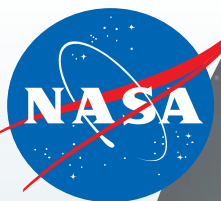


Recent NEPP Program Work and Fiscal Year 2024 Plans

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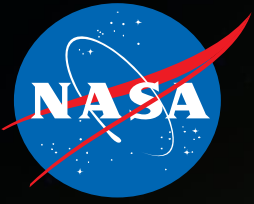
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Agenda

- FY23 Highlights
 - Standards & Guidelines
 - Parts Selection
 - COTS Utilization Effort
 - ILPM & PEAL
- FY24 Plans
 - Topics in NEPP Five Focus Areas
 - Parts Assurance
 - Parts Reliability
 - Radiation Assurance
 - Radiation Reliability
 - Packaging



FY23 Highlights



Standards & Policy and Guideline Development



- Electrical, Electronic, Electromechanical and Electro-optical (EEEE or Quad-E) Parts Selection, Testing and Derating Standard (NASA-STD-8739.11)
- Radiation Hardness Assurance (RHA) Standard for Space Flight Hardware
- Electrical, Electronic, Electromechanical (EEE) Parts Assurance Standard (NASA-STD-8739.10)



NASA-STD-8739.11 (441 pages)



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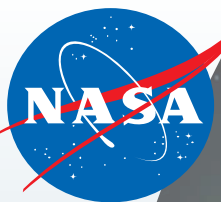
Standards & Policy and Guideline Development

Radiation Hardness Assurance (RHA) Standard for Space Flight Hardware

- RHA methods rely on risk avoidance (part-level RHA), risk management (system-level RHA), or hybrid approach (concurrent engineering).
- Integrates the RHA activities into the program schedule or project lifecycle. Early start of RHA activities and adherence to the stipulated timeline of tasks and deliverables is critical to meet performance requirements in the mission radiation environments and

Table 6. SEE Taxonomy – RHA Scope and Assurance

RHA Category	S1	S2	S3	S4	S5
Risk tolerance posture	Low	Low-Medium	Medium-High	High	Highest
Anticipated scope of SEE testing ⁶⁻⁸	Piece-part heavy ion characterization test data if not already available. Additional testing as needed for NDSEE characterization, low-LET-threshold parts proton susceptibility, CCA-level for complex system interactions (e.g., SW and HW) validation, etc.	Combination of CCA- and piece-part-level, high-energy proton and heavy ion testing. Additional testing as needed for NDSEE characterization, low-LET-threshold parts proton susceptibility, CCA-level for complex system interactions (e.g., SW and HW) validation, etc.	Combination of CCA- and piece-part-level, high-energy proton and heavy ion testing ⁶⁻⁷	CCA-level high energy proton testing	None

