

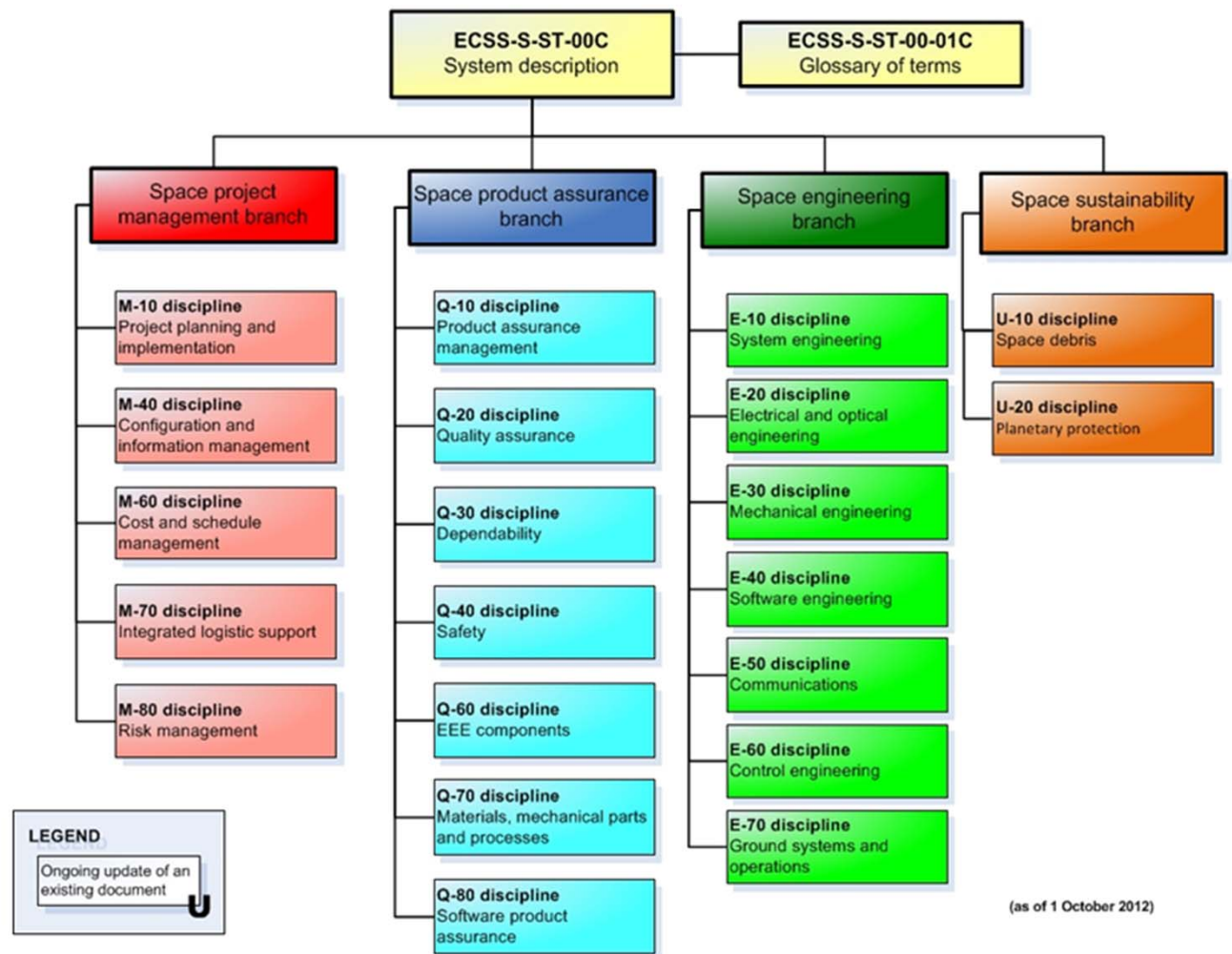
# Standards in the area of Spacecraft Plasma Interactions

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- ‘The European Cooperation for Space Standardization is an initiative established to develop a coherent, single set of user-friendly standards for use in all European space activities’

[www.ecss.nl](http://www.ecss.nl)



(as of 1 October 2012)

- ECSS-E-ST-20-06C published 31<sup>st</sup> July 2008
- Covers assessment and design in the context of surface and internal charging and plasma effects
  - Surface material requirements
  - Secondary Arc requirements
  - High voltage system requirements
  - Internal parts and materials requirements
  - Tether requirements
  - Electric propulsion requirements
- Time for review?
  - There is no current or shielding limit below which internal floating metals may be permitted. Also no minimum size that would be acceptable.
  - It is not stated in tailoring that surface charging only applies to surface equipment

- ECSS-E-ST-10-04C published 15<sup>th</sup> November 2008
- Defines environment specifications for all space regimes, where feasible, including
  - Surface charging worst case for GEO
  - Internal charging in magnetosphere
  - Plasma environments in various regimes
- Alternative models may need consideration
  - AE9/AP9? – at low altitude & energy AE9 difference from AE8 is huge
  - Jorem?
  - New solar proton models?
- Things missing
  - Worst case Jovian surface charging environment?
  - Internal charging at Jupiter?

