NASA EEE Parts and Packaging (NEPP) Program – Welcome to the Ninth Annual Electronics Technology Workshop (ETW)

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To be presented by Kenneth A. LaBel at the 2018 NEPP Electronics Technology Workshop (ETW), NASA GSFC, Greenbelt, MD, June 18-21, 2018.
Acronyms

- Three Dimensional (3D)
- The Aerospace Corporation (Aerospace)
- Air Force (AF)
- Air Force Research Laboratory
- Amkor Technology
- Ames Research Center (ARC)
- Arctic Slope Regional Corporation (ASRC) Federal Space and Defense (AS&D)
- Bayesian Networks (BN)
- Body of Knowledge (BOK)
- Capability Leadership Teams (CLTs)
- Complementary Metal Oxide Semiconductor (CMOS)
- Carnegie Mellon University (CMU)
- Commercial Off-the-Shelf (COTS)
- Cosmic Ray Effects on Micro-Electronics (CRÈME)
- Defense Logistics Agency (DLA)
- Department of Defense (DoD)
- Department of Energy (DOE)
- Electrical, Electronic, and Electromechanical (EEE)
- NEPP Electronics Technology Workshop (ETW)
- Field Programmable Gate Array (FPGAs)
- MSU Facility for Rare Isotope Beams (FRIB)
- Gallium Nitride (GaN)
- Government-Industry Data Exchange Program (GIDEP)
- Glenn Research Center (GRC)
- Goddard Space Flight Center (GSFC)
- Goal Structuring Notation (GSN)
- Headquarters (HQ)
- Integra Technologies, LLC (Integra)
- Joint Electron Device Engineering Council (JEDEC)
- Jet Propulsion Laboratories (JPL)
- Johnson Space Center (JSC)
- Langley Research Center (LaRC)
- Lawrence Berkeley National Laboratories (LBNL)
- Mission Assurance Improvement Workshop (MAIW)
- Model-Based Mission Assurance (MBMA)
- Missile Defense Agency (MDA)
- Michigan State University (Michigan)
- Marshall Space Flight Center (MSFC)
- Michigan State University (MSU)
- National Aeronautics and Space Administration (NASA)
- NASA Electronic Parts Assurance Group (NEPAG)
- NASA Electronic Parts and Packaging (NEPP) Program
- NASA Engineering and Safety Center (NESC)
- United States Navy National Reconnaissance Office (NRO)
- National Superconducting Cyclotron Laboratory (NSCL)
- NASA Space Radiation Laboratory (NSRL)
- NASA Office of the Chief Engineer (OCE)
- NASA Office of Safety and Mission Assurance (OSMA)
- Point of Contact (POC)
- Reliability and Maintainability (R&M)
- Vanderbilt University's Notional RHA Tool (R-GENTIC)
- Radiation Hardened (RH)
- Radiation Hardness Assurance (RHA)
- Society of Automotive Engineers (SAE)
- Space Asset Protection Program (SAPP)
- Systems Engineering and Assurance Modeling (SEAM)
- Single Event Effect (SEE)
- Single Event Upset (SEU)
- Silicon Carbide (SiC)
- Air Force Space and Missile Systems Center (SMC)
- Subject Matter Expert (SME)
- SSL is a business unit of Maxar Technologies (SSL)
- NASA Space Technology Mission Directorate (STMD)
- SUNY Polytechnic Institute (SUNY)
- University of Surrey (Surrey)
- System Modeling Language (SysML)
- Texas A&M University (TAMU)
- To Be Determined (TBD)
- Texas Instruments (TI)
- Technical Operating Reports (TORs)
Outline

• Meeting Introduction and Logistics
• NEPP Program
  – Brief Diatribe: NASA Electrical, Electronic, and Electromechanical (EEE) Structure
  – NEPP Program Structure
• NEPP 2018
  – NEPP Overview
  – Changes in 2018
  – Key efforts, concerns, and status
• NASA Electronics Parts Assurance Group (NEPAG)
• Summary
Ninth Annual ETW!

• Annual meeting
  – Originally, “just” a Program Review
  – Has morphed into a Program Review with multiple focused and timely technical and infrastructure topics
    • Examples include: Space Radiation Test Facilities, Copper Bond Wires, 2.5/3D Packaging, Small Mission Success, and more!

• Four full days
  – All presentations will be posted on the NEPP website after appropriate release by presenters and their organizations

• Long breaks and on-your-own lunch periods to foster networking opportunities

• Coffee is supplied by hosts (but Starbucks across the street)

• >350 registrants this year
NASA EEE Parts – New Structure

• New NASA EEE Parts Manager:
  – Leads efforts related to EEE Parts workforce and capabilities
  – Jonathan Pellish is the new EEE Parts Manager*

• NEPP remains *virtually* the same:
  – Owns the EEE parts assurance processes (and related technical efforts)

• Increased NASA-wide documents
  – NASA Standard 8739.10, *Released*
  – EEE-INST-002 update and unification underway*

* = on the agenda

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NEPP Mission Statement

Provide NASA’s leadership for developing and maintaining guidance for the screening, qualification, test, and reliable use of Electrical, Electronic, and Electromechanical (EEE) parts by NASA, in collaboration with other government agencies and industry.

