



NASA Small Spacecraft Anomaly Reporting Process: Overview and Next Steps

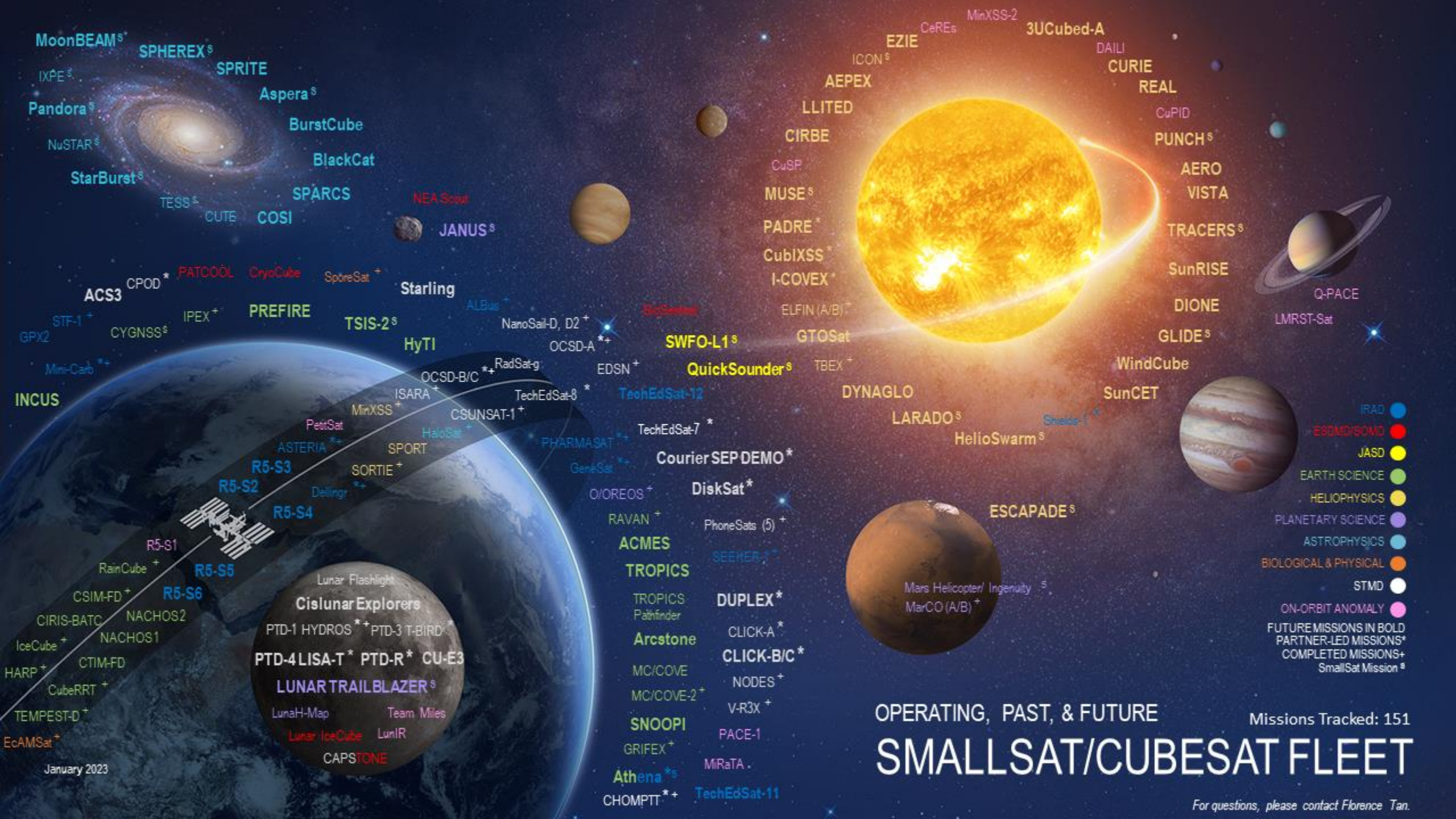
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SmallSat Anomaly Definition

A SmallSat anomaly is considered to be any failure occurrence of the subsystems and/or satellite that takes place during testing or post-launch and has or could have an impact on the health or performance of the satellite.

