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Personnel Recovery in Space: A New Venture for Human Space Flight Support

by

Brian L. Desautels, Major, USAF

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Advisor: Lt Col Peter A. Garretson

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Abstract

This paper will define Personnel Recovery (PR) and the construct in which the Department of Defense (DoD) currently operates and the proposed amendment to the manner in which Human Space Flight Support (HSFS) is conducted for all phases of space operations. There are requirements that currently exist in the construct for terrestrial PR operations and a HSFS program. The gap in coverage is when the space vehicle departs the Earth for operations in Low Earth Orbit (LEO). There are challenges for conducting PR operations in space, but this proposed structure presents a new construct in which the commercial and DoD space activities can be supported.

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Introduction: DoD and Civilian Commercial Construct for PR Operations in Space

The USAF currently supports the HSFS program with a staff where personnel from around the DoD support the various missions that launch into space. Unfortunately, the current construct does not provide a fully developed architecture to support astronauts after departing the atmosphere on Earth. The DoD plans, programs, and executes joint PR operations with military forces but the United States Coast Guard (USCG) utilizes a unique program that integrates a support structure for civilian sea craft to execute the mission. The proposed construct for a fully developed PR structure for space is a blend of the DoD joint PR operations with the USCG program for budgeting and executing Search And Rescue (SAR) of both military and civilians distressed in space.

Discussion: Validated Requirement.

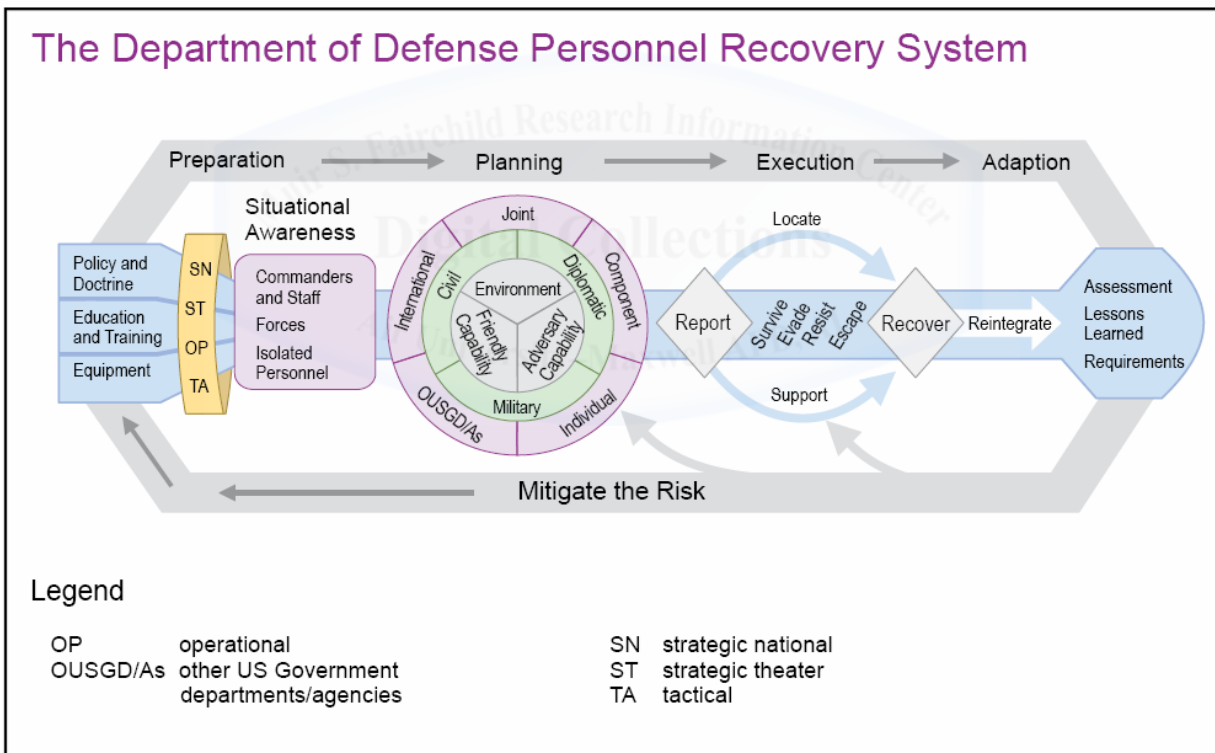
The importance of Personnel Recovery solidified within the US Air Force when it became a service core function in 2009.² Even though the USAF and DoD have come to an agreement that it is important to provide this valuable service to the service members of this nation, senior leaders continue to remind everyone of the strategic purpose and moral influence on service members.

