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DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND (AFMC)
NUCLEAR WEAPONS INTEGRATION DIVISION

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MEMORANDUM FOR DISTRIBUTION 28 Oct 94

FROM: SA-ALC/NWIW
1651 First St SE
Kirtland AFB NM 87117-5617

SUBJECT: HPRF Phase 2 Study General Meeting 94-3 (#10) Minutes

Attached is a copy of the Minutes from the High Power Radio Frequency Phase 2 Study General Meeting 94-3 (#10) held 22 Sep 94 at the Kaman Sciences Corporation, Colorado Springs CO. If you have any questions or comments please call me at (505) 846-6767 or my direct number of 846-4001, ext 208. DSN is 246-6767 or 246-4001, ext 208.

Keith M Baird
KEITH M. BAIRD
HPRF Study Director
Weapons Management Branch

Attachment:
HPRF Phase 2 Study General Meeting 94-3 (#10)
Minutes, Including Distribution List

Redacted Copy

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MINUTES ~~UNCLASSIFIED~~

HIGH POWER RADIO FREQUENCY (HPRF)
PHASE 2 STUDY GENERAL MEETING 94-3 (# 10)
22 SEPTEMBER 1994

Keith M. Baird
HPRF Study Director

NUCLEAR WEAPONS MANAGEMENT BRANCH
NUCLEAR WEAPONS INTEGRATION DIVISION
SA-ALC NWIW (AFMC)
1651 FIRST STREET SE
KIRTLAND AIR FORCE BASE NEW MEXICO 87117-5617

DOE & DTRA (b)(1) (b)(3) & USAF

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~~CNWI~~
~~CRITICAL NUCLEAR WEAPON DESIGN INFORMATION - DOD DIRECTIVE 5210.2 APPLIES.~~

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MINUTES

HIGH POWER RADIO FREQUENCY
PHASE 2 STUDY GENERAL MEETING 94-3 (#10)

22 SEPTEMBER 1994

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MINUTES

HIGH POWER RADIO FREQUENCY

PHASE 2 STUDY GENERAL MEETING 94-3 (#10)

22 SEPTEMBER 1994

I. (U) **INTRODUCTION.** The High Power Radio Frequency (HPRF) Phase 2 Study General Meeting 94-3 (#10) was hosted by the Kaman Sciences Corporation (KSC), Colorado Springs, Colorado on 22 September 1994. Mr Keith Baird, HPRF Study Director, Directorate of Nuclear Weapons, Nuclear Weapons Integration Division (NWI), chaired the meeting.

A. (U) **Administration.** Mr Baird welcomed the attendees and Mr Cliff DeJong, KSC, provided administrative information. A special thanks to Mr DeJong and KSC for hosting the meeting. The meeting agenda and list of attendees are attached as Appendices A and B, respectively.

B. (U) **Executive Working Group Membership.** All members and observers or their representatives, except for the Det 10 Space and Missile Center, Ogden Air Logistics Center, SAF/AQQS (N), and Headquarters Department of Energy were present. Mr Karl Rueb, Department of Energy/Albuquerque Operations Office (DOE/AL) is retiring and Cheryl Stivers represented DOE/AL. Current members and observers, and their organizations are identified in Appendix C.

C. (U) **Schedule/Milestones.** The Working Group Chairmen were reminded of the importance to work towards meeting the schedule milestones in Appendix D. Draft reports are due from the Requirements, Surety, Warhead Design and Systems Engineering Working Groups on 17 November 1994 and the Vulnerability and Mission Analysis Working Groups on 15 December 1994.

D. (U) FE Warren Air Force Base Tour. Maj John Valverde, Headquarters Air Force Space Command (HQ AFSPC), provided information on the base tour which was scheduled for 23 September 1994. The tour included a 90th Missile Wing Mission Briefing and tours of a Launch Control Center, Launch Facility and Weapons Storage Area. The HPRF Study was briefed to the 90th Missile Wing personnel.

II. (U) DISCUSSION TOPICS.

A. (U) Program Update. Mr Baird, HPRF Study Director, addressed administrative program issues (Appendix E).

1. (S-FRD) Security Classification. A draft HPRF Security Classification Guide (Appendix E) was proposed by the HPRF Study Director as there are concerns with classification disconnects on the HPRF program. [redacted] An action was assigned to the HPRF Executive Working Group membership to review the draft guide for accuracy and completeness, and provide comments/additions to the HPRF Study Director prior to 17 November 1994. Mr William Barry, NWI Security Officer, was requested by the HPRF Study Director to review the guide for proper formatting, accuracy, completeness, and to determine appropriate channels it must go through for approval.

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2. (U) Final Report Outline. The outline for the final HPRF Phase 2 Study Report was presented as agreed to by the HPRF Study Director and Working Group Chairmen (Appendix E).

1. (U) **Nuclear Detonation Safety.** The evaluation process for nuclear detonation safety was essentially completed under the direction of Mr Paul Rexroth, SNL (NM), prior to the September 1993 HPRF General Meeting #6, and a preliminary evaluation of the candidates was completed. The methodology is in place to evaluate the final warhead candidate designs. The designs are now essentially complete and the final evaluation is in progress. Safety themes have been developed (Appendix G).

2. (U) **Use Control.** The use control evaluation methodology is in place. Key issues have been identified. Communications issues involving the missile computer, warhead programmer, and silo/missile interfaces have been nominally addressed. It should be possible to implement use control up to and including a Category F (CAT F) Permissive Action Link should implementation be required to achieve CAT F comparability. Use control themes and an assessment process have been developed (Appendix G).