- These failures could occur at the payload, subsystem / instrument and / or component levels.
- An anomaly is not considered to be due to human error or software integration issues.



MoonBEAM[§] SPHEREX[§] SPRITE

IXPE[§] Pandora[§] NuSTAR[§] StarBurst[§] TESS[§] CUTE COSI

ACS3 CPOD^{*} FATCOOL CryoCube SpireSat⁺ Starling

INCUS

R5-S1 RainCube⁺ CSIM-FD⁺ CIRIS-BATC NACHOS2 IceCube⁺ NACHOS1 HARP⁺ CTIM-FD CubeRRT⁺ TEMPEST-D⁺ EcAMSat⁺

R5-S2 R5-S3 R5-S4 R5-S5 R5-S6

Asteria⁺⁺ SPORT SORTIE⁺ Delinger⁺ Lunar Flashlight

Cislunar Explorers

PTD-1 HYDROS⁺⁺ PTD-3 T-BIRD⁺⁺

LUNAR TRAILBLAZER[§]

LunaH-Map Team Miles Lunar IceCube LunIR CAPSTONE

NEA Scout JANUS[§]

ALBus⁺ NanoSail-D, D2⁺ OCSD-A⁺⁺ OCSD-B/C⁺⁺ RadSat-g TechEdSat-8^{*} ISARA⁺ HaloSat⁺ CSUNSAT-1⁺ PHARMASAT⁺⁺ GeneSat⁺⁺

HyTI TechEdSat-12 QuickSounder[§] TBEX⁺ DYNAGLO LARADO[§] HelioSwarm[§] ESCAPADE[§]

ACMES TROPICS TROPICS Pathfinder Arcstone MC/COVE MC/COVE-2⁺ SNOOPI GRIFEX⁺ Athena⁺⁺ CHOMPTT⁺⁺

Courier SEP DEMO^{*} DiskSat^{*} RAVAN⁺ PhoneSats (5)⁺ SEEKER⁺⁺ DUPLEX^{*} CLICK-A^{*} CLICK-B/C^{*} NODES⁺ V-R3X⁺ PACE-1 MIRATA⁺ TechEdSat-11

EZIE CeREs MinXSS-2 3UCubed-A DAILI CURIE REAL CuPID PUNCH[§] AERO VISTA TRACERS[§] SunRISE DIONE GLIDE[§] WindCube SunCET

AEPEX LLITED CIRBE CuSP MUSE[§] PADRE⁺ CubIXSS⁺ I-COVEX⁺ ELFIN (A/B)⁷ GTOSat



- IRAD (Blue)
- ES&M/DS&M (Red)
- JASD (Yellow)
- EARTH SCIENCE (Green)
- HELIOPHYSICS (Orange)
- PLANETARY SCIENCE (Purple)
- ASTROPHYSICS (Light Blue)
- BIOLOGICAL & PHYSICAL (Dark Orange)
- STMD (White)
- ON-ORBIT ANOMALY (Pink)
- FUTURE MISSIONS IN BOLD (Bold text)
- PARTNER-LED MISSIONS* (Asterisk)
- COMPLETED MISSIONS+ (Plus sign)
- SmallSat Mission § (Section symbol)

Questions to Consider

- What is the goal of this new reporting process? How will it supplement/replace the reporting processes currently in place at each NASA Center?
 - *Centralized reporting across each Center and Mission Directorate (MD); Will not replace, will only supplement. Goal is to break down the information barriers.*
- Who will submit the anomalies?
 - *Programs and projects across MDs (can be anyone); Potential anonymous submissions and drawbacks*
- How do we get the Programs and Projects to submit anomalies?
 - *Do we implement a top-down approach?*
- Who will receive SmallSat anomaly notifications through JARIVS³?
 - *Center reps & Small Spacecraft Working Group reps will receive email notification pointing them to the information in JARIVS³ (CUI compliant internal SharePoint site)*
- Who can people follow up with regarding anomaly questions or to seek more information?
 - *Any follow up beyond the initial process is with the Project POC listed in the template*

