Minutes of the 47th WG3 Meeting - Fall 2016 held at CNES HQ, Paris / France November 15th to 17th, 2016

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The ISO/TC20/SC14/WG3 Convener

Dr. André LACROIX

List of Participants

Participants in WG3 meeting

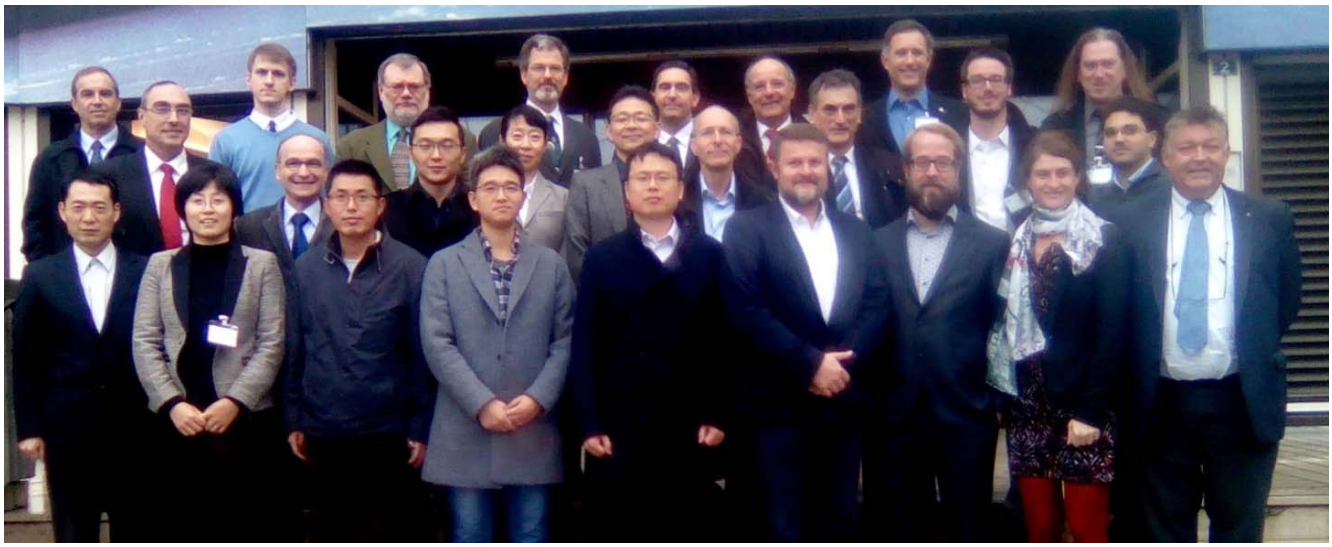
Convener	Germany	Andre LaCroix	Airbus Safran Launchers
	China	Han Feng	China Academy of Launch Vehicle Technology
	China	Jialin Wu	Shanghai Academy of Spaceflight Technology (SAST)
	China	Mingliang Tang	Shanghai Academy of Spaceflight Technology (SAST)
	China	Xiaofang Zhao	China Academy of Space Technology
	China	Zhaozhao Gao	China Academy of Space Technology
	Japan	Jun'ichi Horikawa	Mitsubishi Heavy Industries (MHI)
	Japan	Mari Goto Yuzawa	Mitsubishi Electric Co.
	UK	Brian Swinburne	Airbus Defence and Space
	USA	Dan Oltrogge	AGI

Participants in joint WG3/WG7 meeting session

- *See Minutes of Meeting ISO TC20/SC14/WG7 Fall-2016.*

Absent WG3 members from previous meetings:

apologies	Brazil	Antonio Vinicius Diniz Merladet	Industrial Fostering and Coordination Institute (IFI)
apologies	Brazil	Mario Niwa	Industrial Fostering and Coordination Institute (IFI)
	China	Hu Haifeng	China Academy of Launch Vehicle Technology
	China	Shao-wie Feng	China Academy of Launch Vehicle Technology
	China	Tong Xin	China Astronautics Standards Institute (CASI)
	China	Yanfeng Gu	Shanghai Academy of Spaceflight Technology (SAST)
	Germany	Osvaldo Peinado	DLR - German Space Operations Center (GSOC)
present WG7	Japan	Akira Kato	Japan Aerospace Exploration Agency (JAXA)
	Japan	Yoichiro Uchida	The Society of Japanese Aerospace Companies (SJAC)
	Russian Federation	Anton Agoshkov	TSENKI
apologies	Russian Federation	Artem Bondarenko	TsNIIMash
	Russian Federation	Anton Spivak	TsNIIMash
	Ukraine	Valeriy Kapinus	Yuzhnoye State Design Office
	Ukraine	Galyna Matus	Yuzhnoye State Design Office
	UK	John Davey	UK Head of Delegation ISO TC20 SC14
	USA	Dave Finkleman	Comcast / SkySentry
	ISO TC20/SC13	David Berry	CCSDS NAV WG (NASA Jet Propulsion Laboratory)
	Europe	Tim Flohrer	ESA ESOC



Roll-call of Delegates

Apologizes were received from Brazil delegation not able to attend the meeting, as well as from Mr. Artyom Bondarenko (TsNIIMash).

Mr. Brian Swinburne (Airbus DS) was welcomed as new WG3 member. Those present WG3 members introduced themselves.

In summary, ten WG3 members were present, representing **five** countries during WG3 Fall 2016 meeting.

- Brazil: 0 (2 apologies received due to travel reasons)
- China 5
- France: 0
- Germany: 1
- Japan: 2
- Russia: 0 (1 apology received due to visa reasons)
- Ukraine: 0
- UK: 1
- US: 1

ISO TC20 SC14 Resolution 393 (May-2016):

> *TC20/SC14 resolves to execute Resolution 374 with a written gratitude letter signed at least by the SC14 Chairman, to recognize the outstanding leadership and dedication of Dr. Dave Finkleman, and to thank him for his extensive contributions to WG3 as well as for having significantly advanced the overall SC14 standardization activities.*

This closes **WG3 action 45-01**.

ISO TC20 SC14 Resolution 394 (May-2016)

> *TC20/SC14 resolves to confirm Andre LaCroix as WG3 convener, (…) with the confirmation and approval of the their respective delegations.*

ISO TC20 SC14 Resolution 395 (May-2016)

> *TC20/SC14 resolves that Dan Oltrogge act as the technical liaison from SC14 to the CCSDS.*

This closes **WG3 action 45-02**.

During WG3 Fall-15 meeting, Bruno Gerard (Arianespace), announced that a new contact point would be nominated for WG3 activities, to succeed Didier Aubin who retired in 2014. In addition, Bruno Lazare, WG3 representative from France (CNES) announced Fall-2015 his retirement. The French delegation (Karim Benmeziane, BNAE) has been contacted Dec-15 to clarify the nomination of new representative(s) and contact point(s) from France for WG3 activities. Even so the subject has been addressed several times in 2016 period, the French delegation did not manage to provide a name until today.
WG3 action 45-03 remains open.

Adoption of the Agenda

The agenda as distributed by e-mail on 05-Sep-2016 has been revised before the meeting together with the WG7 convener. No further comments have been received.

Those present WG3 members approved the revised agenda as presented (see in **Attachment 01**).

Review and Approval of the previous WG3 meeting minutes

The minutes of the both last meetings (45th WG3 meeting Nov-15/Darmstadt and 46th WG3 meeting joint with WG7/Beijing) were reviewed and approved by all the participants.

In particular it was noted, that specific WG3 minutes (in addition to the published WG7 minutes - see in **Attachment 02**) could have been established for the joint WG3/WG7 meeting May-16/Beijing.