“By pledging to put every effort into recovering our highly trained [personnel], we send a powerful signal about their importance and help sustain their spirit under the stress of combat.”

General Henry H. Shelton, US Army, 14th Chairman of the Joint Chiefs of Staff,
27 October 1999³

United States Strategic Command (USSTRATCOM) outlines within their CONOPS for HSFS Operations a structure, authority, and responsibility.⁴ The HSFS program currently trains

and prepares for PR operations during the launch and recovery phase, but does not stand alert in the event of a mission gone awry once it has entered LEO.⁵ This proposal best compares with the current DoD posture by service components and joint operations for personnel recovery. Hypothetically, if the Combatant Commanders (CCDR) would only have the capability to have their personnel recovered within the confines of the base, it would present an issue should their personnel depart outside the wire. In this scenario, the CCDR could not even have the capability to launch a recovery mission; so would the CCDR approve or accept this risk? Unfortunately, this is the plan that USSTRATCOM tasks the HSFS program to operate.



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Figure 1: DoD Personnel Recovery System

Currently the DoD executes the PR mission by accomplishing the tasks of reporting the event, locating the isolated personnel (IP), supporting the IP, recovering the IP, then reintegrating the IP. This fundamental process does not change for space. The HSFS program

currently plans and executes PR under this construct to accomplish these tasks, but does not provide PR capability for all environments. Within the space environment, rotations of commercial space programs and DoD space programs could fill the gap to create a full spectrum PR support structure where astronauts and future space explorers can become recovered in the event of an emergency.

Force Structure.

In *Developing National Power in Space*, Dr. Ziarnick proposes the US establish a Space Force similar in the construct of the United States Coast Guard (USCG) and prepare to execute “massive rescue operations to relieve a colony on Mars, much like the U.S. Coast Guard’s 19th – century operations in remote frontier Alaska.”⁷ Because there is not a Space Force on the short term, a space Personnel Recovery Task Force (PRTF) would support PR operations in Space primarily for rescue and support as required which aligns with the USCG model. The current DoD construct for using the HSFS program to support space would continue for national missions, but for future space activities by civilians it would be best to build a force to support civil rescue missions.

A space PRTF can be economically feasible if compared to the 2015 discretionary budget for the USCG has \$786,189 for SAR out of the total discretionary budget of \$9,796,995.⁸ This is eight percent of the budget that provides a service not only to DoD and US government assets but also to the population of the United States. The US must program for a space PR capability for future for space flight. As the commercial space industry grows to inhabit LEO, this is a service that the US needs to provide to commercial industry to further space exploration in the same manner it supports its mariners while at sea.

Space PR alert status.

Even though this may not be feasible initially, there can be a blend of forces both on active duty and a ready reserve fleet. Proposals can be made to identify astronauts that are currently employed by civilian space companies to maintain a ready reserve status in the USAF. This same construct could be done in other services within the DoD until a fully mature space force is established.

Currently the CCDRs require a PR capability within their Area of Responsibility (AOR). All desire to have dedicated PR professionals and assets ready on alert to support any IP within their AOR. Many joint leaders question the USAF and their need for dedicated PR forces; however, PR is a service core function in the USAF. This not only provides the COCOM with rescue forces, but dedicated personnel who prepare for PR operations as their primary duty. For future capability and flexibility for response to an IP, an on-orbit construct must exist.

Much consideration has been given to a proposed alert posture for a space vehicle ready to launch from an alert status, similar to the DoD in the manner PR forces are ready in the event of a PR mission. To propose a realistic construct for future space PR alert, the author consulted military space experts and commercial space representatives need to consider the options. Mr. George Zamka, the Director of B330 Crew and Cargo Program at Bigelow Aerospace, LLC. and a former US Marine Corps officer and NASA astronaut both as a pilot and mission commander corresponded with the author to present several scenarios where space PR could be implemented.

