CANCELLATION NOTICE

Safety and Mission Assurance Readiness Review (SMARR) Process

(OSMA-SMARR-05-01)

Safety and Mission Assurance

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SAFETY AND MISSION ASSURANCE READINESS REVIEW (SMARR)

PROCESS

OSMA-SMARR-05-01

May 2005

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1.0 Introduction

1.1 Purpose/Background

This document defines the process for performing a Safety and Mission Assurance Readiness Review (SMARR). The document also identifies the responsibilities of the various participants and provides several common templates to be used in the SMARR briefing.

The SMARR is a NASA Headquarters Safety and Mission Assurance (SMA) review that is held for the Chief SMA Officer to independently assess, from an SMA perspective, the readiness to proceed with selected high-risk program or project activities. The SMARR provides the basis for the Chief SMA Officer or a designee to knowledgeably and confidently sign the Certification of Flight Readiness, or to issue a recommendation to the appropriate Mission Directorate Associate Administrator to proceed with the activity.

The SMARR is held prior to NASA Human Space Flight (HSF) and Expendable Launch Vehicle (ELV) launches and selected Experimental Aerospace Vehicle (EAV) flights. The Chief SMA Officer may also request a SMARR prior to other SMA-critical program or project activities, including Test Readiness Reviews, Design Certification Reviews, and Extravehicular Activities, or may delegate authority to conduct the senior NASA SMA review prior to a selected activity.

The SMARR is designed to:

1. Affirm that assurance processes have been implemented over the life of the program and verify compliance with the applicable baseline requirements set relevant to the program or project activity;
2. Identify and evaluate the SMA residual risks for this program or project activity;
3. Provide a forum to address program, alternate, and minority opinions;
4. Poll the SMA mission stakeholders for concurrence or nonconcurrence with a recommendation to proceed.

Other issues addressed at the SMARR include an examination of preparation status, open work, issues and concerns, and an assessment of overall systems readiness.

Data presented at the Headquarters SMARR is developed by program SMA organization(s), lead Center SMA organization(s), SMA Panels, the Review and Assessment Division (RAD) Institutional/Facility/Operational audit team, the RAD Programmatic Audit and Review (PA&R) team, individuals with minority opinions, and other SMA mission stakeholders.

The SMARR is consistent with the Columbia Accident Investigation Board recommendations for SMA reviews prior to a major program or project activity.

1.2 Scope

This process document defines the preparation, conduct, and follow-up procedures required to complete a SMARR. In addition, the document identifies the responsibilities of the various participants and contains several common templates to provide consistency in the assessment and reporting activities of the SMA organizations at the SMARR.

1.3 Applicability

This process applies to NASA programs, projects, and SMA Organizations with responsibilities in the design, development, manufacturing, processing, integration, test, assessment, and operation of flight and ground hardware and software.

1.4 Authority

42 U.S.C. 2473(c)(1), Section 203(c)(1) of the National Aeronautics and Space Act of 1958, as amended.

NPD 1000.3, The NASA Organization, paragraph 4.6, Chief Safety and Mission Assurance Officer.

NPD 8700.1, NASA Policy for Safety and Mission Success, paragraph 5.c.(6).

NPD 8700.2, NASA Policy for Safety and Mission Assurance (SMA) for Experimental Aerospace Vehicles (EAV).

NPD 8700.3, Safety and Mission Assurance (SMA) Policy for NASA Spacecraft, Instruments, and Launch Services, paragraph 5.a.(3).

NPR 8715.3, NASA Safety Manual, paragraph 1.11.9.

NASA STD 8709.2, NASA Safety and Mission Assurance Roles and Responsibilities for Expendable Launch Vehicle Services.

1.5 Acronyms

EAV	Experimental Aerospace Vehicle
ELV	Expendable Launch Vehicle
FRR	Flight Readiness Review
HSF	Human Space Flight
IA	Independent Assessment
IV&V	Independent Verification and Validation
KSC	Kennedy Space Center
MSD	OSMA Mission Support Division
MSFC	Marshall Space Flight Center
NESC	NASA Engineering and Safety Center
OSMA	Office of Safety and Mission Assurance

PA&R	Programmatic Audit and Review
PR	Problem Report
RAD	OSMA Review and Assessment Division
SARD	OSMA Safety and Assurance Requirements Division
SMA	Safety and Mission Assurance
SMARR	Safety and Mission Assurance Readiness Review

1.6 Definitions/Descriptions

Independent Assessment (IA) – The IA is a group of SMA experts supporting the Chief SMA Officer and SMA Directors at Johnson Space Center, Kennedy Space Center (KSC), and Marshall Space Flight Center (MSFC).