3. (U) **Operational Safety.** The Quality Function Deployment methodology for operational safety previously developed and tested in a preliminary evaluation of candidates (March 1994) was revisited during the 9-10 August 1994 subgroup meeting. The designs of all the warhead candidates are sufficiently complete and a draft evaluation was completed. Figure 1 is the current House of Quality and tables 1-4 summarize the results (Appendix G). Table 4 is a draft evaluation of the warhead candidates performed during the August meeting. All candidates were evaluated relative to the reference values listed. Observations of the evaluation are documented in Appendix G. Subsequent to the August meeting, a number of design parameters have changed for most of the candidates which are not reflected in these minutes. The next draft evaluation will include design parameter changes and the updated results will be more completely analyzed. The general nature of the results should probably not change substantially except where design changes might be made to improve the candidates.

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3. (S-RD-N) New Mexico Candidate Designs. LANL presented the engineering layouts for Candidates 3 and 4.

DOE & DTRA b(1) b(3) & USAF

4. (S-FRD)

DTRA b(1) b(3)

E. (U) Systems Engineering Working Group Report. presented a summary of the topics addressed at the 21 September 1994 Systems Engineering Working Group (SEWG) meeting (Appendix I). Topics discussed at the meeting included New Mexico and California design updates and use control themes and evaluation.

USAF b(1)

1. (S-FRD) New Mexico Design Update.

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5. (S-RD) Sandia National Laboratories Test Program. Dr William Tedeschi, SNL (NM), presented test results for foreign systems tested.

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The SNL (NM) report input is approximately 50% complete.

G. (U) Mission Analysis Working Group Report.

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presented a summary of topics, associated with the Mission Analysis Working Group (MAWG) (Appendix J), addressed at the 21 September 1994 MAWG meeting.

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Mr Dave Fordham, SNL (NM), is working with the National Air Intelligence Center (NAIC) located at Wright Patterson Air Force Base, Ohio. The assessment is behind schedule because of delays in modifying

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and testing the model at NAIC. The first runs should be completed by the end of September 1994. Options for other ways to do the assessment if the NAIC model is not available were reviewed.

DOE & USAF b(3)

This time is multiplied by the number of weapon types considered by the number of repeat runs for statistical purposes (estimate ten repeats). Because of study time constraints, a prioritized list of weapon types has been established (Appendix J).

DOE & USAF b(3)

Mr Whitted will initially attempt to fit the data to a normal distribution, but other distributions will be considered if these yield better goodness of fit statistics.

III. (U) <u>ACTION ITEMS.</u> Five action items were closed from previous meetings and three remain open. Three new action items were assigned as a result of this meeting.

A. (U) <u>Old Action Items.</u>

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1. (S-RD) 7-2. Assigned to the SWG.

This action item is closed.

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DOE b(3)

DOE & DTRA b(1)

3. (U) 7-6. Assigned to the RWG. [redacted] Provide information to the SEWG. This information was provided to the SEWG along with other W78 information. This action item is closed.

4. (U) 94-1-1. Assigned to the VWG and WDWG. Review MC requirements in paragraphs 2.2.1 and 2.6.1 and provide the RWG recommended wording for the warhead's design [redacted] This action item is still being worked. **Suspense: 17 November 1994.**

DOE & DTRA b(1) b(3)

5. (U) 94-2-1. **Assigned to all HPRF Agency Representatives (EWG members):** Provide estimate of manyears expended by your agency on the HPRF Phase 2 Study from the beginning in August 1992 through the projected end in March 1995. Provide estimates to HPRF Study Director. A total of approximately 63 manyears will be used by the completion of the study by all agencies, which equates to $11 million at $180,000/manyear. The estimates by agency are in Appendix K. This action item is closed.

DOE b(3)

DTRA b(1)

SAF

7. (U) 94-2-3. **Assigned to AFSPC/DOMN.** Provide reason the HPRF Phase 2 Study Group did not address the fifth mission in the tasking letter. Provide the reason to the

APPENDIX A
AGENDA

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AGENDA

HPRF PHASE 2 STUDY GROUP GENERAL MEETING 94-3
at Kaman Sciences Corp
22 September 1994

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APPENDIX B
LIST OF ATTENDEES

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HPRF General Mtg 94-3 Attendance List 22 Sep 94 @ KSC

