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ASSESSMENT OF CRITICAL MASS LABORATORY SAFEGUARDS AND SECURITY UPGRADES (U)

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ASSESSMENT OF CRITICAL MASS LABORATORY SAFEGUARDS AND SECURITY UPGRADES (U)

B. J. Merrill
J. J. DeMyer

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ASSESSMENT OF CRITICAL MASS LABORATORY SAFEGUARDS AND SECURITY SYSTEMS (U)

I. Purpose

Pacific Northwest Laboratory (PNL) conducted an evaluation of the safeguards and security systems at the Critical Mass Laboratory (CML) in February, 1985, to identify appropriate upgrading actions necessary to ensure that effective and efficient systems consistent with DOE-RL policies, procedures, and site priorities are in place. Since that evaluation, there have been changes in Patrol contingency philosophy, response tactics, and distribution of manpower. Because of these changes, and at the request of DOE-RL, PNL has re-evaluated the safeguards and security systems in place at CML.

II. Evaluation Elements

The major elements of the CML security system evaluated include detection, assessment, access delay, and response. To be effective, these elements must interface and perform in a complementary manner. Delay and response elements depend on the detection and delay elements to have adequate time in which to function properly, and are established through the use of armed security personnel and/or security hardware. In comparison, the use of security hardware for detection is the more cost-effective approach.

Other considerations for this evaluation were the attractiveness of the material being protected and CML's role in National Defense Programs. Both subjective and objective information was used in this evaluation. Data was gained through real-time security force exercises, audit evaluation techniques, documentation, vulnerability analysis, and input from individual contributors.

III. Summary

As a result of this evaluation, PNL has concluded that physical security upgrades and modifications completed, or in a construction phase, will provide a demonstrated enhancement to the security posture of the facility and are cost effective. (Attachment #1). It was further concluded that some upgrades and/or modifications planned would provide only minimal improvement to the overall security system and require a significant outlay of funds.

These conclusions are borne out by the high probability of interruption calculated in the Estimated Adversary Sequence Interruption (EASI) analysis (Attachment 2) completed as part of this evaluation. While the EASI analysis cannot predict a win/loss probability, it may be assumed to be indicative of the potential for a win scenario.

[redacted]

III. (Cont'd.)

PNL will continue to upgrade areas identified in this report, proceed with efforts to find alternate storage locations for non-essential SNM, and enhance Patrol response by supporting the back-filling of positions 530 and 531.

Based upon this evaluation, the present security system at CML, when reviewed in context of a graded Safeguards and Security Posture, provides a level of protection sufficient to warrant removal of the 24-hour Patrol Post.

IV. Analysis

A. In reviewing the safeguards and security needs of the CML, the first concern was to assess 1) the attractiveness of Special Nuclear Material, 2) the impacts of sabotage, 3) the facility's importance in the Hanford Defense Mission, and 4) its relative importance compared to other identified Hanford targets.

The review revealed the following:

1. Special Nuclear Material (SNM) at CML can be categorized as less than attractive because of its physical form (liquid nitrate) or configuration (oxide fuel rods and pins), (Attachment 3). Difficulties encountered in attempting to steal or divert these materials vary from the need to transport bulky items to having to extract liquid plutonium nitrate from shielded tanks and transfer it into critically safe containers. PNL, with support from Hanford Patrol, (Attachment 4), conducted a series of five response time-and-motion exercises to evaluate the ability of intruders to remove and transport Category I quantities of either nitrate or fuel pins. The scenarios were developed utilizing worst-case and shortest-distance criteria. Administrative controls and barrier-delay time factors were used for barrier penetrations. Simulated nitrate (water) and fuel pins (pipe) of size, configuration and quantity to compare with Category I quantities of SNM, were utilized in these exercises.

Through observation, it was determined that to extract nitrate, (10 liters) in the crudest sense, without regard to personal contamination, would require 5 to 7 minutes for completion.

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IV. A. 1. (Cont'd.)

To remove a Category I quantity of the least bulky fuel pins would require the intruder(s) to move and transport out of the Protected Area approximately 110 fuel pins weighing a total of 220 pounds. The metal containers used to store the fuel pins are chained and padlocked. The pins are distributed in the containers in such a way that only three or four pins at a time can be removed. It took approximately 3.5 minutes to remove the fuel pins from the container, and once removed, they were difficult to handle. Adversaries attempting to steal or divert the FFTF rods would require power-assist-lift equipment or additional equipment to transport the Model 60 Inserts. Disassembly of the Model 60 Inserts for the purpose of removing individual rods would require a time in excess of the 3.5 minutes to gather SNM used for this evaluation.

