydraulic boltcutters	20	288
Concrete-10cm Thick 210 kg/cm <sup>2</sup> one layer No. 5 rebar, 15-cm centers	Sledgehammer, cutting torch	30	240
	Rotohammer, chisel, punch, sledgehammer, hand boltcutters, generator	50	470

### Penetration Times – Walls (continued)

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
Concrete-15cm Thick 210 kg/cm <sup>2</sup> one layer No. 4 rebar, 20-cm centers	Sledgehammer, hand boltcutters	13.0	480
	Explosives (1.0 Kg), sledgehammer, hand boltcutters	14	222
	Explosives (3.0 Kg), hand boltcutters	6	175
	Explosives (5.0 Kg), hand boltcutters	8	150
Concrete-20-cm Thick, 210 kg/cm <sup>2</sup> one layer No. 5 rebar, 15-cm centers	Rotohammer, drill, sledgehammer, chisel, punch, cutting torch, generator	65	840
	Explosives (2.0 Kg), sledgehammer, hand hydraulic boltcutters	30	390
	Explosives (3.0 Kg), hand hydraulic boltcutters	13	225
	Explosives (5.0 Kg), hand hydraulic boltcutters	15	225
	Explosives (12Kg)	12	180
Concrete-30-cm Thick 210 kg/cm <sup>2</sup> one layer No. 4 rebar, 15-cm centers	Explosives (5.0 Kg), hand boltcutters	8	195
	Explosives (7.0 Kg), hand boltcutters	10	210
	Explosives (12.0 Kg), hand boltcutters	15	230
	Explosives (16.0 Kg), hand boltcutters	19	230

## Penetration Times – Walls (continued)

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
Concrete-46cm Thick 350 kg/cm <sup>2</sup> three layers No. 6 rebar, 15-cm centers	Explosives (16.0 Kg), hand-held power hydraulic boltcutters, generator	282	450
Concrete-46cm Thick 350 kg/cm <sup>2</sup> two layers No. 4 rebar, 15-cm centers	Explosives (20.0 Kg), hand boltcutters	23	300
Concrete-60cm Thick 350 kg/cm <sup>2</sup> four layers No. 6 rebar, 15-cm centers	Explosives (30.0 Kg), gas-powered hydraulic boltcutters	59	660
Wood studs and sheetrock wall	No equipment	0	60
	Sledgehammer	5	30
	Chainsaw	8	30
Tempered glass window	No equipment or hand tools	0	5

## Penetration Times- Doors

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
Standard industrial pedestrian door, 1.6-mm sheet metal, hollow, panic hardware, cylinder lock, rim set, butt hinges with removable pins	Explosives (1 Kg)	1.0	115
	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit	170	192
	Cordless drill	2.7	180
	Pry bar	7	12
	Fire Ax	4.5	230
	Hammer, suction cups, punch, chisel	4	120
	Suction cups, sledgehammer, cutting torch	25	60
	Explosives (0.5)	0.5	150
	Lock picking tools	0.2	150
	Pipe Wrench	1	24
	Explosives (2.0)	2.0	150
Standard industrial pedestrian door, 1.6-mm sheet metal, hollow, narrow glass one side, louvers near bottom	Hammer	2.0	18
	Fire Ax	4.5	96
Standard industrial pedestrian door, 1.6-mm sheet metal, hollow, narrow half glass expanded metal 2.8-mm grill	Grappling hook, wire cable, truck	1520	36
	Manual boltcutters	3.0	60
30-cm wood pedestrian door with 3-mm metal sheeting	Circular saw, Fire Ax, Pry bar	20	530
	Explosives (1.0)	1.0	160
	Explosives (3.0)	3.0	30
10-cm wood pedestrian door with 1.6-mm metal sheeting	Circular saw, Fire Ax, Pry bar	20	180
	Explosives (1.0)	1.0	30