This paper proposes a construct where PR alert could be provided to space using a blended model of DoD and Commercial Crew Programs to maintain a ready status while

minimizing the cost to the US government. Mr. Zamka noted that using a space craft and crew that are intended for a launch on a later mission was the approach NASA had taken in the past.⁹

NASA did this for the last Hubble mission, using one of the Shuttles that was going to go to the ISS as a ready-rescue craft for the Shuttle that was going to Hubble. The two missions were STS-125 (Hubble) and STS-400 (Rescue crew that was also STS-123).¹⁰



Figure 2: NASA's Orion Space Flight Program
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Figure 3: Commercial Crew Program,
Boeing CST-100



Figure 4: Space-X Crew Dragon Capsule
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Training for a PR mission in space.

The challenges for accomplishing the PR mission tasks of Report, Locate, Support, Recover, and Reintegrate in the space environment are extensive but not insurmountable. The unique training challenges for a space PRTF would be:

- Rendezvous/docking
- Toxic/partial atmosphere during rescue/recovery
- Execute with minimum personnel due to limited space for support equipment and recovered personnel
- First aid/combat medical techniques in microgravity
- Protocols for treatment: stabilize, treat injuries, telemedicine support, pre-designated medical facilities for follow-on treatment (ISS or returning to Earth)¹³

As outlined within the USSSTRATCOM HSFS CONOPS, “NASA, in coordinating with CDRUSSSTRATCOM, provides HSFS requirements for DoD.”¹⁴ Because of this current CONOPS, the CDRUSSSTRATCOM should provide the HSFS a new set of requirements for the DoD to support not only government space support but also the civilian space program in the event of a PR mission. This paper proposes that CDRUSSSTRATCOM should take lead on pressing the requirement for space flight to have HSFS not only for terrestrial rescue and recovery, but also provide a capability in space, the HSFS could begin planning and coordination with civilian space corporations.

Scenario

The following scenario illustrates how to properly utilize a space PRTF that has personnel and spacecraft ready on alert, one must consider a scenario. Mr. Zamka proposed the following scenario:

It's possible that their route to egress to the Soyuz capsule got blocked, and that would present the scenario that we are talking about. Assuming that the crew could isolate themselves to one module, they would probably need to be rescued within 24 hours before their CO2 built up. A total rescue capability would require the distressed crew members to have some kind of airlock through which EVA equipment, like a rescue sphere, could be brought in and the crew rescued by being placed into the sphere, or other such device, and moved to the rescue craft, which itself would need an airlock capability. This all would be easier if the rescue vehicle could dock, or berth, directly with the module that the crew was in. Not all ISS modules have available docking/berthing ports.

Recommendations: Zero to Five Year Plan.

In order to meet near term objectives, a timeline of five to ten years is proposed. This will allow for the DoD to provide new direction for the HSFS program and get a joint PRTF to prepare for the new tasks. Currently the plan for HSFS is to support Soyuz, Orion, and Commercial Crew Program (CCP) with rescue and recovery of astronauts, but the Soyuz contract for lift to the International Space Station (ISS) ends in 2018.¹⁵ Because of the end of the Soyuz contract, this is the ideal time for the DoD to combine with the CCP to set a rotational schedule where DoD members and civilians (prepared to be on military orders as ready reservists) could prepare together and begin alert cycles at the various locations. This construct allows for a further development of the integrated civilian and DoD personnel to provide the best service at

the lowest cost to the taxpayer. Until the fully capable space PRTF can be manned, there is a current proposal that USAF Lt Col Marilyn Manifold presents:

“The best solution to space personnel recovery is for the United States to set up a Civil Reserve Space Fleet (CRSF) agreement with civilian space companies to ensure PR spacelift capability is available. Like the CRAF arrangement with civilian airliners, the PR CRSF would prevent the wasteful redundancy of a dedicated military fleet and would align with Presidential Policy Directive 4, which directs the government to purchase and use commercial space capabilities where available. CRSF carriers must maintain federal certifications and commit to have a vehicle ready when tasked, regardless of other paying missions slated to launch. Civilian space companies like SpaceX and Orbital Sciences, which already have NASA and USAF contracts, could fulfill this need in addition to their commercial business. In return, the government would offer CRSF companies government peacetime spacelift business. The government would need to enlist multiple companies to provide system redundancy. These companies would provide the flight crew, and the military would provide the rescue team. Training and research would mitigate rescue team difficulties with unfamiliar equipment and safety considerations regarding breaching and use of lethal force in pressurized space containers.”¹⁶

