**AIRCRAFT AND SPACE VEHICLES SPACE SYSTEMS AND OPERATIONS**

**Space Operations and Ground Support Working Group (WG3)**

Minutes

Venue: Deutsches Institut fur Nurmung

Date: 23th to 26th May 2011

1. The meeting was called to order at 0930 on 23 May 2011. The attendance list is attached. The Ukrainian Delegation was not present, and there was no WG3 representation from Brazil.

2. After a long delay due to Dr. Finkleman's lack of preparation and overhead projector issues.

3. The Convenor's Report was delivered first. Dr. Finkleman reviewed standards published recently. He noted exceptional collaboration between NASA and the Russian Delegation on Launch Site Failure Reporting and between the Aerospace Corporation and JAXA on interpretation of the probability of successful end of life disposal from the geostationary protected region.

4. Action Items from the joint meeting in London, Oct 2010, were discussed.

* 16159: Space Systems - Launch pad and integration site - Analysis of failures
	+ Action: Adjudicate the difference through Mr. Schultz. WG recommendation is to move this work item to the next stage with the section in question with clarification to follow during the next version and vote.
	+ Status: Completed
* 24113: Orbital Debris Management: FDIS to be circulated.
	+ Action: Dr. Ailor to provide an unambiguous formula and definitions as well as examples of how this process is employed at the Aerospace Corporation.
	+ Status: Completed
* Terminology
	+ Action: Ukrainian delegation to provide the database for Dr. LaCroix. Dr. Finkleman to facilitate.
	+ Status: Not completed. Ukrainian delegation again absent. Database not provided.
	+ Next Action: Dr. LaCroix to contact Ukrainian delegation directly via telephone. ISO terminological database requested for Dr. LaCroix to examine for terms relevant to space. Review of all documents by the Ukrainian delegation suspended pending resolution of long term prospects.
* CD 11233: Orbit Determination and Estimation
	+ Action: Dr. Finkleman to follow up with Secretariat.
	+ Status: Document with comments addressed provided to Secretariat and item registered for DIA
	+ Next Action: Dr. Finkleman was not aware of comments submitted in Feb 2011 by UK and Japan. Review at current meeting implies that none were substantive, but Dr. Finkleman should investigate with Secretariat whether status should revert pending adjudication of the few remaining comments.
* NWIP: Space systems-Relative Motion Analysis Elements for Launch Vehicle/Spacecraft Separation (China) and Launch Collision Avoidance Support Plan (US).
	+ Action: Song Qiang to update status and indicate whether this item is sufficiently well justified for continuation.
	+ Status: Complete
	+ Action: Members to provide information on their individual launch support arrangements and documentation in order to determine if some or any of the provisions of the work item proposal are already covered in other ways and confirm the need for standardization if there is wide diversity or no provision.
	+ Status: No information received from any delegations. Proposal was not approved because of inadvertent administrative oversights.
* 16158: Space systems - Avoiding collisions with orbiting objects and Conjunction Assessment Message.
	+ Action: Additional NWIP to be circulated relevant to collision assessment requirements for implementation by the spring plenary.
	+ Status: Completed
* 16699: Disposal of Orbital Launch Vehicle Stages.
	+ Action: Dr. Ailor to produce a working draft to be distributed in time for members to examine it and be prepared for more substantial discussion at the next meeting.
	+ Status: Initial working draft completed. Example of Delta II post launch disposal provided.
	+ Next Action: In the absence of Dr. Ailor or any alternative representative capable of addressing this work as well as the absence of Dr. Kato due to health issues, discussion will be continued to the next meeting.
* 16164: Space systems - Disposal of satellites operating in or crossing Low Earth Orbit
	+ Action: Mr. Cawthorne to conceive a representative worked example.
	+ Status: Dr. Stokes reviewed status in the absence of Mr. Cawthorne, who was granted paternity leave. Dr. Ailor provided a recent USAF SMC Standard very closely related. Mr. Cawthorne incorporated many elements.
	+ Next Action: USAF representatives to compare Mr. Cawthorne's current draft with the USAF standard to identify differences or omissions for discussion at the next meeting.
* 16127: Prevention of Breakup of Unmanned Spacecraft.

Action: Deferred until outcome of the very recent WG1 meeting in Brazil are known.

Status: WG1 retains this work, which Dr. Stokes reviewed independently for WG3 and ODCWG.

5. We discussed work items in the following order.

5.1 N726: Space systems-Relative Motion Analysis Elements for Launch Vehicle/Spacecraft Separation:

Mr. Song Qiang delivered an excellent presentation reviewing the proposal, which was not approved because of administrative oversights by delegations, omitting commitment to participation in the development.

