

II. AGENCY RANGE SAFETY PROGRAM

A. Range Safety Training 2012

The NASA Range Safety Training Program was initiated in 2004. To date, NASA Range Safety (NRS) team has conducted 52 training courses to over 1,000 participants from NASA, Department of Defense (DoD), Federal Aviation Administration (FAA), and NASA contractors. The course breakout and number of students is shown in Figure 1.

Courses	# Classes	# Students
Range Safety Orientation	26	684
Range Flight Safety Analysis	9	155
Range Flight Safety Systems	13	194
Range Safety Operations	4	24

FIGURE 1: TOTAL NUMBER OF CLASSES AND STUDENTS TAUGHT

As in past years, NASA Safety Training Center (NSTC) funding was severely reduced for 2012. Therefore, the two classes taught in 2012 were funded by the Agency Range Safety Program. The first Flight Safety Systems (FSS) course was conducted at Wallops Flight Facility (WFF) upon request from their Range Safety organization. The second FSS class was conducted and recorded at Kennedy Space Center (KSC) to create a video that will eventually be included in the online System for Administration, Training, and Educational Resources for NASA (SATERN) training courses catalog. The dates of these courses are listed below in Figure 2.

Course	Date	Location
Flight Safety Systems	17-19 Jan	WFF
Flight Safety Systems	21-22 Aug	KSC

FIGURE 2: 2012 NRS PROGRAM FUNDED COURSES

In addition to the FSS courses offered, two Flight Safety Analysis (FSA) courses were also taught at the request of the Commercial Crew Program (CCP). This fulfilled the request from CCP to teach three of the NRS courses (FSS, FSA, and Orientation). As shown in Figure 3, two Range Safety Orientation classes were taught in October 2011 at KSC and one Flight Safety Systems course was taught in December 2011, also at KSC.

Course	Date	Location
Range Safety Orientation	6-7 Oct 2011	KSC
Range Safety Orientation	13-14 Oct 2011	KSC
Range Flight Safety Systems	7-8 Dec 2011	KSC
Range Flight Safety Analysis	7-10 Feb 2012	KSC
Range Flight Safety Analysis	20-23 Mar 2012	KSC

FIGURE 3: COMMERCIAL CREW PROGRAM FUNDED COURSES

1. Updates to the Range Safety Training Program

While the NRS team has provided excellent training for those seeking a greater understanding of Range Safety, the team routinely looks for ways to improve not only course content but also methods of delivery. The following are descriptions of our course catalog noting updates and improvements where applicable.

a. Range Safety Orientation (SMA-SAFE-NSTC-0074)

The Range Safety Orientation Course is designed to provide an understanding of the Range Safety mission, associated policies and requirements, and NASA roles and responsibilities. It introduces the students to the major ranges and their capabilities, defines and discusses the major elements of range safety (flight analysis, flight safety systems, and range operations), and briefly addresses associated range safety topics such as ground safety, frequency management, and unmanned aircraft systems (UASs). The course emphasizes the principles of safety risk management to ensure the public and NASA/range workforces are not subjected to risk of injury greater than that of normal day-to-day activities.

The Range Safety Orientation Course is designed to inform the audience of the services offered by the Range Safety organization, present timeframes that allow adequate interface with Range Safety during Program/Project startup and design in an effort to minimize potential delays and costs, and recommend ways of making the working relationship with Range Safety the most beneficial for the Range User. This course includes a visit to Range Safety facilities at Cape Canaveral Air Force Station (CCAFS)/KSC when normally presented at the Eastern Range. If you wish to discuss presenting the class at your location, please contact the NSTC staff.

Target Audience:

- Senior, program, and project managers
- Safety, Reliability, Quality, and Maintainability professionals with an interest in range safety activities

Range Safety Orientation



FIGURE 4: RANGE SAFETY ORIENTATION COURSE OUTLINE

b. Range Flight Safety Analysis (SMA-SAFE-NSTC-0086)

The NRS office, in concert with Dryden Flight Research Center (DFRC) and Goddard Space Flight Center (GSFC)/WFF personnel, made significant progress in 2012 on the continuing development of a new NASA-centric FSA course. The new course is designed to provide a broader understanding of Range Safety considerations and will focus more on NASA processes in contrast to the current course which is based primarily on Air Force procedures at the Eastern Range.

