National Aeronautics and Space Administration
Office of the Administrator
Washington, DC 20546-0001

January 13, 2009

Vice Admiral Joseph W. Dyer, USN (Ret.)
Chairman
Aerospace Safety Advisory Panel
National Aeronautics and Space Administration
Washington, DC 20546

Dear Admiral Dyer:

Enclosed are NASA's responses to five recommendations from the 2008 First, Second, and Third Quarterly Meetings of the Aerospace Safety Advisory Panel (ASAP). Please do not hesitate to contact me if the Panel would like further background on the information provided in the enclosures.

I look forward to receiving continued advice from the ASAP that results from your important fact-finding events and quarterly meetings.

Sincerely,

Michael D. Griffin
Administrator

Enclosures

Tracking Number 2008-01-01
Mass Scrub Process

Recommendation
The design team used a set of analysis gates to equip Orion with sufficient hardware to achieve an acceptable safety requirement for the crew, vehicle and mission success. The ASAP believes that this set of analysis gates has considerable engineering rigor and the Panel conceptually agrees with the process the project is using to arrive at a vehicle that is acceptable to the human rating requirements. The ASAP would recommend to the project that the Panel once again snapshot this process.

NASA Response
Concur with recommendation. The proposed time for the review is in the August 2009 Orion PDR timeframe.

Tracking Number 2008-01-04
NASA Safety Reporting System

Recommendation

The ASAP reviewed the NASA Safety Reporting System (NSRS). The Panel would like to obtain more information about the system to see if the information that is being provided might have value as part of the overall safety management information system.

NASA Response

In February 2008, the NASA Safety Reporting System (NSRS) Program Manager provided the ASAP with a complete briefing on the NSRS. This briefing explained the purpose and philosophy behind the NSRS, how reports were received and acted upon, and how investigations were conducted and results were conveyed to the reporter.

As part of the procedures designed to protect reporter anonymity, NASA cannot release NSRS reports for review. Unlike other reporting systems, such as the Aviation Safety Reporting System and the Patient Safety Reporting System, NASA does not consolidate report data for outside review. This is also an intentional approach designed to protect reporter anonymity.

The NSRS is considered to be a safety reporting channel of last resort. This channel is to be used when normal safety reporting channels have been exhausted or if a reporter fears reprisal for raising the concern. Though important, the NSRS is but a very small component of NASA's safety information system.

The NASA response to Tracking Number 2008-01-05, NSRS Benchmarking, recaps the NSRS program information.

Tracking Number 2008-02-01
Inclusion of NASA Safety Center (NSC) in Standards Development

Recommendation
The ASAP recommended that the NSC be included in the NASA process for evaluating whether new standards are needed and the decision on whether to implement those standards.

NASA Response
The NASA policy for the development, maintenance, and adoption of standards is NASA Policy Directive (NPD) 8070.6, Technical Standards. The process for the development, maintenance, and adoption of NASA Technical Standards is divided into those developed by the Office of the Chief Engineer (OCE) and those developed by the Office of Safety and Mission Assurance (OSMA).

1) Standards under the responsibility of the OCE:
The OCE has established the NASA Technical Standards Program (NTSP) at the Marshall Space Flight Center to manage the OCE's standards. Standards either being recommended for adoption or development/maintenance are vetted through the NASA Technical Standards Working Group (now known as the NASA Engineering Standards Panel [NESP]) for participation in the adoption/review/development process. The NESP has membership from the engineering organizations at each Center/Facility as well as representatives from the OCE. Additionally, the NESP has membership from the OSMA and the Office of the Chief Information Officer. For engineering standards, OSMA will engage the NSC on a case-by-case basis as appropriate for the subject matter.

2) Standards under the responsibility of the OSMA:
The SMA standards are controlled by the NASA Headquarters Office Work Instruction (HQ OWI) 1410-GD02 (Rev F) which can be found at http://nodis3.gsfc.nasa.gov/HQDQMS_Docs/QMS/HQ_OWI_1410_GA000_002_F_.pdf. This HQ OWI describes the process in detail in section 6 and mandates that the Director of the NSC is a part of the process for the review, update, and approval for all standards (as well as NASA policy documents and handbooks). Throughout the documentation process, the HQ OWI treats the NSC as one of the OSMA Divisions and places on it the same responsibilities and opportunities to participate as it does on the other two OSMA Divisions.

The OSMA believes that the NSC participates in the standards development process, as explained above, and does not see any need for changing how SMA documents are already processed.

Tracking Number 2008-03-06
Human Rating Requirements Briefing

Recommendation
When the timing is appropriate, the ASAP requests a briefing from NASA on the new, recently published NASA Human-Rating Requirements NASA Procedural Requirement (NPR) 8705.2.