SC14 work program status and progress within WG3 scope

The current latest status of ISO/TC20/SC14 work program (excel file) sent by the SC14 Secretariat (Nick Tongson), is dated October 2016 (see in **Attachment 03**). This status is covering all the WGs items.

The active work program overview Oct-16 within WG3 scope is as follows:

	NWIP	WD	CD	DIS	FDIS	IS	SysRev	Cancelled	Total
WG3	1	0	0	0	0	24	6	9	25

To be noted that the SC14 Secretariat presented during May-16 Plenary meeting, that following changes to the ISO/IEC directives, the step "Final Draft International Standard (**FDIS**)" can now become **optional**:

> *"if DIS comments result in technical changes and leadership wishes to skip FDIS, this must be confirmed by the committee via CIB with a 2/3 majority"*

WG3 standards published in 2015/2016 are as follows:

Project #	Part #	Ed	Project Title	Limit Dates	Project Lead	PL Country	Completion Date
16164		1	Space systems — Disposal of satellites operating in or crossing Low Earth Orbit	PUBLISHED	Cawthorne, Andrew	United Kingdom	01.07.2015
16679		1	Space systems — Relative motion analysis elements after LV/SC separation	PUBLISHED	Qiang, Song	China	01.09.2015
16699		1	Space systems — Disposal of orbital launch stages	PUBLISHED	Finkleman, Dave	USA	01.11.2015
23339		1	Space systems — Unmanned spacecraft residual propellant mass estimation for disposal manoeuvres	PUBLISHED	Funayama, Tomoe	Japan	23.03.2016
27852		2	Space systems — Estimation of orbit lifetime	PUBLISHED	Oltrogge, Dan	USA	01.07.2016
27875	Amd1	1	Space systems — Re-entry risk management for unmanned spacecraft and launch vehicle orbital stages — Amendment 1	PUBLISHED	Kato, Akira	Japan	15.03.2016

WG3 actions **45-04** (status 16679) and **45-05** (status 16699) are confirmed as closed, since both standards have been published in 2015.

During 2016 period, ISO **27852** and ISO **27875 AMD1** have been published, and the systematic review of ISO **23339** has been completed and the document reaffirmed:

- To be reminded, that the disposition of the systematic review outcomes of ISO 27852 and ISO 23339 are related to the plans for consolidation of debris mitigation standards framework (under WG7 discussion) and the contents of the future ISO 24113 revision.

WG3 standards currently under systematic review are as follows:

Project #	Part #	Ed	Project Title	Project Lead	PL Country	Next Action	Next Action Due Date
14625		2	Space systems — Ground support equipment for use at launch, landing, or retrieval sites — General requirements	Schultz, Larry	USA	National Votes Due	05.12.2016
15389		1	Space systems — Flight to ground umbilicals	Schultz, Larry	USA	National Votes Due	05.12.2016
15389	Amd1	1	Space systems — Flight to ground umbilicals — Amendment 1: Add Annex A, Prevention of accidental cross connection	Tsukanov, Evgeny	Russia	National Votes Due	05.12.2016
22108		1	Space systems — Non-flight items in flight hardware — Identification and control	Hobbs, Steven	UK	National Votes Due	05.12.2016
23041		1	Space systems — Unmanned spacecraft operational procedures — Documentation	Miyashita, Makoto	Japan	National Votes Due	05.12.2016
26872		1	Space systems — Disposal of satellites operating at geosynchronous altitude	Ailor, Bill	USA	WG recommendation	01.06.2016

The national votes of all these standards (except ISO 26872) are still running as of today, so that the dispositioning of technical comments will only be validated at the next WG3 meeting. As of today, following comments are already known:

- All documents: Russian titles to be added
- **14625**: none.
- **15389**: none.
- **22108**: clarification of "log of critical non-flight items" and "storage facility" requested by Ukraine.
- **23041**: Modification will be proposed by Japan, in order to add debris mitigation requirements" (see in **Attachment 04** - reviewed with WG3 participants during Fall-16 meeting). Comments from United States included in particular: *A number of space systems now separate "early orbit and anomaly" control from day-to-day control. There is now also frequent separation between mission control and*

spacecraft control. Furthermore, the example of Annexes A and B, while compatible with the document, presents a rather different model than the common interface identified in the normative clauses.

With regard to the systematic review of ISO **26872** (GEO Disposal):

- During the systematic review, several comments related to harmonisation with ISO 24113 framework had been raised by Germany, Italy, Japan, Ukraine, United Kingdom and United States.
- During May-16 WG3/WG7 meeting, it was concluded that ISO 16164 (LEO disposal) and ISO 26872 could be merged into ISO/TR 18146. Separately, for the consolidation of the spacecraft mid-level debris standards, it was agreed to merge ISO 16127 (break-up prevention), ISO 16164, ISO 26872 and ISO 23339 (remaining propellant mass estimation) into a new work item entitled "Detailed Space Debris Mitigation Requirements for Spacecraft". This activity would be led by France, and China would be a co-lead.
- During Nov-16 WG3/WG7 joint meeting, participants agreed to reaffirm formally ISO 26872 for the meantime by dispositioning only the editorial changes as raised during the systematic review (see in **Attachment 05**).

Action ref.	Action	Actionee	Deadline
WG3 47-01	Re-issue ISO 26872 with editorial changes only, and provide related WG3 recommendations to SC14 Secretariat	WG3 convener	Dec-2016

Concerning the systematic review of ISO **14620-2** (transferred 2014 to WG5, see SC14 Resolution 359) and the relevance for WG3 activities, a closer cooperation with WG5 on the operational safety aspects still need clarification (see **WG3 action 45-07**).

WG3 published standards currently under WG/SC review are as follows:

Project #	Part #	Ed	Project Title	Project Lead	PL Count	Next Action	Next Action Due Date	Action Assigned To
11233		1	Space systems — Orbit determination and estimation — Process for describing techniques [Tech Rpt]	Finkleman, Dave	USA	Initiate WG/SC review	15.04.2015	Secretariat
16158		1	Space systems — Avoiding collisions with orbiting objects [Tech Rep]	Finkleman, Dave & Oltrogge, Dan	USA	Initiate WG/SC review	01.12.2014	SC 14 Members
17400		1	Space systems — Launch and integration site general test requirements	Tsukanov, Evgeny	Russia	Initiate WG/SC review	01.08.2014	Secretariat
19473		1	Space systems — Best practices for orbit elements at payload — LV separation [Tech Rpt]	Yu, Chunmei	China	Initiate WG/SC review	01.09.2016	Secretariat

As decided during Fall-2015 meeting, the WG3 review initiations of ISO/TR **11233** and ISO/TR **16158** shall be on-hold until the plans for consolidation of debris mitigation standards framework (currently under discussion in WG7) will be sufficiently clarified, and in particular until agreement will be reached on the contents of ISO 24113 revision.

Concerning the systematic review of ISO **17400**, the related **WG3 action 45-06** can be closed:

- The Russian delegation confirmed on 19-Apr-2016 that "Mr.Tsukanov is the project leader still responsible for 17400 though he doesn't participate in WG3 meetings any more".
- For the time being, Anton Spivak is the Russian point of contact to WG3.

Those present WG3 members decided that the systematic review of 17400 should be initiated.

In addition, it should be clarified at ISO TC20/SC14 level the process to apply and if changes to a published standard are necessary and for which the subject matter expertise is no longer present at WG level.