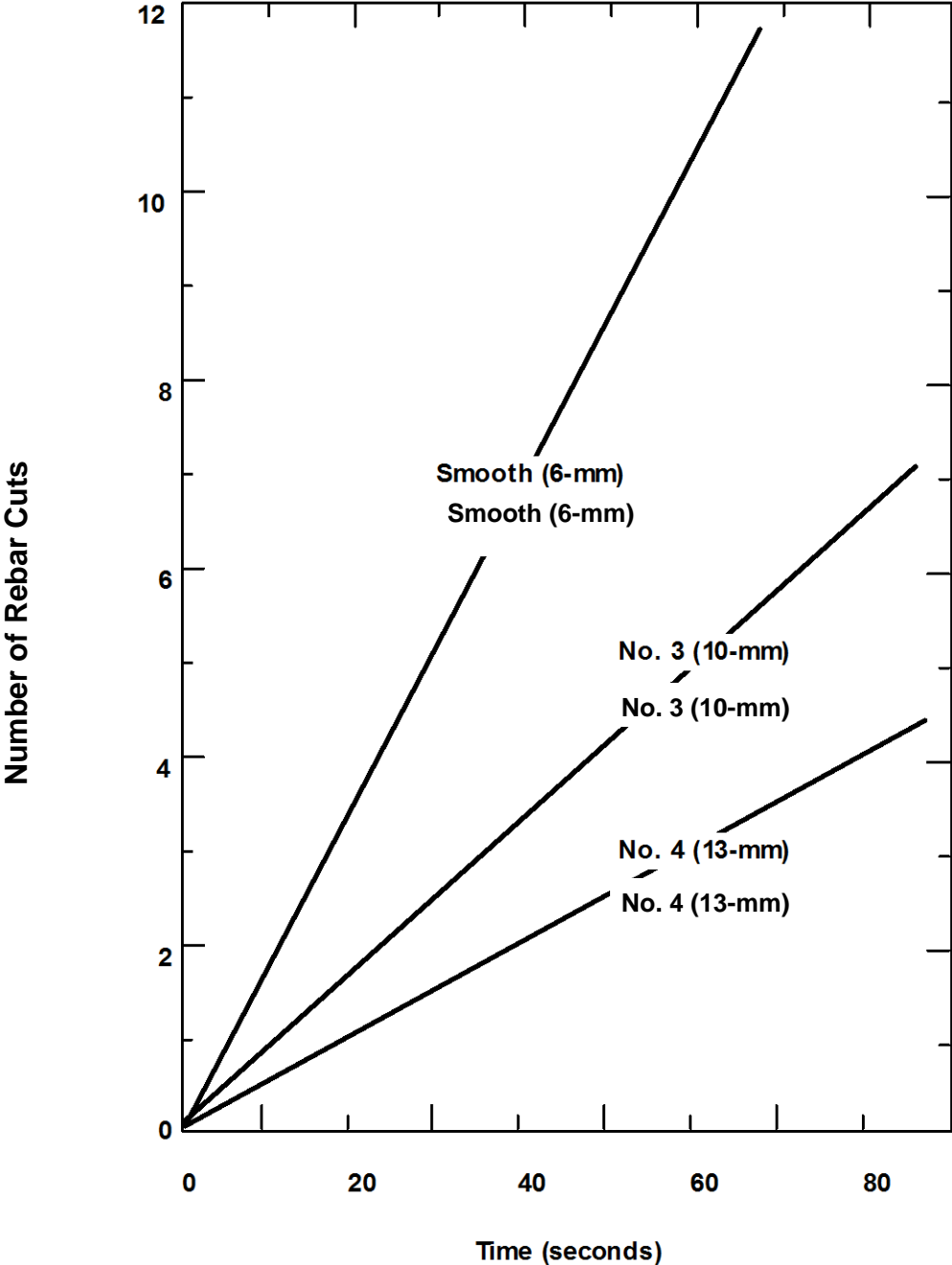
## Penetration Times – Doors (continued)