NASA Response
The Human Rating Requirements for Space Systems, NPR 8705.2, became effective on May 6, 2008. The Office of Safety and Mission Assurance, as the Office of Primary Responsibility for the NPR, provided a briefing to the ASAP during the ASAP's October meeting at the Ames Research Center. Mr. O'Connor, Chief Safety and Mission Assurance, and Mr. Jett from the Flight Crew Operations Directorate at the Johnson Space Center provided answers to additional questions concerning the Human-Rating NPR during the ASAP's December meeting at NASA Headquarters.

NASA understands that the ASAP has additional questions concerning implementation of the Human-Rating NPR and will provide a follow-up briefing at a mutually convenient time.

2008-03-07

Ares I Thrust Oscillation Risk-Based Analysis

Recommendation

The ASAP recommends that NASA perform an updated risk-based analysis in the near future to assess the crew-performance impacts of thrust oscillations generated within the Ares I Solid Rocket Motors. This timely analysis will enable NASA to quantify, manage, and if necessary mitigate operational risks associated with such oscillations.

NASA Response

NASA concurs with the recommendation. Based on the probabilistic analysis of 42 four-segment and one five-segment solid rocket motor ground tests, unmitigated oscillations on the crew are predicted to exceed the current Human System Interface Requirements (HSIR) crew health limit. In the 99.865 probability case, crew accelerations are predicted to be above 5 gs in the worst seat location. The equivalent HSIR crew health limit is 3.7 gs. As a guideline for the analysis of thrust oscillation mitigation options, the Constellation Thrust Oscillation Focus Team used the crew performance limit, set by Gemini, of 0.25 gs in the X or chest in/out direction. Even though crew accelerations above 0.25 gs do not necessarily pose a crew health concern, past data has shown that the crew's ability to perform visual and manual tasks, as well as speech, is degraded. An additional concern is that there could be residual effects due to the short-duration oscillations, just before booster staging, that would affect crew performance during second-stage flight when crew intervention is possible. Because these effects are not well defined, it has been determined that additional data is required to provide input to the crew risk assessment.

Tests have been performed at the Ames Research Center centrifuge facility to provide quantitative data to support crew performance effects. These tests include the effects of both steady-state accelerations and oscillatory accelerations due to thrust oscillation, eliminating the variable of body impedance created by the steady-state acceleration. The findings were presented at the Ares PDR +90 day review and serve as a key parameter in determining risk to crew performance.

During the test, subjects were accelerated to a steady state of 3.8 gs and simultaneously vibrated for 145 seconds at 0, 0.15, 0.3, 0.5, and 0.7 gs. Test subjects were asked to perform a number reading tasks with 10 point and 14 point font sizes. The study indicated that for the 10 point fonts, the error rate (ER) and response time (RT) at 0.15 and 0.3 gs were not significantly different than 0 g. For the14 point fonts, the ER and RT at 0.15, 0.3, and 0.5 gs were not significantly different than 0 g. Also, the study indicated that ER and RT return to zero-vibration levels as soon as the 145-second vibration stops indicating no evidence of statistically significant reading task performance (ER or RT) aftereffects after vibration is stopped.

A thrust oscillation risk mitigation analysis was conducted by the Constellation program where in they analyzed two Ares thrust oscillation mitigation options: (1) passive aft skirt Tuned Mass Absorbers (TMAs), coupled with passive interstage/frustum Isolators; and (2) active aft skirt Reaction Mass Absorbers (RMAs) coupled with passive interstage/frustum Isolator. The focus of the analysis was on the situational awareness of crew and their ability to perform abort during a thrust oscillation event. All design solutions under consideration meet or exceed the crew safety risk requirements. The analysis concluded that thrust oscillation would occur on every flight. However, getting thrust oscillations at the critical levels greater than 3.7 gs are a noncredible event with either passive or active mitigation. Additionally, having an event that the crew has time to respond to (greater than a 2.0-second RT) and having it occur within the time window (even when conservatively expanded to 50 seconds to include crew aftereffects) is a very low probability occurrence of 1/150,000 for passive mitigation options.

In parallel, the Ares project is proceeding toward a System Definition Review of a mitigation strategy that will reduce crew accelerations due to the thrust oscillation being down to 0.25 gs using passively controlled absorber designs. Designs include a passively tuned vibration absorber designed to counter the force generated by pressure oscillations in the motor. Additionally, an isolation system between the Ares first stage and upper stage is designed to reduce the coupling between the solid motor frequency and the natural dynamic frequency of the integrated Ares and Orion vehicle. By moving the natural frequency of the vehicle by reducing the structural stiffness, the response to the solid motor frequency is greatly reduced.

The Orion project is defining follow-on human testing designed to understand the impacts of the launch acceleration and vibration profile on crew performance. Additionally, they are developing an integrated cockpit design that maximizes crew performance throughout all mission phases, including the five to ten seconds where thrust oscillations peak.

The Constellation program and projects recognize that better understanding the impacts of thrust oscillation on crew, as well as maturing passive mitigation designs, decreases the risk to the program as it progresses toward the first human mission, planned for March 2015.