Action ref.	Action	Actionee	Deadline
WG3 47-02	Clarify with ISO TC207SC14 Secretariat the way forward in case of subject matter expertise from originating country being no longer available, and when changes to a published document seem to be necessary	WG3 Convener	May-2017

Terminology harmonisation

Reminder from previous meetings:

- SC14 continues to have inconsistent terminology among documents, despite the continual awareness effort from the Ukrainian delegation and WG3 members.
- WG3 members noted that the application of a relatively static terminology standard such as ISO 10795 may not keep pace with SC14 standards development and harmonisation needs. **Resolution 377** from Jun-15 has not sufficiently remedied the issue:

  "TC20/SC14 resolves that WG5 will take the opportunity in the course of updating ISO 10795 "Vocabulary" (review ending in 2016) to solve the current inconsistencies on WGs standards with the support from Galyna Matus, André Lacroix and the current Project Leader João Matos. The impacted WGs standards will be updated in the course of each standards 5-year review process. It is considered there is no need to create a new task force or a specific WG to align the inconsistencies within each SC14 WG. It is up to each WG convenor to manage this alignment of inconsistencies, with the support of each PL. WG5 is asked to report the status of the inconsistency updates during Plenary sessions. Each WG will provide their issues of inconsistencies resolved to the WG5 PL."
- WG3 members noted that the Ukrainian delegation distributed their terms database listing during the ISO TC20 Fall 2015 meeting. WG3 members suggested that this list could be used within SC14 to identify multiply-defined terms at WG levels. WG3 members noted May-16 that the Ukrainian delegation issued an updated list of the terms and definitions used in SC14 standards. This remains a very useful document.
- WG3 members reminded the terminology harmonisation process steps as proposed by the German and Russian WG3 members during May-2013 meeting and Fall-2014 meeting. WG3 members noted also that TC37 confirmed their willingness to support such harmonisation initiatives..

During WG3 Fall-16 meeting, the discussion continued as follows:

- With reference to SC14 Resolution 377, WG3 members noted that the revision of ISO 10795 should be performed by a specific task force to be established and it should be ensured that every SC14 Working Group will be represented. For WG3, the convener (André LaCroix) shall ensure the interface with WG5.
- WG3 participants noted that the list of harmonisation recommendations for SC14 terms prepared by the Russian delegation (Mr. Tsukanov) and distributed 08-Nov-2016 by the SC14 Secretariat to all SC14 Working Group conveners (see in **Attachment 06**) should be reviewed in detail in the frame of the revision of ISO 10795.
- WG3 participants also noted that terms should be made easily available for public. The revision of terms through a standard document is a slow publication process and time could be saved if, in-between revision steps, the new/updated terms could be made available through internet. E.g. the glossary of SC13 (CCSDS) terms is published on http://sanaregistry.org/r/terms/terms-a.html.

Processing of terms at CCSDS level (ISO TC20/SC13)

WG3 noted that CCSDS is actively pursuing employment of a **SANA database** and registry to ensure consistency across CCSDS books and related standards. WG3 proposed to explore jointly with CCSDS their terminology registry process with the objective to propose a more dynamic harmonisation of terms at SC14 level. WG3 also suggested examining the CCSDS SANA registry.

Mr Oltrogge stated May-16 that CCSDS makes use of the SANA registry to maintain consistency across the various standards, and there is renewed emphasis on using the SANA registry to ensure consistent terminology and metadata elements.

With reference to WG3 action 45-08, Mr Oltrogge further stated Nov-16 that terminology harmonisation is verified when a CCSDS standard is submitted to re-formatting before publication. CCSDS-WG leaders have the responsibility to insist on standardisation of terminology at their levels. In some cases, harmonisation is deliberately not performed for special reasons.

- ***WG3 action 45-08** is herewith considered as formally **closed**.*

As next steps, Mr. Oltrogge will extend liaison with CCSDS to further explore possibilities of terms harmonisation SC13/SC14 and to obtain more information on CCSDS "terms plan".

WG3/WG7 terms harmonisation

WG3 and WG7 members decided Nov-16 during the joined-session that a list of terms relevant to debris and space operations will be provided as input for the ISO **10795** revision (currently running at WG5 level). Both

conveners will respectively act as points of contact for proposing the inclusion of relevant WG3/WG7 terms into the new issue of ISO 10795.

Regarding the term "**spacecraft**", the definition has been reviewed and agreed Nov-16 as follows:

- Spacecraft (S/C): "vehicle designed to perform specific tasks or functions in Space, excluding launch vehicle".

Regarding the term "**launch vehicle**", the definition has been reviewed and agreed Nov-16 as follows:

- Launch vehicle (LV): "vehicle designed to transport one or more payloads from ground to Outer Space".
- "Launcher": "see launch vehicle".

Regarding the term "**re-entry**", WG3 participants confirmed that the definition shall only focus on the return to Earth (harmonisation of definitions 16126, 24113, 27875-Amd.1).

Action ref.	Action	Actionee	Deadline
WG3 47-03 (replacing 45-09)	With reference to SC14 Resolution 377, provide WG3 relevant definitions to ISO 10795 PL (Mr. Roberto Sakai and Mrs. Maria Alice Carneiro), as well as the WG3/WG7 agreed definitions for the terms "spacecraft" and "launch vehicle" and related terms such as "launcher" etc. NOTE-1: The list of SC14 published documents that are impacted by revised terms should be established in the frame of the ISO 10795 revision. NOTE-2: The possibility to provide the glossary of terms through internet should be investigated in the frame of the ISO 10795 revision	WG3 Convener	Dec-2016

Work Items under Development and New Work Item Proposals

(WG1) 19683: Design qualification and acceptance tests of small spacecrafts and units

- The comments of CD-voting indicated that the word "lean satellite" in the title of the standard was not accepted. For DIS-vote, a new title has been submitted using the term "small spacecraft", but without clear definition of this term in clause 3 of the DIS-standard (only the term "cubesat" is defined).
- DIS voting started Aug-16. Comments have been provided in particular by Brazil, France and United States. In particular, *"the US has voted to approve this document but would like to request an immediate revision upon publication for the following reasons:*
  - *This document has an extremely high level of technical detail called out as "shall". This will make it not useable for situations where specific tailoring is required for mission requirements. This level of technical detail is not appropriate for an international standard.*
  - *This document is redundant relative to EMC design and test verification.*
  - *The standard assumes that the consequences of failure are small and that mission life is short. These, and other such assumptions, should be explicit in a revise standard to differentiate small satellites from high reliability satellites.*
  - *The empirical body of evidence for the use of COTS parts, Annex D-style requirements, and reduced qualification and acceptance testing has grown since this standard was initially drafted, A revised standard should incorporate the lessons learned from that increased body of evidence."*
- A quick discussion of this standard at WG3/WG7 meeting May-16 once again reinforced the sentiment that such a standard should not advocate unique space debris mitigation requirements based upon spacecraft size. WG3/WG7 will monitor the development of this document to ensure that the content is consistent with this view.
- As next step, a specific workshop on the subject is planned in Japan/Tokyo from 16-18-Jan-2017.