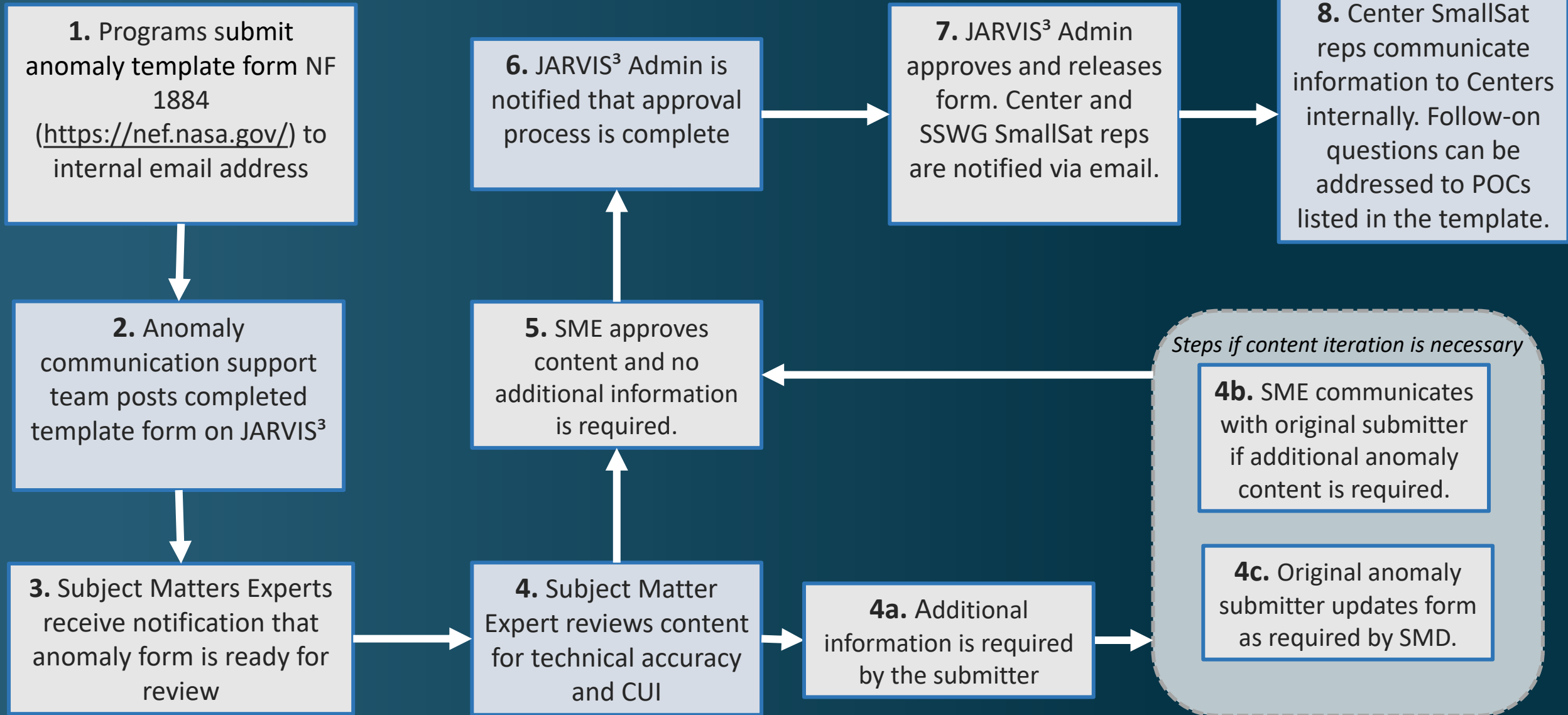
Questions to Consider - Continued

- When are anomalies expected to be submitted?
 - *Anomalies should be submitted at the time the anomaly is first noticed or within 24 hours.*
- Can additional documentation be linked to the original form at a later date, after submission?
 - *Additional documents (e. g., root cause, failure analysis) are currently not able to be linked to the original form but a process is being developed to accomplish this in the future. After submission, the updated form will go through the review process flow.*
- How will the anomaly data be displayed?
 - *A spreadsheet format will be used where the data is searchable and sortable.*
- Will data analytics be performed on the anomaly data?
 - *Data analysis will be performed on the information collected to evaluate if there are any noticeable trends. Trends will be reported to the NASA SmallSat Community.*