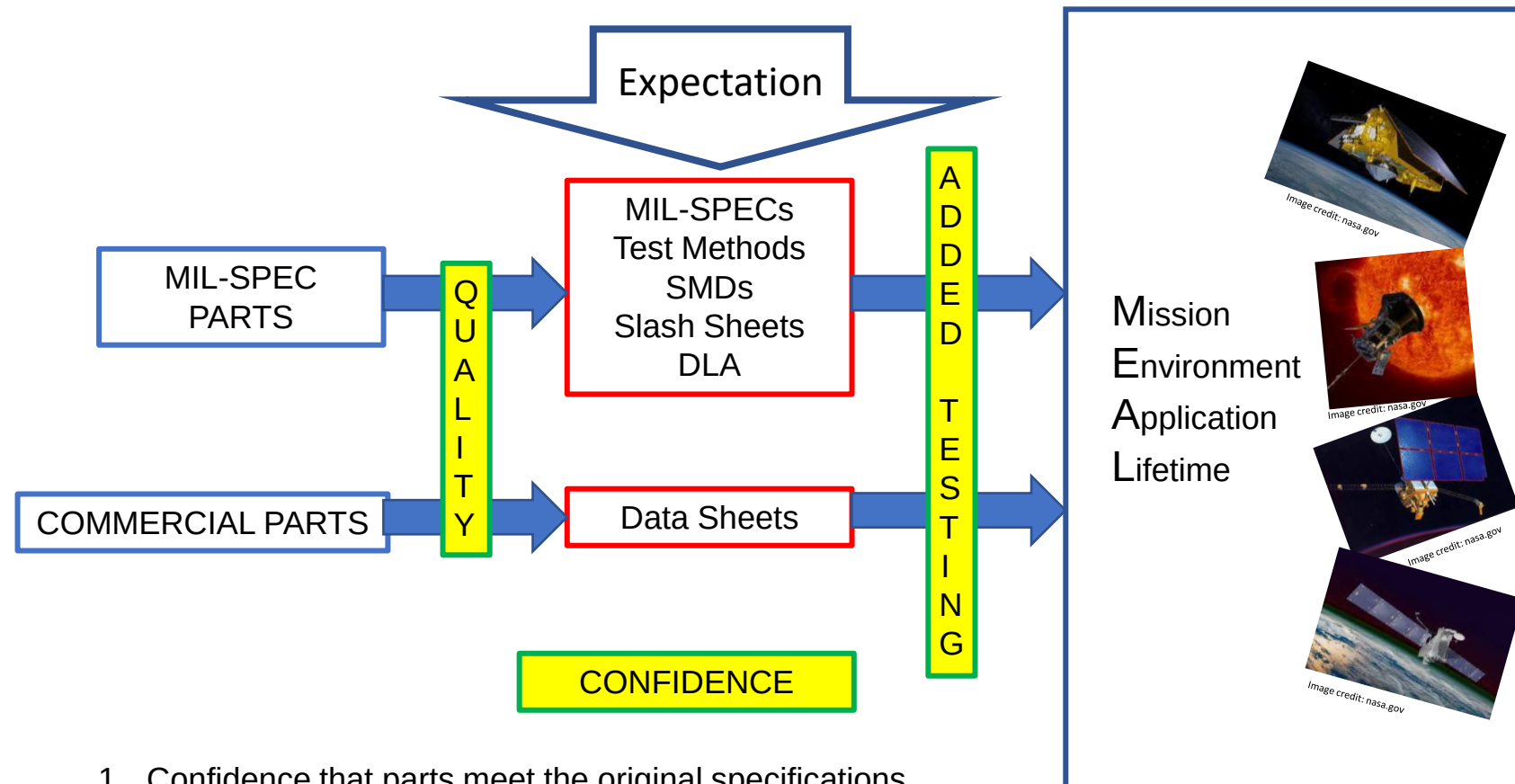


COTS UTILIZATION STEPS

- Relationship with COTS manufacturers
 - Industry Leading Parts Manufacturers (ILPM)s
 - Data sheets
 - Process control data
 - Qualification & Screening
 - Sampling
 - Process for implementing changes
- Parts Evaluation & Assessment Laboratory
 - Initial motivation for NEPP Program's predecessor in the 70s
 - Failure rate determination
 - Failure mechanisms/Physics of Failure/Acceleration Factors
 - Environmental testing geared towards NASA missions (MEAL)
 - Not re-inventing the wheel
 - Attempt at "Standardization" for generic mission profiles



Concerns for Picking Parts



1. Confidence that parts meet the original specifications.
2. Analysis to ensure mission requirements are being met, especially if requirements are above data sheet/SMD limits.
3. Added testing should be done with extreme caution



What Is An ILPM?

NESC Report defined an **Industry Leading Parts Manufacturer (ILPM)** as:

A parts manufacturer with high volume automated production facilities and which can provide documented proof of the technology, process, and product qualification, and its implementation of the best practices for “zero defects” for parts quality, reliability and workmanship.

ILPM Criteria

1. Must have at least one Established COTS Part category
2. Willing to share parts quality and reliability data with NASA (DPPM, FIT) and how those statistics are derived
3. Willing to provide NASA documents substantiating parts quality and reliability
4. Willing to work with NASA or prime contractors to maintain a strong customer-manufacturer relationship (preference for on-site visit)



An Established COTS Part is a Part That:

- Is produced using processes that have been stable for **at least one year** so there are enough data to verify the part's reliability.
- Is produced in **high volume**. High volume is defined as a series of parts sharing the same datasheet having a combined sales volume over one million parts during the part's lifetime.
- Is **100% electrically tested per datasheet specifications** at typical operating conditions in production. Additionally, the manufacturer must have completed multi-lot characterization over the entire set of operating conditions cited in the part's datasheet, prior to mass production release.
- Is produced on fully **automated production lines** utilizing statistical process control (SPC), and undergoes in-process testing, including wafer probing for microcircuits and semiconductors, and other means appropriate for other products (e.g., passive parts).
- Has demonstrated **consistent yield** trend appropriate for high volume commercial technologies at that technology node.