This initial stage of alert postures for the PRTF should allow for a minimum crew ready to launch in a space vehicle and respond to an IP within LEO within twelve hours’ notice. Given the potential internal and external factors there should be at least two locations ready (with several personnel and the associated vehicles), but one tasked with the alert posture. If an alert is held out of Texas, but a tropical storm is forecast to impact operations, the PRTF in Florida could be poised to assume the alert posture until Texas locations are ready for launch. The flexibility within the operations for a proposed Low Density – High Demand (LDHD) capability is critical.

Five to Fifteen Year Plan.

Currently, there are personnel within the ISS and ready to support other astronauts if needed, but the fifteen to twenty year plan needs to strive for a greater capability. In order to support future activities within the solar system, such as settling the Moon or Mars, a fully mature capable PR force on orbit must exist. This does not require a launch to Mars or the Moon in the near-term, but it should plan for the capability to provide support from space to support near-term anticipated activities instead using the current construct. There are many potential space vehicles to consider, but ultimately as space traffic increases, the PR force should also. The police force fluctuates in size based on the population that they serve. The International Association of Chiefs of Police conducted research on the population to police officer ratio. Below are the results of this research. Even though the research is for population on earth, this can be utilized to posture an appropriately sized rescue force as space commerce expands and the need for reduced response time based on the population within LEO and further into the solar system.

BJS Ratio Data

The Bureau of Justice Statistics (BJS), within the Office of Justice Programs (OJP), within the United States Department of Justice (DOJ) publishes *Local Police Departments* report every three to four years. This report contains excellent and highly reliable data on state and local police personnel throughout the U.S. One aspect of this report is the average ratio of full time officers per 1,000 residents. The most recent BJS data on this topic (2003), by size of population served follows:

Population Served	*FT Officers Per 1,000 Residents	Population Served	*FT Officers Per 1,000 Residents
250,000 or more	2.5	10,000 to 24,999	2.0
100,000 to 249,999	1.9	2,500 to 9,999	2.2
50,000 to 99,999	1.8	1,000 to 2,499	2.6
25,000 to 49,999	1.8	All Sizes	2.5

*Average Ratio

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Figure 5: Bureau of Justice Ratio Data

Forward thinking and advanced training within the DoD is what has bridged the gap created by degrading systems and dwindling budgets for the past decades, however the future of space operations has been neglected too long. Before NASA, the USAF had the lead on space advancements, but lost the edge and NASA took the lead. Benjamin Lambeth wrote in *Mastering the Ultimate High Ground* about the future of the military forces in space:

Until a more equitable cross-service military space funding arrangement is put into place, the Air Force will continue to confront a mission-development dilemma. Should it move *too* fast toward expanding its percentage of funding support for space, it will run the danger of further undercutting its support to its equally important air obligations. Alternatively, should the Air Force be perceived as dragging its heels with respect to funding the nation's military space needs out of a determination to do right by its mandated *air* force-projection obligations, it will risk appearance to have willfully violated the Space Commission's trust and thereby run the danger of eventually being asked to turn over its stewardship of space to a separate Space Corps or Space Force.

Recommendations for Future Study.

After the interest among decision makers within the USAF, NASA, and STRATCOM have determined the need for a Space PRTF, there should be a deep dive on the budget. The requirement is valid, but there must be a determination to utilize the funds appropriately now, and program for the long-term vision of Space PR.

There are several civilian companies that can provide personnel and the associated equipment to supplement the DoD PR forces. Utilizing the civilian companies shares the burden of the federal government and incentivizes the corporations to further their advancements for space technologies.

The Commander of Joint Forces Component Command SPACE (Deputy DoD Manager for HSFS) “serves as financial point of contact for NASA reimbursement to DoD HSFS.”¹⁸ This is the starting point to begin to refine a proposed budget adjustment for the HSFS to expand the current protection is provides to NASA. Developing a new construct for Space PR must build upon the current support for the HSFS program, however it needs to push the boundary to encourage future space exploration as it will be critical in supporting civilian companies to stretch themselves to their maximum potential with the security of a PRTF on earth and in orbit ready to support.

