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(12)

High Power Radio Frequency (HPRF) Phase 2 Study

Meeting #6 Minutes (U)

16 September 1993

Captain William A. Lamb

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High Power Radio Frequency (HPRF) Phase 2 Study

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TABLE OF CONTENTS

FIGURES

TABLES

(U) ACKNOWLEDGMENTS

(U) I would like to take this opportunity to thank Dr. James Hogan of Sandia National Laboratories, California who hosted the sixth meeting of the Joint DOE/DOD Phase 2 Feasibility Study of an HPRF device. His efforts along with the efforts of Mr. Kenneth Buck and Mr. Scott Faas prior to and during the meeting helped immensely and were appreciated by all in attendance.

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(U) INTRODUCTION

(U) The Nuclear Advanced Concepts Branch of the Nuclear Weapons Integration Division (SA-ALC NWI (AFMC)) conducted meeting #6 of the Joint DOD/DOE Feasibility Study of a High Power Radio Frequency (HPRF) Device on 14-16 September, 1993. The meeting was held at Sandia National Laboratories (CA) in Livermore, California. The purpose of the meeting was to convene working groups, review working group progress, and update the program status. Individual working groups met during the first two days of the meeting. A general session was held in the morning of the final day. The agenda for the general session is contained in appendix A.

(U) The former Nuclear Weapons Concept Division of the Office of Aerospace Studies has been integrated into the Nuclear Weapons Integration Division at Kirtland AFB, New Mexico. The only impact upon this study will be the name change, the new address, and the new phone numbers of the study director.

(U) These meeting minutes document meeting #6 and include copies of presentations from the working group meetings as well as the general meeting. Additionally, a list of attendees is provided in appendix B. The meeting highlights are presented in the following sections.

(U) The topics of discussion during the meeting dealt with the progress of the working groups, funding aspects of phase 2 work, information requirements and interchanges needed for the working groups.

(U) CLASSIFICATION AND SECURITY

[redacted] The study director, Capt Lamb, presented an overview of the classifications involved in the HPRF Phase 2 Study. Specifically, each individual involved in this study needs to be aware of the proper classification of the materials generated or produced. The classification guides for this study are listed inside the front cover of this report.

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[redacted] Information provided on the employment of such a device can also carry other caveats such as Not Releasable to Foreign Nationals (NOFORN) and Warning Notice - Intelligence Sources and Methods Involved (WNINTEL). Additionally, information concerning the nuclear design of the HPRF device most likely contains Critical Nuclear Weapon Design Information (CNWDI). It is imperative that all information that is classified be afforded the proper classification security protection. If there is any doubt as to the classification of any information, please take the time to investigate the classification guides or ask the proper knowledgeable individual. A request for information about classified material requires a need-to-know before access to the information can be provided. Make sure you have properly identified an individual's need to know. In regards to unclassified material associated with this program, please handle the information with care. Proper operation security (OPSEC) requires that the unclassified material not be released that can give uncleared individuals enough information to piece together classified information.

(U) SURETY WORKING GROUP

[redacted] The SWG report for meeting #6 is included in appendix C. The working group has continued to evaluate the operational safety and nuclear safety use control issues. The House of Quality (HOQ) and the PUGH matrix are being used to evaluate the proposed design candidates and preliminary evaluations presented. In the use control area, work is continuing to identify the implementation options. Mr. William Barry presented details of the Failsafe and Risk Reduction study (FARR). Other discussion from the working group centered around the work in analyzing the warhead candidates.

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(U) SYSTEM ENGINEERING WORKING GROUP

[redacted] These inputs are provided as appendix D. The SEWG reviewed the New Mexico design concepts and the California design concepts. A review of the baseline designs and the variables for the designs were discussed. Further analysis of the flight calculations are required to provide the confidence levels desired. The availability of hardware for the HPRF program was discussed.

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(U) REQUIREMENTS WORKING GROUP

[redacted] The Requirements Working Group (RWG) met during the first day of the working group meetings. The meeting minutes are included in appendix E.

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The working group reviewed the action items from their previous meeting and discussed the requirements for inputs from other working groups. The working group planned to review the Military Characteristics (MCs) during the working group meeting but the material was not available so discussion centered on the future work by the group. An MC review meeting will be held in November after the members have a chance to review the current MCs with results reported back during the December HPRF meeting. Additionally, the Stockpile-to-Target Sequence document will be reviewed beginning in early 1994.

(U) WARHEAD DESIGN WORKING GROUP

[redacted] Certification of the warhead design is still an important issue to be addressed in the future. Additional discussion centered around the information required from the vulnerability working group.

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(U) MISSION ANALYSIS WORKING GROUP

(U) The Mission Analysis Working Group (MAWG) met during the working group sessions. [redacted] The areas discussed included activities since the last meeting, status of the mission need statement (MNS), and mission modeling work. [redacted] The largest focus of work is on the modeling efforts for the study. The modeling work identified areas for emphasis. These areas included consolidation of the target data base, completing the preprocessor coding, vulnerability data structure, and identification of funding requirements. [redacted]

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(U) VULNERABILITY WORKING GROUP

[redacted] His slides are provided in appendix H. The results of work completed since the previous meeting were presented. The testing of assets has continued as scheduled and an overview of each organizatrions status was presented

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(U) ACTION ITEMS

(U) Table 1 provides the list of action items assigned during meeting #6. The action items assigned during previous meetings are listed in table 2. Figure 1 shows the study schedule.

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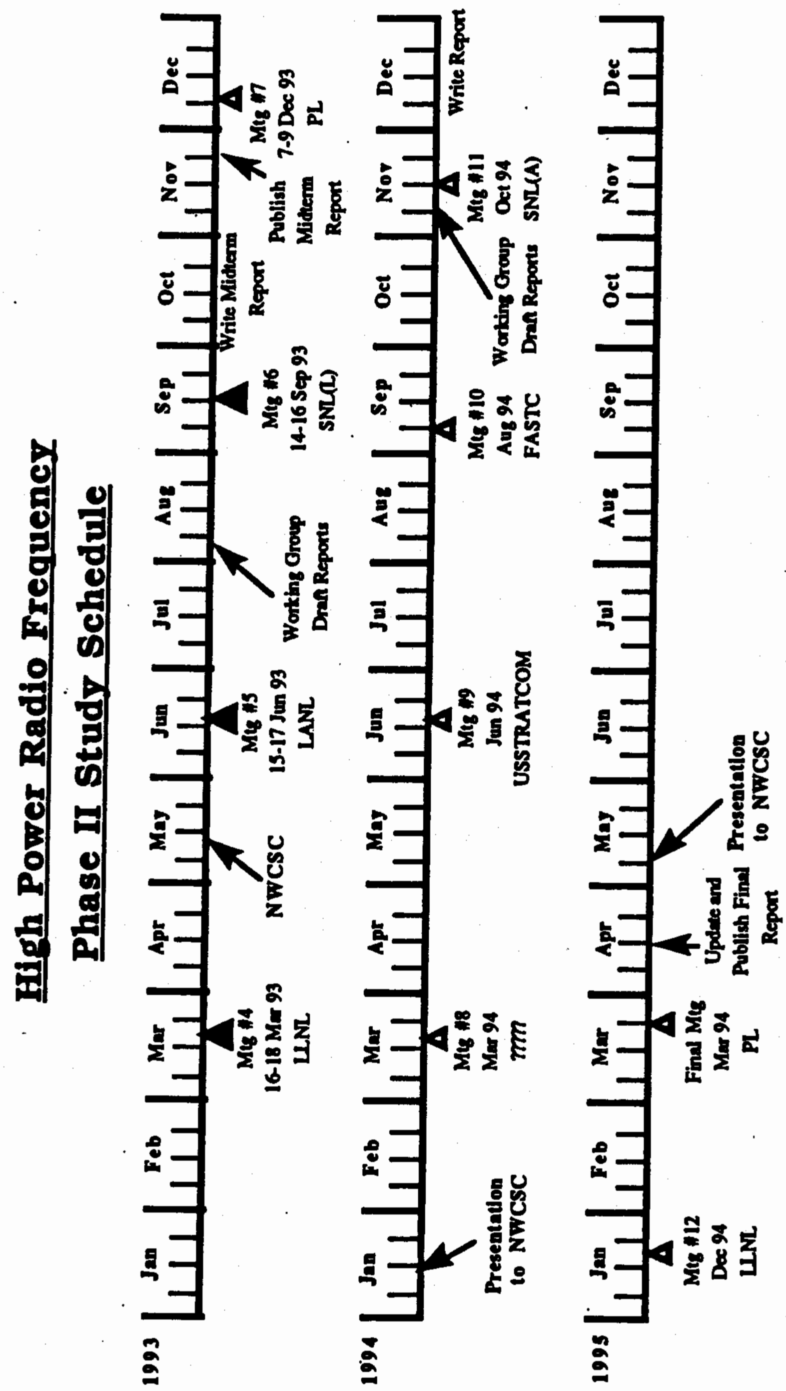

Figure 1. (U) HPRF Phase 2 schedule.

