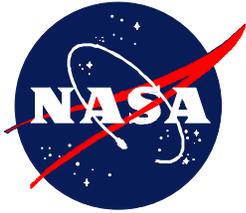


UnESS Reviews, Risk Management, Red Team Process

**David Pierce
GSFC
December 18, 2000**



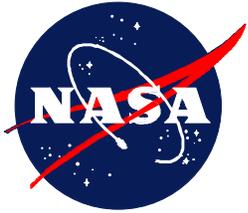
Topics

- PI-Mode Management Responsibility**
- Safety and Mission Assurance**
- Reviews**
 - **Peer reviews**
 - **Systems Level Reviews**
- Red Team Reviews**
- Red Team Concept**
- Red Team Specific Targets**
- Red Team 13 Point Criteria**
- Typical costs for NASA Integrated Action Team (NIAT) requirements**
- Examples of Red Team Charters for other Missions**



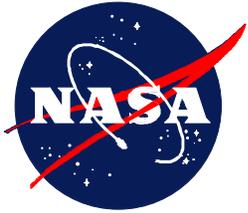
PI-Mode Management Responsibility

- ❑ The PI is responsible for mission scientific and programmatic success and safety.
- ❑ GSFC is responsible for ensuring the PI takes the appropriate actions to achieve mission success within his/her committed cost, schedule, and NASA requirements/constraints and to provide early warning if the PI heads outside this “box”.
- ❑ NASA system engineering participates as part of reviews and with the PI’s engineering team, as requested.
- ❑ NASA discipline engineering supports the NASA Project Manager and PI, as requested, with technical insight and troubleshooting.



Safety and Mission Assurance

- ❑ Each UnESS mission must plan and implement a comprehensive Safety and Mission Assurance program.
 - It must apply to all flight hardware, software, ground support equipment and mission operations.
 - It must include the following systems/processes:
 - design assurance
 - quality assurance
 - systems review
 - requirements verification
 - risk mitigation
 - mission readiness
 - integrated spacecraft / launch vehicle safety



PI Mode Reviews

Peer Reviews

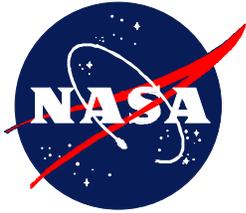
- The PI is responsible for Peer Reviews and to provide the results to the System Level Reviews.
- The PI is required to staff the Peer Reviews with independent, experienced, experts from outside the PI Team as well as Team members.

System Level Reviews

- GSFC is responsible for System Level Reviews and will assist in peer reviews as requested.
- The System Reviews will address the results of the Peer Reviews and the project responses, the interface issues and lastly the processes being followed by the project.

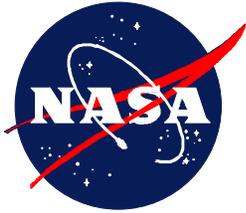
System Level Reviews

- **The UnESS System Level Review requirements are listed below. The Required Reviews originally outlined in the UnESS AO are followed with an (*):**
 - **Concept Review (*)**
 - **System Requirements Review (SRR)**
 - **Preliminary Design Review (PDR) (*)**
 - **Mission Design Review (MDR)**
 - **Mission Confirmation Review (MCR) (*)**
 - **Subsystem Peer Reviews**
 - **Critical Design Review (CDR)**
 - **Pre-Environmental Review (PER)**
 - **Pre-Ship Review (PSR)**
 - **Operational Readiness Review (ORR)**
 - **Flight Readiness Review (FRR)**
 - **Mission Operations Review (MOR)**
 - **Mission Readiness Review (MRR) (*)**
 - **Launch Readiness Review (LRR) (*)**



Red Team Reviews

- ❑ Risk Mitigation and Mission Readiness will be evaluated by GSFC and KSC through Red Team reviews.
- ❑ Red Team Reviews:
 - Red Team reviews will be implemented as part of the review process beginning at PSR.
 - The reviews will enhance the probability of mission success and will cover the following mission elements:
 - Spacecraft and instrument(s)
 - Mission operations
 - Launch vehicle integration
 - Mission-unique items for launch vehicle and mission operations



