



NASA ARMSTRONG FLIGHT RESEARCH CENTER AIRWORTHINESS AND FLIGHT SAFETY REVIEW PROCESS OVERVIEW

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OBJECTIVES

- Communicate the purpose of the AFRC airworthiness and flight safety review process
- Understand the operation of the AFRC airworthiness and flight safety review process

UPDATE



ARMSTRONG AFSR PROCESS APPLIED



One Process Many Applications



IMPLEMENTATION

- Per NASA Procedural Requirement 7900.3 - Aircraft Operations Management
 - “NASA maintains the level of airworthiness and aircraft/UAS operating standards that will ensure the safe operation of aircraft/UAS missions.”
 - “Center Directors shall **establish airworthiness**, flight safety, mission readiness, and configuration control review processes and procedures to **identify any hazards**, to **manage the risks** associated with flight programs, to **ensure safe flight operations**, to manage and thoroughly document aircraft configurations, and to ensure that flight objectives satisfy programmatic requirements.”



GOAL

- Provide a flexible, risk management based review system that...
 - Provides an airworthy vehicle that can be operated safely with the highest probability of mission success
 - Assesses, Communicates and Accepts the residual risks of vehicle test and operation

Injury Severity Classifications	Probability [Pr] Estimations				
	A: Expected to occur ($Pr > 10^{-1}$)	B: Probable to occur ($10^{-1} \geq Pr > 10^{-2}$)	C: Likely to occur ($10^{-2} \geq Pr > 10^{-3}$)	D: Unlikely to occur ($10^{-3} \geq Pr > 10^{-4}$)	E: Improbable to occur ($10^{-4} \geq Pr$)
I: Catastrophic					
II: Critical					
III: Minor					
IV: Negligible					
	DFRC Policy: Human Safety Primary Risks are NOT Accepted at the Center level. When considered, risk acceptance requires Center Director approval and will normally require higher authority approval. These are "Accepted Risks" only by exception.				
	Risk acceptance requires Center Director approval. These are "Accepted Risks".				
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Asset/Mission Severity Classifications	Probability [Pr] Estimations				
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FAILURE CAN BE AN OPTION: SAFETY VS RISK

- Safety and risk are often used interchangeably, but in the flight research world they mean different things.
- Our primary motivation is to do everything we can to ensure mission success, but with no compromise to human safety
 - Public/non-participants
 - Ground personnel
 - Flight Crew
- But technical risk can be acceptable
 - Failure to meet mission objectives
 - Some system failures
 - RTB and live to fly another day



EXPERIMENTAL FLIGHT RISK

- Experimental flight often carries a higher technical risk than operational flight...
 - Less system maturity/demonstrated reliability,
 - Single-string elements,
 - Reused systems/components...
- But, experimental flight can allow mitigations that aren't available to operational flight
 - Real-time system health and performance monitoring (control room)
 - Flight envelope and other mission-specific operating limits – rely on procedure to stay out of trouble



APPLICATION OF STANDARDS

- It's important to evaluate not just the airplane, but the entire system when assessing risk.
- Design standards are essentially risk mitigations based on lessons learned over time, and they should be strictly applied to the development of operational systems.
- In an experimental flight application, however, the previously mentioned mitigations should be considered as potential rationale for deviation or relaxation of design standards. Tailor as appropriate for the application.