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APPENDIX A

(U) MEETING AGENDA

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APPENDIX B

(U) MEETING ATTENDANCE LIST

High Power Radio Frequency Phase 2 Study
Meeting #6, 17 September 1993
Attendance List

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71	Sefcik, Joe Initials JAS	Lawrence Livermore National Laboratory L-13, PO Box 808 Livermore CA 94550	Com: (510) 423-0671 DSN: FAX: (510) 423-0925
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HPRF Meeting #6

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APPENDIX C

(U) SURETY WORKING GROUP

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5161/93/00123
SEPT. 22, 1993
TOTAL PAGES: 37

HPRF Phase 2 Study, Meeting #6
Surety Working Group Report (U)

USAF b(1)

The Surety Working Group met at 1300 Sept 15, 1993 to review results from an August 3-4 interim meeting where work continued on the evaluation of warhead candidates using the Quality Function Deployment (QFD) process, and to address issues of use control which are emerging as the study progresses. Figure 1 is the agenda for the Sept 15 meeting. The approach the Surety Working Group has taken to assess surety is to use the QFD process, but to break it up into smaller, more manageable pieces, then combine the sub-task results into an overall evaluation. The QFD process is particularly applicable when either there are problems with a product or a new product is being developed. For the purposes of a feasibility study, only the House of Quality (HOQ) and PUGH matrix parts of QFD are exercised. The House of Quality serves to identify customer requirements (supplied by the customer) and to develop working measures against which design candidates are evaluated. It also identifies the most important measures. These are then plotted on the ordinate of an evaluation matrix against which the candidate designs are compared.

b(3) DOE, USAF DTRA

This feature does not appear to have significant impact on Nuclear Safety or Use Control, but does impact Operational Safety. Thus the HOQ was used to generate measures for **Operational** Safety, assess their relative importance, and identify which have negative cross correlations (where engineering tradeoffs are involved). Most of the measures were then transferred to the PUGH matrix for candidate evaluation. For **Nuclear Safety and Use Control**, the measures are already well known, so sub-groups were formed in each of these areas, chaired by Paul Rexroth, SNL 324, and Larry Moore, SNL 5712, respectively. In each of these cases the evaluation starts with the Pugh matrix. When the individual evaluations are complete in all three areas, they will be combined into a single overall evaluation matrix.

As noted, the SWG met on August 3-4 in Albuquerque. During that meeting, the QFD process for Operational Safety was continued. The House Of Quality was essentially completed, and a start was made at assembling the PUGH matrix. The status of these efforts is summarized by Figures 2 and 3, respectively.

Since HPRF Meeting #5, considerable progress has also been made in the area of nuclear safety evaluation. Figure 4 is a preliminary nuclear safety evaluation of the candidates in the form of a PUGH or evaluation matrix. Text immediately following Figure 4 describes the rationale for the ratings. The evaluation will be updated as the warhead candidate designs develop during the course of the study.

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5161/93/00123
SEPT. 22, 1993

In the area of use control, considerable effort has been expended in determining the level of use control which is appropriate and the degree to which use control options for different candidates should be critically evaluated. Part of this uncertainty is due to the fact that the recommendations of the FARR study have not yet been implemented by DOD. A directive is currently being prepared in the DOD; Overall details appear in William Barry's presentation to the SWG (attached). DOE has, for several years operated under a policy that any new weapons should be equipped with use control for use when the weapon is in DOE custody. Also during the meeting, Larry Moore, SNL, discussed the approach he is using to assess use control options and Charles Chow, LLNL, described the California approach to use control (VG hardcopy attached). In discussion subsequent to the presentations, the consensus was that as a group we should attempt, in the course of the next year, to determine what is feasible and could practically be implemented for the Minuteman III strategic system. It was pointed out that the House Armed Services Committee zeroed out the line item for the new missile computer in the FY 94 budget. The question thus came up whether we should reconsider our nuclear safety themes, most of which require the new computer, and look at interfaces with the present system both for Use Control and Nuclear Safety. The consensus was that we should still conduct the study on the assumption of a new missile computer.

Figure 1

HPRF PHASE 2 Surety Working Group Agenda
Meeting #6, Sandia National Laboratories/CA, Sept. 15, 1993

Operational Safety and Nuclear Safety Update-- J. F. Cuderman (15 Min)

Discussion--All (30 Min)

Use Control Update

- Overview-- Larry Moore (15 Min)
- CA Team Approach-- Charles Chow (15 Min)
- Air Force Perspective-- William Barry
- Discussion (All) (30 Min)

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5161/93/00123
SEPT. 22, 1993

Figure 2- QFD House of Quality

[redacted] PUGH

5161/93/00123
SEPT. 22, 1993

b(3)

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Figure 3- Evaluation (PUGH) Matrix

DOE, USAF, DTRA

PAGE 4

Figure 4

PRELIMINARY NUCLEAR SAFETY ASSESSMENT

EVALUATION CRITERIA	NM #1 DSL	NM #2 SSL/DSSL	NM #3 SSL/IS	NM #4 DOI	CA #1 W87
Direct Initiation Resistance	2	1	2	1	1
Insensitivity of Detonators	0	1	0	2	1
ER Thermal Resistance	2	2	2	2	1
ER Mechanical Resistance	2	1	2	2	1
Discrimination of SLs	2	2	0	2	-1
SL Resistance to Bypass	2	1	1	1	1
Stronglink Location	1	2	1	1	2
Weaklinks	0	1	0	1	0
Total	11	11	8	12	6

5161/93/00123
SEPT. 22, 1993

**Preliminary
Nuclear Safety Assessment of
HPRF Warhead Candidates**

DRAFT

1. Methodology

Each of the warhead candidates will be evaluated based upon eight criteria that were agreed upon by the nuclear safety assessment team. These attributes are intended to address only nuclear detonation safety. It is assumed that all candidates will be inherently one-point-safe and employ a TATB based insensitive high explosive (IHE). IHE is relevant to nuclear detonation safety only in that it decreases the likelihood of a multi-point initiation by means other than initiation of the main detonators. Each of the weapon candidates is evaluated against each criterion and given a rating between -2 and +2. The resultant matrix is the Pugh Matrix used in the QFD process.

2. Evaluation Criteria

2.1 Resistance to Direct Multipoint Initiation

If the physics package is one point safe, as has been assumed here, the only way in which a nuclear detonation can be achieved is by initiating the main charge explosive at more than a single point. This may be either at multiple discrete points or along a line or surface. What we are looking for here paths other than the intended modes through the detonators. The critical consideration is the overall integrity of the exclusion region, and especially, lack of penetrations into it.

2.2 Insensitivity of Detonators

Main charge detonators can be grouped into three broad categories, based on sensitivity, exploding bridge wires (EBWs), electrical slappers, and direct optically initiated (DOI) slapper detonators. EBWs and electrical slappers require a rapidly rising, high voltage pulse for activation. The required pulse is rather unique as far as abnormal environments go. Weapon firesets, however, are an ever present source of such a pulse. Lightning is another source. The electrical slapper detonator requires a higher peak current and faster rise time than does an EBW and can thereby be considered less sensitive. It was assumed, however, that all candidates except DOI would employ electrical slappers. The baseline W78 was rated lower because it uses EBWs. The DOI detonators are said to be extremely insensitive to any stimulus other than the laser produced light source of the fireset. This concept was therefore rated high in this category. It must be kept in mind, however, that the claims of insensitivity still need to be verified.

2.3 Exclusion Region Thermal Robustness

This attribute is a measure of the ability of the exclusion region to maintain integrity and provide isolation during or following exposure to high temperatures. The key feature here is high melting point materials for all elements of the barrier and minimizing the impact of joints and penetrations.

2.4 Exclusion Region Mechanical Robustness

This attribute is a measure of the ability of the exclusion region to maintain integrity and provide isolation when exposed to such mechanical environments as crush, impact, vibration or puncture. The key features here are high strength and ductile materials for all elements of the barrier and strong joints between exclusion region elements. It is recommended that the safety theme for each candidate clearly identify and describe and locate all elements of the exclusion region and especially the joints and boundaries.

2.5 Discrimination Level of Stronglinks

The stronglinks provide a gateway into the exclusion region for intended sources of arming energy when intended use of the weapon is desired. To perform its safety function, it must stay in the reset position until there is a positive indication of intended use. This indication may be a unique signal input to the system by a direct human action at the person system interface or derived from the sensing of a unique intended use environment or trajectory. In order to attain the level of uniqueness desired, there should be the equivalent of 24 events in the signal that drives a discriminator stronglink. It is difficult to identify 24 unique events that are unique to an intended use environment that cannot be simulated by an accident environment. Simple inertial sensing devices detect only one or two events that may be as simple as acceleration or deceleration which can be sensed in many accident environments. Flight environments can provide a suitable, 24 event unique signal to drive a discriminator stronglink if sensed and processed judiciously. Thus in this category, the figures of merit are the integrity of the methods for introducing or generating the unique signal and the discrimination ability of the stronglink actuator. An electro-mechanical discriminator is much better than an inertial ESD.