Agency	Rank	First Name	Last Name	DSN	AC	Phone #	FAX #	City or Base	ST	ZIP C
Dept of Defense										
USSTRATCOM/J533	Mr	Stan	Gooch	271-5	402	294-5254	294-6148	Offutt AFB	NE	68113-
USSTRATCOM/J5231	Maj	Steven	Langer	271-5	402	294-5070	294-3433	Offutt AFB	NE	68113-
HQDNA/RAES	MAJ	Gerald	Baird	221-4	703	325-6617		Alexandria	VA	22310-
FCDNA/FCPRA	Capt	Skip	Langbehn	246-5	505	846-8575	846-8611	Kirtland AFB	NM	87117-
US AIR FORCE										
HQ AFSPC/DOXN	Maj	John T.	Valverde	692-5	719	554-5995	554-5354	Peterson AFB	CO	80914-
SA-ALC/NWIC	Mr	Keith	Baird	246-9	505	846-9575	846-4618	Kirtland AFB	NM	87117-
SA-ALC/NWIS	Mr	William R.	Barry	246-9	505	846-9576	846-4618	Kirtland AFB	NM	87117-
SA-ALC/NWIW	Mr	Frank	Carrillo	246-6	505	846-6767	846-2038	Kirtland AFB	NM	87117-
SA-ALC/NWIM	Mr	Daniel	Granados	246-4	505	846-4611	846-2441	Kirtland AFB	NM	87117-
SA-ALC/NWIC	LtCol	Roger	Kropf	246-9	505	846-9575	846-4618	Kirtland AFB	NM	87117-
PL/WSM	Mr	Sam	Gutierrez	246-4	505	846-4823	846-7836	Kirtland AFB	NM	87117-
NAIC/TAC	Capt	Dorotha	Biernesser	787-3	513	257-3556		Wright-Patterso	OH	45433-
US ARMY										
US ARMY ARDEC	Mr	Philip	Angelotti	880-5	201	724-5451	724-2375	Picatinny Arsnl	NJ	07806-
US Army ARDEC	Mr	Donald	Huie	880-3	201	724-2720	724-5461	Picatinny Arsnl	NJ	07806-
ARL/AMSRL-WT-ND	Dr	Christopher	Kenyon	356-3	301	394-3060		Adelphi	MD	20283-
US ARMY ARDEC	Mr	Dan	McGrath	880-4	201	724-4920	724-2375	Picatinny Arsnl	NJ	07806-
US NAVY										
Dept of Navy, SSPO	Mr	Richard	Hess		408	742-4929	743-0072	Sunnyvale	CA	94088-
Dept of Energy										
DOE/AL-WPD	MS	Cheryl	Stivers		505	845-6386	845-5188	Albuquerque	NM	87185-
Los Alamos Nat Labs										
LANL/X-5	Dr	Michael	Bernardin		505	667-1439	665-7725	Los Alamos	NM	87545-
LANL	Dr	Keith	Despain		505	667-2388	665-2227	Los Alamos	NM	87545-
LANL	Mr	Troy	Eddleman		505	667-6811		Los Alamos	NM	87544
LANL	Mr	Mike	Haertling		505	667-0592	667-1878	Los Alamos	NM	87545-
LANL	Mr	John	Hutchinson		505	665-3665	665-2017	Los Alamos	NM	87545-
LANL	Dr	Ronald	McFee		505	667-1682	665-2227	Los Alamos	NM	87545-

APPENDIX C

EXECUTIVE WORKING GROUP MEMBERSHIP

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HPRF Phase 2 Study
Executive Working Group Membership

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APPENDIX D
SCHEDULE/MILESTONES

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APPENDIX E
PROGRAM UPDATE

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SECURITY CLASSIFICATION GUIDE

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FINAL REPORT FORMAT

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HPRF Phase 2 Study Report Format

Executive Summary

1. Introduction
   - 1.1 Background
   - 1.2 Tasking
   - 1.3 Navy Involvement
   - 1.4 Study Organization
   - 1.5 Scope of Study

2. Related Issues
   - 2.1 START Implications
   - 2.2 Warhead Certification
   - 2.3 DODD C3150.7 "Controling the Use of Nuclear Weapons" 6/20/94
   - 2.4 Maintaining the Nuclear Technological Base
   - 2.5 Excercising the DOE Production Facilities

3. Mission Effectiveness Analysis & Assessment
   - 3.1 Mission 1
   - 3.2 Mission 2
   - 3.3 Mission 3
   - 3.4 Mission 4
   - 3.5 Mission 5

4. Vulnerability Testing, Analysis & Assessment
   - 4.1 FAAT Analysis
   - 4.2 High Level Tests
   - 4.3 Low Level Tests & Data Extrapolation

5. Warhead Candidates
   - 5.1 California Designs Descriptions
   - 5.2 New Mexico Designs Descriptions
   - 5.3 Joint CA/NM Design Description
   - 5.4 DOE Engineering Trade Studies
   - 5.5 Peer Review

6. System Engineering
   - 6.1 MMIII Delivery System Interface
   - 6.2 RV/Warhead design options
   - 6.3 IAF&F
   - 6.4 Packaging
   - 6.5 Use Control

7. Nuclear Surety
   - 7.1 Requirements
   - 7.2 Special Concerns
   - 7.3 Unique Issues

[redacted]

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8. Requirements
   - 8.1 Tentative Mission Needs Statement
   - 8.2 Military Characteristics
   - 8.3 Stockpile-to-Target Sequence
   - 8.4 Unique Issues

9 Conclusions and Recommendations
   - 9.1 Conclusions/Discussion
   - 9.2 Weapon Output
   - 9.3 Vulnerability Analysis
   - 9.4 Mission Analysis
   - 9.5 Recommendations

References
   - FAAT Report
   - Vulnerability Report
   - Mission Analysis Report

Glossary

Appendices
   - A Taskina Letters
   - C Testing Plan
   - D Military Characteristics
   - E Stockpile-to Target Sequence
   - F Vulnerability Final Report
   - G Mission Analysis Final Report
   - ~~H Major Impact Report (or Executive Summary of MIR)~~

Distribution

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SAF/AQQ TASKING

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[redacted]

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

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OFFICE OF THE ASSISTANT SECRETARY

Rec'd Aug 94

MEMORANDUM FOR SA-ALC/NWI

FROM: SAF/AQQS
1060 Air Force Pentagon
Washington DC 20330-1060

SUBJECT: USSTRATCOM/J5 Memorandum, dated 23 Jun 1994, Subject: High Power Radio Frequency (HPRF) Study

The subject memorandum, provided as an attachment, expresses interest in the ongoing HPRF Phase 2 Study. It also asks that the study address two specific questions of interest to USSTRATCOM.