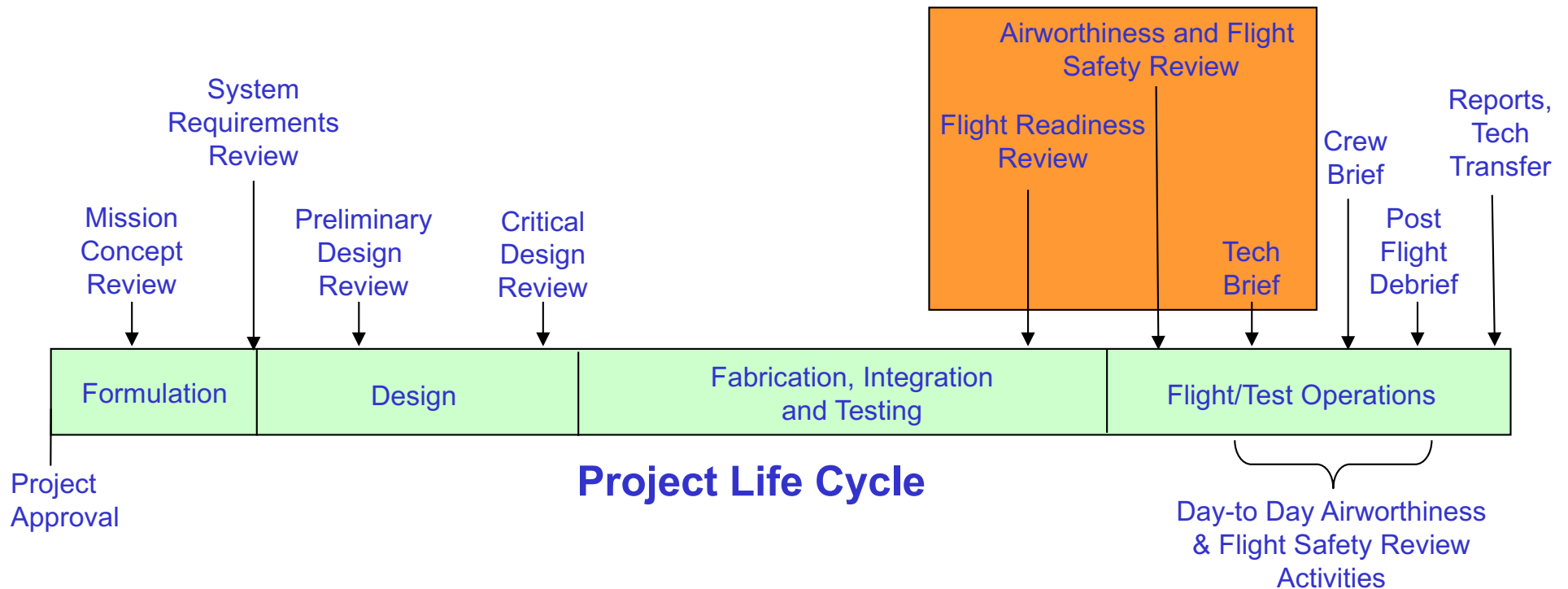


PROJECT TEAM RESPONSIBILITIES

- Select appropriate standards to design and build hardware, software and systems
- Develop systems, test, procedures and documents, that will allow the project to meet its technical objectives.
- When the project believes it has accomplished sufficient validation in preparation for flight, it presents its plans and rationale for flight readiness to the appropriate reviewing body