(WG1) 20991: Requirements for Small Spacecraft

- Background: the SC14 heads of delegations decided in Jun-15 to proceed with item N1144 (requirements for small spacecraft) project under WG1 lead (co-leaders are Japan and France).
- WG3 decided Nov-15 to closely monitor this work item to ensure alignment / consistency with WG3 position.
  - WG3 doesn't see a need for separate small spacecraft or unique operational requirements. The existing operations standards also apply to small spacecraft, and in the event that they

don't meet some specific aspects, the related generic operations standard should be expanded to address such specific aspects, also in order to reduce the risk in Space for all kind of spacecrafts.
    - Having said that, those present WG3 members felt that observability of spacecraft should be mandated. WG3 advocates the WG7 approach, which is to update and maintain (reorganize) the debris framework to be applicable across all spacecraft categories.
    - WG3 considers that a SC14 wide N0957-type approach (see WG3-Fall-2015 minutes attachment 15) would be the better way forward.. To be noted that the former N0929 national votes had not been sufficient for progressing, however the subject remains important, as guidance documentation and educational aspects are needed for small spacecraft communities.
    - WG3 noted, that for a constellation with collision avoidance capability, the key driver is the probability of disposal success, having the biggest impact and being of the highest concerns, and the second driver is the disposal time duration with short-time impact.
    - WG3 also noted, that one key particularity of small spacecraft is the fact that they are not adapted to any class of operational launcher existing in the world in terms of cost and performance, and therefore they cannot be launched alone as of today. The specificity of small spacecraft is more located at launcher level...Does this imply specific rules or reliability constraints?
- The CD/C-20991 draft was discussed briefly during WG3/WG7 May-16 meeting. A reference to orbital debris mitigation refers solely to ISO 24113 and seems suitable. However several participants expressed concern at the lack of formal consultation between the working group responsible for leading the "small spacecraft" items and other working groups in SC14. It is understood that on at least one occasion an important debris-related question has been put informally to an individual member of WG7 outside of the normal meeting sessions. Dr Stokes stated that this type of "coffee break" dialogue is not an appropriate way for SC14 members to conduct business, especially on sensitive matters such as the small spacecraft items. Important debris questions should be addressed formally to the whole of WG3/WG7 so that a properly considered response can be given.
- The CD/V-20991 review initiated Jul-2016 has been disapproved by China and United States. Decision of next step (DIS or CD/V revision or revision to a less normative TS or TS document) might be confirmed during the planned workshop on the subject (Japan/Tokyo from 16-18-Jan-2017).

Revision of ISO 26900 Orbit data messages ODM

- This is a joint work item with SC13 (CCSDS) and Space Data Association (SDA) formed by satellite operators with the focus to enhance ODM with additional manoeuver information for better convey en-masse deployments and tracking of space debris population
- Mr. Oltrogge presented the latest status of work (see **Attachment 07**). It was reminded that ODMs are becoming more popular in Space operator community and that existing ODM types do not meet today the needs, having deficiencies as well as unnecessary mandatory data contents. The revised draft content is maturing. Mr. Oltrogge also noted that CCSDS NAV WG is responsive for working together with WG3, and that several other CCSDS subjects in addition to ODM are relevant, such as:
    - S/C manoeuver message (SMM) - to be replaced by ODM
    - Re-entry data message - nominal message with East-West / North-South
    - Fragmentation message
    - Launch data message
    - Tracking data message (TDM) - way to share observation, today not used and limited in scope

NWIP Test requirements for launch vehicles at launch site (China)

- Subject already addressed during previous WG3 meetings
- The proposed standard would focus on what should be tested on the launch vehicle to confirm its launch readiness. Aim is to harmonize test requirements at launch site to be considered for the development of launchers and related EGSE. The proposal includes also requirements for the launch control process. (see **Attachment 08** - presentation from May-16 with CD-draft from Aug-15)
- Proposal is in particular related to ISO standards 14625, 17400, 15864, 24917, 14303
- Discussion that this may instead be useful to convey the elements of information which testing procedures may include and methods for sharing with other countries and agencies
- Discussion on the needs to standardise the test requirements and related commercial benefits. Specific test and certification procedures already exist at launch site levels, that it is uncertain what the commercial benefit of the proposed standard would be.
- Mr Spivak said May-16 that ISO 24917 (LV readiness) is virtually identical to the new proposed

standard and said that there was a decision to work with this document at the DIS stage, and he felt that rather than pursue another standard on this topic, the community should work together to meet international needs. Mr Han agreed to contact the Russian project leader for ISO 24917 to identify if this document is the right place to insert Mr Han's new proposed content.

- Comments rose again Nov-16 that this could be more useful as a technical report guidance complementing ISO 14625 and future ISO 24917. After discussion, it was concluded that preparing detailed changes to complement ISO 24917 with missing information seem to be the better way forward.

Action ref.	Action	Actionee	Deadline
WG3 47-04	Propose detailed changes (test requirements at launch site) to complement ISO DIS 24917 (general test requirements for LV), in cooperation with WG2 project leader (Mr. Alexander Isaev)	Mr. Han Feng	Feb-2017

NWIP: Procedure for Multiple Satellite Collocation in GEO (China)

- A Chinese proposal (originating from Mr Zhao Xiaofang) to standardize collocation procedures in GEO was presented May-16. WG3/WG7 participants decided that there may be merit in such a standard and asked to see a draft version of such a standard to better understand and judge its proposed scope and content [WG7 Action 27/14]. Mr Oltrogge said that WG3 should be careful not to create a technical collocation document, because handbooks and extensive course material for this already exist.
- An outline has been presented Nov-16 (see **Attachment 09**). Discussion with WG3 participants addressed in particular the following points:
  - Flowchart: why are the constraints checked twice?
  - Flowchart step 3: each country may have different constraints
  - Flowchart step 6: if one strategy is selected, evaluate if constraints can be fulfilled, else select another strategy: 1) start process; 2) coordinate with other operators; 3) assemble the list of constraints; 4) select collocation strategy, check if it fits with the constraints, else go back to refine…
  - Box of several strategies: show to other operators, select what is needed…
  - Evaluation before selection? Each operator already knows what the platform can do and which strategies are working
  - More efficient: compare own list and priorities which gone best with the operator list and perform selection of the best common collocation option based on priorities and lessons learnt. Better to have different strategy types with implication of needed considerations…
  - Slide 6: better title would be "considerations". Point 3: add ITU frequency allocations and assigned orbital slots (e.g. within 0.5 minimum distance). Point 4 might not always be needed (available collocation strategy). Point 5 also includes how operating-intensive the collocation management is, also depending on the quality of relationships between involved operators (workload to process, communication between operator staff). Point 10 (S/C collocation limitations) could be merged with or linked to point 8 (special requirements).
  - Slide 8: Good list of strategies. The pro/con of each strategy or priority considerations could be added. E.g. safety margins: some require orbit precision, fule consumption, some require workload, operating complexity…
  - Slide 16: add "maintained" for the first two items.
  - Slide 17: review/change title: the 1st point addresses simulation.
  - WD draft: important to differentiate clearly between "shall" (mandatory requirements) and "should" (e.g. list of strategies).
- How to conduct communication between operators need to be addressed in more details, as well as how collocation is transferred. Mr. Swinburne will provide some additional input related to operator communication.
- WG3 participants agreed Nov-16 that this proposal is a valuable piece of work. The Chinese delegation is invited to raise a formal new work item to SC14 Secretariat with the proposal updated as discussed above.

Action ref.	Action	Actionee	Deadline
WG3 47-05	Provide input to the multiple collocation in GEO NWIP (to Mr. Zhao Xiaofang) with regard to operator communication for collocation scenario	Mr. Brian Swinburne	Dec-2016

Action ref.	Action	Actionee	Deadline
WG3 47-06	Initiate formal NWIP to SC14 Secretariat on "Procedure for multiple satellite collocation in GEO"	Mr. Zhao Xiaofang	May-2017

NWIP Atmospheric density / spacecraft aerodynamic forces (USA)

- No progress since 2015. This NWIP was planned 2014 in agreement with WG4 on aerodynamic forces (see WG3 Jun-15 minutes). The proposal (see attachment-16 of WG3 Nov-16 minutes) was assessed during WG3 Fall-15 meeting.
  - In WG3 assessment, this proposal could be useful for certain types of high-fidelity orbit modelling. E.g. if an analyst determines that their special case requires more detailed modelling, this proposed guidance could be useful.
  - For normative purposes, WG3 recommended that a simplified non-physical approach is justified in many cases.
  - WG3 also noted that WG4 work tends to focus on a-few-days timescale whereas WG3/WG7 are more interested in the 25-years context. In particular, the existing WG3 standard ISO 27852 (orbital lifetime) does not contain requirements to use a specific atmosphere model, whereas WG4 intends to mandate specific modelling.
- This NWIP were addressed again Fall-16 by WG3 participants. Status and benefits of this NWIP should be clarified (as well as the interactions with WG4, if confirmed). E.g. high-fidelity aspects are today not addressed in ISO 27852, in which a part of low-fidelity portion is incorporated. It was also noted that input and output to geo-localisation systems (interference and radio-frequency issues in particular) are not standardized today and that this impacts certainly the operators.