Request you prepare a response to these questions for USSTRATCOM at the conclusion of the study, or earlier if possible. We believe the HPRF Phase 1 study provides some information and that the current study, as already planned, will provide additional information for answering these questions . The response should be separate from the study's final report or other documents, but it should include references to supporting information in these documents as appropriate. This tasking does not change the scope, budget, or schedule of the Phase 2 study.

The SAF/AQQ point of contact for this action is Lt Col Bill Mullins, SAF/AQQS(N), DSN 223-6303

THOMAS B. GOSLIN, Colonel, USAF
Chief, Long Range Power Projection Division
DIR/Long Range Power Projection, SOF, Airlift
and Training Programs

Attachment:
USSTRATCOM/J5 Memorandum,
dated 23 Jun 1994

cc: SA-ALC/NW
USSTRATCOM/J5

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Unclassified when attachment is withdrawn

[redacted]

[redacted]

DEPARTMENT OF DEFENSE
UNITED STATES STRATEGIC COMMAND

[redacted]

COPY FOR YOUR INFORMATION

Reply To:
USSTRATCOM/J5
901 SAC BLVD STE 2E10
OFFUTT AFB NE 68113-6500

23 JUN 1994

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MEMORANDUM FOR THE DIRECTOR OF LONG RANGE POWER PROJECTION, SOF, AIRLIFT & TRAINING PROGRAMS

Subject: High Power Radio Frequency (HPRF) Study (U)

1. (S) The USSTRATCOM Staff recently received a briefing on the status of the HPRF Phase 2 Study. We appreciate the effort that has gone into this study, and believe the end product will contribute significantly to our understanding of systems vulnerability and the value of this tactic. The briefing generated considerable interest.

2. (U) If possible, given time and budget constraints, we would like the following questions to be addressed in the Phase 2 Study.

DOE b(3)

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3. (U) The inclusion of this information will greatly enhance the usefulness of the study. I would appreciate your support for this request.

4. (U) My POC for this study is Mr. Stan Gooch, J533, DSN: 271-5254.

Richard S. Wilson
for DAVID M. GOEBEL
Rear Admiral, USN
Director, Plans and Policy

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APPENDIX F
REQUIREMENTS WORKING GROUP REPORT

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HPRF Warhead Phase 2 Study Group
General Meeting 94-3
22 September 1994
Kaman Sciences, Colorado Springs CO

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REQUIREMENTS WORKING GROUP REPORT

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NUCLEAR WEAPONS INTEGRATION DIVISION
NUCLEAR WEAPONS MANAGEMENT BRANCH
1651 FIRST STREET SE
KIRTLAND AFB NM 87117-5617

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HPRF Warhead Phase 2 Study Group
General Meeting 94-3
22 September 1994
Kaman Sciences, Colorado Springs CO

RWG UPDATE

- MCs (Draft 5) have been distributed to WG Chairpersons
- STS (Draft 4) document will be distributed to EWG
  - Expect all EWG Signatures by Mid-November 1994
- RWG 94-5 scheduled for first week in Nov 94 at Orion

HPRF Warhead Phase 2 Study Group
General Meeting 94-3
22 September 1994
Kaman Sciences, Colorado Springs CO

RWG UPDATE

- RWG 94-3 held on 23-24 Aug 94
  - Reviewed Draft 4 of the MCs
  - Reviewed Draft 3 of the STS

- Use Control Requirements
  - DoD Directive S-3150.7 Approved
  - Members requested time to review Directive

- RWG 94-4 held on 20 Sept 94
  - Major topic - Unique Issues

USAF

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(1) (U) It is still believed to be important to select some samples for testing in environments and/or flight.

(2) (U) To assure high reliability, it is important to consider design features that will accommodate testing at the users facilities. This may be implemented as: built-in test capability, or field testing rather than testing at Pantex.

(3) (U) Increasing design redundancy by installing redundant components in the weapon or by redundant targeting may help meet the reliability objectives for the mission.

(4) (U) Use of components (or modules) that are common with other systems, and tested in the other systems, may improve reliabiility.

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In light of the issues associated with the stockpile program discussed above, the DoD will have to determine what the lowest acceptable reliability will be for this system. This may require a Trade Study in Phase IIA.

II. (U) STRATEGIC ARMS REDUCTION TREATIES

(U) Based on current START agreements, the Reentry System for the HPRF will have to be visually indistinguishable from current Reentry Systems. This requirement has been documented in the Draft MCs, but may have to be further defined in Phase IIA. Currently, this requirement severely limits the design options available.

III. (U) USE CONTROL

(S-FRD) Use Control will be an area of significant importance during Phase IIA. A new DoD Directive S-3150.7 "Controlling the Use of Nuclear Weapons," has just been approved by the DoD. [redacted] Other DoD policies and procedures for Use Control are defined in the "General Characteristics for Permissive Action Links Used with Nuclear Weapons." Whether these requirements should be included in the MCs has been a topic of discussion. [redacted] CG HPRF-1

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IV. (U) NON-COMPATIBILITY WITH MK21 OR MK 12A

(C-FRD) The HPRF WXX warhead must be compatible with the Minuteman III weapon system. [redacted] A cost trade-off may be needed to look at both options (i.e. MK21/MK12A or BMW).

USAF, DOE & OTRA b(1) b(3)

V. (U) OPPORTUNITY COSTS

(C-FRD) [redacted] 9,F CG HPRF-1

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VI. (U) MISSION NEED STATEMENT

(U) A Mission Need Statement (MNS) is required to document a mission deficiency and provide credibility for this program.

