

8th International Space Safety Conference 2016

Safety First, Safety for All

Melbourne, Florida, USA
18 - 20 May 2016

ISBN: 978-1-5108-7530-2

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2016) by International Association for the Advancement of Space Safety (IAASS)
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact International Association for the Advancement of Space Safety (IAASS) at the address below.

International Association for the Advancement of Space Safety (IAASS)
Kapteynstraat 1
2201BB Noordwijk
The Netherlands

Phone: +31(0)712020023

spacesafety@iaass.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

Table of Contents

Conference Organizing Committee	3	Safety Considerations Regarding Commercial Human Space Flight Training.....	54
Table of Contents	4	<i>Nicholas Mercury Carlstrom, Michael Long, Gavin James</i>	
Acknowledgements	8	The Right Stuff ‘v’ the Right (Safe) Thing	60
Preface	9	<i>Dr Andy Quinn MSc PhD MRAeS CEng, Dr Ivan Sikora MSc PhD MRAeS FHEA</i>	
Conference Purpose and Goals	10	Session 05: Space Debris - I	68
Plenary Session	11	A Systematic Study of Laser Ablation for Space Debris Mitigation	69
NASA Administrator Charles Bolden Opening Remarks .	12	<i>R. Battiston, W.J. Burger, A. Cafagna, C. Manea, B. Spataro</i>	
Session 01: Launch Safety Risk.....	15	Long Term Orbit Propagation: Lessons Learnt and On Going Activities at CNES.....	80
Source Data Applicability Impacts on Epistemic Uncertainty for Launch Vehicle Fault Tree Models	16	<i>Vincent Morand, Clemence Le Fèvre, Hubert Fraysse, Juan Carlos Dolado Perez</i>	
<i>Mohammad Al Hassan, Steven D. Novack, Robert W. Ring</i>		Session 06: Regulations and Standards - I	87
Pitfalls and Precautions when using Predicted Failure Data for Quantitative Analysis of Safety Risk for Human Rated Launch Vehicles	21	2016 United States Safety Regulations Status Update ..	88
<i>Glen S. Hatfield, Frank Hark, James Stott, Ph.D.</i>		<i>Diane Howard, J.D., LL.M., DCL</i>	
Characterizing Epistemic Uncertainty for Launch Vehicle Designs	26	Regulation of Safety of Space Mining and Its Implications for Space Safety	93
<i>Steven D. Novack, Jim Rogers, Mohammad Al Hassan, Frank Hark</i>		<i>Ram S. Jakhu, and Joseph N. Pelton</i>	
Session 02: Lessons Learned.....	31	Commercial Human Spaceflight: What Regulation?	99
Role of Ground Safety Reviews in ISS Payload Mission Success	32	<i>Tommaso Sgobba, Michael Kezirian</i>	
<i>Ravi Margasahayam, Theodore Meade</i>		Filling the Regulatory Void for Launch and Reentry Safety Resulting from the Commercialization of Space Operations.....	106
Icarus Laugh. Risk And Space Exploration	38	<i>Dr. Ruth Stilwell</i>	
<i>Jacques Arnould</i>		Session 07: Launch Ground Operations Safety	113
The Demise of the Safety Engineer – Overcoming the Potential Impact to Space Safety	41	Dealing with a Subtle Danger During Launch Preparation Operations: Oxygen-Deficient Atmosphere Leading to Anoxia	114
<i>James A. Runnells</i>		<i>Miguel Morere</i>	
Session 03: Commercial Spaceflight - I	47	The Payload Safety Handbook: A Self -Supporting Tool to Ensure the Respect of Regulations Applicable to Spacecraft at the Guiana Space Center	121
The Evolution of the NASA Commercial Crew Program Mission Assurance Process	48	<i>Loriane Bourjac</i>	
<i>Amy Canfield</i>			