2. A radiological risk assessment for the CML revealed that for the scenarios performed, the off-site impact of sabotage using up to 50 pounds of plastic explosives would be a small fraction of the release limit defined in DOE Order 6430.1. (Ref Letter #5 Cover Letter)

3. Present activities at CML are not related to Hanford's Defense Mission. A possibility exists that a limited amount of work performed at the Los Alamos Critical Facility could be duplicated at CML should that facility be lost. Thus, the overall impact on the nation's defense program, while not zero, is presently viewed as small.

4. CML is currently rated as the number seven (7) priority (behind all other Hanford Protected Areas or operating reactors) on the Hanford Patrol priority list.

B. The second element in the review of CML's security needs was to determine, based on the above information, what the overall objectives of the security system at the CML are, and what elements of that system need improvement to meet these objectives. It is PNL's opinion that the CML security system should:

1. Have a greater than 75% probability that attempted thefts or diversions by the defined maximum credible threat would be interrupted by Patrol. Based upon

[redacted]

IV. B. 1. (Cont'd.)

our analysis, the most cost-effective method of accomplishing this objective is to enhance the delay factors at CML. Our analysis also revealed that, because of close proximity of the Protected Area perimeter to the Material Access Area, significant expenditures of funds to upgrade perimeter protection systems would not noticeably improve the probability of thwarting the adversary.

2. Have a minimal probability of protecting the facility from radiological sabotage by outsiders.

3. Have a limited probability of thwarting radiological sabotage by insiders. PNL's analysis concludes that enhanced package searches and improved physical protection for Patrol personnel at CML would accomplish this objective.

4. Have a strong probability of detecting attempts to divert SNM by an insider. A strong two-person program coupled with an effective SNM screening process at the Protected Area portal and statistically sound warning limits in the safeguards' system should make this objective obtainable.

C. The concluding portion of the review was to identify specific actions to be taken and to quantify, where possible, their impact on the CML security system. The Estimated Adversary Sequence Interruption (EASI) program, developed by Sandia, (Attachment 2) was used to quantify the probability of interruption (PI). The PI used here does not calculate the probability of the Patrol forces winning against the adversaries, but only refers to the probability of their interrupting the adversaries before they can depart the CML Area with SNM.

Rockwell Hanford Operations (Rockwell) is presently conducting a more sophisticated Vulnerability Assessment (VA) than PNL is able to do with an EASI program. Rockwell is using a computer-based evaluation utilizing SAFE, DIATAM, and MAIT models. The position stated in this evaluation will be reviewed with respect to the complete Rockwell report.

[redacted]

V. Conclusions

A. The CML Badgehouse should be manned only on the day shift of regular workdays. Considering a high reliability of the physical barriers, exterior, interior and the badgehouse security systems, the EASI analysis demonstrated more than a 90% probability of interruption of, and a greater than 80% probability of interruption for a degraded system. However, the loss of the primary alarm monitoring station communications link would require 24-hour manning of the CML Badgehouse.

B. PNL should continue to support the backfilling of patrol positions 530 and 531. These positions will provide additional responders and enhance the win/loss ratio.

C. PNL should continue to pursue the application of interior CCTVs for assessment and enhancement of the Patrol's layered response.

D. PNL Safeguards and CML Operations should continue to evaluate and identify SNM at CML that is retained in the facility but that is not being used for any criticality experiments. This material can then possibly be moved to another facility for storage. Tentatively, 600 mixed oxide fuel pins have been identified for alternate storage and requests for storage made to Rockwell and Westinghouse. Also, any proposals to bring additional SNM into the CML should address the necessity of sending the material back to the supplier or providing an alternate storage location at the conclusion of the criticality experiments.

E. PNL should proceed with completion of identified upgrades and/or modifications. (Attachment 1)

F. PNL should maintain a maintenance group with responsibility to monitor, diagnose, and maintain the alarm system at CML on a continual basis.

G. PNL should proceed with plans to develop and install an in-place NDA system for the CML. This system would improve SNM inventory accuracy and help reduce the insider diversion threat.