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Penetration Time (Seconds)</i>
5-cm wood pedestrian door	Fire Ax	4.5	15
	Circular saw	10	15
	Explosives (1Kg)	1.0	15
5-cm wood pedestrian door with glass panel	Fire Ax	4.5	15
	Circular saw	10	15
	Explosives (1Kg)	1.0	15
0.75-cm steel plate door	Pry bar, sledgehammer	17	360
	Cutting torch	20	45
	Explosives (1 Kg)	1.0	45
5-cm metal, Class V or VI vault door	Pry bar, sledgehammer	17	600
	Cutting torch	20	75
	Explosives (2 Kg)	2.0	75
High security padlock	Hand tools	3	120
	Power saw	4	90
	Explosives (1Kg)	1	45
Standard industrial vehicle door, hollow steel panel, 1.6 mm	Explosives (0.5)	0.5	102
	Sledgehammer, cutting torch, oxy-lance, fire resistant suit, water	385	144
	Truck	2025	54
	Pry bar, wooden plank	9	135
	Fire Ax	4.5	198
	Explosives (1.0)	1.0	170
Standard 10 cm wooden vehicle door, with 1.6-mm sheeting	Explosives (0.5)	0.5	114
	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit, water	385	180
	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit	171	117
	Truck	2025	9
Sheet metal roll-up vehicle door	Truck	2025	9
	Pry bar, wooden plank	9	180
	Fire Ax	4.5	198
	Explosives (1.0)	1.0	168

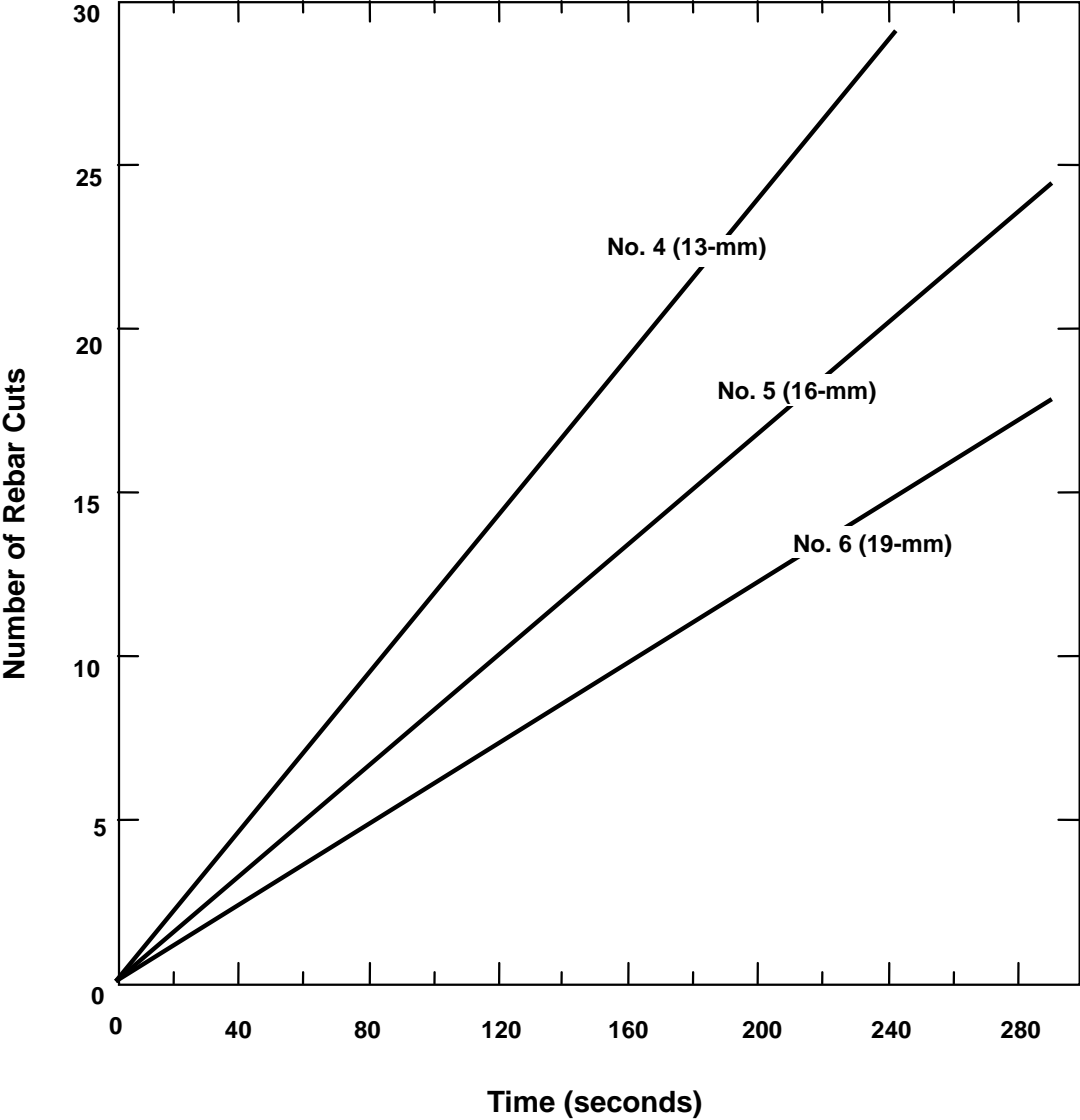
## Penetration Times – Doors (continued)