Ensuring Payload Safety on Missions Involving Special Partnerships 126 <i>Calvert A. Staubus, P.E., CSP, Rachel C. Willenbring, Michael D. Blankenship</i>	Session 11: Operations Safety 208
Session 08: Designing Safety – I 132	You Can't Reach for the Stars If You Are Tripping over the Ground! (Preventing Slips, Trips, and Falls).... 209 <i>Darcy Miller, Mark Raysich, Mary Kirkland</i>
Flat H Frangible Joint Evolution 133 <i>Thomas E. Diegelman, Todd J. Hinkel, Andrew Benjamin, Brian V. Rochon, Christopher W. Brown</i>	Probabilistic Survivability versus Time Modeling..... 217 <i>James J. Joyner, Sr.</i>
Pressure Suits for Suborbital Spaceflight Mandatory or Not? 139 <i>Christian Lüthen, M.D., Neil Jaschinski, Dipl. Ing. (FH)</i>	Session 12: Probabilistic Risk Assessment..... 221
Overview of Non-Ionizing Radiation Safety Operations on the International Space Station..... 144 <i>John Flores-McLaughlin, James Runnells, Sam Ghalayini, Ramona Gaza</i>	Space Mission PRAs 222 <i>D. L. DeMott</i>
Session 09: Safety Critical Software..... 148	Resilience Engineering for Space Missions' Safety Assessment 228 <i>Riccardo Patriarca, Giulio Di Gravio, Francesco Costantino</i>
STPA for Space Software Dependability and Safety 149 <i>Carlos H. N. Lahoz, Synara R. G. Medeiros</i>	International Collaboration for HTV PRA Analysis 240 <i>Masami Miki, Satomi Takada, Takashi Goto, Koji Oga, Toru Yoshihara, Hiraku Kudo, Norimitsu Kamimori, Jinfeng Ni, John Yasensky, Philip Mortillaro</i>
A FDIR Implementation Based on Functional and Software Units Design..... 158 <i>Olivier Boudillet, Jacques Magné</i>	Session 13: Commercial Spaceflight – II 248
Safety Characteristics in System Application Software for Human Rated Exploration Missions 166 <i>Edward J. Mango</i>	SABRE – Enabling Commercial Single Stage to Orbit, Safely 249 <i>Dr Andy Quinn MSc PhD MRAS CEng, Richard Varvill</i>
Session 10: Launch Safety - I 173	Operational Safety Considerations for Rapid Turnaround Private Suborbital Flight Providers..... 256 <i>Justin Karl, Ph.D., Jennifer Thropp, Ph.D.</i>
Launch and Reentry Safety Objectives 174 <i>Jerold M. Haber</i>	Development of a Commercially Available Pressure Suit for Suborbital Flight 261 <i>Erik Seedhouse, Ph.D.</i>
Improved Range Safety Methodologies for Long-Duration Heavy-Lift Balloon Missions Over Populated Regions 182 <i>George M. Lloyd, Kevin Benn, Jerry Haber, Danielle Franklin</i>	Session 14: Launch Safety – II 266
Near Range Safety Analysis for a Reusable Launcher Concept Based on Toss-Back 191 <i>A. Martinez Torio, J.M. Bahu, D. Delorme, V. Guenard, H. Poussin</i>	Potential Uses of Consequence Analyses for Range Safety 267 <i>Paul D. Wilde Ph.D., P.E.</i>
Common Cause Failure Modeling in Space Launch Vehicles 201 <i>Frank Hark, Rob Ring, Steven D. Novack, Paul Britton</i>	Managing a Safe and Successful Multi-User Spaceport 278 <i>Taylor Dacko, Kirk Ketterer, Phillip Meade</i>
	Launch System Hazard Study: Methodology and Lessons Learnt after 5 Years of Application 285 <i>D. Delorme, A. Biard</i>
	The Use of an Atmospheric Model for Studying the Gas Dispersion at the Brazilian Space Launch Center..... 292 <i>Gilberto Fisch, Paulo Geovani Iriart, Daniel Andrade Schuch, Vinicius Couto Milanez, Carlos Augusto, Teixeira de Moura</i>

Session 15: Organization Culture – I.....298

Purpose, Principles, and Challenges of the
NASA Engineering and Safety Center 299
Michael G. Gilbert, Ph.D.