AIRWORTHINESS AND FLIGHT SAFETY REVIEWS

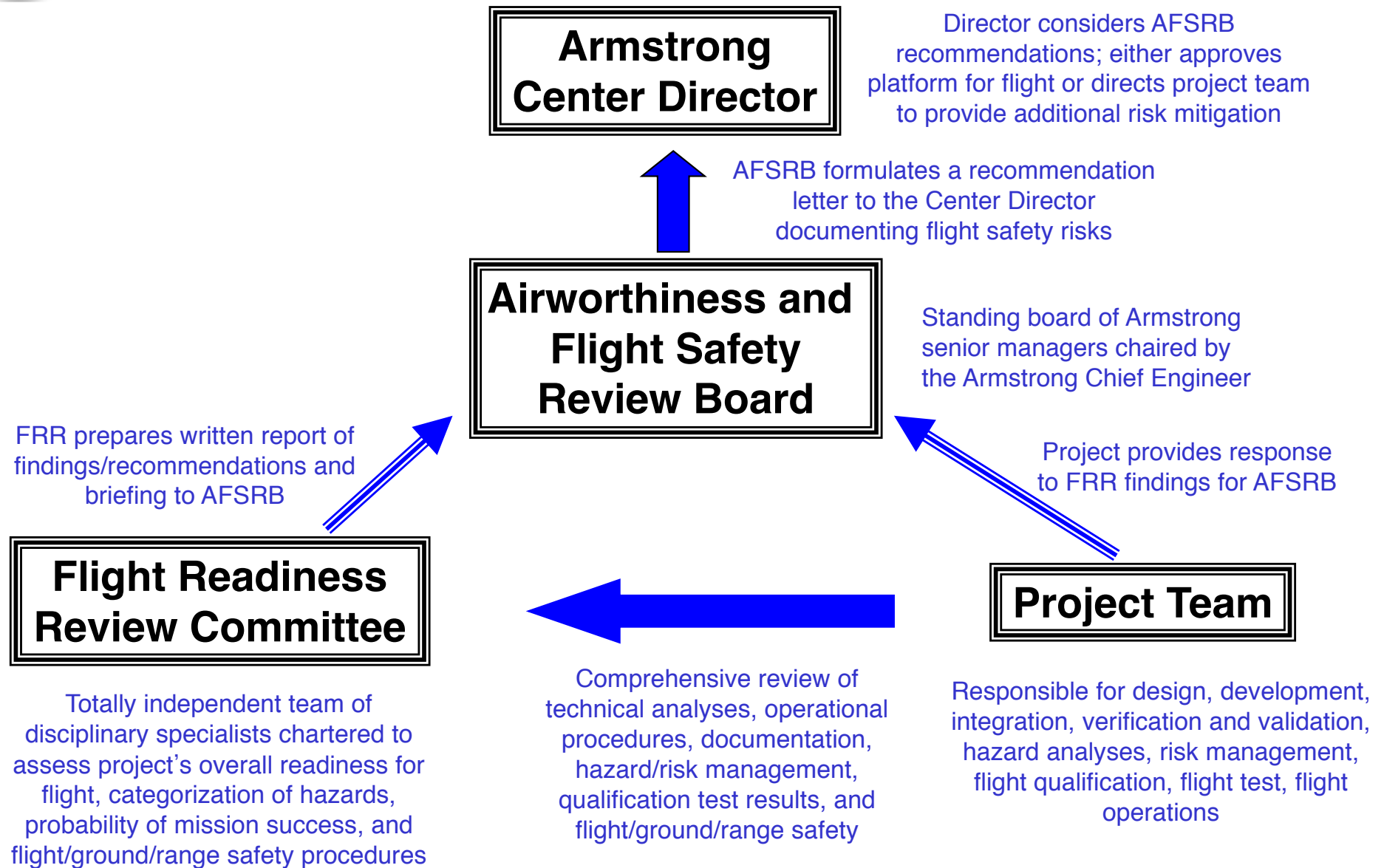


“The AFSRB is tasked with performing certain review processes in order to ensure the flight safety of all projects conducted at Armstrong Flight Research Center.”