Action ref.	Action	Actionee	Deadline
WG3 47-07	Clarify the status of the "atmospheric density / spacecraft aerodynamic forces" NWIP	WG3 Convener	May-2017

Debris mitigation standards framework and consolidation

NOTE: see furthermore the WG7 Fall-2016 minutes and attachments.

20893 (N1138) Prevention of break-up of orbital launch stages

- Reminder from previous WG3/WG7 meetings Nov-2015:
  - Discussion on coherency and consistency of SC14 standard sets. Besides linking, consolidation should be the focus, separating requirements and guidance material. Conflicting opinions were expressed about where to place the content of 16127 (spacecraft break-up prevention) and 20893 (launch vehicle break-up prevention). Some prefer the content of these items to be brought together into a single document; others prefer the content to remain separate, i.e. transferred into 18146 and 20590, respectively. Dr Lohvynenko emphasized the importance of passivation and suggested that such requirements be transferred into 24113.
  - Comment raised on the title, if the term “passivation” should be added for clarification. However, this was largely rejected. The document is concerned with all design approaches to prevent break-up, not just passivation measures. Also, the title needs to be consistent with the related standard on spacecraft break-up prevention (16127), which has already been published.
  - Discussion on §4.1 design process with reference to 16127 which shall be replaced in the future, so better to reference/update 20590 to avoid duplication. Discussion on having one unique combined spacecraft/launcher document as intermediate step (extending 16127 with launcher aspects).
  - Discussion on possible merging of 20893 standard initiative with the revision of 24113 (functional requirements) and 20590 standard (technical “how” guidance).
  - It was agreed to allow the document to proceed as a separate work item for now and to review the situation at the next meeting May-2016.
- During WG3/WG7 meeting May-2016, it was agreed to consolidate ISO 16699 (Disposal of orbital launch stages) with ISO 20893 (Prevention of break-up of orbital stages) and potentially incorporate the proposed launch vehicle separation content as well. The plan is for ISO 20893, which is currently in development, to be the basis for the consolidated standard. The proposed title of the new document would be “Detailed Space Debris Mitigation Requirements for Launch Vehicle Orbital

Stages". This activity would be led by China, and France would be a co-lead.

- SC14 Resolution 400 (May-2016): *TC20/SC14 resolves that the title of ISO **20893** be changed to "Space systems – Detailed space debris mitigation requirements for launch vehicle orbital stages", and that its scope and structure be expanded to incorporate the content of ISO 16699 and other detailed requirements relevant to launch vehicle related debris mitigation. Upon publication of ISO 20893, ISO 16699 will then be cancelled. This modification is necessary to accomplish WG7's debris standards consolidation objectives within a reasonable timescale. This will be led by China with France as co-lead.*
- Following SC14 Resolution 400, a first draft of the consolidated WD-20893 with changed structure and expanded to incorporate 16699 contents has been presented Nov-2016, including the related NWIP and a version comparison table (see in **Attachment 10a**). CNES provided supplemental comments (see in **Attachment 10b**). The confusion between "requirements", and "technical suggestion" was in particular noted.

NWIP Detailed space debris mitigation requirements for spacecraft (France & China)

- During WG3/WG7 May-2016 meeting, WG3 and WG7 agreed to transfer and to merge ISO 16127 (break-up prevention), ISO 16164 (LEO disposal), ISO 26872 (GEO disposal) and ISO 23339 (propellant mass estimation) for the consolidation of spacecraft-related mid-level debris mitigation requirements.
  - Dr Kato provided a briefing on how the contents of ISO 16127 could be incorporated into ISO/TR 18146. Dr Kato had also investigated the possibility of incorporating the contents of ISO 23339 into ISO/TR 18146.
  - Dr Ailor provided a draft candidate showing how the contents of ISO 16164 and ISO 26872 could be merged into ISO/TR 18146.
  - Participants noted that there are positive and negative aspects to merging guidance and requirements into a single document.
    - Mr Oltrogge reiterated his concern that the current approach of using ISO/TR 18146 as the basis for the spacecraft consolidation could make it difficult to distinguish between normative and informative elements.
    - The Chinese delegation stated that there needs to be a top-level document, a mid-level "how-to" layer, and a low-level guidance layer. Later in the meeting, China presented their preference for consolidating the mid-level standards into two documents – one for spacecraft and another one for launch vehicles.
    - Dr Kato stated that in Japan they have top-level standard requirements and a handbook for guiding users on how to implement them, however they don't have a mid-level standard and their proposal is to combine several ISO mid-level standards into a unique one.
    - Ms Fuentes said being in favour of a merged document into ISO 24113, as France has one Space Law document and they find that to be sufficient. Her concept would be to maintain the contents of the different disposal documents as separate chapters in ISO 24113.
    - Mr Spivak stated that in Russia, they have top-level, mid-level and implementation-level standards, and he would be in favour of reflecting that structure at ISO level.
    - Mr Destefanis said that that the maintenance of core standards is a lot of work, and we are resource-limited. He would like the standards framework to be simplified so that it is easier to maintain.
    - Dr LaCroix said that ISO 24113 should contain high-level requirements only, harmonized with those contained in the French Space Law. Below that, one handbook for satellites and one for launch vehicles could be sufficient.
    - Dr Stokes said that on balance he preferred the approach which he presented during the WG7 Fall-2014 meeting, i.e. to create one, or preferably two, new standards to consolidate the information in the mid-level standards.
- SC14 Resolution 401 (May-2016): *TC20/SC14 resolves that a new work item with the title "Space systems – Detailed space debris mitigation requirements for spacecraft" be developed to incorporate the content of ISO **16127**, ISO **16164**, ISO **23339**, ISO **26872** and other detailed requirements relevant to spacecraft related debris mitigation. Upon publication of the new work item, ISO 16127, ISO 16164, ISO 23339 and ISO 26872 will then be cancelled. This modification is necessary to accomplish WG7's debris standards consolidation objectives within a reasonable timescale. This will be led by France with China as co-lead.*
- Following SC14 Resolution 401, a first draft of the consolidated NWI has been presented Nov-2016, (see in **Attachment 11**).
  - Two options were presented: separating by design/operation-jobs or by topics. Sorting by

topics would allow easier document maintenance and check of consistency. This would also support small spacecraft application, where the designer and the operator are often the same. Differentiating between LEO and GEO would also be useful. It was also noted that separating design and operations would imply some necessary repetitions or duplication.
  - For disposal: a common clause is needed with generic requirements referring to ISO 24223, and specific sub-clauses with requirements for LEO and GEO.
  - Flight dynamics people should be involved in the decision on what to do with the existing big GEO-disposal annexes (e.g. annex-D tables, risk of obsolete information).