Observations, Reflections, and Lessons Learned...
From ~500 SSPCBS & ~1000 IMMTS... And GOBS of
SORRS, FRRS, Etc. 306
George K Gafka

Evolving United States Air Force Space Safety Policy and
Culture to Meet Today's Space Safety Challenges 310
*Lt Col Steve Bogstie, Lt Col Beth Nayder,
Maj James Souders*

Launch Systems Conformity Training Process and
Academic Methodology..... 314
C. Aussilhou, D. Miot

Session 16: Regulations & Standards – II323

Need for Space Governance for India and Global Space
Governance 324
Dr. Sanat Kaul

Policy Challenges Related to Nanosatellites..... 332
*Matteo Emanuelli, Blake James Edwards, Matt Driedger,
Justin Atchison, Jordan Sotudeh, Gabriel Lapilli,
Maria Grulich, Laura Bettiol, Caroline Thro, Eren Gorur,
Leehandi De Witt, Alon Davidi, Suman Gautam,
Sirisha Bandla, Juan Gramajo, Milan Mijovic, Laura León
Perez, Chantelle Dubois, Emmanuelle David,
Meidad Pariente, Chris Johnson*

Status of the Governing Space Safety
Treaty Organization 338
Leslie Ann Alford

Session 18: Space Traffic Control – I.....346

Preliminary Study on Inadvertent Laser Illumination
Hazards Posed to Satellite Optical Sensors..... 347
*Patrick Shriver, Karen Yamamoto, Chad Cogburn,
Chris Jones, Ken Miller*

The Impact of New Trends in Satellite Launches on the
Orbital Debris Environment 358
Arif Göktug Karacalioglu, Jan Stupl

Orbital Debris: What Are the Best Near-Term Actions
to Take? A View from the Field 366
Dr. Mark A. Skinner

Analysis on Spacecraft Safety Enhancement through
On-Orbit Servicing 376
*Aureliano Rivolta, Yuval Porat, Nicolò Carletti, JeremyWang,
Caroline Thro, Ali Nasser, Joao Lousada, Matteo Emanuelli*

Session 19: Designing Safety – II.....384

A Proposed Method to Quantify Orbital Debris Impact
Risks on Space Pressure Vessels 385
Michael S. Surratt, Michael Kezirian, PhD

Early Engagement of Safety & Mission Assurance
Expertise Using Systems Engineering Tools:
A Risk-Based Approach to Early Identification of
Safety and Assurance Requirement..... 389
Scott Darpel, Sean Beckman

“Safe Use of Electrical COTS hardware in Human
Space Flight” 396
James A. Runnells

Introducing IAASS-ISSB-S-1700-REV-B Space Safety
Standard Commercial Human-Rated System..... 402
Tommaso Sgobba

Session 20: Human Performance – I.....407

Human Factor in Flight Safety 408
H. Poussin, L. Rochas, T. Vallée, R. Bertrand

Managing Cognitive Bias in Safety Decision Making:
Application of Emotional Intelligence Competencies ... 412
Walter S. Hersing

Session 22: Space Debris – II.....419

Good Practice for Upper Stages Going to Lagrangian
Point Application to the Ariane 5 JWST Mission 420
D.-A. Handschuh, J. Campedelli, N. Lidon, E. Canalias

Satellite Design for Demise: Updated State of the Art
and Innovative Concepts 431
S. Heinrich , F. Leglise, F. Renard, L. Grassi, R. Destefanis

Debris Remediation Examined via an Operational
Success Framework 445
Dr. Darren McKnight

Fast and Flexible Space Debris Risk Assessment
for Satellites 455
Max Gulde, Scott Kempf, Frank Schäfer