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APPENDIX G
SURETY WORKING GROUP REPORT

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SURETY WORKING GROUP REPORT FOR HPRF MEETING 94-3 (#10)

USAF & DOE b(3) DTRA (b)(3)

The primary responsibility of the SWG is to evaluate the safety themes of the various warhead candidates presented by the Warhead Design and the Systems Engineering working groups. Evaluating Use Control features in proposed warhead concepts is new for land-based missile systems. Because of the FARR study, it has become a timely issue for both DOD and DOE.

USAF & DOE DTRA (b)(3)

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The SWG is organized into sub-groups to assess the four major areas. Ronald Pederson, SNL 12324, leads the Nuclear Detonation Safety Sub-Group. Larry Moore, SNL Dept. 5122, leads the Use Control evaluation Sub-Group. The entire SWG addressed the issues of Operational Safety from the onset of the study through the December General Meeting #7. By that time, all of the issues had been thoroughly discussed using the QFD process, and the remaining work was to tie up loose ends to complete the process for evaluating the candidates. A sub-group of the SWG-- consisting of Charles Chow, LLNL, Mike Haertling LANL, Jim Hogan, SNL/CA, and Jerry Cuderman, SNL/NM has since brought the QFD process to closure for candidate evaluation of the candidate warheads and has conducted Preliminary and Draft evaluations. Roger Breeding, SNL/NM, 6411, is responsible for the material dispersal analysis.

The current status of the Surety Working Group efforts in the four major areas is as follows: (1) The evaluation process for Nuclear Detonation Safety evaluation was essentially completed under the direction of Paul Rexroth prior to the September General Meeting #6, and a preliminary evaluation of the candidates completed. The methodology is in place to evaluate the final warhead candidate designs. The designs are now essentially complete and the final evaluation is in progress, (2) The Use Control evaluation methodology is in place. Key issues have been identified. Some ideas involving CAT- F equivalency have been discussed. Areas where use control would provide added security have been identified. Communications issues involving the missile computer, warhead programmer, and silo/missile interfaces have been nominally addressed. It appears that it should be possible to implement use control up to and including CAT-F should that implementation be required to achieve Cat-F equivalence. Use Control themes and an assessment process have been developed. (3) The QFD methodology for Operational Safety previously developed and tested in a preliminary evaluation of candidates (presented at the March meeting) was revisited during the August 9 sub-group meeting. The designs of all the warhead candidates are sufficiently complete that a DRAFT evaluation was completed. Figure 1 is the current House Of Quality. Tables 1-4 summarize the results. Table 4

USAF & DOE b(3)

is a **DRAFT** evaluation of the warhead candidates carried out during the August 9-10 meeting. All candidates are evaluated relative to the reference values listed.

DTRA b(3)

However, these measures are still important Operational Safety concerns, and it seems desirable to carry them along through the final evaluation of the candidates.

The Operational Safety Sub-Group completed the inputs for the matrices in Tables 1-3 during the August 9-10 meetings but did not have time to fully analyze and evaluate the results. Also, subsequent to that meeting, a number of design parameters have changed for most of the candidates which are not reflected in this presentation. Before the next draft, these results will be incorporated, the evaluation will again be reviewed; and the updated results more completely analyzed. The results presented here should thus be considered to represent the status of the evaluation as of August 10; there will be changes, but the general nature of the results should probably not change substantially except where design changes might be made to improve the candidates.

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Nuclear Detonation Safety — One point safe NEP with optical slapper dets, IHE, and FRP.
Optical Nuclear Detonation Safety — Isolate detonation critical components (optical slapper dets) from enabling energy until intended. Safe enabling energy from intended source until intended, using first principles and the 4 "I"s (isolation, incompatibility, independence, and inoperability):

- **Isolation** —

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- **Incompatibility** — Optical detonator is incompatible to all optical environments except the similar man-made optical signals mentioned above in the isolation section above. Human Intent UQS enables LCS to generate laser firing power and Trajectory UQS enables LOS to output laser firing power. If the WH breaks up during abnormal environments at the fireset interface, the UQS information incompatibilty prevents laser function/output in the OPA. The Intent UQS is information and signal waveshape incompatible with LOS stronglink. Likewise, the exclusive-or trajectory output is information and signal waveshape incompatible with LCS stronglink. The SESD output and its storage version in the programmer are each incompatible with both LCS and LOS due to differences in waveshapes.
- **Independence** — Three independent safety subsystems (Intent, Trajectory, Arming), each contributing 10^{-3} safety factor (exception: arming safety subsystem is applicable to normal environments only). Interlocking Trajectory UQS with Intent UQS and the exclusive-or function may violate true independence between the two subsystems, but it does enhance safety in an inadvertant launch scenario.

  Arming Safety Subsystem — Separation and design features within the Laser Drive Electronics isolate and prevent charging of firing capacitor unless both A1 and A2 are present (both provided by missile). The SESD packaged within the warhead also prevents the "all electrical interface" situation wherein the det may be fired via only electrical connections to external equipment. However, this safety enhancement is achieved at the loss of some independence between subsystems since the SESD is also part of the trajectory subsystem.

  Intent Safety Subsystem — Missile delivers Intent UQS to WH during 3rd stage burn, thereby providing de facto prearm reversibility before launch.