Conclusion.

The DoD must be prepared to continue PR because of the strategic effects it can provide not only to military, but the national commercial space industry and the US allies it could support. The DoD and NASA took lead when pushing the boundaries for space exploration and putting the first man on the moon. Building a Space PRTF will allow for the DoD and NASA to utilize their expertise along with corporations to maximize efficiencies. A team effort to build a Space PRTF will support the mining of asteroids, building of habitats in LEO, and stretch the imagination of all participants. Furthermore, the PRTF in space can provide strategic effects when supporting coalition space operations in the same manner the Russian space force has provided the US with space lift to the ISS since the elimination of the space shuttle.

This paper recommends STRATCOM proactively submit an expanded PR requirement to the Joint Requirements Oversight Council (JROC) implementation of a near term plan immediately after approval to get on the Integrated Priority List.¹⁹ After approving the initial programmed budget, the focus must shift to programming a fifteen to twenty year plan for PR in

space. I recommend USAF A/8 PR branch, which focuses on the planning and programming of USAF PR, to work with HSFS to ensure the plan appropriately addresses the gaps in coverage. An acceptable space PRTF plan of action will allow further exploration into space not only for activities within LEO but to GEO, asteroids within the asteroid belt, and later to potential settlements on the Moon or Mars. These may seem like lofty goals, but the US companies are vigorously working on the technologies now. Similarly to the requirement to gain insurance on a new automobile before departing the car lot, these space activities need a PRTF ready and waiting if the call comes for support. The DoD and United States of America need to lean forward now and begin the expansion of the HSFS tasking and provide PR support for all stages of space flight. This plan for space PR will enable the space explorers and commercial operators to push the boundaries of space, not only to touch the moon with a boot print, but further technologies for the economy of the world the same way jet airliners increased travel worldwide and the locomotive increase travel throughout the US.

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- ¹ I wish to thank Major Dalman for his thoughtful comments and suggestions. All errors found therein are my own.
- ² Todorov, Brig Gen Kenneth E. and Hecht, Col Glenn H. "Air Force Personnel Recovery as a Service Core Function." Air and Space Power Journal, 2011.p8.
- ³ 3-50, Department of Defense (DOD) Joint Publication. "Personnel Recovery." Oct 2, 2015. p.I-1.
- ⁴ United States Strategic Command, Major General Heidi V. Brown. Human Space Flight Support Concept of Operations. Offutt Air Force Base, October 29, 2015. p4.
- ⁵ Maj Adam Harris, Director of Staff, 45th Space Wing, Patrick AFB, FL. To the author. E-mail, 5 November 2015.
- ⁶ JP 3-50, p.21.
- ⁷ Ziarnick, Brent. Developing National Power in Space: a theoretical model. Jefferson: McFarland & Company, Inc., 2015.
- ⁸ United States Coast Guard. 2015 Budget in Brief. Washington D.C., 2015, p.24
- ⁹ George Zamka, Director, B330 Crew and Cargo Program for Bigelow Aerospace, LLC., Las Vegas, NV. To the author. Email, 2 December 15.
- ¹⁰ Zamka email 2 Dec 15
- ¹¹ USSTRATCOM CONOPS 2015, p.3.
- ¹² USSTRATCOM CONOPS 2015, p.3.
- ¹³ Email with Zamka, 30 Nov 15
- ¹⁴ USSTRATCOM CONOPS 2015, p10.
- ¹⁵ USSTRATCOM CONOPS 2015, p.9
- ¹⁶ Lt Col Marilyn Manifold, Deputy Chief, Strategic and Capabilities-Based Planning, Robins AFB, GA. To the author. Email, 5 November 2015 and 30 Nov 2015.
- ¹⁷ International Association of Chiefs of Police "Police Officer to Population Ratios Bureau of Justice Statistics Data." Accessed 6 November 2015.
<http://www.theiacp.org/Portals/0/pdfs/Officer-to-Population-Ratios.pdf>
- ¹⁸ USSTRATCOM CONOPS 2015, p11.
- ¹⁹ Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 5123.01G. "CHARTER OF THE JOINT REQUIREMENTS OVERSIGHT COUNCIL (JROC)," 12 February 2015.
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