<i>Description</i>	<i>Adversary Equipment</i>	<i>Equipment Weight (Kg.)</i>	<i>Min.</i>	<i>Penetration Time (Seconds)</i>
Magazine door, 6.4-mm steel plate, one padlock	Explosives (0.5)	0.5	30	60
	Sledgehammer, cutting torch, fire-resistant gloves, water	248	120	240
	Circular saw	11	126	252
	Suction cups, sledgehammer, chisel	4.5	36	72
	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit	385	75	150
Heavy vehicle door with tow large-hinged hasps for padlocking, 19-mm steel, 10-cm air space, 1.3-mm steel		10	78	114
	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit, water	385	186	372
	Sledgehammer, cutting torch, oxy-lance, fire-resistant gloves	165	18	36
30-cm wood vehicle door with 3-mm metal sheeting	Circular saw, Fire Ax, Pry bar	20	300	530
	Explosives (1.0 Kg)	1.0	120	160
	Explosives (3.0 Kg)	3.0	20	30
60-cm steel and concrete rolling vehicle door	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit, water	385	800	930
	Explosives (4 Kg)	10	160	200
30-cm steel and concrete rolling vehicle door	Sledgehammer, cutting torch, oxy-lance, fire-resistant suit, water	385	450	640
	Explosives (4 Kg)	10	45	54

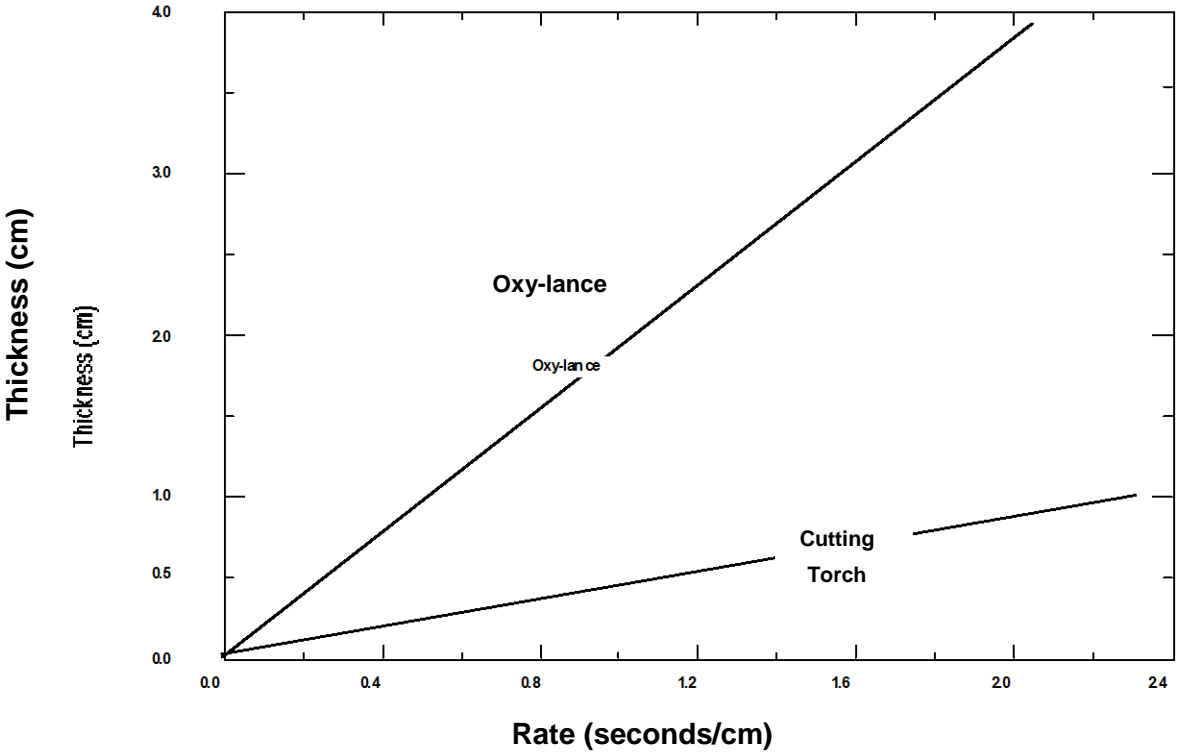
**Cutting Rates for Reinforcement Bar - 1-Meter Boltcutters**