NWIP Operational Debris Mitigation Manual for Space Systems (China)
(formally: "Design specification to mitigate operational debris from launch vehicles")

- Reminder from previous WG3/WG7 meetings Nov-2015:
  - Scope: mitigating operational debris of launchers with multi-satellite separation system, providing guidance for design and testing.
  - Discussion on extension to pyrotechnic devices, attached to document of separation systems and entering more into details (e.g. issues related to cleanliness, changing of pressure…)
  - Discussion on target, interesting to support avoidance of debris and sharing good practices; however it may become a huge work. Some of the participants are doubtful on the need of a separate document. It could be useful to be more precise in 24113 to restrain release of objects (not more than one debris authorized at separation phase with multiple payloads).
  - Decision to keep this subject on-hold until the next meeting (May-16), waiting for more advanced status of running 24113 discussion.
- During WG3/WG7 meeting May-2016, Mr Feng Shao Wei provided a reworking of the draft proposal presented at the previous meeting (see in **Attachment 12**). Dr Stokes asked whether this new information might fit better into the newly-proposed consolidated debris standards framework. Ms Fuentes asked if a draft standard existed so that it can be better evaluated to determine the merits of the standard and whether the standard should stand on its own, or the content be incorporated into the new set of consolidated standards being proposed. Mr Feng Shao Wei took an action to present this concept to WG1 and WG2 [WG7 Action 27/12]. Mr Oltrogge said that in any case, the title of this proposal may be misleading and recommended the use of a more relevant/descriptive title, e.g. referring to “separation systems” rather than “space systems”.
- During WG3/WG7 meeting Nov-2016, a WG7 action has been proposed to review the possibility of incorporating this work into the ISO 20893 (LV handbook).

21095 (N1152) Procedure for limiting risk of re-entering spacecraft and launch vehicle orbital stages

- Reminder from previous WG3/WG7 meetings Nov-2015
  - Scope is to replace 27875 in order to clarify re-entry risk management, with special focus on safety assessment, design for demise, controlled re-entry
  - Discussion on the fact that the work will address several subjects that are relevant for different expertise disciplines (i.e. different customers)
  - Discussion on where this standard should be discussed, as not directly related to debris subject and more on operational safety. However in WG5 there are not the right experts for discussing safety-of-flight aspects which are more WG1/WG3-competence (e.g. design for demise is hardware related). Possibly a subject matter in cooperation with WG1.
- During WG3/WG7 meeting May-16, Dr Kato reviewed the comments received to date and his proposed disposition of them. He also provided a comparison of ISO 21095 with ISO 27875.
  - WG7 discussed whether it would be better to use the terms “casualty expectation”, “expected number of casualties” or “casualty risk”. Differences in the precise meaning of these terms and their method of calculation were discussed. Ms Fuentes presented a comparison of casualty versus casualty risk. The current version of ISO 21095 contains “expected number of casualties”. Dr Kato noted that several national governments have adopted 0.0001 as the limiting value for this. Dr Kato and Ms Fuentes agreed to continue their discussion of casualty expectation / risk after the meeting so as to reach a common understanding of these terms and their suitability for ISO 21095 and ISO 24113 [WG7 Action 27/11].
- During WG3/WG7 meeting Nov-2016, a WG7 action has been proposed to clarify with SC14 Secretariat the publication of the document under the old reference ISO 27875.

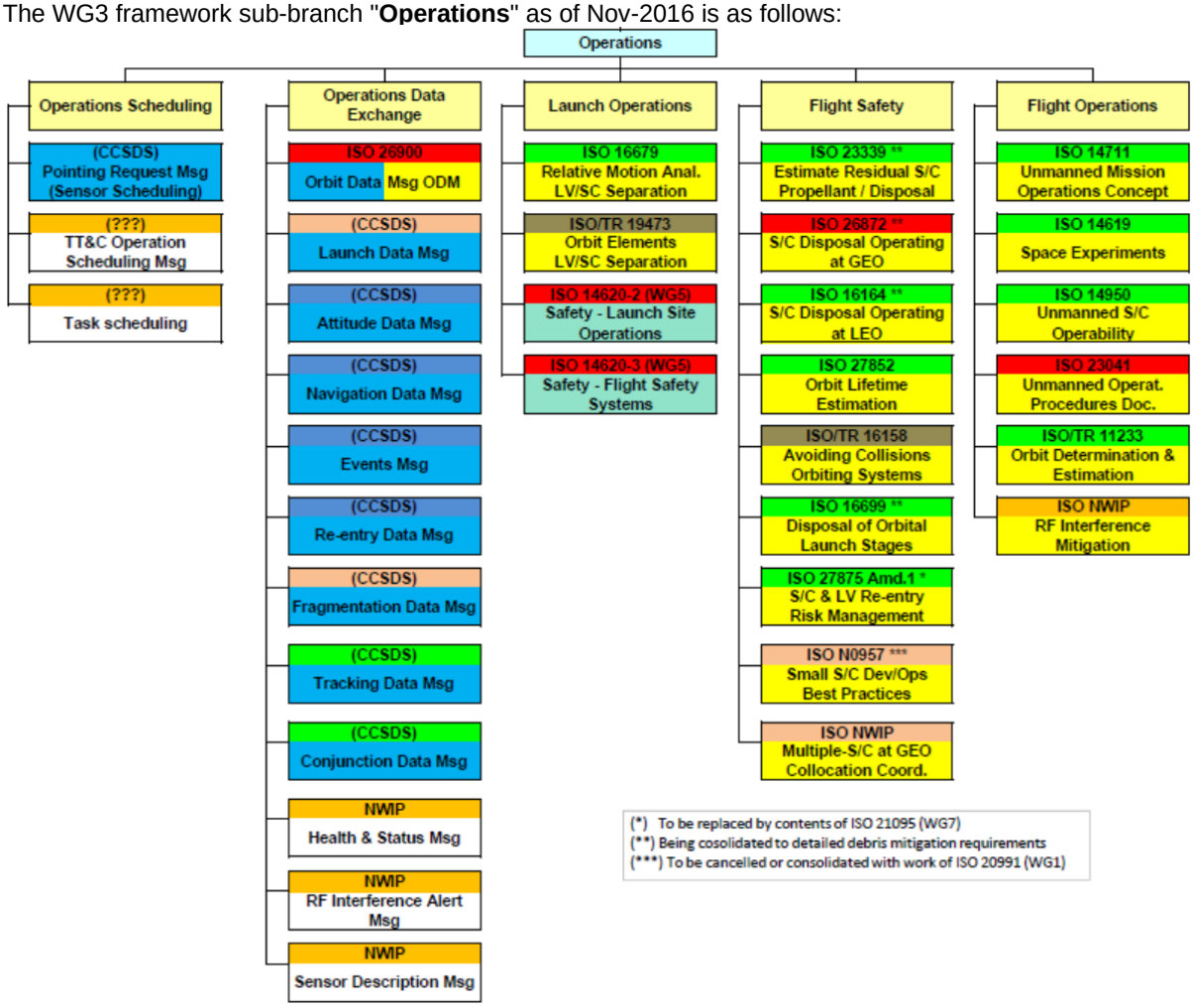
WG3 Work Plan

WG3 Framework

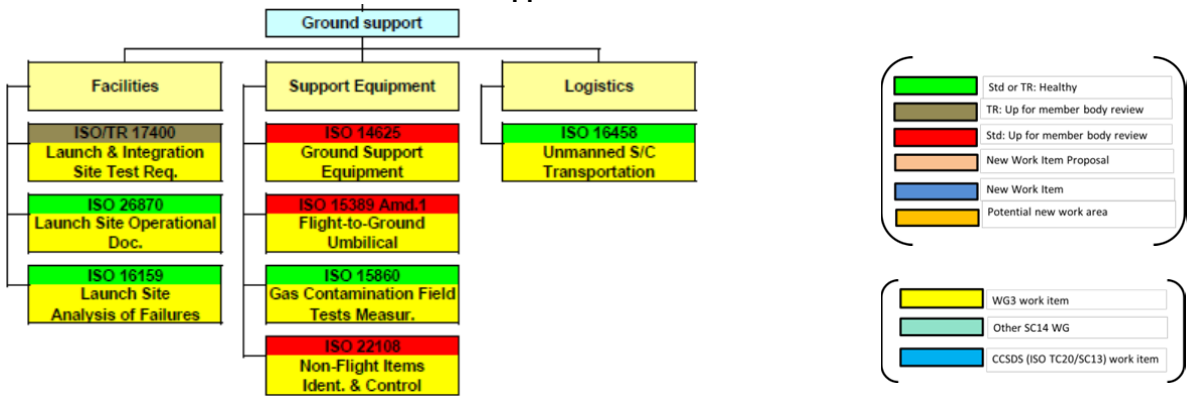
In the frame of the WG3 Fall-2016 meeting, participants completely revised and updated the structure of the WG3 framework and active work program overview (see in **Attachment 13**).