Note: The NASA Electronic Parts Assurance Group (NEPAG) is a key portion of NEPP

- Standards, working groups, guidance, problem parts, …
NEPP Program – Organization Chart

NEPP Program Executive, John Evans/OSMA HQ

NEPP Program Manager, Ken LaBel/GSFC

NEPP Deputy Program Manager, Peter Majewicz (acting)

NEPAG Manager, Mike Sampson/GSFC

Senior NEPAG Staff, Shri Agarwal/JPL, Jay Brusse, GSFC/AS&D

Senior NEPP Staff, Jonathan Pellish/GSFC

NEPP Program Support, Freda Kagere/GSFC – resources

Martha O'Bryan, GSFC/AS&D

Donna Cochran, GSFC/AS&D

NEPP Sys Admin, Carl Szabo/GSFC/AS&D

NESC, Multiple

EEE Parts Manager, Jonathan Pellish, GSFC

NEPP GSFC POC, Chris Green

NEP JPL POC, Doug Sheldon

NEPP MSFC POC, Jeff Martin (acting)

NEPP LaRC POC, John Pandolf

NEPP GRC POC, Kristen Boomer

NEPP JSC POC, Carlton Faller

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NEPP - Charter

Mission Assurance

**Agency Leadership**
- NASA Policies and Procedures
- Agency Guidelines, Body of Knowledge (BOK) documents, and Best Practices
- Coordination of Government and Industry Standards
- Audit Coordination with AF, NRO, DLA
- Partnering within NASA and other Agencies, Industry, University, and International

**Agency Priorities – Independent Support**
- Commercial Crew
- Small Mission Reliability
- Coordination with NASA Consolidation, CLTs, NESC, STMD, SAPP, and radiation block buy
- Collaborate with DoD/DOE on space radiation test infrastructure

**Technology Evaluation**
- Advanced/new EEE parts/technologies
- Ex. Advanced CMOS, GaN, SiC
- Working Groups (NASA, government, aerospace)
- Screening/qualification/test usage guidelines
- Partnering: NASA, Government Agencies, Industry, University, International

**EEE Parts Infrastructure**
- NEPAG Telecons and Working Groups
- SME Capabilities
- Communication and Outreach within NASA and to the greater aerospace community

**EEE Parts Problem Investigations**
- Agency/industry-wide problems
- GIDEP and NASA Alert development

**Trusted and RH Electronics**
- Collaboration with NASA and other Agency Supply Chain and Trust/Counterfeit Electronics Organizations
- Support DoD efforts on Trusted Foundries and FPGAs (w/NASA STMD and OCE/Space Asset Protection)
- Support DoD RH efforts

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NEPP – Product Delivery

Best Practices and Guidelines
• Test, usage, screening, qualification
• Radiation facility studies

Body of Knowledge (BOK)
• Technology and product status and gap analysis

NASA EEE Parts Policy and Standards

Government and Industry Standards Representation
• SAE CE-11 and CE-12
• JEDEC JC13
• Aerospace TORs

NEPP Standard Products
• Test, summary, and audit reports
• Conference and workshop presentations
• Alerts

Assurance

Related task areas:
Technology/parts evaluations lead to new best practices, guidelines,…

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What’s New for NEPP?

• Agency EEE Parts Manager
  – Support efforts on workforce, facilities, etc…

• Increased delivery of assurance products
  – BOKs, Guidelines, Tools, Information Sharing, Training
  – Unification of NASA documentation (NEPAG)

• Increased discussion on the role of standardization processes (NEPAG) and data sharing

• Increased emphasis on
  – Guidance and understanding of small missions such as CubeSats
  – Model-based mission assurance (MBMA) and radiation tool “standardization”
  – Changing EEE parts industry such as the move to “mid-space”
  – Partnering with other NASA organizations, Agencies, and universities
    • Expansion of outreach in all these areas

• Significant update of the NEPP website planned
  – Easier to find guidance and search for data
  – New tie-ins to the SmallSat community

• First look at “big data” analyses…

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### Providing Guidance Based on Function and Exposure since 2014

- **High**
  - Level 1 or 2 suggested. COTS upscreening/testing recommended. Fault tolerant designs for COTS.
  - Level 1 or 2, rad hard suggested. Full upscreening for COTS. Fault tolerant designs for COTS.
  - Level 1 or 2, rad hard recommended. Full upscreening for COTS. Fault tolerant designs for COTS.

- **Medium**
  - COTS upscreening/testing recommended. Fault-tolerance suggested
  - COTS upscreening/testing recommended. Fault-tolerance recommended
  - Level 1 or 2, rad hard suggested. Full upscreening for COTS. Fault tolerant designs for COTS.