H. PNL should continue to work with Hanford Patrol to assist in revising the 200-E Limited Area Contingency Plans. Revisions should include, at a minimum, the following:

   . on-scene commander's ability to use discretion of choice in utilizing all available Patrol manpower

[redacted]

[redacted]

V. H. (Cont'd.)

- a clear definition of the layered response afforded CML
- identification of the current response force available.

I. Of the upgrades identified in this evaluation, none provide a significant enhancement to the PI for theft scenarios in the Mix Room, nor do they mitigate the potential for sabotage.

J. PNL should continue to fund and support the Rockwell analysis of the CML. The position stated in this report should be reviewed with respect to the completed Rockwell report.

[redacted]

[redacted]

ATTACHMENT #1

Physical Security Modifications and Upgrades

Completed

Class V Vault Door (Critical Assembly Room) Installed
Metal Fire Door (Critical Assembly Room) Installed
Doors on the CML Modified
Fences Modified
Vents and Openings Modified
Steamline Sensors and Razor Ribbon Installed
Barrier Upgrade on Steamlines
Alarm Sensors in the 209-E Badgehouse Installed

Construction Phase

	Scheduled Completion
209-E Badgehouse Modification	June 1985
North Perimeter Lighting Upgrade	June 1985

Engineering Requests and/or Feasibility Studies

Interior CCTV

PNL is conducting an Engineering Study to determine the most cost-effective approach for implementing an interior CCTV system at CML. Interior CCTV and monitoring capability at the primary alarm monitoring station will enhance the overall assessment capabilities and afford CML a more timely response. Discussions at PNL are continuing as to the scope of this system. Negotiations with Rockwell are in the initial stage to identify accessibility and operational impacts. Preliminary costs for application are approximately 48K.

Redundant Alarm Monitoring (Location Other Than 209-E)

PNL has initiated an Engineering Study to investigate available locations and cost effects of relocating the CML Redundant Alarm Monitoring Station from the 209-E Badgehouse to another location. This upgrade would not have a significant impact on the PD or PI of CML.

Exterior Perimeter CCTV

An Engineering Study has been completed on installing exterior Pan Tilt and Zoom CCTV on the CML Isolation Zone Perimeter. The preliminary cost for the installation of this system is in excess of 88K. Based on the results of EASI, we conclude that it is not cost effective to upgrade perimeter assessment capabilities.

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ATTACHMENT #2

EASI BACKUP DATA

I. Description of Assigned Values

A. Response Time (RT)

Patrol response times are based on times demonstrated in actual exercises and reflect the available manpower in the 200-E Area Contingency Plan:

1 Responder - 5 Minutes
2 Responders - 5 Minutes
3 Responders - 7 Minutes
7 Responders - 8 Minutes

B. Probability of Communication (PC)

The PC refers to the probability that an alarm that is generated will send a signal that is received by the response force.

PC - .9

C. Probability of Detection (PD)

PD refers to the probability that an assessment or detection device (i.e., motion detector or BMS), will detect the intruders. The assigned PD for detection and assessment equipment is as follows:

Perimeter Alarms - .9
Door Alarms - .95
Motion Alarms - .95

D. Adversary Action Sequence (AAS)

The AAS may take the routes of force, stealth, or deceit, and may change at any time. The AAS performed for this evaluation included all of these elements.

E. Scenario Criteria

PNL used the "worst case" response time and "best" adversary times for scenario criteria derived from Patrol exercises for the EASI Evaluation.

[redacted]

II. Scenario #1

Adversary Action

		Time (Min)	Standard Deviation (SD)	PD
1.	Climb 200-E Limited Area Fence	.15	.05	.01
2.	Insider picks up other Adversaries, Drives to 209-E Protected Area	3.0	.5	.01
3.	Climb Outer 209-E Fence	.15	.02	.01
4.	Travel Through and Over Alarmed Area	.15	.02	.01
5.	Climb Inner Fence	.15	.02	.01
6.	Travel to Building	.25	.05	.01
7.	Penetrate Double Metal Doors (Explosive)	.75	.15	.95
8.	Penetrate CAR Vault Door (Explosive)	3.0	.45	.95
9.	Penetrate Fire Door (Explosive)	2.0	.15	.95
10.	Gather SNM	3.5	.5	.95
11.	Exit Building and Area	.5	.1	.95

RT = 8 SD = 1 PC = .9

Results indicate that Patrol probability of interruption of Adversaries is .947.