  Trajectory Safety Subsystem — Fluid metering type SESD senses first stage acceleration and generates Trajectory UQS in several consecutive time intervals. Trajectory UQS is temporarily stored in volatile memory and later enabled by Intent UQS (via logic exclusive-or) during 3rd stage burn before it can drive the LOS. This enhances "inadvertant launch" safety. Safety credit for this subsystem is exhausted as soon as the Trajectory UQS is generated. The LOS is designed differently from the LCS to avoid common mode behavior. The volatile memory erasure must be ensured before any power up or launch scenario.
- **Inoperability** — All components are designed to fail predictably safe in abnormal environments, employing first principles and stronglink/weaklink concepts. The fireset capacitor is a thermal weaklink (internally shorting out) before detonator or stronglink springs fails, while the detonator is also a thermal weaklink (decomposing before the HE activates). The OPA becomes inoperable in abnormal crush and shock environments.

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HPRF NM CANDIDATE UC THEMES (U)

SRD VERSION

AUGUST 24, 1994

KAZUO OISHI, 5161
JERRY ADAMS, 2783
SANDIA NATIONA LABORATORIES

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08/24/94

HPRF NM CANDIDATE USE CONTROL THEMES
(SRD VERSION)

GENERAL FEATURES:

All of the New Mexico designs promote as a minimum Cat-D level of protection and command disable. The genesis of these systems is the W91 warhead. Candidates NM1, NM2 and NM3 are Cat-D designs, to minimize space. Candidates NM1A and NM2A are Cat-F. [redacted] DOE b(3)

Attached are figures of the designs to help with the evaluation.

The use control feature of all the systems is the encrypted Multiple -Application Coded Switch (MACS) Code Activated Processor (CAP), here after called CAP, currently under development. [redacted] DOE & USAF b(3)

The use control and denial features are common to all the New Mexico candidates except candidate 4.

NM1:

This candidate is Cat-D. It has the features described in the opening paragraphs and no additional features that are unique.

NM1A:

This candidate is Cat-F. CG HPRF-1 (d-e) tcguc2 1132.2 [redacted] DOE & USAF b(3)

of interest listed in Jerry Adams' proposed Use Control evaluation criteria * are addressed below:

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* memo from Jerry Adams, SNL/2783, to Distribution, subject: Use Control on Phase 1 and 2 Feasibility Candidates, SRD-SUCI, 5161/94/61123, dated July 14, 1994

NM2:
This candidate is Cat-D. It has the features described in the opening paragraphs and no additional features that are unique.

USAF & DOE b(3)

NM2A:
This candidate is Cat-F.

- DTRA b(1)

CG HPRF-1 (d-e)

NM3:
This candidate is Cat-D. It has the features described in the opening paragraphs and no additional features that are unique.

DTRA b(1) DOE b(3)

NM4:
This candidate is a Cat-D.

- DOE & USAF b(3)

USAF & DOE b(3)

Cat-E Container:
This device is in the conceptual design stage.

DOE b(3)

Two pictorial concepts of the container are enclosed.

The New Mexico designs do not require the RV for completion of the nuclear safety or use control themes. This allows the Cat-E container to protect a smaller more lightweight device that being just the warhead.

The other is incorporation of the entire RV into the Cat-E container. This may become very heavy, but it removes the burden of assembling the warhead into the RV.

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HPRF UC Theme

Objectives

- To meet MC UC requirements of CD and of use denial features consistent with DoD/DOE policies.

- To meet potential DOD FARR recommendations of weapon *system level* CAT F equivalent protection.

[redacted]

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HPRF System Level CAT F Equivalence

Proposed Definition

- System Level CAT F Equivalence is system level equivalent adversary time delay measured from first intrusion at system perimeter to successful usage of weapon by the adversary.

[redacted]

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GENERAL HPRF UC THEME

- Maximize UC protection at all STS stages and weapon system configurations.
- Base theme and implementation on current PAL components, and on new components only as needed.
- [redacted] CG HPRF-1 (d-e)
- Implement most protective PAL at the smallest appropriate assembly level (Cat F at WH level is first choice).
- Incorporate command disable capability in all candidates.
- Incorporate CAT E in appropriate weapon configurations if CAT F is not practical.
- [redacted] CG HPRF-1

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NM1, 2, 3 UC Theme

BASELINE FEATURES

- ★ CAT D
  - ❑ MACS CAP presently under development
  - ❑ Based on W91 design

CG HPRF-1 (d-e)

DOE & USAF b(3)

[redacted]

OPTIONAL FEATURES

(If Baseline found not CAT F Equivalent)

- ★ CAT E (Transportation and Storage)
  - ❑ User's discretion of protection at RV or WH

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  - ❑ In conceptual design stage

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DOE & USAF b(3)

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NM1A, 2A UC Theme

BASELINE FEATURES

- ★ CAT F
  - ❑ MACS CAP presently under development
  - ❑ Based on W91 design

CG HPRF-1 (d-e)

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NM4 UC Theme

BASELINE FEATURES

- ☆ No PAL [redacted] DOE b(3)
  - ❑ No new user UC responsibilities
- ☆ No CD

OPTIONAL FEATURES

- ☆ CAT E (Transportation and Storage)
  - ❑ User's discretion of protection at RV or WH
  - ❑ Penalties TBD
  - ❑ In conceptual design stage

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USE CONTROL ASSESSMENT (U)

September 13, 1994

Larry Moore, 5122
SANDIA NATIONA LABORATORIES

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DEFINITIONS FOR MEASURES

CG HPRF-1

11. **INSENSITIVE ACTUATOR THRESHOLD TO ELECTROSTATIC DISCHARGE:**
Actuator threshold to electrostatic discharge. The threshold specification is that of the "Sandia Static Man". Currently, insensitive actuators are certified to withstand 80 SSM or greater number of discharges.

12. **PRESSURE SAFETY FACTOR(S):**
Reservoir burst pressure = 3 times maximum STS pressure for tritium, at end of life.