Radiation Concerns

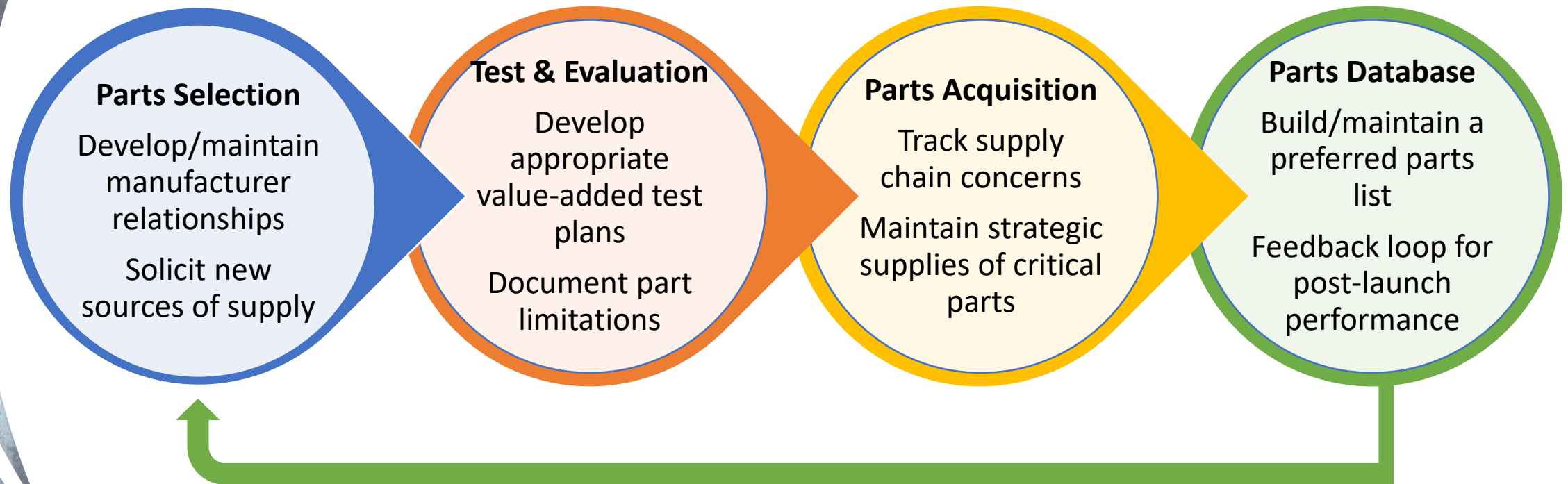
- Parts levels in EEE-INST-002 and equivalent documents do not indicate the level of radiation tolerance, and thus the selection of parts level 1, 2, or 3 does not imply or provide any type of radiation hardness or mitigation of radiation effects.
- MIL-SPEC parts may or may not include a radiation hardness designator signifying TID performance but may be sensitive to SEE.
- Lot-to-lot variation of radiation sensitivity may be larger for non-radiation-hardness-assured (non-RHA) parts than for RHA parts, since space radiation tolerance is typically not designed and optimized for parts without radiation addressed in their datasheets.
- RHA mitigations must include system-level techniques and not depend solely on part-level robustness.



Credit: NASA/GSFC



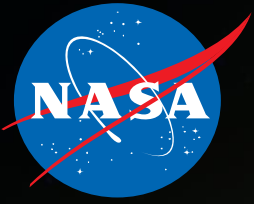
Parts Evaluation and Assessment Laboratory (PEAL)