 Actions: Song Qiang and Dr. Finkleman to work with delegations assuring that positive votes are accompanied by commitments of participation. US, Brazil, and Japan at least are willing to do so but neglected to indicate that on the recent ballot.

 Action: Launch Collision Avoidance Support Plan NWIP to be circulated with renewed request for information from each delegation describing how such preparations are conducted in each venue. The objective is to decide whether a uniform standard similar to the LCASP is necessary.

5.2 11233: Orbital Determination and Estimation: As described above, this work may have advanced to DIS while some comments were not yet resolved. Dr. Finkleman reviewed the content of the work item as well as the recently issued ANSI-AIAA S-131-2010, Astrodynamics Best Practices, which emphasizes orbit propagation. These two documents provide long needed normative guidance for these important practices.

 Action: Resolve remaining comments and move to DIS.

5.3 16158: Avoiding Collisions with Orbiting Objects: Over the past year, this item was redirected to provide guidance and information on approaches to estimate the probability that two orbiting objects in close conjunction might actually collide. In addition, a new work item was discussed to establish information requirements for collision estimation. That proposal was submitted at the present meeting, and a document circulated that quantifies the regions of greatest precision for the major four or five collision probability approaches. After some controversy provoked by Dr. Finkleman over division of responsibility with SC13/CCSDS, higher management directed developing the Memorandum of Agreement required by SC13/SC14 liaison agreements for work of mutual significance. CCSDS is responsible for developing a Conjunction Data Message with SC14 participation, and CCSDS will participate in pursuing the present SC14 work items.

Action: Continue work on 16158 redistributing work assignments recognizing that principals Dr. Ailor and Dr. Klinkrad have diminished their involvement and that Mr. Oltrogge recently changed jobs.

 Action: NWI vote for collision assessment information requirements.

 Action: Develop and negotiate CCSDS-SC 14 MOA.

5.4 16164: LEO Disposal: Discussed above with associated continuing actions. In addition, the Japanese delegation noted that the probability of sufficient remaining propellant, which appears in probability of successful disposal reflected in 24113 and the GEO disposal standard, both already published, is not defined nor is there any guidance as to what it is or how to compute it. The WG decided that these probabilistic elements should appear only in 24113 in order to avoid confusion and to mitigate the need for changing multiple documents should any of the probabilistic guidance change. In the absence of Japanese delegates to speak to this matter, it is continued to the next meeting.

Action: Dr. Stokes to add this item to the living compendium of potential changes to 24113 at the next opportunity for revision.

5.5 CD 11233: Orbit Determination and Estimation: This item lapsed through lack of action by the Secretariat. Required documentation was provided to the Secretariat which lost it leading to cancellation. The item was reactivated by ISO. The documentation was reconstructed, and the document should pass into DIS by the May 2011 plenary.

Action: Dr. Finkleman to follow up with Secretariat.

5.6 16159: Launch Site Failure Analysis: Described above under past action items. Working group actions are complete.

5.7 16158: Disposal of Orbital Launch Vehicle Stages. Discussed above with associated actions. We discussed reasons for it perhaps being infeasible to deorbit all spent boosters. We focused on boosters for geostationary satellites. These boosters remain in Geostationary Transfer Orbits and are potentially one of the most significant threats to geostationary satellites. M. Aubin commented that GTO's with perigees as low as 250 km still had very long orbit lifetimes.

Action: In the absence of Dr. Ailor, we examined the draft he had submitted but without an alternative expert to speak for him further action is deferred until the next meeting unless additional information is forthcoming.

5.8 26900: Orbit Data Messages: This joint work item is completed and published. However, errata were noted at the CCSDS meeting that preceded the present gathering. These will be compiled to be addressed at the next revision opportunity. If straightforward corrigenda are possible without subjecting the standard to additional, lengthy and unnecessary review, this will be the approach.

 ACTION: Corrigenda are possible.

5.9 27852: Orbit Lifetime Estimation: Dr. Finkleman reviewed the objectives and content of this standard already published. The objective is a set of normative rules with simple application and interpretation that represent ISO consensus for sufficiency of declarations of orbit lifetime estimates meeting IADC guidelines. There is no claim of exquisite scientific precision, although there is such a basis for the broad guidance. Mr. Fraysee presented the CNES Stela approach developed to meet the requirements of French national legislation. Mr. Tobiska, WG4, presented comments and alternatives. Misunderstanding about the terminology used to represent atmospheric property proxies was resolved. Dr. Finkleman noted that all of the approaches to estimating the density consequences of relatively unpredictable solar cycles met the letter and the intent of 27852. All agreed that this work cuts across several working groups and that the most current, internationally vetted science should be incorporated continuously.