- **Low**
  - COTS upscreening/testing optional. Do no harm (to others)
  - COTS upscreening/testing recommended. Fault-tolerance suggested. Do no harm (to others)
  - Rad hard suggested. COTS upscreening/testing recommended. Fault tolerance recommended

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To be presented by Kenneth A. LaBel at the 2018 NEPT Electronics Technology Workshop (ETW), NASA GSC, Greenbelt, MD, June 18-21, 2018.
The Future of Radiation Hardness Assurance (RHA)?

**Bottom line goal:**
*Provide appropriate and stream-lined approaches for flight projects (of all sizes)*

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NEPP Small Mission Efforts and MBMA (w/ NASA MBMA Program)

NASA/GSFC (Campola)
Small Mission RHA
TBD
Small Mission EEE Parts Best Practices

Saint Louis University
CubeSat Success Study

JPL
CubeSat EEE Parts Databases

TBD
CubeSat EEE Parts Testing

TBD
Resilience, autonomy

NASA/GSFC (Xapsos)
RHA Confidence Approach

Air Force SMC
CubeSat Supply Chain and “Mid-space” Grade Electronics Survey and Requirements Definition

Vanderbilt University
GSN Exemplar (SEE) – complete
TBD
GSN Exemplar – EEE parts reliability

NASA/GSFC (Xapsos)
Small Mission EEE Parts Best Practices

NASA/GSFC (Xapsos)
Small Mission RHA
TBD
Small Mission EEE Parts Best Practices

NASA/GSFC (Berg)
SEE Classic Reliability

Vanderbilt
CRÈME Toolsuite

TBD
Resilience, autonomy

Vanderbilt University
BN follow-on
BN integrated into SEAM

Other
MAIW
SmallSat Reliability Initiative (NASA/AF/ others)

https://modelbasedassurance.org/

Tenet: the best ideas will die on the vine without integration into standard approaches or tools. It’s all about access.

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# Notional Schedule

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<th>Tues 19-Jun</th>
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<tbody>
<tr>
<td>NEPP Overview</td>
<td>Radiation Test Facilities</td>
<td>National Academies of Science Outbrief of Testing at the Speed of Light - Nielsen - CMU (study co-lead), et al</td>
<td>Guertin - NASA JPL, Wyrwas - NASA-GSFC/Lentech</td>
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<td>LaBel - NASA NEPP</td>
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<td>Small Spacecraft Systems Virtual Institute (S3VI)</td>
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<td>NASA Parts Standard and Plans Moving Forward</td>
<td>Clark - TAMU, Phair - LBNL, Sivertz - NSRL, MSU, Stolz - NSCL/FRIB, LaBel - NASA NEPP (brief proton status)</td>
<td>Processes</td>
<td>Yost - NASA ARC</td>
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<td>Majewicz - NASA NEPP</td>
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<td>Guertin - NASA JPL, Wyrwas - NASA-GSFC/Lentech</td>
<td>Small Mission Success</td>
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<td>Organized by Swartwout - SLU (LaBel - NASA NEPP subbing in person)</td>
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<tr>
<td>NASA EEE Parts Manager Overview</td>
<td>Future path brainstorming</td>
<td>Berg - NASA GSFC/AS&amp;D, Allen - NASA JPL</td>
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<td>Pellish - NASA</td>
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<td>Lauenstein - NASA GSFC, Scheick - NASA JPL</td>
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<td>NEPP Small Mission Guidance</td>
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<td>EEE-INST Unification and Update Government Working Group and Hybrids Working Group</td>
<td>Advanced device packaging (2.5/3D, etc...)</td>
<td>Lead: Sheldon, NASA JPL (presentation)</td>
<td>Campola, Green, Moe - NASA GSFC</td>
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<td>Loman - SSL</td>
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<td>Laird - NASA MSFC, Majewicz - NASA NEPP</td>
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<td>Capacitors, Resistors</td>
<td>Dodd - DFR Solutions</td>
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<td>COTS Data Sharing</td>
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<td>PEMS/PEDS/Cu</td>
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<td>ESD Surveys and Gaps</td>
<td>Yarbrough - Aerospace</td>
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<td>Agarwal - NASA JPL</td>
<td>Big Data (radiation)</td>
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<td>COTS diodes in Hi-rel applications</td>
<td>Austin - Vanderbilt/NASA GSFC</td>
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<td>Lead: Sampson, NASA NEPP; Harztark, Panning - Aerospace; Majewicz - NASA NEPP, Agarwal - NASA JPL, TBD</td>
<td>Model Based Mission Assurance</td>
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<td>Loman - SSL</td>
<td>Integration of tools</td>
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<td>Witulski or Sierawski - Vanderbilt</td>
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<td>Panel: Utility of EEE Parts Audits</td>
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Questions?

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