- International Standards Organisation
- Members are national standards bodies
- (ESA is not such a body)
- Full members can participate in technical and policy meetings
- TC20 Aircraft and Space Vehicles
  - Brazil (ABNT), China ( SAC), **France (AFNOR)**, **Germany (DIN)**, India ( BIS), Israel (SII), **Italy (UNI)**, Japan (JISC), Kazakhstan (KAZMEMST), Korea, Rep. of (KATS), Russian Federation (GOST R), Ukraine (DSSU), **United Kingdom (BSI)**
  - Observers: **A, CZ, DK, FIN, H, NL,PL,S..**
- SC14 Space systems and operations/WG4 Space environment (natural and artificial)



# ISO Spacecraft charging standard - Resolution 432



- Led by Dale Ferguson, AFRL, USA
- A proposal to create a comprehensive charging standard
- Proposed committee composition (4/12/2012)
  - 15 USA
  - 4 Japan
  - 1 Russia
  - 2 Europe
- ECSS-E-ST-20-06C table of contents used as template – add and subtract from other standards
- What are the consequences of this for European industry?
- Should this be encouraged/blocked?
- May is ISO WG4 meeting

# ISO Spacecraft charging standard - Resolution 432 (from Ferguson)



- Standard must include
  - Require evaluation of orbit for possibility of charging
  - If charging present, assess magnitude of threat
  - Require mitigation to reduce threat to acceptable level
  - Require verification methods with respect to threat
  - All of the above must be managed by experienced ESD analyst
- Standard may include
  - Both surface and internal
  - Environments- ambient and spacecraft generated
  - Test methods – refer to ISO 11221 whenever possible
  - Mitigation methods- general and tuned for specific hardware
  - Informative material
  - National Standards
  - Code lists
  - Expected ESD and mitigating

# ISO Worst-case spacecraft charging environment



- Led by Kazuhiro Toyoda, KIT, Japan
- Apparently already iterated with US, but their focus has been GEO
- Strategy
  - combine severe environments, spacecraft models and charging models to assess worst-case(s)
  - There would be a 'round-robin' phase where different groups try out their codes on the same cases
- USA and Japan seem already to have planned for this
- Europeans brought in too late for funding to be ready
- CNES, ONERA and ESA attended meeting in January
- We cautiously accepted this proposal



## European position on NWIP for ISO WG4 : Spacecraft charging potential estimation in the worst case environments - Tokyo - January 23, 2013



- Based on presentations and discussions of Jan 22, 2013
- NWIP is supported pending on the following agreement (1/2)
  - Orbits of interest : GEO, PEO, MEO, GTO
  - All worst-cases shall be justified within the course of the round-robin. The way data were extracted from measurements will be explained in order to check data consistency, and to understand and quantify possible differences in data processing (especially concerning spacecraft potential impact on spectrum calculation)
  - The list of worst-cases will be possible to increase during the round-robin.
  - Several simple but realistic spacecraft configurations will be tested.
  - The material properties used will represent a large range of expected values in order to assess ESD risk in most of real situations
  - Secondary electron emission (under electron, ion and photon) will be simulated
  - Radiation induced conductivity will be simulated
  - The ESD risk will be assessed by local IPG on solar cells

- NWIP is supported pending on the following actions (2/2)
  - After the first round-robin, a second round-robin must be possible in order to consolidate results (there is no need to hurry)
  - The final objective is to determine if environment worst-case(s) for spacecraft surface charging can be extracted from our knowledge
  - Possible outputs of the round-robin may be : "the worst-case identified are ..." or "no worst-case is clearly identified" or "an envelope of worst-cases is identified" or "worst-case for a mission can be obtained following different approaches ..."
- In addition, our partners inside Europe will be consulted for a common answer. Action to Denis Payan and David Rodgers : to get feedbacks from european industry by end of February 2013 and report to K. Toyoda.
- The round-robin may not consist in the same list of simulations for all codes but the consistency of the runs with the target objective will be assessed by K. Toyoda

# European position on NWIP for ISO WG4 : Spacecraft charging potential estimation in the worst case environments - Tokyo - January 23 2013



- As of today, there is no identified manpower and funding for the round-robin with SPIS within Europe.
- At ONERA
  - 2013 is fully booked with no possibility to hire somebody for the round-robin
  - 2014 is also busy. Action: Jean-Charles Matéo-Vélez to try finding funding and manpower for beginning of 2014 and report regularly to K. Toyoda in order he can adapt the planning.
- Other solution within Europe ?
  - perhaps some university
- Please add to the minutes

- Do we need to update the ECSS standards. - If so, we need to collect RIDs
- How can Europe be involved in influencing the ISO standards?

# 1. THE END

# Standards in the area of Spacecraft Plasma Interactions



1. ECSS system
2. ECSS-E-ST-20-06C
3. ECSS-E-ST-10-04C
4. ISO system
5. ISO NWI proposal charging environment
6. ISO NWI proposal charging standard