G-7900.3-001

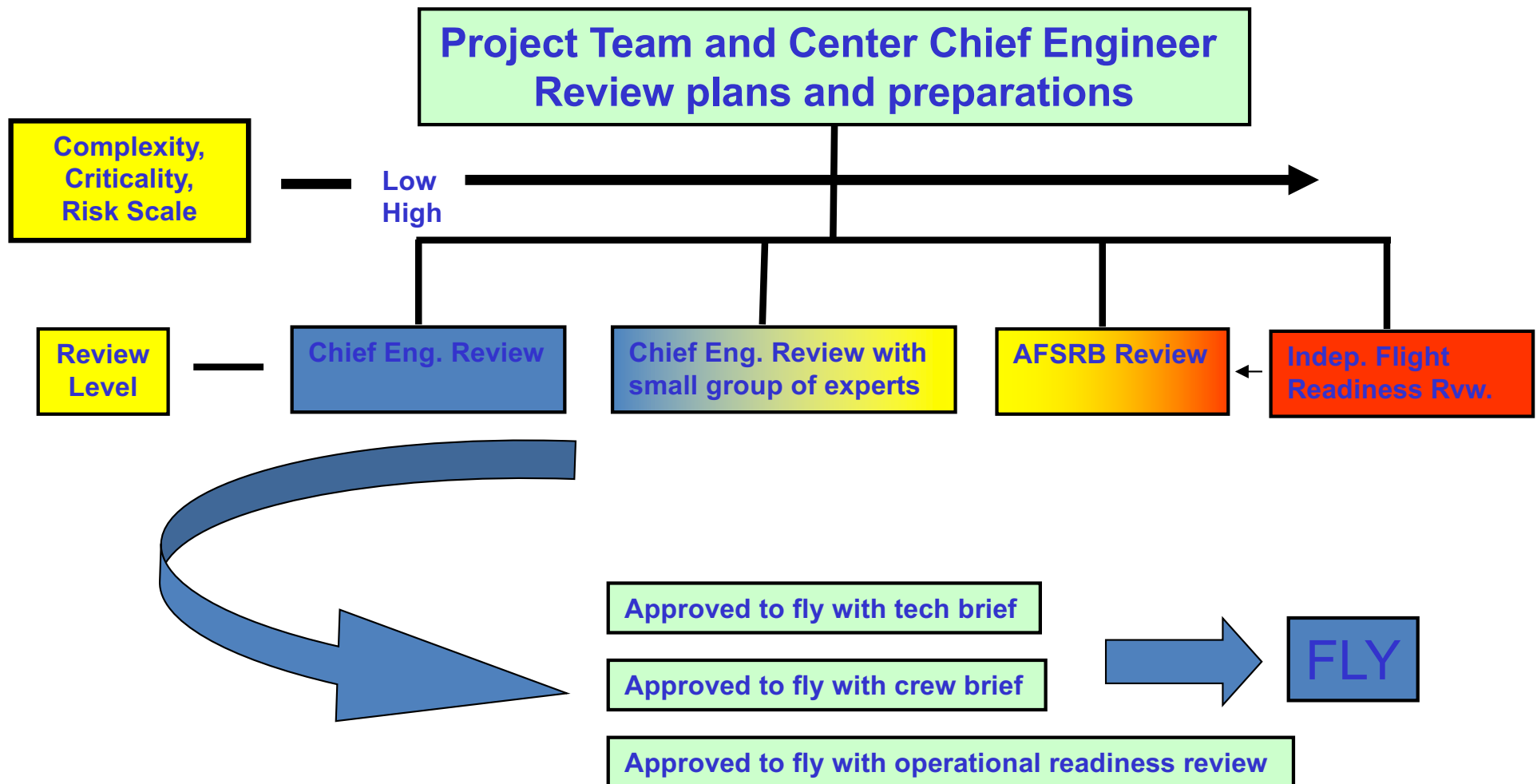


AIRWORTHINESS AND FLIGHT SAFETY REVIEW





PROCESS TAILORABILITY





AFSR ROLES AND RESPONSIBILITIES

- Flight Readiness Review (FRR) Board
 - An Ad Hoc committee chartered by the Center Chief Engineer to evaluate the systems, activities, procedures, and documents developed by the project, assessing the approach and implementation in regards to public, ground, flight, and range safety
 - The FRRB examines the project generated hazard analyses in detail, verifying that proper mitigations have been implemented and that reasonable residual risk has been identified
 - The Board's findings and conclusions are presented to the Airworthiness and Flight Safety Review Board (AFSRB)
 - Membership is independent of the project under review, consisting of lead or journeyman level individuals assigned to other projects
 - Membership includes representation from the technical disciplines critical to the project



AFSR ROLES AND RESPONSIBILITIES

- Airworthiness and Flight Safety Review Board (AFSRB)
 - A standing board of Armstrong senior managers (Engineering, S&MA, Flight Ops, Test Systems, Projects), chaired by the Center Chief Engineer
 - Receives the FRR Committee's findings and conclusions
 - Receives the project's response to the FRR findings, as well as the project's plans to close remaining work prior to flight
 - The AFSRB deliberates on the material presented and formulates a consensus-based recommendation to the Center Director regarding the project's readiness for flight and the acceptability of residual risk
 - If consensus can not be reached, a majority based recommendation is presented to the Center Director along with the minority opinions.
 - The AFSRB Chair formulates a recommendation letter to the Center Director regarding the adequacy of the project's preparation. Special attention is given to quantifying the residual risk, with Accepted Risk hazards clearly identified



TECHNICAL BRIEFING (TECH BRIEF)

- Purpose
 - Closes out all open items for flight
 - Provide for peer review of goals and plans
 - Current assessment of project risks
 - Final briefing to management to gain approval for flight
 - Ensure safe and efficient conduct of a specific mission (or set of missions)



SUMMARY

- Get Off the Stage Chart

UPDATE



QUESTIONS?