Independent Verification and Validation (IV&V) - The NASA IV&V Facility is responsible for independent verification and validation of NASA safety/mission-critical software for NASA programs and projects.

NASA Engineering and Safety Center (NESC) - The NESC improves safety by performing in-depth independent engineering assessments, testing, and analysis to uncover technical vulnerabilities and to determine appropriate preventive and corrective actions for problems, trends, or issues within NASA's programs, projects, and institutions.

Risk – Risk is characterized by the combination of the probability that a program or project will experience an undesired event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological breakthrough or mission success criteria) and the consequences, impact, or severity of the undesired event, were it to occur (NPR 8000.4, "Risk Management Procedural Requirements").

SMA Residual Risk – Any change from the accepted technical baseline that increases or introduces new risk to safety or mission success.

SMA Mission Stakeholders – Includes individuals and organizations supporting SMA activities related to the specific activity under review (e.g., Program SMA, Center SMA, Crew Office), the NASA Technical Authority, independent assessment organizations (e.g., Center SMA IA offices, the Supplier Assurance Contract, IV&V, NESC), and individuals with minority opinions.

1.7 Cancellation

OSMA-IMAR-POP-03-03, Science Mission Safety and Mission Assurance Prelaunch Integrated Mission Assurance Review (IMAR) Process Operating Plan, dated March 2003.

QE-HEDS-01-01, Safety and Mission Assurance (SMA) Processes for Human Space Flight Missions, dated March 2001.

2.0 SMARR Process

The SMARR is typically held between 2 weeks and 1 month prior to the selected critical program or project activity.

SMARRs for HSF launches are generally scheduled prior to both the Stage Operations Readiness Review and the Flight Readiness Review (FRR).

SMARRs for ELV launches are scheduled prior to the FRR. The SMARR usually follows both the Mission Readiness Review and the Launch Vehicle Readiness Review.

SMARRs for EAV flights and other activities are scheduled based on an agreement between the program or project and the SMARR Manager.

2.1 Chief SMA Officer Determines Need for SMARR

The SMARR is held prior to all NASA HSF and ELV launches and selected EAV flights. For other specific activities, the decision to conduct a SMARR is made by the Chief SMA Officer based on cost, complexity, and risk. The program will be notified by the Chief SMA Officer when an activity has been determined to require a SMARR. The Chief SMA Officer may also delegate SMARR responsibilities to a Center SMA organization or may waive the requirement to conduct a SMARR on some programs or projects.

2.2 SMARR Preparation

Preparation for the SMARR requires close coordination among NASA Headquarters and the participating programs or projects, Centers, and SMA organizations. The SMARR Manager schedules a series of SMARR preparation meetings to accomplish this task. The SMARR preparation meeting is also known as the "Lorraine."

2.2.1 SMARR Preparation Meetings

The SMARR Manager will conduct an initial SMARR preparation meeting with appropriate program or project SMA managers and other SMA mission stakeholders to discuss scheduling and content for the SMARR. SMARR preparation meetings include an initial identification and discussion of topics to be added to the SMARR agenda. For HSF launches, SMA mission stakeholders prepare a list of potential topics for the SMARR, which are distributed to all participants 1 week prior to the first preparation meeting. Selection criteria for the topics are as follows:

- Items representing residual risk to safety or mission success for the upcoming activity (SMA residual risk).
- Any item an individual wishes to present as a minority opinion.

- Items requested by the Chief SMA Officer.
- Any item which will be raised at the FRR or Launch Readiness Review, as applicable.

SMARR preparation meetings are also used to identify presenters and individuals to be polled at the SMARR. Additional preparation meetings will be scheduled, as necessary, to refine the list of topics and presenters.

2.2.2 SMARR Presentation Preparation

The program or project SMA managers and other SMA mission stakeholders provide a draft version of the SMARR presentation to the SMARR Manager no later than 7 business days before the SMARR. The SMARR Manager then provides any comments or suggested revisions to the draft presentation no later than 5 business days prior to the SMARR. The final presentations from each organization are submitted to the SMARR Manager no later than 2 business days before the SMARR. The SMARR Manager then consolidates the presentations and distributes the package the day before the SMARR.

2.2.3 Pre-Brief to Chief SMA Officer

The SMARR Manager and the Headquarters OSMA Mission Support Division Representative may review with the Chief SMA Officer the list of risk items to be addressed at the SMARR.

2.3 SMARR

The SMARR is a voice-recorded review chaired by the Chief SMA Officer or a designee.

