

Fiscal Year:	FY 2018	Task Last Updated:	FY 09/14/2017
PI Name:	Newby, Nathaniel M.S.		
Project Title:	Soyuz Landing Injury Risk Characterization		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HFBP: Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) Dynamic Loads: Risk of In-Mission Injury and Performance Decrements and Long-term Health Effects due to Dynamic Loads		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
Project Type:	Ground	Solicitation / Funding Source:	Directed Research
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No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC
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Flight Program:			
Flight Assignment:	NOTE: Element change to Human Factors & Behavioral Performance; previously Space Human Factors & Habitability (Ed., 1/19/17) NOTE: Original task was with PI Jeffrey Somers and period of performance 7/2/2014-10/31/2016; PI change with the delayed start, per E. Connell/JSC SHFH element (Ed., 8/10/16)		
Key Personnel Changes/Previous PI:	September 2017 report: Brett Siders, University of Houston, and Jacob Putnam, KBRwyle, were added to the project as CoInvestigators. August 2016 report: Nathaniel Newby - new Principal Investigator (PI), KBRwyle Science, Technology and Engineering Group; Jeffrey T. Somers - now CoInvestigator (CoI), KBRwyle Science, Technology and Engineering Group; Michael Gernhardt - no longer a CoI		
COI Name (Institution):	Somers, Jeffrey M.S. (KBRwyle Science, Engineering and Technology Group) Siders, Brett M.S. (University of Houston) Putnam, Jacob M.S. (KBRwyle Science, Technology and Engineering Group)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

	<p>NOTE: Original task was with PI Jeffrey Somers and period of performance 7/2/2014-10/31/2016; PI change with the delayed start, per E. Connell/JSC SHFH element (Ed., 8/10/16)</p> <p>Currently, it is unknown how the current Soyuz landing injuries and accelerations relate to the new requirements levied on new vehicles. Understanding this connection will allow better quantification of the risk of injury for current crewmembers as well as allow NASA to relate this risk to the new design requirements recently enacted.</p> <p>The following are the specific aims for this task:</p> <ol style="list-style-type: none"> 1. Collect retrospective post-landing questionnaire data and develop injury database 2. Determine the occurrence of landing injuries to crewmembers 3. Determine whether the Soyuz meets current Multi-Purpose Crew Vehicle (MPCV) and Commercial Crew Program (CCP) requirements 4. Evaluate whether injury rates are consistent with the results of Finite Element (FE) modeling <p>Using data contained in the flight medicine databases, supplemented with data collected from crewmembers, flight surgeons, Russia sources, and international partner sources, an accurate estimation of the occurrences of injury during Soyuz landings will be determined. In addition, post-landing questionnaires will be developed for retrospective data collection to supplement the above sources.</p> <p>Through collaboration with our Russian colleagues, information about Soyuz landings will be collected to determine the dynamics of landing. The goal will be to obtain actual landing accelerations for individual landings; however, this may not be possible. If not available, all available information about nominal and off-nominal landings will be collected to develop a statistical model of possible landing distributions.</p> <p>In parallel, a Finite Element model of the Soyuz seat will be developed and the Test Device for Human Occupant Restraint (THOR), Hybrid III, and Human FE models will be fitted into the seat. Using the landing data obtained or calculated, landing simulations will be conducted.</p> <p>The resulting THOR, Hybrid III, and Human FE responses will be compared to the injury occurrences and current requirements. These comparisons will allow an estimation of the true risk of injury to deconditioned crew related to THOR and Hybrid III metrics.</p>
Rationale for HRP Directed Research:	<p>This task meets the criteria for a Directed Task due to the required access to operational data and because of insufficient schedule available to solicit this work. Because of the sensitive nature of the Soyuz injury and landing acceleration data, it would be very difficult to perform this task outside of NASA. In addition, based on the approved Path to Risk Reduction, this task is required to be completed by the end of FY18 in order to meet the Orion schedule for EM-2.</p>
Research Impact/Earth Benefits:	<p>This research benefits life on Earth by contributing to knowledge about how the body responds to impact, particularly after exposure to microgravity.</p>
Task Progress:	<p>The study has gone through select for flight through ISSMP (ISS Medical Project) and now includes all US Orbital Segment (USOS) crew plus space flight participants. Digitization of Soyuz drop test data traces has been performed and completed. To date, 36 out of 38 US crewmembers have provided consent to release of their Lifetime Surveillance of Astronaut Health (LSAH) data including landing-related injuries and pre-existing medical conditions. 14 of the 36 crewmembers experienced some type of injury related to the landing. Two additional injuries have been identified, but are confounded by pre-existing conditions. Most of the injuries are minor in nature, but 2 required some medical follow-up. Of the 36 crewmembers, 29 have consented to take part in the interview/survey sessions. To date 16 crewmembers have completed the interview/survey process. The study team is also in the process of obtaining survey data from Space Flight Participants (SFP). The post-flight Soyuz debriefs/interviews have been data mined to determine landing locations, weather, and terrain conditions at the landing site, parachute performance, and vehicle dynamics during impact for all of the Soyuz TMA landings. Seat accelerations have been discovered from full-vehicle Soyuz drop tests covering the range of expected impact velocities, angles, and ground conditions. From the data that has been recovered, we can begin to recreate the potential range of impact accelerations at landing based on survey crew responses and ground teams at the landing. An accelerometer is mounted to each of the three Soyuz seats and we are in pursuit of that data. A letter has been drafted to officially request seat acceleration data from our Russian colleagues. The Occupant Protection team has also developed an SBIR (Small Business Innovation Research) request for a standalone accelerometer that could be attached to the head and /or spine of future crew members to capture human responses to the landing. Finite Element Modeling is slated for next year.</p>
Bibliography Type:	<p>Description: (Last Updated: 02/12/2022)</p>