Back up Charts



AFSR ROLES AND RESPONSIBILITIES

- Center Chief Engineer
 - Chairs AFSRB and Tech Brief Committee
 - Determines the appropriate level of independent review based on project complexity and risk
 - Center Chief Engineer only
 - Center Chief Engineer with consultation from SME's
 - Project brief to AFSRB
 - Independent Flight Readiness Review brief to AFSRB
 - Communicates AFSRB recommendation to Director
 - Communicates residual risk to Director



AIRWORTHINESS AND FLIGHT SAFETY PROCESS ROLES AND RESPONSIBILITIES

- Center Director
 - Considers the recommendation of the AFSRB and assesses the identified residual risk, including any Accepted Risk hazards
 - The Center Director's signature on the AFSRB letter indicates a formal approval of the recommendation and acceptance of any Accepted Risk hazards, thereby permitting the project team to proceed toward the planned flight activity



WHO IS THE AFSRB?

- Airworthiness and Flight Safety Review Board
 - AFRC Chief Engineer (Chair)
 - Deputy Center Director (Alternate Chair)
 - Director, Research and Engineering (R)
 - Director, Flight Operations (O)
 - Director, Mission Information and Test Systems (M)
 - Director, Programs (XP)
 - Appropriate Projects Mission Director
 - Aeronautics (PA), Exploration (PE), Reimbursable (Z), Science (PS)
 - Director, Safety and Mission Assurance (S)
 - Chief Pilot (OF)
 - Aviation Safety Officer
 - Other Outside Organizations as Required

 - (Quorum = Chair, O, R, S, ASO*, Pilot*, RSO**)



AIRWORTHINESS AND FLIGHT SAFETY REVIEW

Disagreement resolution

If the project team disagrees with an FRR recommendation, it can present an alternative to the AFSRB for consideration.

If the project team is still dissatisfied with the AFSRB's disposition of the issue or with the Armstrong Director's decision, it can appeal through the appropriate Mission Directorate.

If the project appeals to the Mission Directorate, then the Armstrong Director and the Associate Administrator attempt to resolve issue, in consultation with OCE and OSMA.

If the Armstrong Director and Associate Administrator fail to resolve issue, final disposition is taken to the NASA Associate Administrator.

Armstrong's Directors for Engineering, Flight Operations, and Test Systems are members of the AFSRB and are also responsible to OCE at HQ on technical engineering matters ... can appeal directly to OCE in the event of a disagreement with an AFSRB recommendation

Armstrong's Director for Safety and Mission Assurance is a member of the AFSRB and is also responsible to OSMA at HQ on safety related reviews ... can appeal directly to OSMA in the event of a disagreement with an AFSRB recommendation



HUMAN SAFETY HAZARD ACTION MATRIX

	Probability [Pr] Estimations				
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LOSS OF ASSET/MISSION HAZARD ACTION MATRIX

	Probability [Pr] Estimations				
Asset/Mission Severity Classifications	A: Expected to occur (Pr > 10 ⁻¹)	B: Probable to occur (10 ⁻¹ ≥ Pr > 10 ⁻²)	C: Likely to occur (10 ⁻² ≥ Pr > 10 ⁻³)	D: Unlikely to occur (10 ⁻³ ≥ Pr > 10 ⁻⁶)	E: Improbable to occur (10 ⁻⁶ ≥ Pr)
I: Catastrophic					
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TECHNICAL BRIEFING

- Mandatory attendance (cancel if not represented)
 - 1. Project Manager
 - 2. Project Pilot
 - 3. Center Chief Engineer (Chairs the Tech Brief meeting)
 - 4. Director for Engineering
 - 5. Director for Aerospace Projects
 - 6. Director for Flight Operations
 - 7. Director for Safety & Mission Assurance
 - 8. Director for Test Systems
- Flight Request Signatures
 - The “Directors for”, Director for S&MA, and the Center Chief Engineer are required to sign the Flight Request to signify approval to fly.