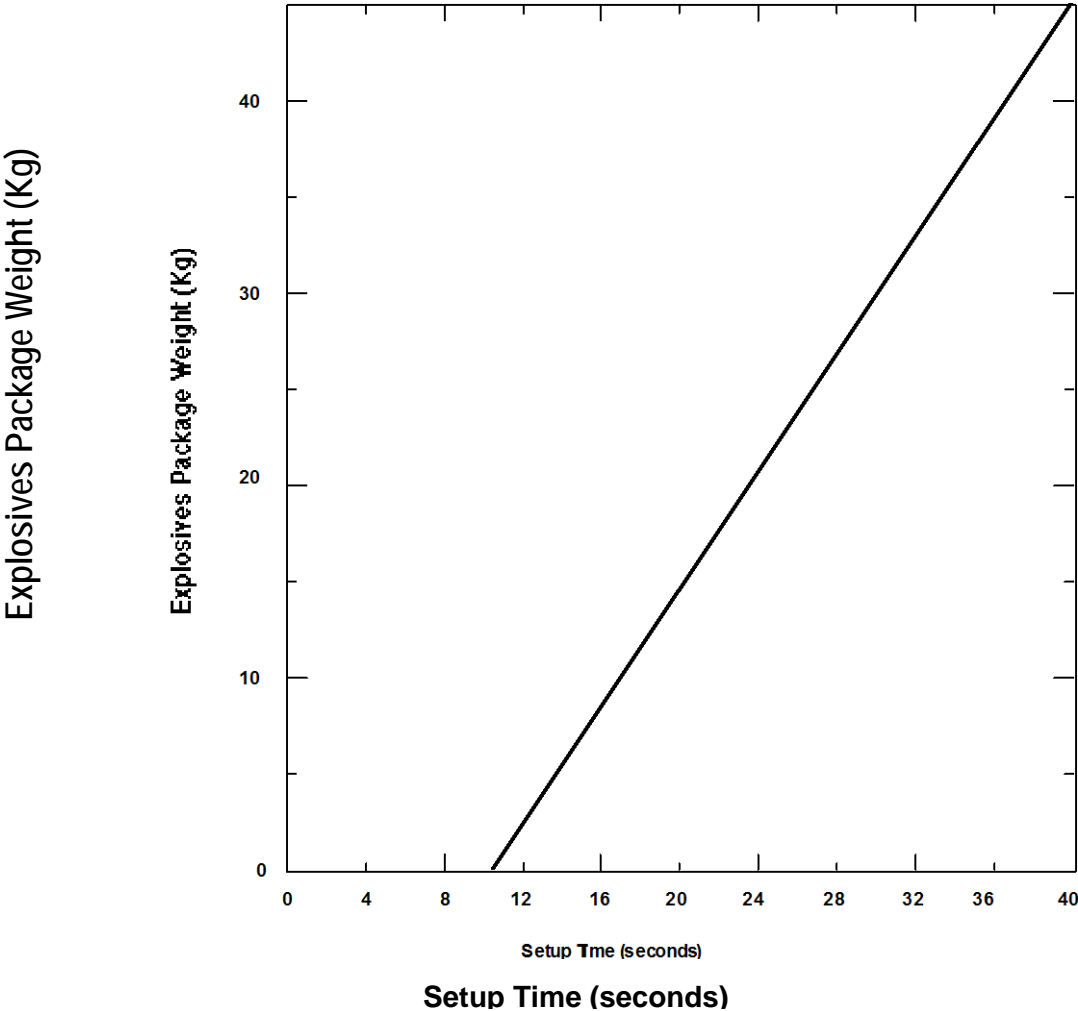
**Cutting Rates for Reinforcement Bar - Portable Cutting Torch**