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13. **CRUSH RESISTANCE:**
Load (lbs) applied to the tritium storage bottle between parallel plates that produces a 5 percent deformation.

CG HPRF-1

17. **SPECIAL NUCLEAR MATERIAL DISPERSAL PROBABILITY:**
PUGH concept matrix will be created to establish relative SNM Dispersal Probability Rankings Of Candidates And Baseline.

18. **USE CONTROL THEME RANKING:**
PUGH concept matrix will be created to establish relative Use Control Rankings Of Candidates And Baseline.

19. **SAFETY THEME RATING:**
PUGH concept matrix will be created to establish relative Safety Rankings Of Candidates And Baseline.

DEFINITIONS FOR REQUIREMENTS (HOUSE OF QUALITY)

USAF & DOE, DTRA b(1) b(3)

CG HPRF-1

3. **PREVENT SPECIAL NUCLEAR MATERIAL DISPERSAL:**
Prevent the dispersal of Special Nuclear Material during accidents and incidents. There shall be positive measures to prevent accidental, inadvertent, and deliberate unauthorized dispersal of plutonium to the environment.

4. **PROVIDE USE CONTROL FEATURES:**
Nuclear Weapons will incorporate features to prevent unauthorized use. Ref: AFR 122-10, Para. 2-6.

5. **PREVENT INADVERTENT NUCLEAR YIELD IN AN ACCIDENT OR INCIDENT:**
Less than four pounds of TNT equivalent from Special Nuclear Material in an accident or incident. There shall be positive measures to prevent nuclear weapons/explosives involved in accidents or incidents (or jettisoned weapons) from producing a nuclear yield. Ref: AFR 122-10 Para. 1-2, A.

APPENDIX H
WARHEAD DESIGN WORKING GROUP REPORT

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Minutes of the Phase 2 HPRF Warhead Design Working group,

September 20, 1994 (U)

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USAF & DOE & DTRA b(1) b(3)

Joe Sefcik of LLNL presented calculations on their Candidates 1 and 2. (See Appendix.)

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CG HPRF-1 (d-a)

New Mexico Candidates 3 and 4

USAF DOE & DTRA b(1) b(3

Jim Schulze and Jerry Adams, Sandia Albuquerque, presented the engineering layouts for NM Candidates 3 and 4.

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APPENDIX I

SYSTEMS ENGINEERING WORKING GROUP REPORT

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Sandia National Laboratories
Managed and Operated by Sandia Corporation
a wholly-owned subsidiary of Martin Marietta Corporation

Albuquerque, New Mexico 87185
Livermore, California 94551-0969
MS 9014

29 September 1994

Mr. Keith Baird
HPRF Phase 2 Study Chairman
SA-ALC NWIC(AFMC)
Kirtland AFB, New Mexico

THIS DOCUMENT CONSISTS OF 2 PAGE(S)
NO. 1 OF 1 COPIES, SERIES A

Subj: SEWG SEPTEMBER UPDATE (U)

The following summarizes the discussion of issues addressed during the SEWG general meeting held at Kaman Sciences Corp., Colorado Springs, September 21, 1994.

NM Design Update:

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DOE & DTRA b(1) b(3) & USAF

[redacted] Due to schedule and resource limitations of the engineering effort, the design will remain at the preliminary concept stage.

[redacted]

DOE & DTRA b(1) b(3) & USA

The team also reviewed the use control theme and implementations for all New Mexico candidates.

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DOE & DTRA b(1) (3)

CA Design Update:

[redacted] The parts have been delivered by the machine shop and are currently being assembled in a Mk21-Mod 6 RV. Results of the experiment should be available in early October.

USAF

The use control theme and implementation for the California candidates were presented. Options ranged from a full implementation of Cat-F to a minimal use control option (Cat D/CD warhead with a Cat E shipping container) were discussed. Specifics of the penalties for each of the configurations will be delivered by the middle of October.

Review of Use Control Evaluation:

The criteria and methodology for evaluating the use control themes and implementations for all candidates. It was decided that the nuclear labs must participate in developing the criteria, metrics and methodology for the penalty mechanisms.

Schedule and Outline for SEWG Report:

A draft outline for the SEWG report, including proposed authorship for each of the topics was discussed. Several changes were made and approved. Detailed outlines for each of the major sections were requested from the designated authors.

J. R. Hogan

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HPRF SEWG PRESENTATION

NEW MEXICO DESIGN CANDIDATES

NM-3

NM-4

JIM SCHULZE - SNL/5161

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HPRF SAFETY THEME (U)
Candidate NM 4

HPRF Phase 2 SEWG Meeting

KSC Colorado Conf Rm 533

September 21, 1994

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Kazuo Oishi - SNL/5161

Jerry Adams - SNL/2783

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HPRF USE CONTROL THEME (U)
Candidate NM 4

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HPRF Phase 2 SEWG Meeting

KSC Colorado Conf Rm 533

September 21, 1994

Kazuo Oishi - SNL/5161

Jerry Adams - SNL/2783

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C6 HPRF-1

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CA Use Control Concepts and Design Considerations

Gerry Standin & Charles Chow
SNL/CA & LLNL
Livermore, CA

19-22 September 1994
Kaman Sciences Corp
Colorado Springs, CO

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Sandia National Laboratories

Livermore, California 94551-0969

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date: September 16, 1994

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from: G. E. Strandin, MS9014

subject: Comments on Matrix of Use Control Concept Vs. the California Warhead Candidate Options (U)

1. All combinations of use control and warhead candidate options are potentially viable.

2. The combination denoted by shading are shown as examples in Figures A through D.

CG HPRF-1(d-e)

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6. Note that this form of use control does not modify the exterior shape of any of the candidate options except for the fact that provision for a descrete line programmed interface (DLPI) connector at the aft cover (not shown) must be made.