Session 24: Materials 458	The Uncontrolled Reentry of Progress-M 27M 540 <i>Carmen Pardini, Luciano Anselmo</i>
Investigation of Ti-6AL-4V Alloy Response to Atmospheric Re-Entry Exposure..... 459 <i>Jessica L. Buckner, Stephen W. Stafford, Darren M. Cone, John D. Olivas</i>	Session 28: Organization Culture – II..... 549
The Spacecraft Fire Experiment (Saffire) - Objectives, Development and Status 469 <i>William Schoren, Gary A. Ruff, David L. Urban</i>	The Evolution of Continuing Education & Training for Safety & Mission Assurance Professionals..... 550 <i>Megan K. Stroud, Tom Pfitzer</i>
About the Demisability of Propellant Tanks during Atmospheric Re-Entry from LEO..... 475 <i>T. Lips, B. Fritsche, R. Kanzler, T. Schleutker, A. Gülhan, B. Bonvoisin, T. Soares, G. Sinnema</i>	Session 29: Designing Safety – III 554
Demise and Survivability Criteria for Spacecraft Design Optimization..... 483 <i>Mirko Trisolini, Hugh G. Lewis, Camilla Colombo</i>	How to Ensure Medical Safety and Rescue in Human Spaceflight for the Future..... 555 <i>Yacine Benyoucef</i>
Session 26: Space Traffic Control – II 494	Session 31: NEO & Cosmic Hazards..... 561
Exploring Necessary Altitude Awareness and Response Times for Air Traffic Control during Space Launch and Re-Entry Operations..... 495 <i>Zheng Tao, Paul D. Wilde, Ph.D., P.E, Jonathan L. Schwartz, Jon L. Semanek, Dr. Ganghuai Wang, Ashley G. Williams</i>	Space Situational Awareness Programme: Enhanced Neo Propagator (NEOPROP2)..... 562 <i>Valentino Zuccarelli, Sven Weikert, Celia Yabar Valles, Detlef Koschny</i>
Application Analysis for Aeroassisted Orbit Transfer in Noncoplanar Orbit Debris Remove..... 504 <i>Yan Ruidong, Wang Ronglan, Liu Siqing, Shi Liqin, Gong Jiancun</i>	Global Cosmic Risk Assessment Study (COSRAS) by the IAASS 570 <i>Joseph N. Pelton</i>
Why a Future Commercial Spacecraft Must Be Able to Swim 512 <i>Frank Morlang, Jorge Ferrand, Remzi Seker</i>	Session 32: Human Performance – II..... 573
Session 27: Re-entry Safety – II..... 517	Human Factors Checklist: Think Human Factors – Focus on the People..... 574 <i>Darcy Miller, Katrine Stelges, Timothy Barth, Damon Stambolian, Gena Henderson, Charles Dischinger, Barbara Kanki, Ian Kramer</i>
Update of Aerodynamics and Heat Flux Model For ORSAT-J 518 <i>Keiichi Fujimoto, Hiroumi Tani, Hideyo Negishi, Yasuhiro Saito, Nobuyuki Iizuka, Koichi Okita</i>	Session 33: Safety on Long Duration Missions 584
Atmospheric Entry of Space Debris: Oxidation and Emissivity Data for Model Implementation..... 526 <i>M. Balat-Pichelin, L. Barka, J. Annaloro, P. Omaly</i>	Develop Global Safety Synergies for Long-Range Human Space Exploration, with Focus on Launch Systems 585 <i>Aline Decadi</i>
Statistical Issues for Calculating Reentry Hazards 535 <i>John B. Bacon, Mark Matney</i>	Identification of Hazards Associated with a One-Way Human Mission to Mars 594 <i>Joao Lousada, Aureliano Rivolta, Matteo Emanuelli, Ali Nasser</i>
	Plenary Closing Session 603
	Hypersonic, Space Transit, and Space Access Flight Test 604 <i>James Vasil Souders, Timothy R. Jorris</i>