2.6 Stronglink Resistance to Bypass

This characteristic is the thermal, mechanical and electrical robustness of the stronglink and its attachment to the exclusion barrier. A magnetic stronglink is seen as having better holdoff capability than a mechanical switch or a typical ESD because it is not susceptible to high-voltage arcing. A welded attachment is usually better than screws. A protected location is preferable to hanging off the end of the fireset. Physical size, strength and thermal integrity are advantageous.

2.7 Stronglink Location

Here we are talking about stronglinks at the fireset versus the Detonators. There is believed to be an advantage to locating the stronglink as close as possible to the physics package so that protection may be maintained even if the fireset is torn away or the exclusion barrier otherwise compromised.

2.8 Weaklink(s)

A weaklink is an element or component that is necessary to produce a nuclear detonation, that becomes irreversibly inoperable at an environmental stress level lower than that which will threaten the exclusion region (including stronglinks). Because the stronglinks provide a path into the exclusion region, they are usually more vulnerable than the rest of the exclusion region. Therefore, it is usual to collocate a weaklink with a stronglink. The best weaklinks, from a fundamental point of view, are the main charge explosive and the fissile material. Both are absolutely necessary for a nuclear detonation. It is difficult to assure, however, that either will become inoperable in many abnormal environments because they tend to be located in the heart of the warhead and protected from accident assaults. Another commonly cited weaklink is the capacitor in a CDU fireset. Capacitors with low melting dielectrics (e.g. mylar) cannot store sufficient charge to fire a detonator if they have seen temperatures above about 250 ^{o}C. Capacitors employing a higher temperature dielectric have been rigged to short at lower temperatures, but this does not change the fundamental character of the capacitor and is considered a sterilizer rather than a weaklink. The PETN pellet in a detonator stronglink will vaporize and "disappear" at a relatively low temperature, rendering the detonator inoperable. This is a good weaklink having excellent collocation with a stronglink. If the energetic material in an explosive fireset goes away at a relatively low temperature, it too may be considered a weaklink.

3. Evaluation of New Mexico Candidate #1

New Mexico candidate #1 is uses a MAST type fireset that is described in detail elsewhere in this report. Though the design has not been in production, it is well into development and its characteristics are fairly well understood. Considerable testing and verification would be required, however, to verify the some of the assertions and assumptions that have gone into this assessment. Below is a discussion of how this design was assessed relative to the eight criteria and the evaluation rating is given.

3.1 Resistance to Multipoint Initiation

This design has a relatively robust exclusion region. The aluminum can around the primary is not as strong as one might like, but it is better than typical designs that use the aeroshell as part of the barrier. Exclusion region penetrations that lead to the main charge HE are kept to a minimum. The pit tube penetration is fitted with a bracket to divert lightning or other high voltage sources. Other lines entering the exclusion region are interrupted by a pizo-electric isolator. This candidate is therefore given a rating of +2 in this category.

3.2 Insensitivity of Detonators

The main charge detonators for this design are electric slappers, which is judged adequate but not exceptional, so a rating of 0 is given.

3.3 Exclusion Region Thermal Robustness

The fireset is made from stainless steel having excellent high temperature properties. The aluminum primary can has a relatively low melting temperature, but if that can should melt, the high explosive will likely be hot enough to decompose or burn preventing nuclear detonation. An assessment rating of +2 is given.

3.4 Exclusion Region Mechanical Robustness

The fireset is a sturdy design of high strength material. Mounting of the stronglinks appears quite solid. The taped joint between the fireset and the primary can is strong. It is highly recommended that the warhead trigger signal be passed into the fireset through the stronglink eliminating the penetrations necessitated by the plasmatron. An assessment rating of +2 is given.

3.5 Discrimination level of the stronglinks

Each of the stronglinks in the Dual Stronglink Assembly (DSA) has acceptable discrimination of a well designed, 24 event, unique signal so a rating of +2 is given. It should be pointed out, however, that the present and currently envisioned future warhead/missile interface can supply only a single unique signal. This may necessitate providing a unique signal generator (USG) within the warhead. A high level of safety is difficult, but possible to achieve in a ballistic missile USG.

3.6 Stronglink Resistance to Bypass

The magnetic stronglinks are very resistant to high voltage arc over. The strong mounting arrangement minimizes the likelihood that they may be torn away. As stated above, sending the trigger signal through the stronglink is recommended. A rating of +2 is given.

3.7 Stronglink Location

The stronglinks are mounted on the fireset rather than the detonators so a rating of +1 is given.

3.8 Weaklinks

The weaklink that is designated to fail prior to the failure of the stronglinks in thermal environments is the fireset capacitor. This is believed to be only moderately effective. It has mylar dielectric, but it is mounted inside a can that insulates it from external environments. Tests have shown that for certain "smart" fires, the capacitor may not fail before the stronglinks. There is no mechanical weaklink identified for the system. The robust fireset and attachment alleviate this concern to some extent. This candidate is rated 0 in this category.

3.9 Total

The total rating score is +11

4. Evaluation of NM Candidate #2

New Mexico candidate #2 is said to be structurally very similar to candidate #1. The main difference is that one of the dual magnetic stronglinks is replaced by a Detonating Safing Stronglink (DSSL). This assessment is very tentative since the design is only conceptual. Since it is similar to candidate #1, I will address only those areas in which there are differences.

4.1 Resistance to Multipoint Ignition

The existence of the DSSL and associated actuator and monitor cables provide potential paths for introducing energy to the physics package, therefore this design is not seen as resistant to this threat as the first candidate. Rating is +1

4.2 Insensitivity of detonators

The detonators in this design are protected by a stronglink, so even though they are not inherently less sensitive, they could be given additional credit in this category to +1.

4.3 Exclusion Region Thermal Robustness

See section 3.3, rating +2.

4.4 Exclusion Region Mechanical Robustness

In general this design should yield a mechanically robust exclusion region, but it is believed that the penetrations required by the DSSL cables will degrade this attribute some to a +1.

4.5 Discrimination level of the stronglinks

Each of the stronglinks, the SSA and the DSSL has acceptable discrimination of a well designed, 24 event, unique signal so a rating of +2 is given. It should be pointed out, however, that the present and currently envisioned future warhead/missile interface can supply only a single unique signal. This may necessitate providing a unique signal generator (USG) within the warhead. A high level of safety is difficult, but possible to achieve in a ballistic missile USG.

4.6 Stronglink Resistance to Bypass

The DSSL has the advantage that is location near the physics package offers little room for bypass. Because, however, it requires bringing actuator and monitoring cables up to the physics package, it may provide its own path for bypass. A raring of +1 is given.

4.7 Stronglink Location

This is the area where the DSSL shines. It is located near the physics package, so that if the fireset or other part of the exclusion region has been penetrated, the stronglink may still provide protection. Rating is +2.

4.8 Weaklinks

[redacted] Both are good, first principle weaklinks. A feature that needs to be evaluated is the collocation of the capacitor and the SSA. For now, a tentative rating of +1 is given. DTRA b(3)

4.9 Total

The total rating score is +11.

5. Evaluation of New Mexico Candidate #3

New Mexico candidate #3 is said to be structurally very similar to candidate #1. The main difference is that one of the dual magnetic stronglinks is replaced by an Inertial Piston Accelerometer Stronglink. This assessment is very tentative since the design is only conceptual. Since it is similar to candidate #1, I will address only those areas in which there are differences.

5.1 Resistance to Multipoint Initiation

This candidate is seen as equivalent to candidate #1 in this category. Rating is +2.

5.2 Insensitivity of Detonators

This candidate is seen as equivalent to candidate #1 in this category. Rating is 0.

5.3 Exclusion Region Thermal Robustness

This candidate is seen as equivalent to candidate #1 in this category. Rating is +2.

5.4 Exclusion Region Mechanical Robustness

This candidate is seen as equivalent to candidate #1 in this category. Rating is +2.

5.5 Discrimination Level of the Stronglinks

The inertial switch is judged to have a much poorer discrimination capability than the multi-event electromechanical stronglinks. Rating is 0.

5.6 Stronglink Resistance to Bypass

The inertial stronglink can be bypassed by high voltages and is therefore more vulnerable than the magnetic switches. Rating is +1.

5.7 Stronglink Location

This candidate is seen as equivalent to candidate #1 in this category. Rating is +1.

5.8 Weaklink

This candidate is seen as equivalent to candidate #1 in this category. Rating is +0

5.9 Total

The total rating score is +8.

6. Evaluation of New Mexico Candidate #4

This candidate utilizes the direct optical initiation (DOI) fireset. This design, too, is still rather conceptual. The following assessment will be based upon my best understanding of the safety theme and expected implementation.

6.1 Resistance to Multipoint Initiation

It is often claimed that a DOI implementation will not need as robust an exclusion region as conventional architectures because of the incompatibility of the detonators with available environments. This being the case, I am assuming that the physics package will not be as well protected as that in the more traditional candidates. Therefore a ranking of +1 is given

6.2 Insensitivity of detonators

This is the feature for which this entire design has been pursued. Assuming that the claims for incompatibility are born out by testing and analysis, this architecture should rate +2 for this attribute.