**Cutting Rates for Mild Steel Sheet & Plate**



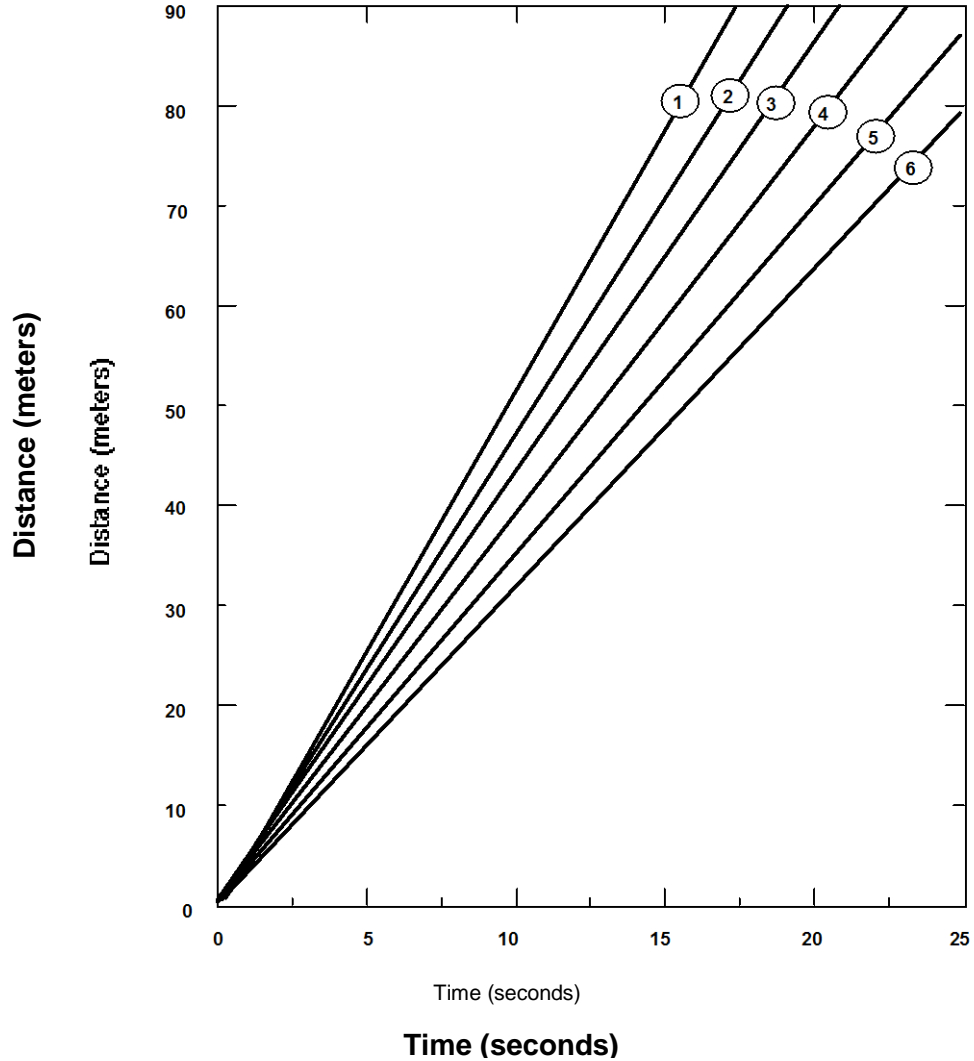
***Time Required to Set an Explosives Package***