Action: Continuing interaction among stakeholders.

5.10 24113: Orbital Debris. Dr. Stokes reviewed the accumulated comments for incorporation in next revision.

Action: None

5.12 Informational report on time related work items. Dr. Finkleman summarized findings from examination of the ITU recommendation to eliminate the leap second from Universal Coordinated Time (UTC). The conclusion is that normative standards are required for appropriately qualified definitions of the various kinds of seconds (the fundamental time interval) and UTC (the civil time scale). In addition guidance is required either for properly implementing leap seconds or, if leap seconds are eliminated, transitioning efficiently the many systems that currently accommodate leap seconds.

Action: None.

6. New Work Items

6.1 NWIP: Normative Definition of Time Intervals and Time Scales. Dr. Finkleman reviewed the NWIP. There was discussion of the claim of urgency and the conclusion that there was no normative definition or authority for time as it affects astrodynamics, astronomy, and space operations. Dr. Finkleman explained that the ITU would consider material change in UTC at the next World Radio Conference in Geneva in early 2012.

 Action: Review and ballot NWIP

6.2 NWIP: Requirements for Collision Estimation. Dr. Finkleman presented information from recent papers on this subject, offering such as nearly completed draft standards.

 Action: Review and Ballot NWIP.

6.3 NWIP: Guidance for Operation of Small Satellites: Dr. Finkleman reviewed the content of this NWIP. Small satellites are proliferating, and several in long lived trajectories within the heavily populated Sun synchronous regime. The standard would address allowed operating orbit regimes based on considerations such as observability, maneuverability, communication capabilities, and the population of the regions.

 Action: Review and Ballot NWIP.

6.4 NWIP: Design and Operation Handbook for Satellites in a Debris Environment. This is proposed by JAXA as guidance for executing debris mitigation measures and standards throughout the system engineering process for space missions. No NWIP was provided, and there was no alternate for Dr.Kato to described the work.

 Action: Produce NWIP for circulation at the next meeting.

7. Resolutions. The following resolutions are proposed for the Plenary.

7.1 Whereas the hospitality and support of DIN has been exceptional be it resolved that ISO WG3 is grateful in the extreme.

7.2 Whereas the relationship between SC13 and SC14 is growing strong, be it resolved that appropriate members of each group be appointed to relevant working groups in each group to foster greater face to face interaction and continuing collaboration.

7.3 Resolved that development and technical review of orbital debris work items is the responsibility of project leads designated by the technical working groups and that duplication of working group responsibilities shall be avoided.

Respectfully Submitted:

David Finkleman

Convenor and Recorder, TC20/SC14/WG3

ATTENDANCE

Igor Zhokin, Russia

Gortro Alexev, Russia

Sarah Amunsen, USA

Marlon Sorge, USA

Michelle Voelker, USA

Bruno Lazare, France

Hubert Fraysee, France

Itsuo Wakamatsu, Japan

Didie Aubin, France

Hedley Stokes, UK

Dave Finkleman, USA

John Davey, UK

Larry Schultz, USA

Anton Spivak, Russia

Evgeny Tsukanov, Russia

Andre LaCroix, Germany

Manuiel Metz, Germany

Dominique Hoeguellet, France

Song Qiang, China

Xu Hongping, China

Roberto Destafanis, Italy

David Berry, USA**ATTACHMENTS**

**1.** ISO 16164: Disposal of Satellites from Low Earth Orbit

2. SMC Standard SMC-5-022, End of Life Disposal of Satellites in Low Earth Orbit

3. Controlled Deorbit of the Delta IV Upper Stage for the DMSP-17 Mission

4. ISO N712, Disposal of Orbital Launch Stages

5. Conjunction Data Requirements

6. Collision Assessment Requirements, NWIP, Form 4

7. Standard Time Intervals and Time Scales, NWIP, Form 4

8. Concept Paper: Normative Definitions and Application of Time Intervals and Time Scales for Space Missions, Astrodynamics, and Astronomy.

9. ANSI/AIAA S-131-2010, Astrodynamics – Propagation Specifications, Technical Definitions, and Recommended Practices.

10. ISO CD-1123, Orbit Determination and Estimation – Process for Describing Techniques

11. ISO S-27852, Determining Orbit Lifetime (WD version)

12. WG3 Minutes, BSI, London, Oct 2010

13. CNES Presentation: STELA, Long term orbit propagation

14. CALT Presentation: Relative Motion Analysis for LV/SC Separation

15. Operational Guidelines for Small Satellites presentation

16. Draft SC13/SC14 Memorandum of Agreement for Conjunction Data