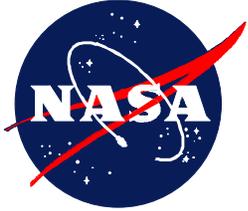
Red Team Concept

- ❑ **The Red Team will address the following mission elements to the specified levels:**
 - **Spacecraft/Instruments/Initial operations safety-Fully**
 - **Launch vehicle integration-Fully**
 - **Launch vehicle mission unique changes-Fully**
 - **Unique-to-project mission operations-Fully**
 - **Launch vehicle core design and implementation-On a mission/situation unique issues basis only**
 - **SOMO/institutional mission operations- On a mission unique issues basis only**
 - **Mission science operations-Limited to systems needed for science data capture**



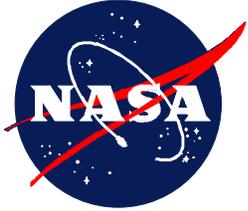
Red Team Review Specific Targets

- Technical Peer Review process conducted**
- System Review process conducted**
- Test and verification program (hardware and software) conducted**
- Mission assurance implementation**
- System management approach used**
- Project technical staffing**



Red Team Review Specific Targets (continued)

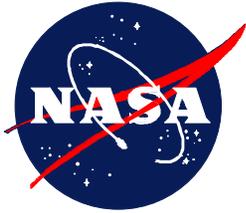
- Results of the integration and test program**
- Operating hours and failure free hours**
- Results of technical reviews (RFA's) (Peer and System Reviews)**
- Review and assessment of the project's subsystem level FMEA**
- Review and assessment of the project's Requirements Verification Matrix**



Red Team Review Specific Targets

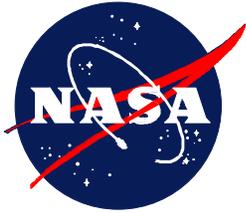
(continued)

- Review and assessment of all single point failure mechanisms**
- Review and assessment of the project's planned mission operations**
- Review of mission simulations done/planned**
- Review of launch vehicle integration done/planned**
- Review of launch vehicle mission unique changes**
- Launch vehicle currently applicable issues**



Red Team Criteria vs. UnESS AO Assessment

Red Team Criteria	UnESS AO Rating (Scale:1-10, with 10 being Med. Risk and 7 being nominal or High Risk)	Possible Mitigation If Rating 6 or Lower
1. The level, competence and independence of technical peer reviews that were performed or are planned on each of the elements and components.		
2. The performance, level and independence of system level reviews that were conducted or planned.		
3. The level and thoroughness to which the test and verification program was planned. The test and verification program at all levels from black box to spacecraft and integrated mission shall be detailed. This shall also include the V&V and IV&V processes used on software.		
4. The level of mission assurance that was imposed on the implementation of the mission. This shall include parts usage as well as workmanship standards imposed. It shall also address the software assurance processes implemented or planned.		



Red Team Criteria vs. UnESS AO Assessment

Red Team Criteria	UnESS AO Rating (Scale:1-10, with 10 being Med. Risk and 7 being nominal or High Risk)	Possible Mitigation If Rating 6 or Lower
5. The systems management imposed and implemented within the mission. This shall include the performance and thoroughness of analyses, requirement management, systems engineering, software metrics, configuration management, documentation and technical record-keeping and workmanship and test process management that has been implemented or planned.		
6. Factors such as staffing and the experience of the implementing organization.		
7. Plans for the test and integration process of all of the hardware and software elements of the mission. This shall include information on the review and assessment of all failures and anomalies and their resolution.		



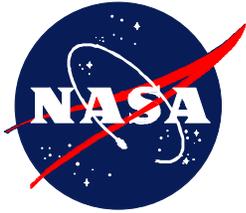
Red Team Criteria vs. UnESS AO Assessment

Red Team Criteria	UnESS AO Rating (Scale:1-10, with 10 being Med. Risk and 7 being nominal or High Risk)	Possible Mitigation If Rating 6 or Lower
8. Planned failure free hours as well as the total operating time on all mission critical hardware and software.		
9. The plans and results, if any to date, of the technical review process shall be assessed. It shall include an assessment of the planned tracking and closeout of all RFA's.		
10. The amount, level and fidelity of mission simulations and launch/operations training that is planned to be done to prepare the mission for launch and on orbit operations.		
11. Assess the subsystem level Failure Modes and Effects Analysis if available.		