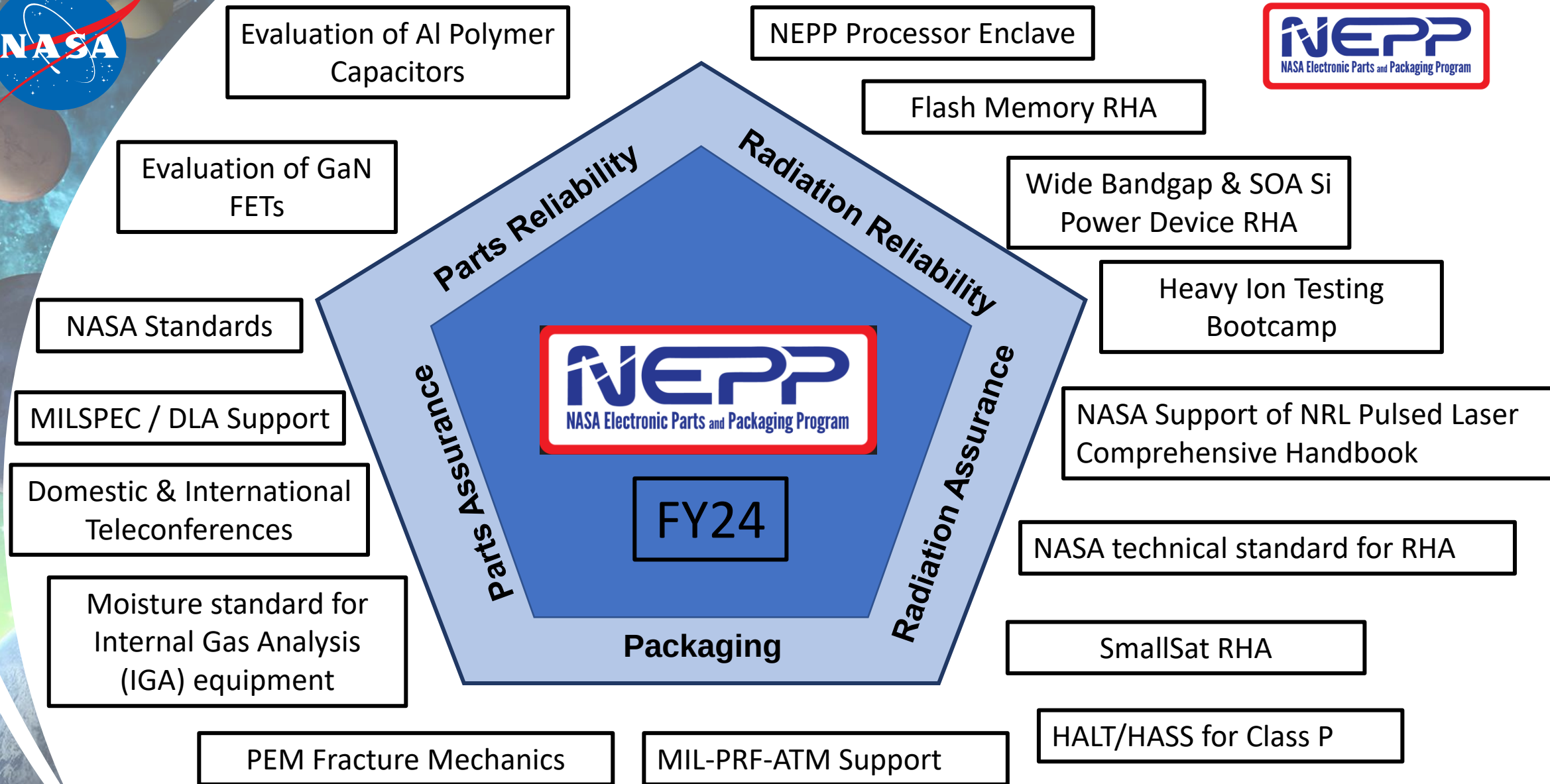


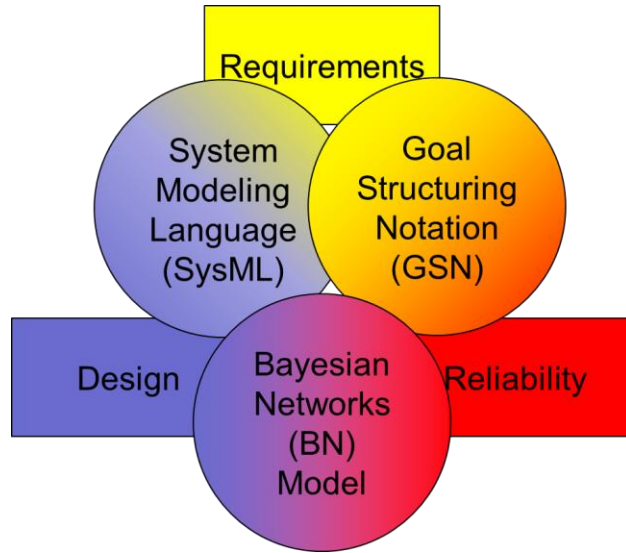
Cost of Not Implementing PEAL

- Major impediments to the use of new technology with the potential for high reliability in space missions
- Tendency to maintain outdated heritage designs that are not only costly and time consuming, but keep us rooted in the past
- Continued reliance on the use of parts that are growingly rapidly in cost and very long lead time, and too often uncertain delivery
- No easy path for taking proven technologies into flagship missions
- Risk of repeating testing efforts for multiple projects across the Agency that can be solved centrally
- Lack of knowledge-base in the NASA community about current Quad-E part technology advancements