III. Scenario #2

Adversary Action

		Time (Min)	Standard Deviation (SD)	PD
1.	Climb 200-E Area Fence	.15	.05	.01
2.	Insider picks up other Adversaries, Drives to 209-E Protected Area	3.0	.5	.01
3.	Climb Outer 209-E Fence	.15	.02	.01
4.	Travel Through and Over Alarmed Area	.15	.02	.9
5.	Climb Inner 209-E Fence	.15	.02	.01
6.	Travel to Building	.25	.05	.01
7.	Penetrate Double Metal Doors (Explosive)	.75	.15	.95
8.	Penetrate Mix Room Doors	1.5	.15	.95
9.	Penetrate Holding Tanks	1.0	.25	.95
10.	Gather SNM	6.5	1.0	.95
11.	Exit Building and Area	.5	.1	.95

RT = 8 SD = 1 PC = .9

Results indicate that Patrol probability of interruption of Adversaries is .955.

[redacted]

IV. Scenario #3

Adversary Action

		Time (Min)	Standard Deviation (SD)	PD
1.	Climb 200-E Area Fence	.15	.05	.01
2.	Insider picks up other Adversaries, Drives to 209-E Protected Area	3.0	.5	.01
3.	Climb North Vehicle Gate	.15	.02	.01
4.	Intrusion System Inoperative*	0	N/A	N/A
5.	Climb Inner Vehicle Gate	.15	.02	.01
6.	Travel to Building	.25	.05	.01
7.	Penetrate Double Metal Doors (Explosive)	.75	.15	.95
8.	Penetrate CAR Vault Door (Explosive)	3.0	.45	.95
9.	Penetrate Fire Door (Explosive)	2.0	.15	.95
10.	Gather SNM	3.5	.5	.95
11.	Exit Building and Area	.75	.05	.95

RT = 8 SD = 1 PC = .9

Results indicate that Patrol probability of interruption of Adversaries is .915.

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*For the purpose of evaluation, this scenario has the perimeter sensors inoperative.

[redacted]

[redacted]

V. Scenario #4

Adversary Action

		Time (Min)	Standard Deviation (SD)	PD
1.	Climb 200-E Area Fence	.15	.05	.01
2.	Insider picks up other Adversaries, Drives to 209-E Protected Area	3.0	.5	.01
3.	Climb North Vehicle Gate	.15	.02	.01
4.	Intrusion System Inoperative*	0	N/A	N/A
5.	Climb Inner Vehicle Gate	.15	.02	.01
6.	Travel to Building	.25	.05	.01
7.	Penetrate Double Metal Doors (Explosive)	.75	.15	.7
8	Penetrate CAR Vault Door (Explosive)	3.0	.45	.7
9.	Penetrate Fire Door (Explosive)	2.0	.15	.7
10.	Gather SNM	3.5	.5	.7
11.	Exit Building and Area	.75	.05	.7

RT = 8 SD = 1 PC = .9

Results indicate that Patrol probability of interruption of Adversaries is .805.

*For the purpose of comparison, this scenario was developed as an imaginary "worst case" having the perimeter sensors inoperative and lowering PD to .7 for all interior sensors.

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ATTACHMENT #3

CML SNM INVENTORY

Location	Tank	Grams Per Liter	Category II (ℓ)	Category I (ℓ)
Mix	DM	54.5	7.3	36.7
CAR	DS	70.0	5.7	28.6
CAR	T3	93.6	4.3	21.4
Mix	ACID	144.7	2.8	13.8
CAR	T4	160.1	2.5	12.5
Mix	WASTE	186.9	2.1	10.7

FFTF Rods

10 Model 60 Inserts @120 = 1200 (Approximately 7 pounds each)

31.4g of Pu Each

	No. of Pins	Weight
CATEGORY II =	13	91 Pounds
CATEGORY I =	64	448 Pounds

600 Pins

Box 1-3-5 237-237-126 (Approximately 2 pounds each)

18.3g of Pu Each

	No. of Pins	Weight
CATEGORY II =	22	44 Pounds
CATEGORY I =	109	220 Pounds

[redacted]

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ATTACHMENT #4

The following is a series of time-motion Patrol response exercises which were recently conducted at the CML. To minimize the "expectancy" factor of multiple exercises, only the least-attractive results were used for evaluation purposes.