At the end of the SMARR, the SMARR Manager reviews any action items assigned. The Chief SMA Officer then conducts a readiness poll. Individuals identified at the SMARR preparation meetings (section 2.2.1) are asked to agree or disagree with the following statements:

- I affirm that residual risks within my area of expertise and responsibility have been fully addressed at this SMARR.
- Within my area of responsibility, and pending satisfactory completion of open work, I recommend that the Chief SMA Officer concur with proceeding with this activity.

If any polled individuals disagree with the above statements, the Chief SMA Officer will take action based on the specific circumstances.

2.4 SMARR Follow-up and Close-out

All action items assigned during the review will be tracked to closure. Action items are closed when the SMARR Manager receives evidence of completion and concurrence by the Chief SMA Officer or a designee. Minutes will be kept for the review.

3.0 SMARR Roles and Responsibilities

3.1 *Chief SMA Officer*

- Identifies program and project activities which will have a SMARR.
- Directs the implementation of the Headquarters SMARR.
- Selects a SMARR Manager for Headquarters SMARRs.
- Chairs each Headquarters SMARR and conducts a readiness poll of selected SMARR participants to solicit concurrence or nonconcurrence with a recommendation to proceed.
- Delegates above responsibilities to another SMARR chairperson, when appropriate.

3.2 *Headquarters OSMA Mission Support Division Representatives*

- Identify topics, including SMA residual risks, which should be discussed by the program or project SMA managers and other SMA mission stakeholders during the SMARR.
- Participate in the SMARR preparation meeting(s) and the SMARR.
- Participate in the pre-brief to the Chief SMA Officer.
- Participate in the SMARR readiness poll.
- Checks the NASA Safety Reporting System (NSRS) database for minority opinions related to the upcoming activity.

3.3 *SMARR Manager*

- Coordinates with the Headquarters SMA Mission Support Division Representatives, the program and project SMA managers, and other SMA mission stakeholders to identify participants in the SMARR preparation meeting(s) and to establish an appropriate schedule for the preparation meeting(s) and the SMARR.
- Conducts the SMARR preparation meeting(s).
- Participates in the pre-brief to the Chief SMA Officer.
- Facilitates the SMARR.
- Reviews SMARR presentation packages, seeking rigor, completeness, consistency, and a thorough presentation of risks and risk acceptance rationale.
- Identifies the appropriate members of the SMARR polling group.

3.4 *Program or Project SMA Managers*

- Help to identify all independent organizations which have assessed portions of the program or project.
- Identify topics of interest and residual risks.

- Provide draft and final versions of the program or project presentation material to the SMARR Manager. This includes, at a minimum, a risk one-pager for each significant SMA residual risk.
- Provide draft and final versions of the program/project presentation material to the SMARR Manager.
- Participate in the SMARR preparation meetings and the SMARR.
- Participate in the SMARR readiness poll.
- For HSF launches, prepare a list of potential topics for the SMARR preparation meetings.

3.5 *Independent Assessment Organizations*

- Identify program/project assessments conducted by their respective organizations and present a summary of these assessments at the SMARR.
- Describe any significant SMA residual risks which represent a departure from the program/project opinion.
- Provide draft and final versions of the independent organization's presentation material to the SMARR Manager. This includes, at a minimum, a risk one-pager for each SMA residual risk where the individual or organization's opinion differs from the program or project.
- Present the independent organization's material at the SMARR.
- Participate in the SMARR readiness poll.
- For HSF launches, prepare a list of potential topics for the SMARR preparation meetings.

3.6 *Mission Support Organizations and Minority Opinions*

- Describe any significant SMA residual risks which represent a departure from the program/project opinion.
- Provide draft and final presentation material to the SMARR Manager. This includes, at a minimum, a risk one-pager for each SMA residual risk where the individual or organization's opinion differs from the program or project.
- Present material at the SMARR.
- Participate in the SMARR readiness poll.
- For HSF launches, prepare a list of potential topics for the SMARR preparation meetings.

3.7 *Other Participants*

The following individuals or their designees may also be required to participate in the SMARR and/or SMARR preparation meetings, including the SMARR readiness poll, as notified by the SMARR Manager:

- SMA Directors or SMA Managers from Centers participating in the upcoming activity (participants include spacecraft, payload, launch vehicle, etc.).
- KSC Range Safety Officer.
- NASA Technical Authority systems safety warrant holder.

- Astronaut Office Safety Branch Chief.
- Chief Health and Medical Officer.