Stakeholder Feedback

- “There needs to be something that doesn’t contain details of the anomaly, just makes folks aware that there is a problem and they need to look for more information. Make it simple, such as “There is a problem with my avionics system.”
- “If there are too many alerts, people won’t read them. You could set it up so that you can select which systems you are interested in getting emails about.”
- “We could put together a database, vet everyone, and put anything we want in it. We would need to trust folks.”
- “One thing to note is that for any one anomaly, one doesn’t know if the anomaly was caused by improper use/integration/testing of the part, or if the part was problematic directly from the vendor.”

Anomaly Reporting Process





National
Aeronautics and
Space
Administration

SMALL SPACECRAFT ANOMALY REPORTING TEMPLATE

When completing the anomaly template please be as specific as possible.
All fields with an asterisk (*) are required for submission.

Title of Anomaly*:	Anomaly Date*:
Submitter Name*:	Submitted Date*:
POC Name*:	
POC Email*:	POC Phone*:
Anomaly Summary*: (Provide one or two sentences stating the single most important finding. Provide the "cause and effect" relationship.)	
Description*: (Describe the situation, giving a complete, concise account of the findings as they relate to the specific situation, procedure or design. Describe what went right or wrong and why.)	
Impact*: (Check all that apply)	
Subsystem: <input type="checkbox"/> Instrument: <input type="checkbox"/> Avionics: <input type="checkbox"/> Communication: <input type="checkbox"/> Deorbit Systems: <input type="checkbox"/>	
Guidance, Navigation and Control: <input type="checkbox"/> Integrated Spacecraft Platforms: <input type="checkbox"/> Power/Electrical: <input type="checkbox"/>	
Propulsion: <input type="checkbox"/> Software: <input type="checkbox"/> Structures/Mechanisms/Materials: <input type="checkbox"/> Thermal: <input type="checkbox"/>	
Other: <input type="checkbox"/>	
Corrective Action(s): (Provide the course of action and who is taking what action. Identify when during the project the suggested action should take place. This block should answer the questions "Who, What, When.")	
Documents Related to Anomaly: (Provide document URL(s), name(s), location(s), and POC(s).)	
Use the Submit by Email button to route the form for processing. <input type="button" value="Submit by Email"/>	

Next Steps

- Investigate potential database platforms for small spacecraft anomalies knowledge dissemination and sharing within NASA, NASA funded PIs and Other Government Agencies (OGAs)
- Obtain feedback from stakeholders to continue improving the small spacecraft anomaly reporting process in order to ensure that it is streamline and user friendly
- Continue to investigate other NASA and external anomaly databases and processes to capture lessons learned and leverage existing anomaly data
- Focus on socializing the small spacecraft anomalies reporting process at conferences and workshops
- Promote the capture of anomalies via the reporting process to show the benefits to potential stakeholders to depict the practicality of knowledge sharing

Questions? Feedback?

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2023 Government SmallSat Forum

- Co-Hosted by NASA Small Spacecraft Systems Virtual Institute (S3VI) and The Aerospace Corporation (Aerospace)
- Being held 11 – 13 July 2023 at Aerospace (El Segundo, CA)
- Forum format will consist of presentations, panels and discussions
- Initial topics include: in-space propulsion, cybersecurity and encryption, frequency coordination, standards and modularity, orbital maneuvering vehicles, and lessons learned across subsystems and platforms
- Three day forum with security classifications ranging from: UNCLASSIFIED up to TOP SECRET//SCI//NOFORN and FVEY
- The 2023 Government SmallSat Forum is by invitation only. If interested please let me know.