Fiscal Year:	FY 2015	Task Last Updated:	FY 12/30/2014
PI Name:	Sandridge, Chris Ph.D.	X	
Project Title:	Integrated Radiation Analysis and Design Tools		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline Element/Subdiscipline:	HUMAN RESEARCHRadiation health		
Joint Agency Name:		TechPort:	Yes
Human Research Program Elements:	(1) SR :Space Radiation		
Human Research Program Risks:	 (1) ARS:Risk of Acute Radiation Syndromes Due to Solar Particle Events (SPEs) (2) Cancer:Risk of Radiation Carcinogenesis (3) CNS:Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure (4) Degen:Risk of Cardiovascular Disease and Other Degenerative Tissue Effects From Radiation Exposure and Secondary Spaceflight Stressors 		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	c.a.sandridge@nasa.gov	Fax:	FY
PI Organization Type:	NASA CENTER	Phone:	757-864-2816
Organization Name:	NASA Langley Research Center		
PI Address 1:	Mail Stop 188E		
PI Address 2:	LaRC-D309		
PI Web Page:			
City:	Hampton	State:	VA
Zip Code:	23681-2199	Congressional District:	1
Comments:			
Project Type:	Ground	Solicitation / Funding Source:	Directed Research
Start Date:	10/01/2005	End Date:	09/30/2015
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:	1	Monitoring Center:	NASA LaRC
Contact Monitor:		Contact Phone:	
Contact Email:			
Flight Program:			
Flight Assignment:	NOTE: End date changed to 9/30/2015 per 9/7/20	12 HRP Master Task List information	(Ed., 9/14/12)
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Badavi, Francis (Old Dominion University) Blattnig, Steve (NASA Langley Research Cente Clowdsley, Martha (NASA Langley Research C Simonsen, Lisa (NASA Langley Research Cente Slaba, Tony (NASA Langley Research Center)	er) Center) er)	
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The Integrated Radiation Analysis and Design Tools (IRADT) Project develops and maintains an integrated tool set that collects the current best practices, databases, and state-of-the-art methodologies to evaluate and optimize human systems such as spacecraft, spacesuits, rovers, and habitats. IRADT integrates design models and methodologies in support of evaluation/verification of design limits and design solutions to meet As Low As Reasonably Achievable (ALARA) requirements (NASA STD 3001, Vol 2). IRADT provides the radiation community access to physics and transport capabilities and research improvements. The capabilities are developed under strict version control and are independently verified and validated (IV&V) to the extent possible. Current customers include NASA Exploration Systems as well as Constellation's Orion and Vehicle Integration Office, universities, industry, and Small Business Innovation Research (SBIR). IRADT is designed for utilization by future commercial customers concerned about transfer of proprietary data and results. Deliverables and access to the Integrated Radiation Design Tools fill identified gaps documented in the Human Research Program (HRP) Integrated Research Plan (HRP-47065, Rev. A) to support the evaluation of effective shielding options by the engineering community: • Cancer - 11: What are the most effective shielding approaches to mitigate cancer risks? • Cancer - 13: What are the most effective shielding approaches to mitigate acute radiation risks, how dowe know, and implement? IRADT will specifically address the limitations associated with simplified geometry description (equivalent aluminum, three-layer transport interpolation, random orientation) and straight ahead transport. The design tools increases fidelity by incorporating common spacecraft and user specified materials in the geometry description with ray-by-ray transport to minimize the uncertainties due to range-scaling of material hicknesses and material ordering. Ray-by ray transport also establishes the ba	
Define de fer HDD Dimeted Dessent		
Research Impact/Earth Benefits:	•	
Research impact Larth Denents.	Several new comphilities were added to the OLTAPIS site over the last reporting period	
Task Progress:	The Matthia 2013 GCR (galactic cosmic ray) model (Matthia D., Berger, T., Mrigakshi A., T., Reitz G., A Ready-to-Use Galactic Cosmic Ray Model, Adv. in Space Res. 51 (2013) pp. 329-338) was added for freespace, Earth orbit, and surface environments. The model can be defined one of three ways, by selecting an historic solar min/max, by entering specific dates, or by entering a fitting parameter. A comprehensive comparison of the various GCR models was published by Slaba, et. al. (see publications) and it showed that the Matthia model was on par with the Badhwar-O'Neill 2010 model in terms of uncertainty for space radiation calculations. The Badhwar-O'Neill 2010 and 2004 models are also still available.	
	only available for interpolation-based, thickness distribution jobs for free-space environments. Both the integral and differential flux/fluence vs. LET is computed and the target material can be specified as either tissue or silicon.	
	A new atmosphere model has been added for Mars surface environments. The Mars Climate Database (MCD, http://www-mars.lmd.jussieu.fr/) is a database of atmospheric statistics compiled from state-of-the-art simulations of the Martian atmosphere. It is a much more refined model than MarsGRAM and takes into account the surface location (latitude and longitude), the Martian seasons (Solar longitude) and the time of day (Local solar time).	
	OLTARIS (https://) currently has 223 active accounts, which is an increase of 53 accounts over the current reporting period. 81 accounts are government (including NASA, Oak Ridge National Laboratory, Jet Propulsion Laboratory, Air Force Research Laboratory, and Federal Aviation Administration), 86 are university professors/researchers/students, and 56 are industry (including Boeing, Space X, Lockheed-Martin, Alliant Techsystems Inc., Northrup Grumman, and Bigelow Aerospace).	
	There have been nearly 4000 jobs run through OLTARIS during the current reporting period and 14,500 since counting began in November 2009.	
Bibliography Type:	Description: (Last Updated: 09/07/2020)	
Articles in Peer-reviewed Journals	Badavi FF. "Validation of the new trapped environment AE9/AP9/SPM at low Earth orbit." Advances in Space Research. 2014 Sep;54(6):917-28. <u>http://dx.doi.org/10.1016/j.asr.2014.05.010</u> , Sep-2014	
Articles in Peer-reviewed Journals	Slaba TC, Blattnig SR. "GCR environmental models I: Sensitivity analysis for GCR environments." Space Weather. 2014 Apr;12(4):217-24. <u>http://dx.doi.org/10.1002/2013SW001025</u> , Apr-2014	
Articles in Peer-reviewed Journals	Slaba TC, Blattnig SR. "GCR environmental models II: Uncertainty propagation methods for GCR environments." Space Weather. 2014 Apr;12(4):225-32. <u>http://dx.doi.org/10.1002/2013SW001026</u> , Apr-2014	

Articles in Peer-reviewed Journals	Slaba TC, Xu X, Blattnig SR, Norman RB. "GCR environmental models III: GCR model validation and propagated uncertainties in effective dose." Space Weather. 2014 Apr;12(4):233-45. <u>http://dx.doi.org/10.1002/2013SW001027</u> , Apr-2014
Articles in Peer-reviewed Journals	Badavi FF, Walker SA, Santos Koos LM. "Evaluation of the new radiation belt AE9/AP9/SPM model for a cislunar mission." Acta Astronautica. 2014 Sep-Oct;102:156-68. <u>http://dx.doi.org/10.1016/j.actaastro.2014.06.008</u> , Sep-2014