The current course will continue to be offered for DoD and FAA customers. It includes NASA, DoD, and FAA requirements for flight safety analysis; a discussion of range operations hazards, risk criteria, and risk management processes; and in-depth coverage of the vehicle containment and risk analysis methods performed for expendable launch vehicles (ELVs). An outline of the current FSA course structure is shown in Figure 5.

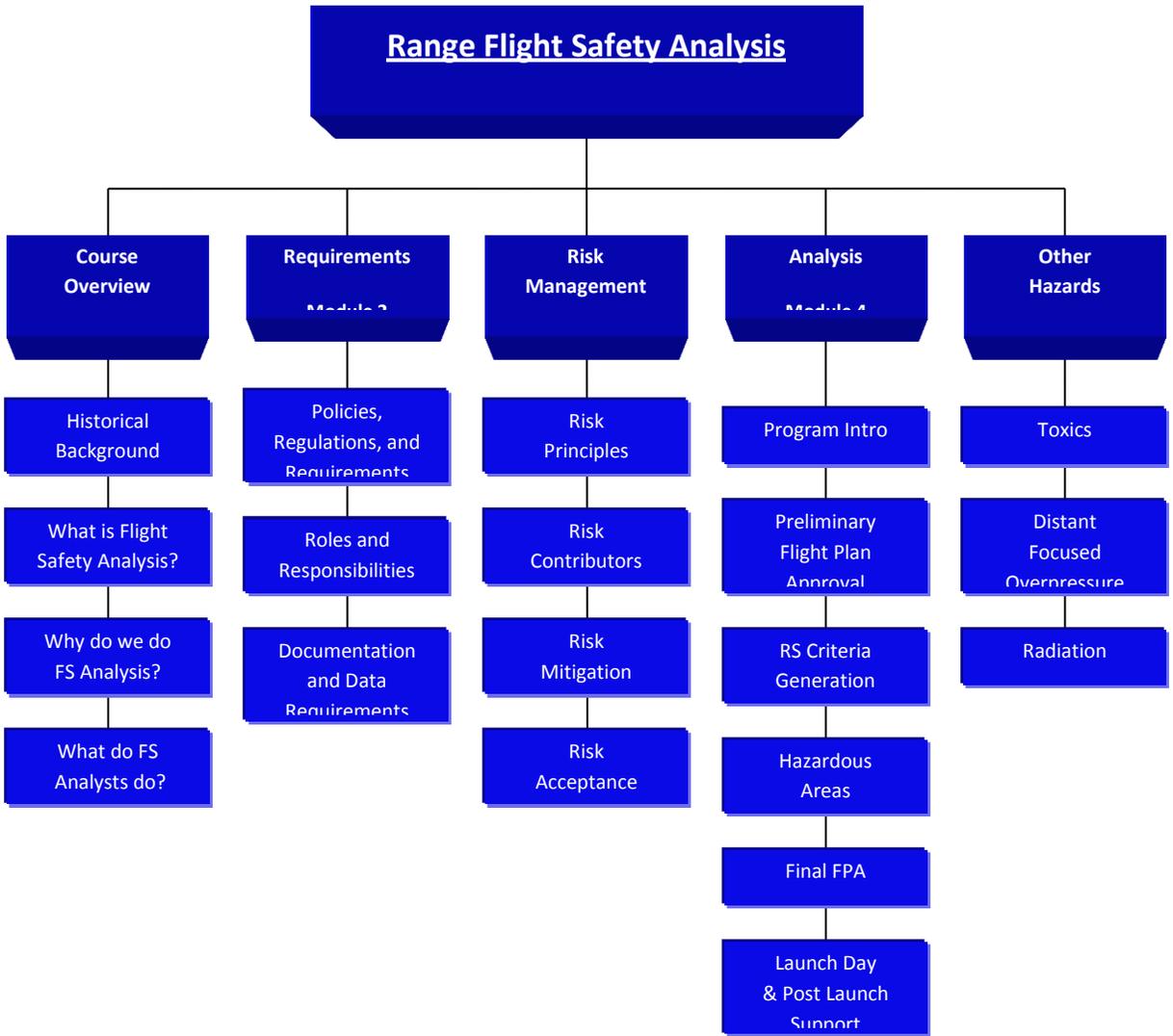


FIGURE 5: CURRENT FSA COURSE OUTLINE

In addition to discussing ELV methods, the new NASA-centric FSA course will cover methods used for other vehicles, such as sounding rockets, reusable launch vehicles (RLVs), UASs, and research balloons. The course will highlight unique Range Safety processes used at several NASA ranges. There will still be coverage of debris hazards and related analyses, as well as an overview of toxic, blast, and radiation hazards and risks. Class exercises will be used to cover key aspects of FSA in a way that helps students absorb the information presented. Figure 6 outlines the new FSA course structure.