6.3 Exclusion Region Thermal Robustness

Although, as mentioned in 6.1 above, the exclusion region may not be as robust as that for traditional designs, it is assumed here that its level of protection is consistent with the safety theme and thus provides protection equivalent to current state of the art. The rating is +2.

6.4 Exclusion Region Mechanical Robustness

Although, as mentioned in 6.1 above, the exclusion region may not be as robust as that for traditional designs, it is assumed here that its level of protection is consistent with the safety theme and thus provides protection equivalent to current state-of-the-art. The rating is +2.

6.5 Discrimination Level of the Stronglinks

It is assumed that stronglinks will provide state-of-the-art discrimination. The rating is +2.

6.6 Stronglink Resistance to Bypass

The conceptual designs that I have seen place the stronglinks on the input and output of the laser. This placement seems somewhat vulnerable to bypass. Rating is +1.

6.7 Stronglink Location

The conceptual designs that I have seen place the stronglinks on the input and output of the laser. This placement provides no "deep" protection. Rating is +1.

6.9 Weaklinks

The weaklinks for this system have not been well documented. Based only upon impression I would give a rating of +1

6.9 Total

The total rating score is +12.

7.0 Assessment of California Candidate

All of the California concepts are based upon the W87 fireset. This assessment assumes that the fireset is used as is in the MK 21 with the exception that the attachment to the physics package is more secure.

7.1 Resistance to Multipoint Ignition

The existence of the DSSL and associated actuator and monitor cables provide potential paths for introducing energy to the physics package, therefore this design is not seen as resistant to this threat as some others. Rating is +1

7.2 Insensitivity of detonators

The detonators in this design are protected by a stronglink, so even though they are not inherently less sensitive, they could be given additional credit in this category to +1.

7.3 Exclusion Region Thermal Robustness

There are components within the exclusion region that contain explosives. In a thermal environment, these may either detonate or deflagrate, compromising the exclusion region. The rating is +1.

7.4 Exclusion Region Mechanical Robustness

From the information that I have, I cannot tell how good the exclusion barrier around the physics package is. For the time being, I will assume that it is as good as that in the MAST design. The penetrations required by the MSAD cables will degrade mechanical robustness some resulting in a rating of +1.

7.5 Discrimination level of the stronglinks

This system has a mechanical discriminator and an inertial switch. The design of the MSAD is such that multiple events can be skipped over. For this reason, this discriminator is not as good as those used in the DSA or SSA. The other switch is simply a two stage accelerometer. It has a quite low level of discrimination. The rating for this attribute is -1.

7.6 Stronglink Resistance to Bypass

The MSAD has the advantage that is location near the physics package offers little room for bypass. Because, however, it requires bringing actuator and monitoring cables up to the physics package, it may provide its own path for bypass. A raring of +1 is given.

7.7 Stronglink Location

This is the area where the MSAD shines. It is located near the physics package, so that if the fireset or other part of the exclusion region has been penetrated, the stronglink may still provide protection. Rating is +2.

7.8 Weaklinks

This fireset has a high temperature, capacitor dielectric. A low melting temperature material is incorporated into the capacitor to try to qualify it as a weak link. This is not a first principles failure mode so this component is not considered a real weaklink. The PETN in the MSAD does make a reasonable weaklink protecting that stronglink. A rating of 0 is given.

7.9 Total

The total rating score is +6.

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5161/93/00123
SEPT. 22, 1993

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USAF NUCLEAR SYTEMS ENGINEERING DIRECTORATE, KAFB NM

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14 SEP 93

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5161/93/00123
SEPT. 22, 1993

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DoD USE CONTROL POLICY

- *INFLUENCE FACTORS*
  - *DRELL Study (FRP, IHE, ENDS)*
  - *FARR STUDY*
- *PROPOSED NEW DoD USE CONTROL POLICY*

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FAILSAFE AND RISK REDUCTION (FARR) STUDY GROUP

- *Remote Destruction Study Group*
- *Failsafe Working Group*
- *Positive Control Material Devices*
- *Risk Reduction Working Group*
- *NCCS Assessment Study Group*
- *Technology Working Group*
- *Policy and Requirements Working Group*
- *Weapon System Review Study Group*

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PRESENTATION TO THE

FAILSAFE AND RISK REDUCTION ADVISORY COMMITTEE

WEAPONS SYSTEM REVIEW STUDY GROUP
INTERIM REPORT
6 JANUARY 1992

COLONEL JOSEPH P. PHILLIP
DEFENSE NUCLEAR AGENCY
CHAIRMAN, WSRSG

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EMERGING THEME

- CURRENT PRACTICE CONGRUENT WITH GUIDANCE
  (NO SHOW STOPPERS)
- CHANGING WORLD SUGGESTS NEW PERSPECTIVES
  (PROMOTE AN EXTERNAL FOCUS)
- MANAGE ACCORDING TO:
  - CONTINUING DANGER
  - INHERENT VULNERABILITIES
- PAY ATTENTION TO PROGRAM REALITIES
  (POINT THE WAY TO BENEFICIAL CHANGE)
- MAINTAIN ENDURING NUCLEAR PROGRAM EXPERTISE
  (COMMUNICATION/CONSOLIDATION)

WSRSG 3

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OVERARCHING ISSUES

- CODED CONTROL DEVICES
- TECHNICAL COMPLEXITY
  - AUTOMATION CERTIFICATION
  - CRITICAL COMPONENTS
- SECURITY
  - STORAGE SITE/TRANSPORT
  - SMALL ARMS PROTECTION
- PROGAM ENHANCEMENTS
  - EXPAND USE OF LAUNCH ANALYSES
  - COMMUNICATION/INTERACTION
  - UTILIZATION OF EXPERTISE

WSRSG 4

UNCLASSIFIED

UNCLASSIFIED

CODED CONTROL DEVICES

- PROCEDURES REDUCE UNAUTHORIZED LAUNCH RISK
  - BASED ON VARIOUS THREATS AND ANALYSES
- CURRENTLY USE FIRING AND FUZING INTERRUPTS
  - DUAL CIRCUIT KEYS AND REMOVABLE PLUGS
- ONE FIELD ADD-ON POINTS WAY TO ENHANCEMENT
  - LOCKING ALL BOMB STRIKE ENABLE PLUGS IN COMBINATION SAFE
- ENDORSE GREATER USE OF CODED CONTROL DEVICES
  = PLACE INHIBIT ON WEAPON SYSTEM VS WARHEAD
  = MODIFY EXISTING SYSTEM COMPONENTS
  = ENSURE CHANGES MEET RESISTANCE STANDARDS
  = HOLD CODES EXTERNALLY, SEND BY MESSAGE

WSRSG 4A

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PROGRAM ENHANCEMENTS

- UNAUTHORIZED/INADVERTENT LAUNCH ANALYSES
  - EXCELLENT TOOLS FOR SYSTEM IMPROVEMENT
  - SERVICE/SYSTEM UNIQUE; NOT ALL COVERED
  - CROSS POLLINATION, EXPANDED USE BENEFICIAL
- INTERDEPARTMENTAL INTERFACE
  - HIGH LEVEL DOD-DOE INTERCHANGE INITIATIVES
  - "POWER DOWN" COMMUNICATIONS AMONG USERS
- NUCLEAR PROGRAM (SAFETY/SURETY)
  - COLLECTIVE CONCERN OVER LOSS OF EXPERTISE
  - REVIEW ORGANIZATIONAL FUTURES
  - CONSIDER CONSOLIDATION

WSRSG 4D

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RECOMMENDATIONS
(EUROPE: SATISFACTORY/FOLLOW-UP)

- Q1: IMPLEMENTATION OF CODED CONTROL DEVICES?
  - PRACTICE PRESAGES EXPANDED USE; ENDORSE GREATER USE TO REDUCE RISK

- Q3: ADEQUACY ACROSS STOCKPILE CONDITIONS?
  - ATTENTION IN FEW AREAS GIVES BIG RETURN; AUTOMATION CERTIFICATION, CRITICAL COMPONENT CONTROL, PERIMETER AND TRANSPORTATION SECURITY

- Q4: IMPROVEMENTS TO POSITIVE MEASURES?
  - INNOVATIVE PROGRAM ADAPTABLE TO CHANGE; RETAIN ESSENTIAL EXPERTISE/CONSOLIDATE, IMPROVE COMMUNICATION/OVERSIGHT, EXPAND USE OF ANALYTICAL TOOLS (ULA/ILA)

WSRSG 6

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5161/93/00123
SEPT. 22, 1993

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DoD USE CONTROL (UC) POLICY

- *Presented to the UC Projects Officers Group*
  - *14 July 93*
  - *Office to the Assistant to the Secretary of Defense for Atomic Energy (OATSD(AE)) by LT COL LEO FLORICK - (703) 697-1797*

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FARR RECOMMENDATIONS

- 58 TOTAL RECOMMENDATIONS
- 8 USE CONTROL TOPICAL AREAS
  - DEVICES
  - MISSING ELEMENTS OF INFORMATION
  - RELOCK
  - NON-VIOLENT DIASABLEMENT
  - RECAPTURE/ RECOVERY
  - STANDARDS
  - CONUS VS OVERSEAS
  - RISK REDUCTION

"Develop and promulgate a consolidated use control policy which explicitly addresses the need for coded control devices on all current and future weapons systems combined with rigorous procedures and minimum standards for unauthorized use denial and delay."

