

<b>Fiscal Year:</b>	FY 2021	<b>Task Last Updated:</b>	FY 09/28/2020
<b>PI Name:</b>	Newby, Nathaniel M.S.		
<b>Project Title:</b>	Soyuz Landing Injury Risk Characterization		
<b>Division Name:</b>	Human Research		
<b>Program/Discipline:</b>			
<b>Program/Discipline--Element/Subdiscipline:</b>	HUMAN RESEARCH--Space Human Factors Engineering		
<b>Joint Agency Name:</b>	<b>TechPort:</b>	No	
<b>Human Research Program Elements:</b>	(1) <b>HFBP</b> :Human Factors & Behavioral Performance (IRP Rev H)		
<b>Human Research Program Risks:</b>	(1) <b>Dynamic Loads</b> :Risk of Injury from Dynamic Loads		
<b>Space Biology Element:</b>	None		
<b>Space Biology Cross-Element Discipline:</b>	None		
<b>Space Biology Special Category:</b>	None		
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<b>Zip Code:</b>	77058	<b>Congressional District:</b>	36
<b>Comments:</b>			
<b>Project Type:</b>	GROUND	<b>Solicitation / Funding Source:</b>	Directed Research
<b>Start Date:</b>	10/01/2015	<b>End Date:</b>	10/01/2021
<b>No. of Post Docs:</b>	0	<b>No. of PhD Degrees:</b>	0
<b>No. of PhD Candidates:</b>	0	<b>No. of Master' Degrees:</b>	0
<b>No. of Master's Candidates:</b>	0	<b>No. of Bachelor's Degrees:</b>	0
<b>No. of Bachelor's Candidates:</b>	0	<b>Monitoring Center:</b>	NASA JSC
<b>Contact Monitor:</b>	Whitmire, Alexandra	<b>Contact Phone:</b>	
<b>Contact Email:</b>	<a href="mailto:alexandra.m.whitmire@nasa.gov">alexandra.m.whitmire@nasa.gov</a>		
<b>Flight Program:</b>			
<b>Flight Assignment:</b>	<p>NOTE: End date change to 10/1/2021 per PI (Ed., 9/28/20)</p> <p>NOTE: End date change to 10/1/2020 per PI (Ed., 7/24/19)</p> <p>NOTE: End date change to 10/1/2019 per PI (Ed., 9/18/18)</p> <p>NOTE: Element change to Human Factors &amp; Behavioral Performance; previously Space Human Factors &amp; Habitability (Ed., 1/19/17)</p> <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>		
<b>Key Personnel Changes/Previous PI:</b>	<p>August 2020 Report: Added Brian Rodriguez as a co-investigator to assist with statistical analysis. Added Teresa Reiber as a co-investigator to assist with data collection and processing. August 2019 report: Preston Greenhalgh added to the project as a co-investigator. September 2018 report: Brett Siders and Jacob Putnam are no longer Co-Investigators. Nate Newby remains the PI, and Jeff Somers Co-I. 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</p>		

<b>COI Name (Institution):</b>	Somers, Jeffrey M.S. ( KBR/NASA Johnson Space Center ) Greenhalgh, Preston M.S. ( KBR/NASA Johnson Space Center ) Reiber, Teresa M.S. ( KBR/NASA Johnson Space Center ) Rodriguez, Brian ( University of Texas Medical Branch )
<b>Grant/Contract No.:</b>	Directed Research
<b>Performance Goal No.:</b>	
<b>Performance Goal Text:</b>	
<b>Task Description:</b>	<p>NOTE: Original task was with Principal Investigator (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 the impact load imparted to crewmembers landing in the Soyuz vehicle is unknown. This study is the first systematic assessment of the number and types of injuries associated with Soyuz landing. To date, we have found than more than a third of US Orbital Segment (USOS) crewmembers are experiencing injuries. Most of these injuries are minor, but they exceed expected rates based on analysis of seat accelerometer data from airborne and drop tests of the vehicle. The yet to be answered question is whether spaceflight deconditioning renders crewmembers more susceptible to landing impact injuries. Another possibility is that the Soyuz landing load is higher than our current estimates. It could also be that our analytical tools are insufficient to predict injury rates accurately for space vehicles. A final possibility is that some combination of these factors are responsible.</p> <p>The following are the specific aims for this task:</p> <ol style="list-style-type: none"> <li>1. Collect retrospective post-landing questionnaire data and develop injury database</li> <li>2. Determine the occurrence of landing injuries to crewmembers</li> <li>3. Determine whether the Soyuz meets current Multi-Purpose Crew Vehicle (MPCV) and Commercial Crew Program (CCP) requirements</li> <li>4. Evaluate whether injury rates are consistent with the results of Finite Element (FE) modeling</li> </ol> <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 have been 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>Initial scope of this investigation included development of a Finite Element model of the Soyuz seat to be used in conjunction with the Test Device for Human Occupant Restraint (THOR), Hybrid III, and Human FE models. Using the landing data obtained or calculated, landing simulations would then be conducted.</p> <p>The resulting THOR, Hybrid III, and Human FE responses would be compared to the injury occurrences and current requirements. These comparisons would allow for an estimation of the true risk of injury to deconditioned crew related to THOR and Hybrid III metrics. However, NASA has currently descope this aspect of the investigation.</p>
<b>Rationale for HRP Directed Research:</b>	<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>
<b>Research Impact/Earth Benefits:</b>	<p>This research benefits life on Earth by contributing to knowledge about how the body responds to multi-axial impact, particularly after exposure to microgravity.</p>
<b>Task Progress:</b>	<p>NASA Johnson Space Center Institutional Review Board (JSC IRB) approval for this investigation was obtained on June 16, 2016. The post-landing questionnaire was drafted and approved by the IRB. The Human Research Multilateral Review Board (HRMRB) approved the study in January 2017, extending the study to USOS crewmembers and spaceflight participants. The potential subject pool (from TM-34, which returned one USOS crewmember from International Space Station (ISS), to MS-15) is 94 total crew missions. Some crewmembers flew multiple missions, so the total number of astronauts is less than 94. Americans crewed 57 of these missions. USOS participants crewed 31 missions, and the remaining 6 spots were crewed by spaceflight participants. Two US and 1 USOS crewmember have declined participation in the study, reducing the total potential dataset to 91.</p> <p>This aim consists of data collection from two sources. One is flight medical records from a database maintained by the NASA Lifetime Surveillance of Astronaut Health (LSAH). This data is only obtainable for US astronauts. To date, medical information from the database has been obtained for 48 of 50 crewmembers from TMA-1 through TMA-MS07. Two crewmembers from these missions declined release of their medical data. The other data source is from a survey that crewmembers are asked to complete. The survey can be completed by US and USOS astronauts, and spaceflight participants. The survey requires an additional consent process. Out of the 57 US crewed missions, 49 have consented to this part of the study, 6 have not responded, and 2 have declined. Of the 49 that have consented, 38 have completed the survey. Of the 31 USOS crewmembers, consent has been obtained from 22 crewmembers (1 crewmember declined). All 22 consented crew have completed the survey. The Research Operations and Integration element is working to obtain consent from the remaining 11 crewed missions. Informed consent was obtained from one spaceflight participant, who completed the survey bringing the total number of completed surveys to 61. A manuscript based on the data collected to date has been accepted by the journal Safe.</p>

Bibliography Type:	Description: (Last Updated: 02/12/2022)
Articles in Other Journals or Periodicals	Newby N, Greenhalgh P, Somers J. "Soyuz Landing Risk Characterization." SAFE Journal 39:1-6. In press as of September 2020. , Sep-2020