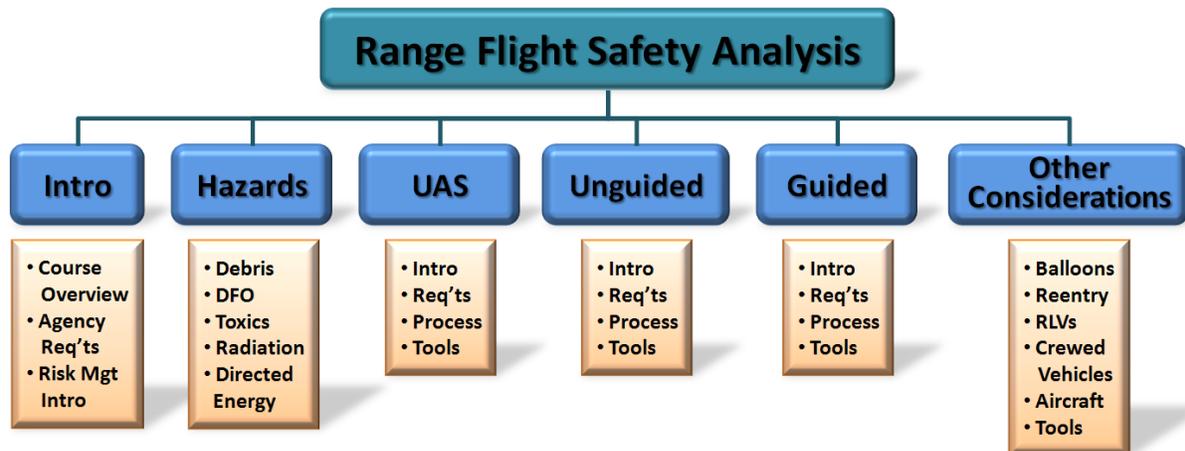


FIGURE 6: NEW FSA COURSE OUTLINE

Prerequisite: Completion of NSTC Course 074, “Range Safety Orientation,” or equivalent experience.

Target Audience:

- NASA, FAA, and DoD Range Safety analysts
- Range Safety personnel in other disciplines
- Program/project managers and engineers who design potentially hazardous systems to operate on a range

c. Range Flight Safety Systems (SMA-SAFE-NSTC-0096)

The FSS Course describes FSS responsibilities and Flight Termination System (FTS) design, test, performance, implementation, analysis, and documentation requirements. The course also includes a review of UAS flight termination systems, balloon universal termination packages, and the Enhanced Flight Termination System (EFTS). The FSS class concludes with a description of the Autonomous Flight Safety System (AFSS) and a tour of the Naval Ordnance Test Unit (NOTU) facilities when the class is held at KSC. The course outline is provided below in Figure 7.

Range Flight Safety Systems

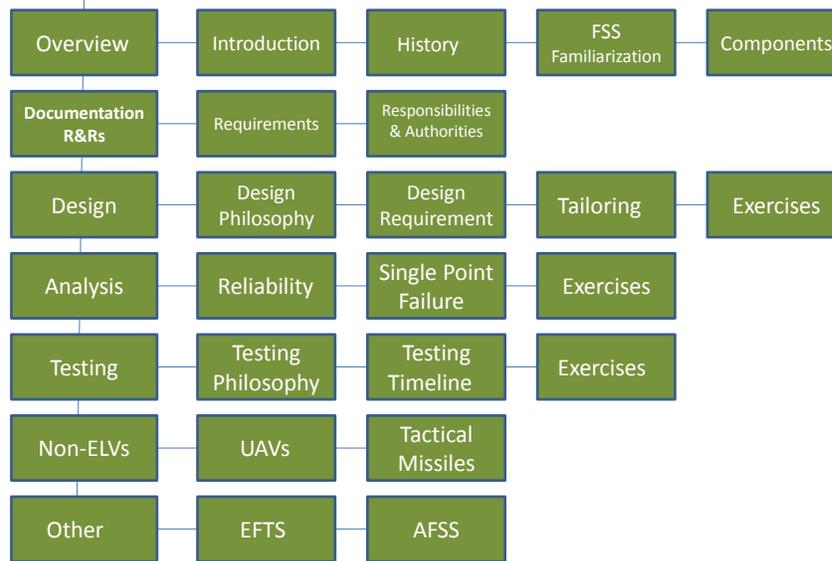


FIGURE 7: RANGE FLIGHT SAFETY SYSTEMS COURSE OUTLINE

Prerequisites:

1. Completion of NSTC 074, "Range Safety Orientation," or equivalent level of experience or training, is required
2. Completion of NSTC 002, "System Safety Fundamentals," or NSTC 008, "System Safety Workshop," is recommended

Target Audience:

- NASA, FAA, and DoD Range Safety Personnel working Flight Safety Systems issues
- Range Safety personnel in other disciplines
- Program/project managers and engineers who design potentially hazardous systems to operate on a range
- Personnel who conduct hazardous operations on a range

d. Range Safety Operations Course (SMA-SAFE-NSTC-0097)

To ensure mission success and safe operations for the Range, a formal process has evolved within the Range community to provide range safety operations. This course addresses the roles and responsibilities of the Range Safety Officer (RSO) for range safety operations as well as real-time support, including pre-launch, launch, flight, re-entry, landing, and any associated mitigation. Mission rules, countdown activities, and display techniques are presented. Additionally, tracking, telemetry, and vehicle characteristics are covered in detail. Finally, post operations, lessons learned, and the use and importance of contingency plans are presented.

Students receive hands-on training and exercises to reinforce the instruction. Figure 8 outlines the Range Safety Operations course structure.

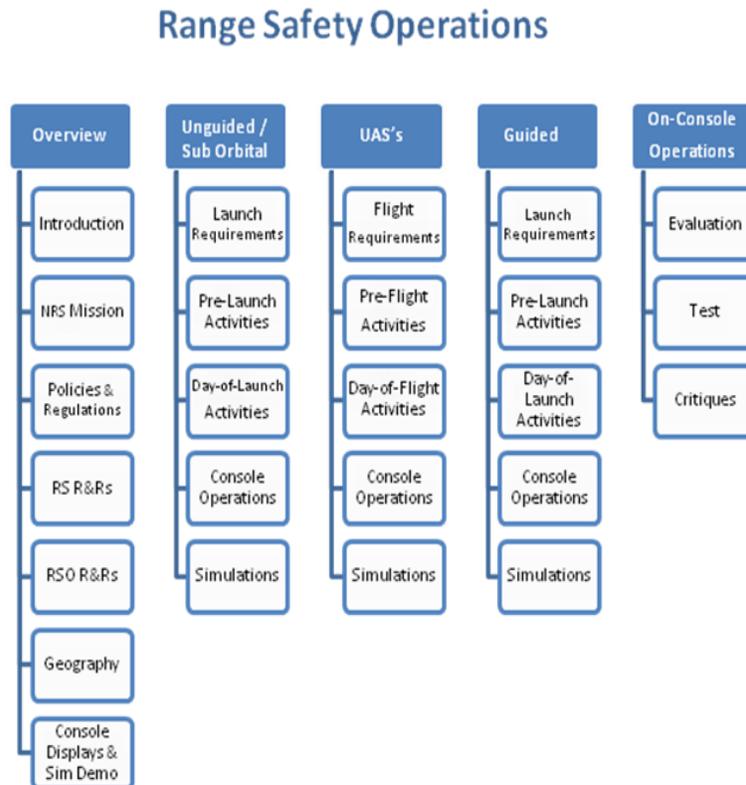


FIGURE 8: RANGE SAFETY OPERATIONS COURSE OUTLINE

This course is only presented at WFF and is limited to six participants. To reduce cost and increase course availability, the goal is to have WFF personnel instruct this course beginning in 2012. NASA Range Safety will help organize the first courses to be taught and possibly provide instructors. The NASA Range Safety Office will still continue to review and control the course content to ensure its applicability across all Centers.

Prerequisites:

1. Completion of NSTC course 074, "Range Safety Orientation," or equivalent experience and/or training, and a background in range safety.
2. Completion of NSTC course 0086, "Range Flight Safety Analysis," or equivalent experience and/or training.
3. Completion of NSTC course 0096, "Flight Safety Systems," or equivalent experience and/or training

Target audience: Persons identified as needing initial training for future/current job as RSO with NASA or RSO management.