FY24 Plans



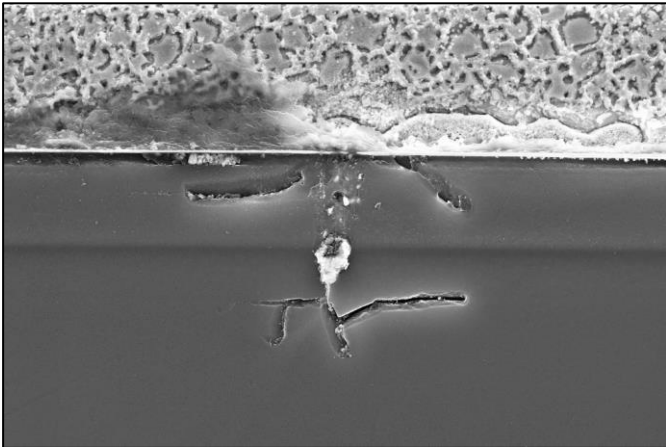


Emerging Assurance Methods
Image Credit: Vanderbilt University

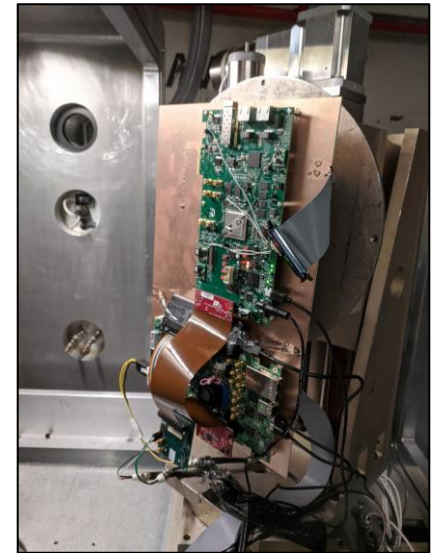
14th Annual NEPP Electronics Technology Workshop (ETW)

Scheduled dates:
June 3-6, 2024

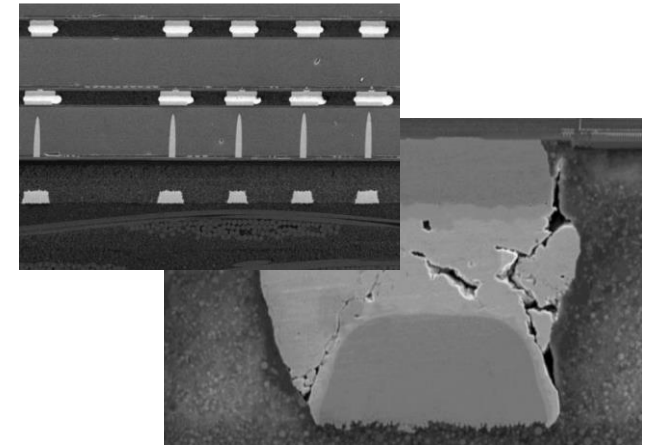
<https://nepp.nasa.gov/>



Advanced Technology Reliability
Image Credit: NASA



Radiation Testing & Analysis
Image Credit: NASA



Advanced Microelectronics Packaging
Image Credit: NASA



2023 NEPP Electronic Technology Workshop Presentations

MILSPECs – Incorporation of Plastics (4)

Processors, FPGAs & Memories (6)

Photonics (4)

Collaborations/Working Groups (4)

WBG (3)

Advanced Packaging (2.5/3D, etc.) (5)

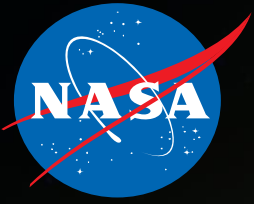
Passives: Capacitors and Resistors (5)

Training / Tutorials (2)

Small Sats & COTS Utilization (5)

Model Based Mission Assurance (MBMA) (4)

All NETW presentations for 2023 and past years are at <https://nepp.nasa.gov/>



The End