The barrier delay times administratively controlled and constant during all the exercises were derived using criteria from the Sandia Handbook.

Barrier Delay Times

Barrier	Delay Times
Perimeter Fences and Isolation Zones	.50 Min.
Double Metal Exterior Doors	.75 Min.
Class V Vault Door (CAR)	3.00 Min.
Metal Fire Door (CAR)	2.00 Min.
Double Metal Doors (Mix)	1.50 Min.
Average Time from Fence to CML	.25 Min.

Average Material Gathering Time

Liquid	6.50 Min.
Pins	3.50 Min.

Patrol Response Times

Unit	Response Time
Unit 54 Responding from PUREX	5 Min.
Unit 59 K-9 (When Available)	4 Min.
Unit 515* East Main Limited Area Gate	7 Min.
Fire Team**	8 Min.

* Response was simulated. Response time was based on actual times derived from other exercises.

**Response was simulated. Response time was based on actual times derived from other exercises. The response times demonstrated include the actual response time, plus the time required for the shift commander to verify activity at other locations that have a higher response priority than CML.

[redacted]

Scenario #1 - Theft of Fuel Pins from Critical Assembly Room

	Time*
Minimum Containment - 1 to 2 Responders	5.00 Min.
Partial Containment - 3 Responders	7.00 Min.
Full Containment - 7 Responders	8.00 Min.
Barrier Delay (CAR)	6.25 Min.
Time to Remove Material	3.50 Min.
Time from Fence to Building and Building to Fence	.50 Min.
Total Time	10.25 Min.

Scenario #2 - Theft of Nitrate from Mix Room

	Time*
Minimum Containment - 1 to 2 Responders	5.00 Min.
Partial Containment - 3 Responders	7.00 Min.
Full Containment - 7 Responders	8.00 Min.
Barrier Delay (Mix)	2.75 Min.
Time to Remove Material	6.50 Min.
Time from Fence to Building and Building to Fence	.50 Min.
Total Time	9.75 Min.

*These times are based on the 209-E Badgehouse being unmanned and the security alarm system operating properly.

For Approval Of		
Name	Approved	
BJ Merrill	[redacted]	5-31-85
RR King		5-31-85
RM Fleischman		31 May 85
CL Simpson		5-31-85

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May 31, 1985

Mr. A. J. Rizzo, Assistant
Manager for Energy
Richland Operations Office
Department of Energy
Richland, WA 99352

Dear Mr. Rizzo:

209-E UPGRADES (U)

Ref 1: Generic Threat to DOE Nuclear Facilities, January, 1983, (C/NSI)

Ref 2: Richland Operations Office Safeguards and Security Cost Effectiveness Task Force Report, November 29, 1982, (C/NSI)

Ref 3: DOE-RL Security Survey of PNL, November, 1984, (S/NSI)

Ref 4: PNL Safeguards and Security Plan, January 15, 1985, (S/NSI)

Ref 5: Letter, R. R. King to T. R. Fitzsimmons dated January 9, 1985, subject, "Radiological Implications of Generic Threat to Hanford Facilities" (U)

Ref 6: Letter, D. B. Cearlock to H. E. Ransom dated February 4, 1985, subject same as above

Ref 7: Letter, K. H. Jackson to Director, PNL dated April 18, 1985, subject "Combined Initial and Special Security Survey of Pacific Northwest Laboratory" (C/NSI)

Pacific Northwest Laboratory (PNL) has reviewed the above-referenced documents with regard to determining appropriate upgrading actions at the Critical Mass Laboratory (CML) to assure that an effective and efficient safeguards and security posture, consistent with DOE-RL policies, procedures, and priorities, is effected.

As a result of this review, PNL has concluded that specific upgrades completed or underway at CML provide a demonstrated enhancement to the overall security posture of the facility, and are based upon prudent expenditures of government funds. It was further concluded that additional recommended upgrades provide

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minimal improvement to the overall security system, but require significant economic expenditure. The basis for these conclusions, and PNL's recommended actions, are contained in the attached study which is being forwarded for your review and comment.

Questions regarding this correspondence should be referred to R. M. Fleischman on 376-4557 or B. J. Merrill on 375-2821.

Very truly yours,

CR Hanse for DBC

D. B. Cearlock, Director
Research

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DBC:BJM:sc

Attachment

cc: K. H. Jackson, DOE-RL (With Attachment)

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