## Adversary Running Rates

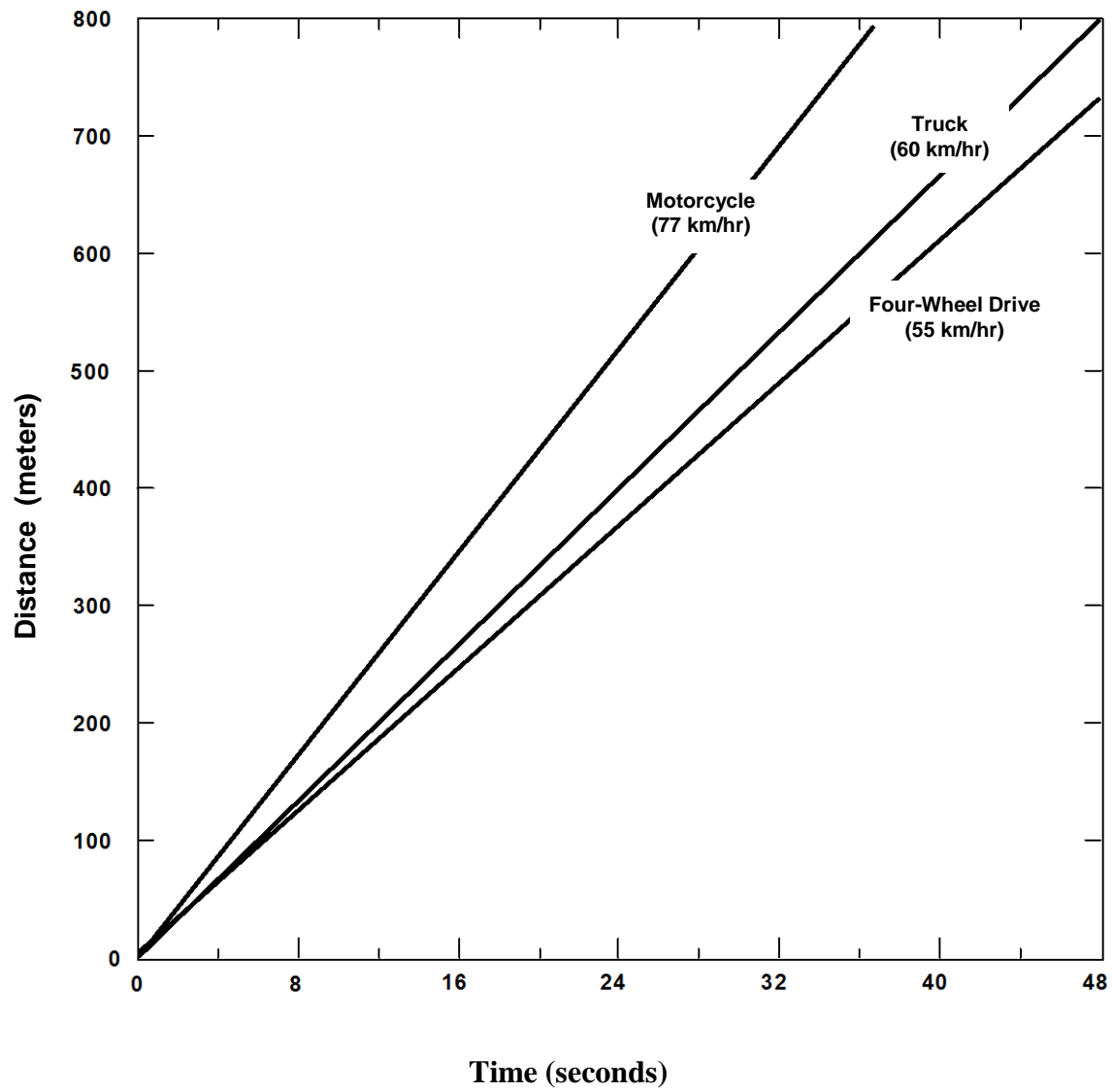
Note: For the purposes of the subgroup exercises, you may ignore fatigue and simply estimate that an adversary on foot can run at approximately 4 meters/second.

- |  |                                      |
|--|--------------------------------------|
| 1-On paved/unpaved ground                            | 4-With weight (16 kg in toolbox)     |
| 2-With tools (1.07-m boltcutters, pickax and shovel) | 5-With 2.4-m stepladder              |
| 3-On sand  | 6-With 10-m extension ladder (2 men) |
| 2-With tools (1.07-m boltcutters, pickax and shovel) | 5-With 2.4-m stepladder              |
| 3-On sand  | 6-With 10-m extension ladder (2 men) |



## Vehicle Rates for Experienced Drivers

TERRAIN – Road with on 90-degree turn.