Red Team Criteria vs. UnESS AO Assessment

Red Team Criteria	UnESS AO Rating (Scale:1-10, with 10 being Med. Risk and 7 being nominal or High Risk)	Possible Mitigation If Rating 6 or Lower
12. Evaluate the mission requirements Verification Matrix that shows the pre launch verification of the mission level requirements, if available. This matrix shall address both the fidelity and type of verification.		
13. Identify all single point failures and provide a subjective assessment of the probability of each such failure mode causing a mission failure. Also provide adequate rationale to substantiate the subjective assessment.		



NIAT Matrix Summary for UnESS Projects

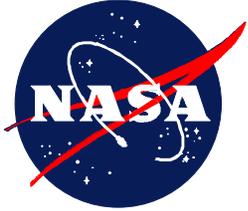
Typical costs for NASA Integrated Action Team (NIAT) requirements

PROJECT	1) HEALTH & SAFETY	2) DEVELOPMENT OF THE WORKFORCE	3) REVITALIZING ENGINEER. CAPABILITY	4) BALANCED TECHNOLOGY INVESTMENT STRATEGY	5) INTEG. TECHNOLOGY PLANNING PROCESS	6) TECHNOLOGY DEVEL. AND INFUSION	7) RISK ID, ASSESSMENT & MANAGEMENT	8) SAFETY AND MISSION ASSURANCE	9) SOFTWARE DEVEL. & ASSURANCE	10) REVIEWS	11) ENSURING ADEQUATE RESOURCES	12) FASTER, BETTER, CHEAPER	13) SURVEILLANCE	14) VERIFICATION AND VALIDATION	15) MANAGEMENT SUPPORT	16) ORGANIZATIONAL COMMUNICATION	17) KNOWLEDGE MANAGEMENT
UnESS-1	c	c	c	na	na	na	0.5	c	c	c	1	c	c	0.6	c	c	c
UnESS-2	c	c	c	na	na	na	0.5	c	c	c	1	c	c	0.6	c	c	c
Total							1				2			1.2			
	na = not applicable																
	c = compliant																
	0 = No \$ needed to become compliant																
	\$M = Cost to go funding required to become compliant																



Risk ID, Assessment and Management

- ❑ Rationale for the increased (\$1.0M) funding:
 - ❑ University Earth System Science (UnESS) missions are low cost, university scientific flight project missions. As such, the mandatory reviews called for originally were kept to the minimum.
 - ❑ The Required Reviews outlined in the UnESS AO are as follows:
 - Concept Review
 - Preliminary Design Review (PDR)
 - Mission Confirmation Review (MCR)
 - Mission Readiness Review (MRR)
 - Launch Readiness Review (LRR)
 - ❑ To ensure proper risk management of these small missions, other reviews will now be required such as:
 - System Requirements Review (SRR)
 - Subsystem Peer Reviews
 - Pre-Environmental Review (PER)
 - Flight Readiness Review (FRR)
 - Mission Operations Review (MOR)
 - Mission Design Review (MDR)
 - Critical Design Review (CDR)
 - Pre-Ship Review (PSR)
 - Operational Readiness Review (ORR)



Ensuring Adequate Resources

- ❑ Rationale for the increased (\$2.0M) funding:
 - ❑ UnESS missions were selected by Code-Y through the established an AO process without a 20% contingency reserve.
 - ❑ This mission class typically has contingency of less than 15% at project start for Phases A/B/C/D .

- ❑ To provide the baseline 20% contingency funding for each mission.



Software Independent Verification and Validation (IV&V)

- ❑ Rationale for the increased (\$1.2M) funding:
 - ❑ None of the UnESS missions were required in the AO to specify support for IV&V.
 - ❑ Both missions may require IA or IV&V using the NASA Selection Criteria.



More Information on Red Teams

- See the Earth Explorers Program Mission Assurance Guidelines & Requirements at the ESSP web site:

<http://essp.gsfc.nasa.gov/essplib/>

- Examples of Red Team charters are available on the UnESS Project web site:

<http://www.wff.nasa.gov/~code850/pages/uness.html>