DOE b(3)

7. Caveats on candidate proposals:

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a. The disablement technique proposed for these candidates may require a nuclear test to certify the design with regard to nominal yield output.

[redacted]

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b. [redacted] CG HPRF-1 (d-9)

Distribution:
1/5 (0470A) T. Chow
2/5 (0650A) J. Cuderman, MS0482
~~3/5 (0769) R. Baird~~
4/5 MS9014 J. Hogan
5/5 MS9014 G. Strandin

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(U) The Vulnerability Working Group (VWG) of the Joint DoD/DOE High Power Radio Frequency (HPRF) Phase 2 Study met at Kaman Sciences Corp, Colorado Springs, CO on Tuesday, 20 September 1994. [redacted] The meeting objectives were:

CG HPRF-1

USAF b(1)

a) to review test and analysis activities progress with emphasis on findings and recommendations for the final report.

b) to coordinate VWG/MAWG data exchange

c) to review plans for the working group report and for the working group input to the final HPRF study report. Attachment A is a copy of the meeting agenda. The following paragraphs summarize the discussions.

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CG HPRF-1

(U) Sam Gutierrez of the Phillips Laboratory summarized the results of their test program.

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Sam also expressed his concerns regarding whether the Phase 2 study was making the most effective use of test data.

(S-RD) Bill Tedeschi of SNLA presented test results for foreign systems tested by Sandia.

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Bill mentioned that the SNLA report input is approximately 50% complete. This was the last presentation of the VWG meeting action items discussed are listed below.

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(This is the minimum number of weapon types which will be considered. The following cases will be done as time permits.)

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7. LANL, unconstrained design

(U) The meeting concluded with a discussion of schedule. Capt Langbehn noted that at this time, it appeared unlikely that the final report input would be done by the 15 December 1994 due date.

(U) The general study group meeting was chaired by Keith Baird on Thursday 24 September 1994 at Kaman Sciences Corporation, Colorado Springs, CO.

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(U) Keith reviewed the overall schedule:

11/17/94	Study group meeting at LLNL
1/26/95	Study group meeting at FCDNA
3/23/95	Final meeting at STRATCOM
2/15/95	Final report to the Executive Working Group for comment
3/23/95	Review report at study group meeting
4/15/95	Final report complete
5/2/95	Brief SAF/AQQ
5/3/95	Brief HQDOE

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HPRF Phase 2 Study
Vulnerability Working Group Meeting
KSC Colorado Springs - 20 Sep 94

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MEETING OBJECTIVES

- Review progress of test and analysis activities supporting VWG input to HPRF study with emphasis on specific findings and recommendations to be included in VWG report.
- Coordinate VWG/MAWG data exchange and review.
- Confirm author responsibilities for draft working group inputs.
- Plan review of draft working group report and input to study final report.

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HPRF Phase 2 Study

VWG

AGENDA

HPRF Phase 2 Study

Vulnerability Working Group Meeting - 20 Sep 94

0830- 0845	Welcome & Administrative Notes
0845-0930	LANL Program Status
0930-1015	SNL Program Status
1015-1030	Break
1030-1115	LLNL Program Status
1115-1230	Lunch
1230-1315	PL Program Status
1315-1430	Report Input and Review
1430-1630	Open Discussion

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HPRF Phase 2 Study

VWG

STUDY SCHEDULE

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- **Study Group Meetings**
  - **STRATCOM (94-4) 16 Nov 94 Omaha, NE *(tentative)***
  - **LLNL (95-1) 26 Jan 95 Livermore, CA**
  - **DOE/AL (95-2) 23 Mar 95 Albuquerque, NM**
- **VWG Input to Final Report**
  - **Draft Author Inputs 30 Sep 94 *-Chairman Consolidates***
  - **Distribute & Review Draft 31 Oct 94 *-Comments NLT 1 Dec 94***
  - **Forward to Study Director 15 Dec 94 *-Final Draft Due 1 Mar 95***

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FCPRA - Sep 94 / 4 of 4

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HPRF
Phase II
Vulnerability Analysis(U)

by

Alfred M. Kaufman
LLNL

September 20, 1994

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Derivative Classifier: *Arnold S. Warshawsky*
Technology Assessment Group Leader
D-Division / LLNL

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HPRF: Phase 1 to Phase 2

Weapons Effects

Operational Inputs

System Effects

Vulnerability Tests

System Analysis

Lessons Learned

HPRF Phase 1

Location

Targets

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Degraded Systems

HPRF Phase 2

Mission Effectiveness
Probability to Penetrate

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Measures of Effectiveness

- **Tasking asks for Mission Effectiveness**

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Relative measures to quantify "value added" by HPRF

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- **Phase 1 MOEs were acceptable to the customer; let's assume they still are**

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- **FCDNA will provide baseline scenario**
  - **Configuration control (Teledyne Brown)**
  - **"AWK" scripts**
  - **Debugging assistance**

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- **Organizations should be paired**
  - **Double check results**
  - **Reduces risk**
- **LANL will provide statistical analysis**
  - **We need another group to provide backup**
- **How do we present the results?**

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APPENDIX K
HPRF PHASE 2 STUDY MANYEAR ESTIMATE

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APPENDIX L
REASON FIFTH MISSION NOT ADDRESSED

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