If you wish to attend any of the courses offered, please contact your Center training manager, or refer to the NSTC web site course catalogue located at: <https://saturn.nasa.gov/elms/learner/catalog/>

2. Joint Advanced Range Safety System (JARSS) Training for NASA Centers

In addition to courses, NASA Range Safety also provided hands-on training of the JARSS Risk Analysis tool to personnel from multiple NASA Centers who are expected to perform risk analysis for their flight operations. JARSS is a tool used by NASA for range safety mission planning, risk analysis, and risk management to provide range safety support for the development, testing, and operation of UAS, ELV, and RLV. The Range Safety Representatives who received this training brought to their Centers the ability to perform needed range safety risk analysis for applicable flight operations. This training was provided to Ames Research Center (ARC), Stennis Space Center (SSC), and Langley Research Center (LaRC) in early 2012.



FIGURE 9: JARSS TRAINING EXAMPLE SCENARIO

DFRC and WFF already utilize this tool, and by providing this capability to other NASA Centers, the



FIGURE 10: POTENTIAL SIERRA OPERATIONS AT ARC

operations of the Science Instrumentation Evaluation Remote Research Aircraft (SIERRA) UAS (see Figure 10).

NASA Range Safety Program ensures that each Center has the necessary tools to protect NASA personnel, property, and the general public from possible hazards occurring from range/flight operations.

Figure 9 provides an example of one of the analysis scenarios from the training seminar.

ARC went on to utilize JARSS-MP to assess several proposed

B. Development, Implementation, Support of Range Safety Policy

1. Agency Policy Update

In 2012, NASA Range Safety supported an out-of-cycle update to the NASA Procedural Requirements document (NPR) 8715.5, Range Flight Safety Program, revision A. Though not

due to be revised until mid-2015, several items needed to be addressed prior to the official NPR revision cycle, currently scheduled to begin late in CY2013. The changes made include updating the language in the RSO section to allow anyone properly trained and certified by a NASA Range Safety Organization to serve as an RSO. The applicability statement was also clarified to include vehicle projects conducting operations under FAA regulation 14 CFR Part 101, and the wording regarding secure FTS implementation was also clarified to reflect current NASA documentation and current practice. Finally, Shuttle-specific requirements were eliminated that were no longer required upon Shuttle fly out.

2. Range Commanders Council (RCC) Range Safety Group (RSG)

The Range Commanders Council (RCC) was founded in 1951 to provide a way for DoD test ranges to communicate and discuss common problems.

The RCC Range Safety Group (RSG) continues to provide a forum in which ranges can standardize, develop, and improve on a variety of subjects and processes related to range safety. NASA participates in this forum on a regular basis and became an official voting member in 2008. Range Safety representatives from NASA HQ, KSC, DFRC, and WFF actively support the RSG and its subcommittees on a regular basis. DFRC is currently the Flight Termination Systems Committee (FTSC) Chair while WFF became the RSG Chair in 2011 and continues to lead the entire RSG. Two RSG meetings were held during 2012, as summarized below.

a. 110th Range Safety Group Technical Interchange Meeting (TIM)

The 110th Range Safety Group TIM was hosted by the FAA located at their headquarters in Washington, D.C., June 13-14, 2011. The RSG main committee, Risk Committee, and FTSC participated in the conference.

In the main committee, the FAA presented a number of briefings discussing current range safety related activities and issues being worked at the FAA. Topics discussed included Range Operations and the National Airspace System, Recent Testing of ADS-B for Space Transportation, and Recent Activities in the FAA Office of Commercial Space Transportation. Other presentations in the main committee were RCC Executive Committee updates and a briefing from 30th Space Wing personnel on the Automated Flight Safety System (AFSS) Development.

Several topics were discussed at length by the group in the Risk Committee, including probability of failure, ship surveillance capabilities, next generation air transportation, range operations and the national airspace system, higher fidelity aircraft vulnerability analysis, air-traffic data requests for range safety, ISS protection from collision with launch vehicles, and potential for aircraft hazard area corridors.

Some of the topics discussed in the FTSC included RCC 319 rewrite and updates, EFTS implementation updates, Air Force Research Laboratory's (AFRL) Reusable Booster System (RBS) effort, and Defense Advanced Research Projects Agency's (DARPA) Airborne Launch Assist Space Access (ALASA) Program.

b. 111th Range Safety Group TIM

The 111th Range Safety Group TIM was hosted by Naval Air Systems Command at Point Mugu Naval Air Station, December 4-6, 2012. The RSG main committee, Risk Committee, and FTSC participated in the meeting.

The main committee mainly received various member range reports among which were highlights from DFRC, WFF, and KSC Range Safety activities.