## Sensors – Relative, Qualitative, Level of Detection

Intruder	System Type										
	Electric Field	Microwave	Active Infrared	Passive Infrared	Fence Motion	Taut-Wire	Seismic	Seismic/Magnetic	Ported Coax	Fiber Optic Cable	Video Motion
Walking	VH	VH	VH	H	N/A	N/A	VH	VH	VH	M	H
Slow Walk	VH	H	VH	M-H	N/A	N/A	H	H	H	L-M	M
Running	VH	H	VH	H	N/A	N/A	H	H	VH	VH	H
Crawling	H	M-H	M-H	L-M	N/A	N/A	M	M	VH	M	M-H
Rolling	VH	M-H	M-H	L-M	N/A	N/A	M	M	VH	H	M-H
Jumping	VH	M-H	H	H	VH	VH	M	M	H	H	H
Tunneling	VL	VL	VL	VL	L	VL	L	L	M	L	VL
Trenching	L	L-M	L	L-M	L	VL	M	M	VH	VH	L-M
Bridging	L	L	VL	M	VL	VL	L	L	L	VL	M
Cutting	N/A	N/A	N/A	N/A	M-H	H	N/A	N/A	N/A	N/A	N/A
Climbing	N/A	N/A	N/A	N/A	H	H	N/A	N/A	N/A	N/A	N/A
Adverse Environment	Surface snow	Surface snow		Body Temp.	Ice coat		Frozen ground			Frozen ground	Shadows, snow, fog, heavy rain
Defeat Methods	Trench	Trench	Bridge trench	Tunnel	Bridge trench	Bridge trench	Bridge	Nonmagnetic materials	Stilts	Bridge	
Characteristics											
Active or Passive	A	A	A	P	P	P	P	P	A	P	P
Convertor Visible	V	V	V	V	V	V	C	C	C	C	V
TF or LOS	TF	LOS	LOS	LOS	TF	TF	TF	TF	TF	TF	LOS

### Key

VL = very low	H = high	P = passive	TF = terrain-following
L = low	VH = very high	C = covert	LOS = line-of-sight
M = medium	A = active	V = visible	N/A = not applicable

## Sensors - Relative Susceptibility to Nuisance Alarms

	Electric Field	Microwave	Active Infrared	Passive Infrared	Fence Motion	Taut Wire	Seismic	Seismic Magnetic	Ported Coax	Fiber Optic Cable	Video Motion
<b>Weather</b>											
Wind speed <47 km/hr	L	VL	VL	VL	L	VL	L	L	VL	L	L
Wind speed (WS) 47 km/hr < WS <115 km/hr	M	L	L	L	H	VL	M	M	VL	M	M
Wind speed >115 km/hr	M	L-M	L-M	L-M	VH	L	H	H	VL	H	M
Rain	L-H	L	L	L	M	VL	L	L	M	L	L
Runoff, Standing Water	VL	M-H	L	L	L	VL	L	L	H	L	M
Snow	M	L-M	M	L	L	VL	L	L	L	L	M
Fog	VL	L	M	L	VL	VL	VL	VL	VL	VL	L
Hail	M	L	L-M	L	L	VL	H	M-H	M-H	M-H	M
<b>Animals</b>											
Small (Rabbits, Squirrels)	M	M-H	M	M	L	VL	L	L	VL	L	L
Large (Dogs, Deer)	VH	VH	VH	L-H	M	L	VH	VH	M	M	H
Small Birds	L	VL	L	L	L	VL	VL	VL	VL	VL	L
Large Birds	M	M	M	M	L	VL	VL	VL	VL	VL	M
<b>Electrical Interference</b>											
Lightning	M	L-M	L	L	L	VL	L	H	M	L	H
Overhead Power Lines	VL	L	VL	VL	VL	VL	L	M	VL	L	VL
Buried Power	VL	VL	VL	VL	VL	VL	M	H	VL	M	VL

## Appendix - 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	Cover when sensor is in access	Disable electronics	X		X			X	X	X					
	Ultrasonic	X		X			Air movement			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			