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STATUS OF DIRECTIVE

- Comprehensive Use Control Directive ready for coordination
- Coordination will begin this month.

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DIRECTIVE TOPICS

	TOPIC	IN EFFECT	LAST DRAFT	COMPREHENSIVE DIRECTIVE
USE CONTROL	DEVICES	JCS PUB 1-04: PAL ON NUC WEAPONS ON FOREIGN SOIL	EXISTING AND FUTURE WEAPON SYSTEMS	↷ EXISTING AND FUTURE WEAPON SYSTEMS
USE CONTROL	MISSING ELEMENTS	NOT REQUIRED	YES	↷ YES
USE CONTROL	RELOCK	JCS PUB 1-04: EARLIEST OPPORTUNITY	NOT ADDRESSED	SPECIFICS INTO USE CONTROL MANUAL
USE DENIAL	NON-VIOLENT DISABLEMENT	AE POLICY LTR: ALL FUTURE WEAPONS IF ECON & TECH FEASIBLE	NOT ADDRESSED	GOAL FOR FUTURE WEAPONS ✓
USE DENIAL	ED	DEPSECDEF POLICY LTR (5 SEP 90): AVOID USE, LIMITED EXCEPTIONS	NOT ADDRESSED	AVOID USE; LIMITED EXCEPTIONS ✓
USE DENIAL	RECAPTURE/ RECOVERY	DoDD 5210.81: EQUIPMENT, PLANS & CAPABILITIES	NOT ADDRESSED	RESTATE JCS POLICIES AS DoD DIRECTIVE ✓
	STANDARDS	NO OVERALL USE CONTROL STANDARDS	NOT ADDRESSED	SPECIFICS INTO USE CONTROL MANUAL
	CONUS VS OVERSEAS	JCS PUB 1-04: OVERSEAS REQs	NOT ADDRESSED	SPECIFICS INTO USE CONTROL MANUAL
	RISK REDUCTION	NO DoD DIRECTIVE	NOT ADDRESSED	NOT ADDRESSED
	MANUAL	DOES NOT EXIST	NOT ADDRESSED	WRITE MANUAL SUPPORTING DIRECTIVE ✓

FARR STUDY ↷ ROLL OVER INFORMATION ✓ NEW TO DIRECTIVE

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Overview of DoD Directive C-3150.aa
Controlling the Use of Nuclear Weapons

Purpose: To establish policy and responsibilities for controlling the use of nuclear weapons and nuclear weapon systems.

Directive composed of following sections:

- Applicability
- Definitions
- Policy
- Responsibilities
- Effective Date and Implementation

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Policy

- Positive measures taken during all phases of life cycle, to include devices and procedural safeguards.
  - Prevent unauthorized access
  - Prevent unauthorized use
  - Counter threats and vulnerabilities
  - Meet legal and policy requirements
- Use control devices on all nuclear weapon systems
  - Procedural safeguards acceptable prior to retrofit
- Use functionally dependent
  - Missing elements of information
- Relock and recode weapons ASAP

DOE b(3)

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Policy (cont.)

- Peacetime - no emergency destruct
  Time of war - emergency destruct only if no other option
- Recapture and recovery capabilities
- Unauthorized use analyses for all use control systems
- Use control, use denial devices, and procedures same for CONUS and OCONUS locations

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Responsibilities

- Assistant to the Secretary of Defense (AE):
  - Develop use control standards and criteria
  - Review and evaluate programs
  - Ensure use control is periodically assessed
  - Ensure DoD components implement use control
  - Assure unauthorized use analyses
- Secretaries of the Military Departments:
  - Establish schedules for retrofitting
  - Conduct unauthorized use analyses
- Commanders, Nuclear Capable Unified and Specified Commands:
  - Post operations requirements

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Responsibilities (cont.)

- Director, National Security Agency:
  - Provide nuclear weapon use control systems security
  - Provide cryptographic products and use control codes
  - Evaluate systems security
- Heads of DoD Components:
  - Implement positive control measures
  - Continually assess control measures
  - Assist unauthorized use analyses

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WHAT NEXT?

Directive needs to be coordinated with following:

- Under Secretary of Defense (Aquisition and Technology)
- Under Secretary of Defense (Policy)
- Assistant Secretary of Defense (C3I)
- OSD General Counsel
- OSD Inspector General
- OSD Director of Administration and Management
- Secretary of the Air Force
- Secretary of the Army
- Secretary of the Navy
- Chairman, Joint Chiefs of Staff and Joint Staff
- Director, National Security Agency

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HPRF Ø-2 Study
Use Control Options for CA. Candidates

SEWG/SWG Meeting
September 15, 1993

(<u>work in progress presentation</u>:
<u>superseding CODT-93-0142</u>)

Charles T. S. Chow

LLNL/DTED

Slide 1

5161/93/00123
SEPT. 22, 1993

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[redacted]

We use layered options to evaluate implementation of use control schemes: Level of Protection vs. Impact on System and RV/RS--benefit vs. cost

Slide 2 [redacted]

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APPENDIX D

(U) SYSTEM ENGINEERING WORKING GROUP

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(This page is unclassified)

HPRF Phase 2 Study

Systems Engineering Status Reports

HPRF Mtg #6
14-16 September 1993
Sandia National Labs
Livermore, CA

SEWG AGENDA FOR 15 SEPT

Previous Action Items-- Hogan
NM Design Concepts:
- Warhead -- Haertling
- Electrical -- Oishi
- Mechanical -- Shultze

CA Design Concepts:
- Warhead -- Chow
- Electrical -- Hogan
- Mechanical -- Buck, Derickson, Faas

Midterm Report Review --All
Program Planning -- All
Discussion -- All

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NM Design Concepts - *Electrical*

HPRF#6 SEWG Meeting
SNLL Bldg 912/112
9/15/93

Kazuo Oishi
SNL 5161

- Electrical
  - Typical HPRF WES
  - HPRF WES Subsystems
- Safety
- Use Control
- HPRF Candidates & Options Matrix
- Missile Interface Issues
- Radiation Issues

RS537

TYPICAL CDU WES (*Simplified*)

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- Status
  - Relatively static
  - Minimal support from others

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[redacted]

- Mast 1.1- like CDU Fire Set
- TUSG
  - Design concept in preliminary stages
  - Same volume as TSSG
  - Fluid metering device senses 3 boost stages
  - rolamite device senses RB spin
  - Trajectory UQS logic-conditioned with Human intent UQS to drive SL2
  - Gates Human intent UQS to drive SL1
- NG
- GTS Drives
- DOI FS and Drive Electronics
  - Repackaging effort into MAST1.1 envelope (roughly feasible)
  - Radiation Hardening Technology
  - Requires Optical Detonator development

RS5371/930100

K. Oishi-SNL/6161

SAFETY

- Require Development of TUSG for second Safety Subsystem in most candidate options
- Safety Themes - *Unchanged*

Safety Theme	WES Description
A	CDU + DSA + TUSG
B	CDU + SSA + DSSL & TUSG
C	CDU + SSA + Inertial Switch
D	DOI + TUSG

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DOE, USAF, DTRA

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DOE, USAF
DTRA.

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USE CONTROL (UC)

- **Approach** *(In absence of DOD inputs)*
  - Provide all major UC options in WH candidates
  - Identify missile/LCC support required to implement it.
  - System practicality determined only after DOD responds
- **UC Themes**
  - Candidate themes represented by
    - » PAL Cat D (e.g., NM-1 & 2)
    - » PAL Cat E (e.g., NM-1 & 2)
    - » PAL Cat F (e.g., NM-1A)
  - Impact of themes to DOD and to DOE
    - » D vs F (Wires & Complexity)
    - » E (Access to WH ID)
- **MSL Communications Needs**
  - PAL must be controlled remotely
  - 19 line DLPI assumed unreasonable (no response by DOD)
  - 6 lines minimum assumed
    - » 2-power
    - » 2-transmit
    - » 2-receive
    - » Requires Mux & Decoders on each end
  - RF links (rcv & xmt) assumed impractical

K. Oishi-SNL/5161
9/15/93

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K. Olshi-SNL/6161
9/16/93

Missile Interface Issues

- Need for Design Data sufficient to size programmer interface package for detailed Phase 2 study
  - Digital Communications
    - » type unknown
    - » Assumed neither RS422, SDI, nor Mil-Std-1553.
  - Analog or Discrete signals
  - Power
  - Terminations
  - PAL communications lines availability
    - » Existing lines (not identified)
    - » New Lines (not determined if available)

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DOE b(3)

HPRF PHASE II
MEETING #6

NM CANDIDATE PROPOSALS

MICHAEL HAERTLING
ROBERT OKAGAWA
RICHARD KEYSER
JAMES MERCER-SMITH
RON MCFEE
TROY EDDLEMAN
JERRY CUDERMAN
JIM SCHULZE
KAZUO OISHI
JERRY ADAMS

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63

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Page 1
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Page 1
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b(3)

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DOE, USAF, DTRA b(3)

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Page 1

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KWB/5371
SNL/CA
Sept 1993

DOE
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HPRF Layouts (U)

Ken Buck
Sandia/California
5371

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Aerodynamic Modelling Methodology and Trajectory Simulations for HPRF Phase 2 Study

USAF
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Presentation for: System Engineering Working Group
Location: Sandia National Laboratories, Livermore, Ca

September 15, 1993

Sandia National Laboratories

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Analysis Methodology

Sandia National Laboratories

Engineering Sciences Center

OBJECTIVE:

- Determine the effect of Aerodynamic Forces during atmospheric reentry on the RV's attitude at small and large angles of attack.