The Risk Committee (RC) discussed a variety of topics such as follow-up work toward updates to the Aircraft Vulnerability Models (AVMs) in the RCC 321 Supplement and potential updates to the FAA aircraft protection requirements. The RC also discussed using the $1E^{-6}$ probability of one or more casualty requirement for aircraft hazard areas as an alternate to using hit probability contours as is current practice. The 45 SW-Safety Risk Lead briefed proposed changes for AFSPCMAN 91-710 for ship and aircraft protection. The Space and Missile Center representative for Launch and Range briefed preliminary results of Aerospace Corp analysis to address collision avoidance (COLA) gap using "NASA proposed probability based method that has the potential to increase launch availability." The results look promising and may be adopted by the RSG. Finally, the risk committee discussed altering current general public expectation of casualty criteria to one significant digit. There are pros and cons to this approach, and further discussions will be held to ascertain a path forward.

Several additional items were discussed by the FTSC. The FTSC elected a new committee chair, Joe Nguyen (30th SW), and a vice-chair, Chuck Loftin (NASA KSC). The FTSC discussed a proposed action for each range to track their own FTS failures and present this data at the next RSG. This would allow the ranges to learn from one another by identifying mutual concerns as well as problems with common hardware. The FTSC is also planning to conduct telecons involving the Range Safety community before the next RSG to discuss any concerns or comments regarding the new revision of RCC 319 that has been submitted for approval. The AFSS and associated requirements were also discussed. It was mentioned that the software requirements in RCC 319 would need to be changed in order to keep pace with the new AFSS requirements. The 30th Space Wing, Northrup Grumman, and Space Information Labs all presented briefings regarding AFSS and how they have been addressing the requirements, and they shared some of the new concerns associated with this development.

For more background and information on the Range Commanders Council and the Range Safety Group, [click here](#).

C. Independent Assessments

NASA Range Safety supports NASA HQ audits and reviews on a regular basis, including Institutional/Facility/Operational (IFO) audits and Inter-Center Aircraft Operations Panel (IAOP) reviews. NASA Range Safety participated in one IAOP review at ARC in July 2012.

The IAOP provides peer review and objective management evaluation of the procedures and practices being used at the operating Centers to ensure safe and efficient accomplishment of assigned missions and goals. The review teams also identify deficiencies in, or deviations from, Agency-wide policies, procedures, and guidelines. The primary focus of the Agency Range Safety Program during IAOP reviews is on the application of range safety requirements and techniques to NASA operations involving UAS. The intersecting aviation safety and range safety requirements that apply to NASA UAS operations dictate the need for close coordination

between the NASA aviation and range safety offices. To facilitate a coordinated review process, NASA Range Safety personnel participate in IAOP reviews at NASA Centers that conduct and/or host UAS operations. At this time those Centers include: ARC, DFRC, LaRC, and GSFC/WFF. KSC and SSC have expressed interest in future UAS operations. Range Safety findings during IAOP reviews and associated Center corrective actions are documented and tracked using IAOP systems and processes established by the NASA aviation office. The Range Safety team participated in the IAOP review at ARC to understand the Center Range Safety Office UAS support activities and to assess compliance with NPR 8715.5A requirements.

The IAOP review at ARC represented an opportunity to assess the Center's flight operations and evaluate NPR compliance. Flight operations at ARC consist of multiple UAS vehicles such as the Giant Scale Electric Trainer (GSET) (NPR 7900.3C Category I), Swift (NPR 7900.3C Category II), and SIERRA (NPR 7900.3C Category III). During the ARC IAOP review, the Range Safety team made a couple of recommendations for the Lead and Designated RSO training plans. The first recommendation was to ensure that Designated RSOs and Lead RSOs have separate training plans as their responsibilities are different. The second recommendation was for the lead RSO to seek out recurring training opportunities using the JARSS Risk Analysis tool by planning on annual visits with Range Safety personnel at DFRC to exercise this key competency.

Range operations other than UAS operations are subject to IFO audits led by the NASA Safety Center (NSC). Such non-UAS range operations include space launch/entry, scientific balloon, and sounding rocket operations. NASA Range Safety participates in IFO audits of NASA Centers that conduct and/or host non-UAS range operations. At this time, those Centers include KSC and GSFC/WFF. Range Safety findings during IFO audits and associated Center corrective actions are documented and tracked using IFO systems and processes established by the NSC. No IFO audits were supported in 2012, and no support is anticipated in 2013.