- Including review of the CCSDS Navigation WG work plan
- Adding colour codes to denote the "health" and status of each work item/proposal.

The WG3 framework sub-branch "**Operations**" as of Nov-2016 is as follows:



The WG3 framework sub-branch "**Ground Support**" as of Nov-2016 is as follows:



WG3 Future Work Plan - Discussion

Seeking the future framework and work plan for space operation standards, WG3 is potentially the source for standards addressing mission design needs. E.g.:

- Operations scheduling and mission planning
- On-orbit maintenance
- Flight dynamics
- Human habitation in space
  - during SC14 Plenary Jun-15, WG3 already recommended to set up a specific transverse working group
- Space Situational Awareness (SSA).
  - Autonomous navigation and station keeping (avoid to collide)
  - Launch collision avoidance is important, even so agencies are all having their own strict requirements. Constraints are often self-imposed. Commercial benefit of standardising would merit clarification.
  - Flight safety (e.g. self destruction during launch)

Reminder from previous WG3 discussion Nov-2015 on the standardisation of orbital debris mitigation and disposal prioritisation activities:

- Observed increase of entities with launch capabilities (more launch systems, more satellites per launch e.g. for constellation projects) will result in greater standardisation needs for orbital debris mitigation and disposal prioritisation activities.
- The more spacecraft in orbit, the more likely collisions are to occur. This does mean that people involved in space operations must be more insightful, collaborative and pro-active!
  - E.g. a spacecraft that is mission ended (even if it is still capable) should be disposed-off safely while that is still feasible. A spacecraft whose life was extended until something critical will fail and disposal was not possible is among the largest potential sources of debris.
  - What is the probability that a mission ended spacecraft would be required as a spare backup relative to the probability that the mission ended satellite would itself become a problem.
  - Furthermore, spare backups were not required in past mission analyses and original plans.
- Should a mission-ended spacecraft not originally required as inactive backup be disposed-off immediately to reduce risks?
  - The financial incentives to protect the environment are often not there, in particular for LEO missions. However, the economic implications seem to focus on meeting the “minimum” requirements and more work is required on the operational procedures and margins of safety
  - Also in GEO this is still a concern, even so most spacecraft are basically compliant and perform re-orbit. .

Reminder from previous WG3 discussion Nov-2015 on the structure and interactions of SC14 working groups and on the lack of participation of SC14 member bodies and Space operations community:

- Needs for interoperability and data exchange are also addressed at CCSDS and ITU/ETSI levels, where Space operators are more present as of today. WG3 members raised their concerns on the lack of participation of operators (launcher as well as spacecraft) and other stakeholders (e.g. commercial space services), in order to bring in their operations and ground support expertise and standardisation needs.
- When observing the recent WG3 activities and membership, it has been difficult to get the participation of the Space operations community; furthermore, the standard items under development are frequently in common with other WG subject matter expertise and interest. Upon consideration of the current WG3 work program, continued lack of participation by SC14 member bodies, and overlap of WG3/WG7 standards and work items, WG3 recommended that the SC14 business plan and the charter/scope of WG structure be reviewed and updated and/or potentially modified.
  - E.g. space operations include all the operations before, during, and after launch, including end of life disposal and re-entry. All have scope beyond just debris mitigation, which is not an independent technical or managerial subject.
  - E.g. passivation, re-entry management, etc. are operational and design matters, which are not and should not be driven by debris considerations. Debris mitigation should confine to estimating the current and future debris environment and guidance in assessing the threat.
  - Such a clarification may help SC14 to more properly reflect where the subject matter expertise is primarily located. This could help to avoid overlaps and contribute to yield gains in efficiency and facilitate greater consensus among the SC14 member bodies.

- This may also support SC14 member bodies to better identify the right WG to address new work item proposals and where their subject matter experts should interface.

During SC14 Plenary meeting May-2016, these subjects have been addressed again by the WG3 convener and the delegations decided the following **Resolution 396**:

- *"TC20/SC14 resolves to assemble a task force to develop a survey to be sent to appropriate stakeholders to increase awareness, obtain feedback, and encourage participation"*
- In accordance with Resolution 396, the SC14 Secretariat provided on 16-Nov-2016 a first draft of the survey to the delegations for collecting their feedback and additional survey questions (see in **Attachment 14**).

Further discussion during WG3 Fal-2016 meeting concluded, that in addition to the existing liaison with CCSDS, WG3 (or SC14) could establish further liaisons, such as:

- UN COPUOUS S&T (Science & Technology)
- CEN/CENELEC TC 5 (space services and data, space situational awareness…)
- FAA Space Traffic Management / ASTM / FAA COMSTAC
  - Background: The ASTM standardisation body organized on 25-Oct-2016 the kick-off meeting of a new committee for producing standards on commercial launch vehicles, spacecrafts and spaceports, in cooperation with the FAA's Commercial Space Transportation Advisory Committee (COMSTAC). In particular activities shall be addressed such as "human spaceflight occupant safety standards and space traffic management".

WG3 members are reminded on the open **WG3 action 45-11**:

Action ref.	Action	Actionee	Deadline
WG3 45-11 **(reminder)**	WG3 members to identify persons from operator organisations (launcher, spacecraft) and other stakeholders (e.g. commercial space services) to be contacted for their involvement in developing the SC14 and WG3 future work plan and objectives	WG3 members	~~May-2016~~ **May-2017**

Mr. Bondarenko proposed on 15-Nov-2016 a set of potential future new work items for consideration within WG3. First comments from WG3 participants were as follows:

- NWIP "Organizational and technical procedures for identifying and preventing dangerous situations in outer space (collision avoidance, intended modification of space environment, etc.)"
  - The subject of the proposal would fit within the WG3 scope "S/C operations safety"
  - Collision avoidance standard for spacecraft is already established and the one for launchers was cancelled, however WG3 thinks it is better to re-proposed.
  - WG3 sees utility for the subject, but more information should be provided on the specific ideas or expressed needs before discussing
- NWIP "International unified standards of information exchange for ensuring safety and security of space operations, and long-term sustainability of outer space activities as a whole";
  - The subject would fit within the WG3 scope "S/C operations safety"
  - More information needed on the scope of the proposal
- NWIP "Group of international standards for sub-orbital spaceflights and cross-domain operations";
  - The scope of the subject seems challenging, already addressed partially by several other work items?
  - What is the meaning of the terms "sub-orbital spaceflights" and "cross-domain operations"?
  - This proposal is worth discussing if there would be needs for such standard among sub-orbital community.
  - More information needed on the scope of the proposal before evaluation
- NWIP "Cyber protection of critical terrestrial infrastructure and ground support systems".
  - Unclear, if the scope covers only cyber-protection or if it is also addressing infrastructure
  - More information needed on the scope of the proposal for evaluation
  - This proposal is also worth discussing, however it should be also clarified if the proposal is in WG3 scope or if it might be rather suitable in the programme management WG (WG5).