The RV must maintain a fixed orientation during reentry through gyroscopic stability.

METHODOLOGY

- Develop a Six Degree of Freedom Aerodynamic Model encompassing three distinct flow regimes
- Compute Six Degree of Freedom Trajectory Simulations for various initial conditions (orientation, trajectory, spin rate)

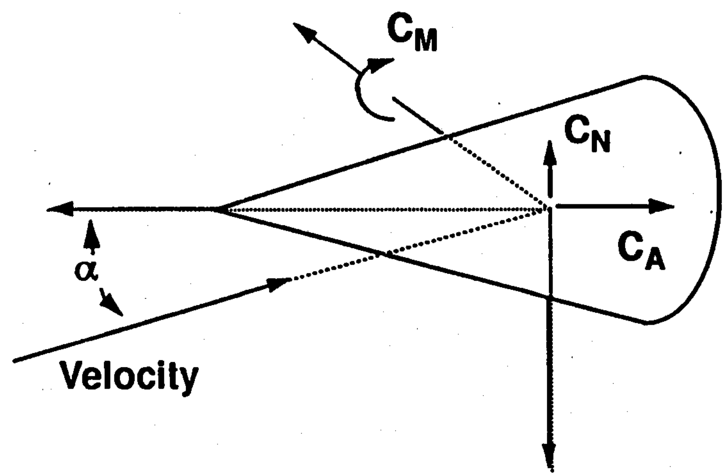
  AMEER (Aero-Mechanical Equations Evaluation Routines Code)

9/13/93 /home/mwknisk/Projects/hprl/hprl_091493.vg

Aerodynamic Coordinate System

Sandia National Laboratories

Engineering Sciences Center



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Aerodynamic Modelling

Sandia National Laboratories

Engineering Sciences Center

Aerodynamic Flow Regimes and Methods:

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53

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63

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HPRF Phase 2 Study

63

Kim W. Mahin
Sandia/California
5371

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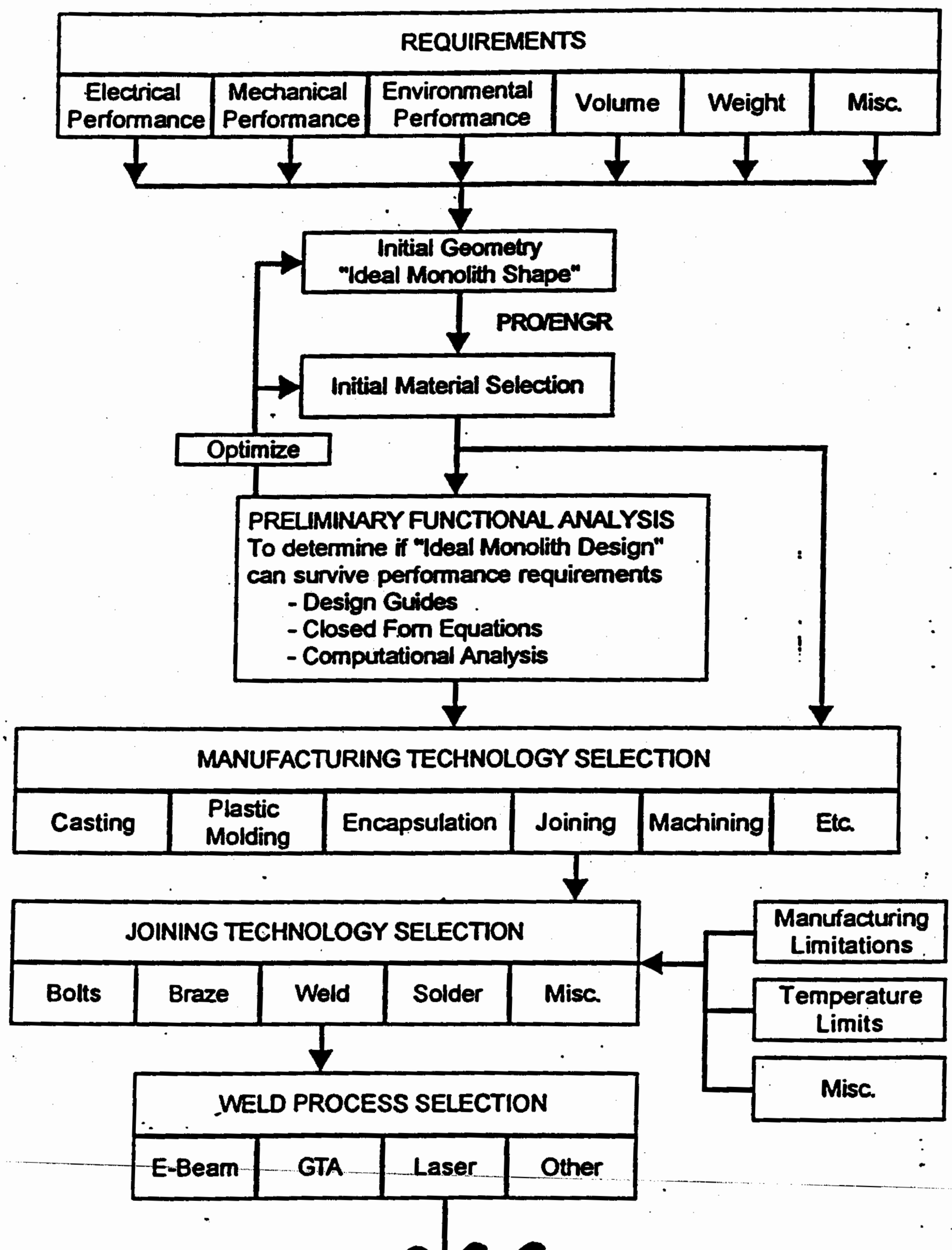
Agile Manufacturing
SMARTWELD

RS5371/930100



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Fabrication of Welded Assemblies in 1993

This type of production cycle costs U.S. industry over $7B a year in lost revenue.

Design Concept
- Geometry
- Material
- Performance / Tolerances

[redacted]

Product Development
- "Trial & error" definition of parameters
- Lab-based prototype

[redacted]

"Bandaid" Cycle
- Rework / redevelopment

10-15%

Quality
- Inspected in

Manufacturing Floor
- Process schedule redevelopment on production equip.
- Limited automation or feedback control

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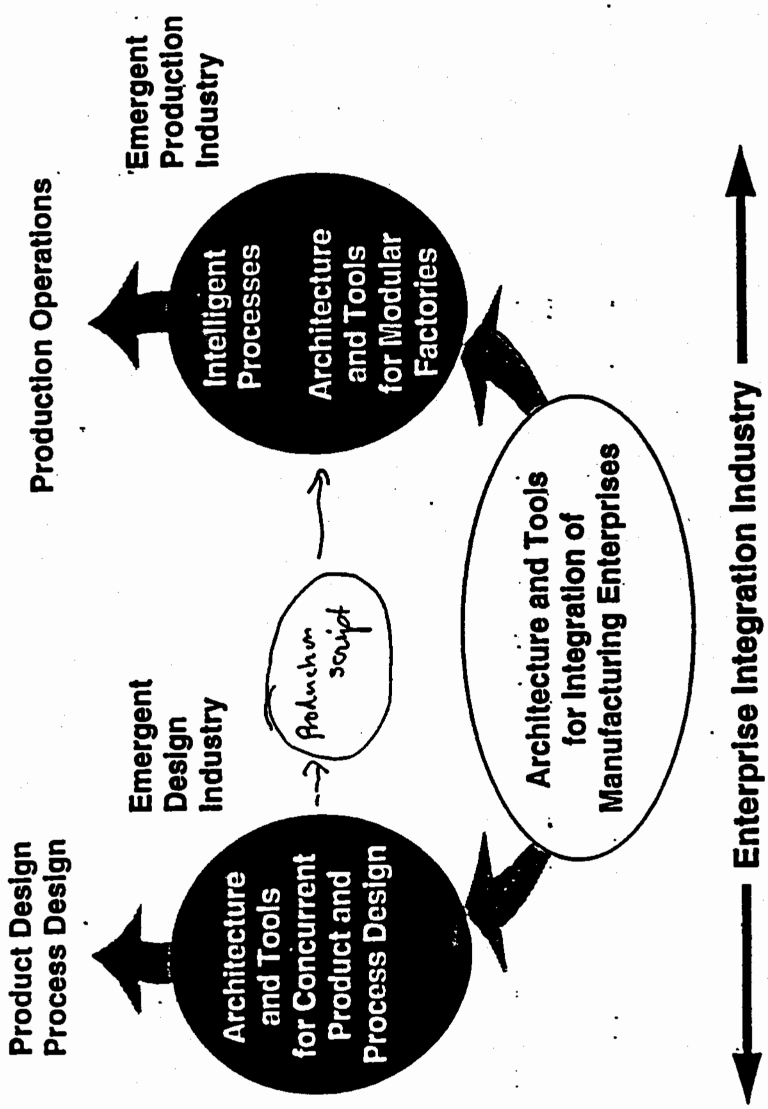
The Information-Technologies-for-Manufacturing Industry