Where applicable, the following individuals are encouraged to participate in the SMARR and/or SMARR preparation meetings:

- Headquarters OSMA Mission Support Division Director.
- Headquarters OSMA Review and Assessment Division Director.
- Headquarters OSMA Safety and Assurance Requirements Division Director.
- Headquarters Program Executive Officer/Project Executive Officer.
- Representatives from the Aircraft Office.
- Representatives from NASA Safety Review Panels.
- Program or project managers and/or representatives.
- Contractor representatives, as designated by the program or project SMA lead.

4.0 SMARR Presentation Specifications

The SMARR attempts to standardize the presentation format across multiple programs and projects. During the SMARR preparation meetings, the SMARR Manager distributes a presentation template to all participants and presenters. The template will undergo continuous process improvement and may change between reviews, upon agreement of the SMARR Manager. Several important features of the review are identified in the following sections.

4.1 Assurance Process Map and Matrix

The Assurance Process Map and Matrix are used to identify the SMA organizations and activities associated with a particular program or project. Starting with top-level SMA requirements identification, the Assurance Process Map shows the flow-down of assurance activities from Headquarters to NASA Centers, programs or projects, contractors, and individual flight elements. The map also identifies the in-line and independent SMA organizations that have performed Safety, Reliability, Maintainability, and Quality Assurance activities to assure verification and validation of requirements. Each assurance activity is identified by a numbered assurance vector, which is then described in detail on the assurance process matrix. The matrix includes a summary of the assurance activity, the life cycle phases involved, the SMA organization, including the level of independence and level of penetration associated with the organization's activity, and the individual leading the activity. Examples of existing assurance process maps and matrices are available by contacting the SMARR Manager.

4.2 SMA Responsibility Matrix

The SMA Responsibility Matrix identifies the key personnel and organizations contributing to or having information related to the SMA work performed on the program or project. The matrix identifies the person responsible in each organization for each element of the program or project. Both the life cycle

elements and the organizations differ for each program or project. Figure 4.2-1 represents a sample SMA Responsibility Matrix.

	Program SMA	Center SMA	IA	NESC	IV&V	PA&R	Crew	Minority Opinions
Systems Effectiveness Program Plan	Name Location Phone Number				Name Location Phone Number	Name Location Phone Number	Name Location Phone Number	
Quality Assurance Requirements	Name Location Phone Number			Name Location Phone Number	Name Location Phone Number			Name Location Phone Number
Hardware Design and Engineering	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number			Name Location Phone Number	Name Location Phone Number	
Hardware Design Verification and Test	Name Location Phone Number			Name Location Phone Number		Name Location Phone Number	Name Location Phone Number	
Software Design	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number			
Software Verification and Test	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number		Name Location Phone Number			
Production	Name Location Phone Number						Name Location Phone Number	
Production Test	Name Location Phone Number	Name Location Phone Number			Name Location Phone Number	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number
Integrated Vehicle Assembly	Name Location Phone Number			Name Location Phone Number				
Integrated Vehicle Test	Name Location Phone Number	Name Location Phone Number	Name Location Phone Number				Name Location Phone Number	
Operations	Name Location Phone Number			Name Location Phone Number		Name Location Phone Number	Name Location Phone Number	
Spacecraft/Payload	Name Location Phone Number	Name Location Phone Number		Name Location Phone Number				
Range/Pad Safety	Name Location Phone Number		Name Location Phone Number					

Figure 4.2-1: Sample SMA Responsibility Matrix

4.3 *Assurance Activities Matrix*

The Assurance Activities Matrix summarizes the status of all SMA activities performed on the program or project to date. The list of activities is defined by the program or project SMA managers, with agreement from NASA Headquarters representatives. Each SMA activity is given a status of "Complete" or "In-work," and includes a short summary of the activity, as well as any significant, remaining open work. If any SMA residual risks are related to a particular activity, these are also noted on the matrix. A sample Assurance Activities Matrix for ELV launches is provided in Figure 4.3-1.

	Status	Summary	Residual Risks
Quality Assurance			
Software	*Complete or In Work*	*Summary of completed tasks and items still in work*	*Risks associated with assurance area (mapped to risk section)*
Hardware Problems/Problem Reports			
Alerts			
Quality Assurance/Inspections			
Reliability / Maintainability			
Failure Modes and Effects Analysis/ Critical Items List			
Reliability/Maintainability Assessment			
Limited Life Items			
Safety			
Hazards			
Contingency Planning			
Range Safety			
NASA Safety Reporting System			
Orbital Debris and Disposal Analysis			
SMA Integrated Activities			
Mission/Flight Rules			
Training			
Lessons Learned Review			
Risk Management			
Waivers/Deviations/Exceptions			

Figure 4.3-1: Sample Assurance Activities Matrix

4.4 Risk Matrix

At the SMARR, program and project safety and mission success risks are presented using color-coded matrices, as currently required by the project's or program's System Safety Plan, including a description of the likelihood and consequence criteria; this approach is used consistently throughout the presentation. Prior to the first risk matrix chart, the presenter provides the rating system for each axis. Example matrices for displaying safety and mission success risks include Figure 4.4-1, the hazard matrix for the Space Shuttle Program, and Figure 4.4-2, the program risk matrix for the ELV program.