Action ref.	Action	Actionee	Deadline
WG3 47-08	Provide further information as discussed during Fall-2016 meeting on the potential work items proposed 15-Nov-2016	Mr. Artyom V. Bondarenko	Dec-2016

Review of WG3 actions list

The status of WG3 actions has been updated at the end of the 47th WG3 meeting (see in **Attachment 15**).

List of WG3 actions that have been **closed** since the 45th WG3 meeting are as follows:

Ref.	Action	Actionee	Deadline	Result
WG3 45-01	Propose to SC14 Secretariat to execute Resolution 374 with a written gratitude letter signed at least by the SC14 Chairman	WG3 Convener	May-2016	see ISO TC20 SC14 Resolution 394 (May-2016) *TC20/SC14 resolves to execute Resolution 374 with a written gratitude letter signed at least by the SC14 Chairman, to recognize the outstanding leadership and dedication of Dr. Dave Finkleman, and to thank him for his extensive contributions to WG3 as well as for having significantly advanced the overall SC14 standardization activities*
WG3 45-02	Propose a resolution for next SC14 Plenary, that Mr Oltrogge's liaison role be expanded to SC14 perimeter	WG3 Convener with SC14 Secretariat	May-2016	see ISO TC20 SC14 Resolution 395 (May-2016) *TC20/SC14 resolves that Dan Oltrogge act as the technical liaison from SC14 to the CCSDS.*
WG3 45-04	Clarify with SC14 secretariat (Nick Tongson) the status of FDIS 16679 and related disposition of comments.	WG3 Convener	Dec-2015	see ISO TC20/SC14 work program (completion date: Sep-2015)
WG3 45-05	Clarify with SC14 secretariat (Nick Tongson) the status of FDIS 16699 and related disposition of comments.	WG3 Convener	Dec-2015	see ISO TC20/SC14 work program (completion date: Nov-2015)
WG3 45-06	Contact the Russian delegation (Anton Spivak) to nominate a contact point for the ISO 17400 5-years systematic review confirmation.	WG3 Convener	May-2016	Mr.Tsukanov is PL still responsible for 17400 though he doesn't participate in WG3 meetings any more (Email AS 19-Apr-2016). For the time being, Anton Spivak is the point of contact to WG3
WG3 45-08	Contact CCSDS (ISO TC20/SC13) to obtain information on how they defined and implemented their process for terminology harmonisation incl. centralized registry management	WG3 liaison CCSDS (Mr. Dan Oltrogge)	May-2016	See ISO TC20/SC14/WG3 MoM Fall-2016
WG3 45-09	With reference to SC14 Resolution 377 propose a resolution for next SC14 Plenary to decide SC14 unique definitions for the term "spacecraft" and related terms "space vehicle", "launcher", "launch vehicle", "payload", etc.	WG3 Convener with SC14 Secretariat	May-2016	Open action at ISO TC20/SC14/WG5 Fall-2016 meeting (revision of ISO 10795) Definition of terms reviewed durint ISO TC20/SC14/WG3+WG7 Fall-2016 meeting. New action WG3 47-03 established Nov-16.
WG3 45-10	Contact Project leader (Dr Akira Kato) to clarify the disposition of the raised comment on 27875 §6.3.2.2	WG3 members	Dec-2015	see ISO TC20/SC14 work program (completion date: Mar-2016)
WG3 45-12	To raise awareness of the SC14 Chair on the needs to review and update the SC14 charter and scope of working groups	WG3 Convener	Dec-2015	Addressed during ISO TC20/SC14 Plenary May-2016 (WG3 status presentation). Delegations did not see needs to revise WG structure for the moment. WG3 Framework has been reviewed/updated during Fal-2016 meeting, which will help to clarify interfaces with the other SC14 Working Groups.
WG3 45-13	Update WG3 distribution list on KAVI server	WG3 Convener with SC14 Secretariat	Dec-2015	see "SC14 WG Rosters" (email Nick Tongsen 30-Jun-2016)

WG3 actions remaining **open** as of 17-Nov-2016 are as follows:

Ref.	Action	Actionee	Deasdline	Result
WG3 45-03	Contact the French delegation (Karim Benmeziane, BNAE) to clarify the nomination of the new representative(s) and contact point(s) from France for WG3 activities, following the announced retirement of Mr Bruno Lazare/CNES.	WG3 Convener	May-2016	Open action at French mirror committee BNAE CB-MES since Dec-2015
WG3 45-07	Contact the ISO 14620 project leaders (Stephan Bonk/DLR, Emmanuelle Vergnault/CNES) for ensuring the liaison with WG3 during revision work of this standard series	WG3 convener	Dec-2015	Action addressed by German delegation at ISO TC20/SC14/WG5 Fall-2016 meeting (revision of ISO 14620-2).
WG3 45-11	WG3 members to identify persons from operator organisations (launcher, spacecraft) and other stakeholders (e.g. commercial space services) to be contacted for their involvement in developing the SC14 and WG3 future work plan and objectives	WG3 members	~~May-2016~~ May-2017	During ISO TC20/SC14 Plenary May-2016 (WG3 status presentation). See ISO TC20/SC14 Resolution 396 *TC20/SC14 resolves to assemble a task force to develop a survey to be sent to appropriate stakeholders to increase awareness, obtain feedback, and encourage participation* See also email SC14 Secretariat 16-Nov-2016 (proposed SC14 survey).
WG3 47-01	Re-issue ISO 26872 with editorial changes only, and provide related WG3 recommendations to SC14 Secretariat	WG3 Convener	Dec-2016	
WG3 47-02	Clarify with ISO TC207SC14 Secretariat the way forward in case of subject matter expertise from originating country being no longer available, and when changes to a published document seem to be necessary	WG3 Convener	May-2017	
WG3 47-03 (replacing 45-09)	With reference to SC14 Resolution 377, provide WG3 relevant definitions to ISO 10795 PL (Mr. Roberto Sakai and Mrs. Maria Alice Carneiro), as well as the WG3/WG7 agreed definitions for the terms “spacecraft” and "launch vehicle" and related terms such as "launcher" etc. NOTE-1: The list of SC14 published documents that are impacted by revised terms should be established in the frame of the ISO 10795 revision. NOTE-2: The possibility to provide the glossary of terms through internet should be investigated in the frame of the ISO 10795 revision	WG3 Convener	Dec-2016	
WG3 47-04	Propose detailed changes (test requirements at launch site) to complement ISO DIS 24917 (general test requirements for LV), in cooperation with WG2 project leader (Mr. Alexander Isaev)	Mr Han Feng	Feb-2017	
WG3 47-05	Provide input to the multiple collocation in GEO NWIP (to Mr. Zhao Xiaofang) with regard to operator communication for collocation scenarii	Mr. Brian Swinburne	Dec-2016	
WG3 47-06	Initiate formal NWIP to SC14 Secretariat on "Procedure for multiple satellite collocation in GEO"	Mr. Zhao Xiaofang	May-2017	
WG3 47-07	Clarify the status of the "atmospheric density / spacecraft aerodynamic forces" NWIP	WG3 Convener	May-2017	

Date and location of the next meeting

The next WG3 meeting and SC14 Plenary meeting will take place in France/Paris, from the 12th to the 16th of June 2017.

Wrap-up session

Dr. André LACROIX, acting as ISO/TC20/SC14/WG3 convener, thanks:

- Participants for their personal contribution to the discussion and work provided during this 45th meeting, and
- **CNES** and especially **Nathalie Fuentes** for their hospitality and the excellent organisation of the meeting.

Reminder: Because only two meetings per year can be organized due to the geographic distance between members, WG3 members are asked to do their best in order to provide analyses, drafts of documents, answers to action items, etc. by e-mail as soon as possible. Some teleconferences or webex meetings can be organized when necessary.