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SMARTWELD

Vision: An innovative, computerized system for concurrently engineering both the product and the process for optimum manufacturability.

MISSION: To integrate our expertise in computer aided design, information networking, process simulation, process optimization and machine controls to facilitate more rapid decision-making, ensure process quality and reduce product realization times and costs.

Features

- Distributed design and analysis
- Common, shared databases - materials, process, weld design
- Integrated communications infrastructure - CAD, analysis, controls
- Optimization Schemes for control and analysis
- Knowledge base system for welded design
- Learning Paths - refinement of predictive models
- Information Management (PDM)

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General SMARTWELD Flow Sequence - PHASE 1

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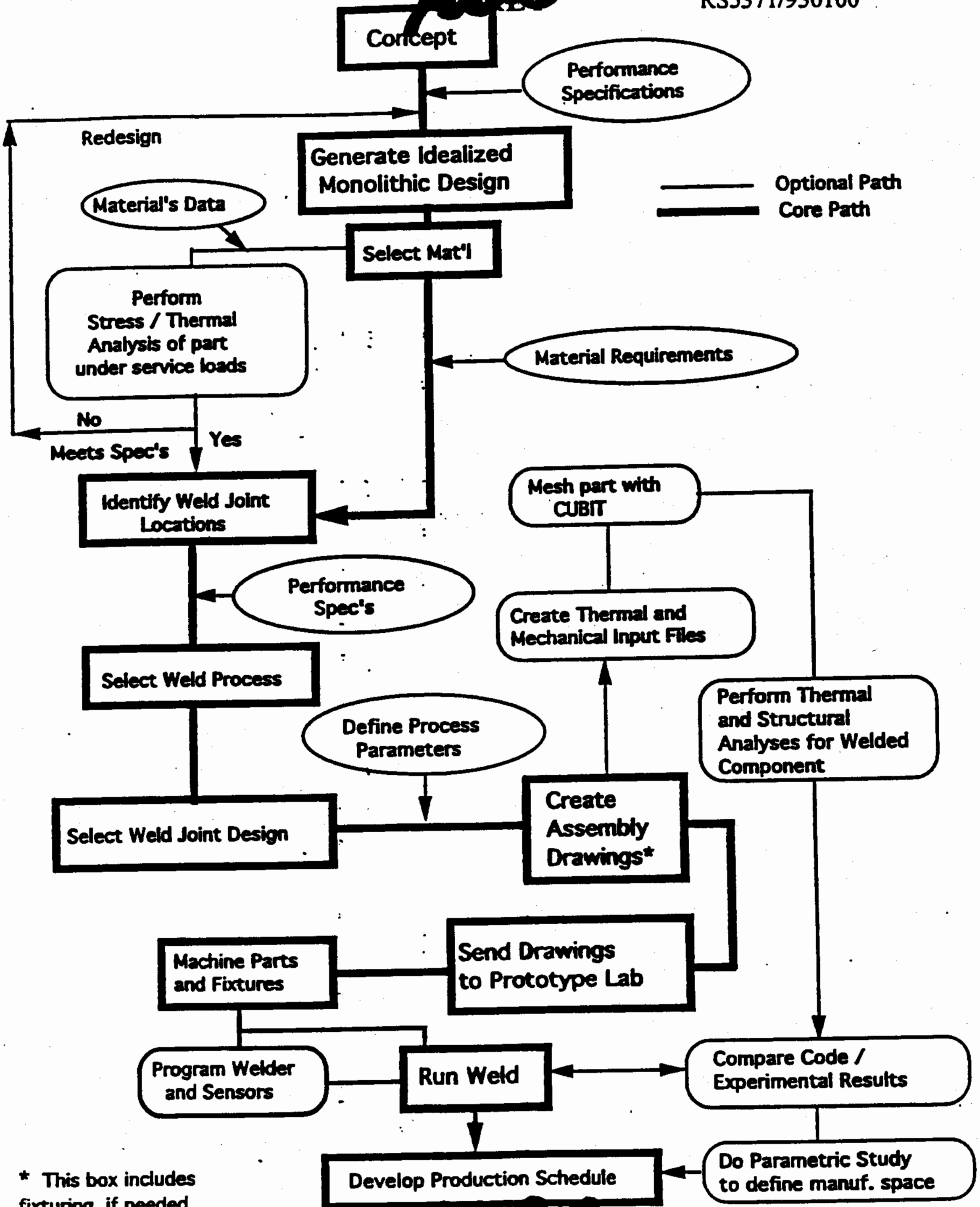

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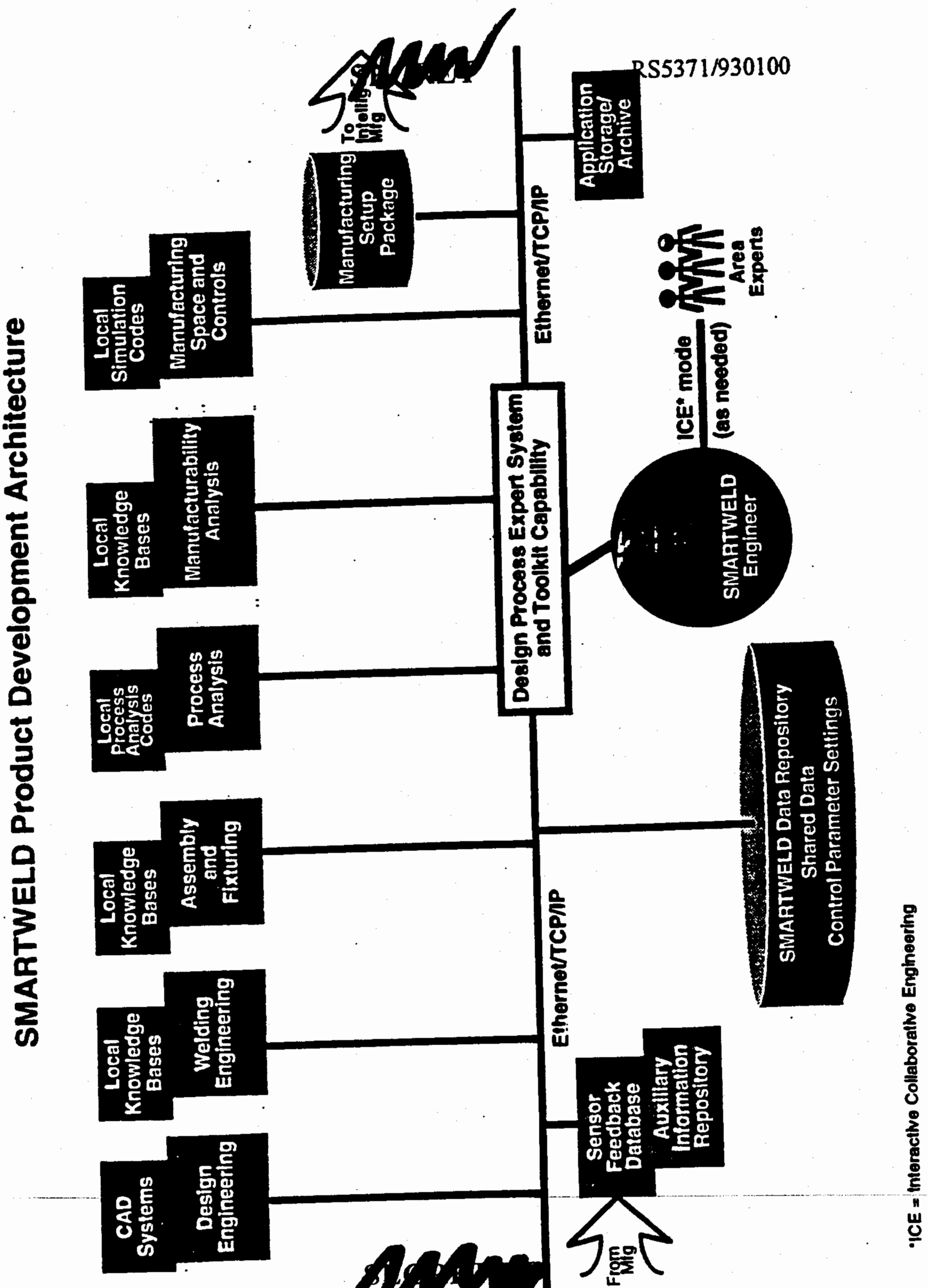