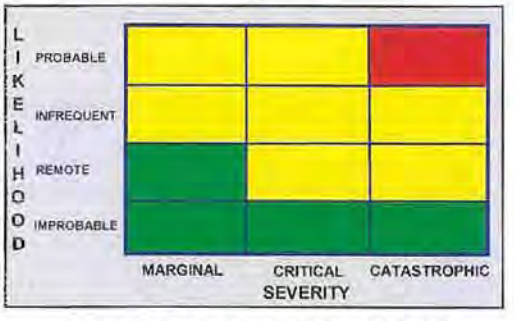

Figure 4.4-1: Shuttle Hazard Matrix

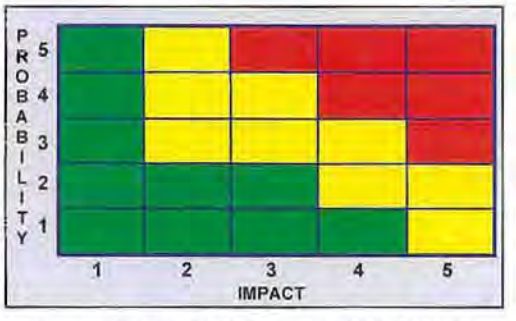

Figure 4.4-2: ELV Program Risk Matrix

4.5 Risk One-Pager

SMA residual risks and other identified risks are presented by the program or project SMA lead in a summary format. All minority opinions and alternate opinions from SMA mission stakeholders are also required to present in this format. The risk one-pager identifies a number of characteristics related to the risk, including:

- Risk Title.
- Risk Type (safety or mission success).
- Risk Score (on a program or project risk matrix).
- Hazard Report/Criticality Designation (if applicable).
- Organization Accepting Risk (person or organization presenting minority opinion presents a separate risk one-pager).
- Assigned Personnel.
- Independent Assessors (identifies all organizations which have performed independent assessments evaluating this risk).
- Risk Description Statement.
  - Conditions, Causes, Effects, Consequences, etc.
- Risk Mitigation Actions.
- Constraints to Upcoming Activity.
- Recommendation/Rationale.

Figure 4.5-1 depicts a sample risk one-pager.

RISK TITLE

RISK TYPE: *Safety or Mission Success*
HAZARD REPORT: *Hazard Report Number*
CRITICALITY: *Criticality Designation (I, II, III, IV)*
ORGANIZATION: *Organization Accepting Risk*
ASSIGNED TO: *Name and Location of Presenter*
INDEPENDENT ASSESSORS: *Independent Assessors/Alternate Opinions*

X: Consensus Risk Assessment

RISK DESCRIPTION/STATEMENT:
Description of the risk, including conditions, causes, effects, consequences, etc.

RISK MITIGATION ACTIONS:
Actions taken to reduce the risk associated with this issue.

CONSTRAINTS:
Constraints associated with this risk that could adversely affect proceeding with the activity.

RECOMMENDATION/RATIONALE:
Recommendation to accept or not accept this risk, including a summary of the rationale which led to this conclusion.

Figure 4.5-1: Sample Risk One-Pager

4.6 Risk Summary

The Risk Summary is a matrix of all risks presented in the SMARR, using the same format as is used in the risk one-pagers. The program or project SMA organization is responsible for integrating the risk positions from all elements providing direct or matrixed support to the program or project. The SMARR

Manager augments the matrix to incorporate the positions of other SMA mission stakeholders. Figure 4.6-1 displays a sample risk summary.

S = Safety M = Mission Success Residual Risks	Accountable Reviewing Organizations							
	Program SMA	Center SMA	IA	NESC	IV&V	PA&R	Crew	Minority Opinions
1 *Risk Title*	M							
2 *Risk Title*	S		S					S
3 *Risk Title*	M							
4 *Risk Title*	S							
5 *Risk Title*					M			
6 *Risk Title*				M				

Figure 4.6-1: Sample Risk Summary

4.7 Lessons Learned Summary

Lessons learned from this activity, which can be shared for the benefit of future programs or projects, are summarized. The summary table includes, at a minimum, a title, a short summary of the lesson learned, and any actions taken as a result of the lesson learned.