APPENDIX E

(U) REQUIREMENTS WORKING GROUP

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MINUTES

HIGH POWER RADIO FREQUENCY
REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER 1993

NUCLEAR SYSTEMS ENGINEERING DIRECTORATE
AERONAUTICAL SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND
1651 FIRST STREET SE
KIRTLAND AFB NM 87117-5617

MINUTES

HPRF REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER 1993

TABLE OF CONTENTS

SECTION | PAGE

APPENDICES

MINUTES
HPRF REQUIREMENTS WORKING GROUP MEETING 93-3
14 SEPTEMBER 1993

I. INTRODUCTION. The High Power Radio Frequency (HPRF) Requirements Working Group Meeting 93-3 was held 14 September 1993 at Sandia National Laboratories (SNL), Livermore, California.

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Attendees introduced themselves and identified their organizations. The attendance list and working group membership are included in Appendices A and B, respectively.

II. TOPICS OF INTEREST.

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The draft HPRF WXX MCs were distributed on 1 September 1993, but only two working group members received them prior to this meeting. The MCs were reviewed for major gaps and for specific information which may not apply to the HPRF mission. Special nuclear material, limited life component exchange, use control and reliability were the specific areas discussed at this meeting.

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Working group members have until 7 October 1993 to mail detailed comments on the draft HPRF WXX MCs so OL-NS/EN receives them by 15 October 1993. The detailed comments will be incorporated into a second draft of the HPRF WXX MCs to be reviewed by working group members on 3-4 November 1993 at OL-NS/EN. The 3-4 November 1993 meeting is scheduled based upon receiving all comments by 15 October 1993.

B. Stockpile-To-Target Sequence (STS). The HPRF WXX STS was not discussed at this meeting. Copies of the current HPRF WXX STS Draft #2 developed early in Phase 2 will be sent to all working group members and chairs of the other HPRF Working Groups by 15 October 1993. Draft #3 of the HPRF WXX STS is planned for completion in early 1994. The System Engineering Working Group requested a status on the radiation environments requirements at their next meeting in October-November 1993.

C. Old Action Items. Five previous action items were closed and one remains open.

1. AI 93-2-1 to OL-NS/ENN: Check to see whether the W62 MCs should be used as a specific reference to the MCs. The W62 MCs were included as a reference to the draft HPRF WXX MCs. Action item is **closed.**

2. AI 93-2-2 to OL-NS/ENN: Mail W62, W78, W87 and W91 MCs to working group members for review. These MCs were mailed to all working group members for use in the draft HPRF WXX MCs review. Action item is **closed.**

3. AI 93-2-3 to OL-NS/ENN: Create first draft of MCs using relevant MCs and distribute to members for review. Put the source of requirements in parentheses after each paragraph. The first draft was documented and distributed to all working group members on 1 September 1993. Action item is **closed.**

4. AI 93-2-4 to OL-NS/ENN: Check to see if there is any tasking from the other working groups that would affect the MCs or the MCs' schedule. There was no tasking by the other working groups which affected the MCs or the MCs' schedule at the time this action item was assigned. Action item is **closed.**

5. AI 93-2-5 to Working Group Members: Review the first MC draft distributed on 1 September 1993 and provide comments at the 14-16 September 1993 meeting at SNL. Tasking was revised: comments will be mailed on 7 October 1993 to be received by OL-NS/EN on 15 October 1993. Action item still remains **open. Suspense: 7 October 1993.**

6. AI 93-2-6 to OL-NS/ENN: Investigate use control requirements. i.e., PAL, etc. Request for use control requirements has been forwarded to the HPRF Surety Working Group. Action item is **closed.**

D. New Action Items. One new action item was assigned at this meeting.

AI 93-3-1 to Requirements Working Group: Provide status at next System Engineering Working Group on MCs' Use Control and STS' Radiation Environments requirements. **Suspense: October-November 1993 timeframe.**

III. NEXT MEETING. The next HPRF Requirements Working Group meeting will be held 3-4 November 1993 at OL-NS/EN, Kirtland Air Force Base, New Mexico to review the second draft of the HPRF WXX MCs. .

APPENDIX A

ATTENDANCE LIST

MINUTES
HPRF REQUIREMENTS WORKING GROUP MEETING 93-3
14 SEPTEMBER 1993
ATTENDANCE LIST

NAME	ORGANIZATION	TELEPHONE
ADAMS, Jerry	SNL NM/5161 PO Box 5800 Albuquerque NM 87185-5800	DSN: COMM: 505-844-1914 STU III: FAX: CFAX:
ADE, Edward LCDR, USN	FCDNA/FCPR 1680 Texas Street SE Kirtland Air Force Base NM 87117-5669	DSN: COMM: 505-846-8737 STU III: FAX: CFAX:
BARRY, William R	OL-NS/ENX1 1651 First Street SE Kirtland Air Force Base NM 87117-5617	DSN: 246-9772 COMM: 505-846-9772 STU III: FAX: CFAX:
CARRILLO, Francisco	OL-NS/ENN 1651 First Street SE Kirtland Air Force Base NM 87117-5617	DSN: 246-6767 COMM: 505-846-6767 STU III: 505-846-6767 FAX: 505-846-2036 CFAX: 505-846-6767
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FAAS, Scott E	SNL CA/5371 PO Box 969 Livermore CA 94550-0969	DSN: COMM: 510-294-2287 STU III: FAX: 510-294-1015 CFAX:

MINUTES

HPRF REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER 1993

ATTENDANCE LIST

NAME	ORGANIZATION	TELEPHONE
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KEENE, Frederick W	TRW (523/310) PO Box 1310 San Bernardino CA 92402-5000	DSN: 876-3273 COMM: 909-382-3273 STU III: FAX: 909-382-6461 CFAX:
KROPF, Roger Lt Col, USAF	OL-NS/ENX4 1651 First Street SE Kirtland Air Force Base NM 87117-5617	DSN: 246-9575 COMM: 505-846-9575 STU III: FAX: CFAX:
MORGAN, Michael Capt, USAF	AFSPACECOM/DOM 150 Vandenberg Street Peterson Air Force Base CO 80914-4730	DSN: COMM: 719-554-5428 STU III: FAX: CFAX:
OISHI, Kazuo	SNL NM/5161 PO Box 5800 Albuquerque NM 87185-5800	DSN: COMM: 505-844-0159 STU III: FAX: 505-844-8745 CFAX:
RAFFERTY, James Michael	ORION International Technologies, Incorporated 6501 Americas Parkway NE Suite 200 Albuquerque NM 87110-5372	DSN: COMM: 505-881-2500 STU III: FAX: 505-869-5060 CFAX:

MINUTES

HPRF REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER 1993

ATTENDANCE LIST

NAME	ORGANIZATION	TELEPHONE
RUEB, Karl	DOE AL/WPD PO Box 5400 Albuquerque NM 87185-5400	DSN: 245-5189 COMM: 505-845-5189 STU III: FAX: 505-845-5188 CFAX:
VILLAREAL, Kenneth	OL-NS/ENN 1651 First Street SE Kirtland Air Force Base NM 87117-5617	DSN: 246-6767 COMM: 505-846-6767 STU III: 505-846-6767 FAX: 505-846-2036 CFAX: 505-846-6767
WHITTED, Edward	LANL/A-5 Mail Station 5000 (Classified) Mail Station F602 PO Box 1663 Los Alamos NM 87545-1663	DSN: COMM: 505-665-0038 STU III: FAX: CFAX:
WOJTOWICZ, Deborah	LLNL/A Division PO Box 808 Livermore CA 94550-0808	DSN: COMM: 510-423-9000 STU III: FAX: CFAX:

APPENDIX B

WORKING GROUP MEMBERS LIST

USAF b(1)

DISTRIBUTION

MINUTES

HPRF REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER

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APPENDIX F

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RS5371/930104

Shielding Calculation (U)

Presented to:
HPRF Phase Three Working Group
Sandia National Laboratory California

14 September 1993

Shawn Cantlin
Lawrence Livermore National Laboratory

[redacted]

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

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Outline

RS5371/930104

I. Introduction

II. Bottom Line

III. Calculational Model

- A. Code
- B. Geometry
- C. Source
- D. Tally Scheme
- E. Problem Set

IV. Results

V. Conclusions

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APPENDIX G

(U) MISSION ANALYSIS WORKING GROUP

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