NASA Electrical, Electronic, and Electromechanical (EEE) Parts Manager Overview

Jonathan Pellish
NASA EEE Parts Manager

July 2018
Goddard Space Flight Center / Greenbelt
## Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRC</td>
<td>Armstrong Flight Research Center</td>
</tr>
<tr>
<td>ARC</td>
<td>Ames Research Center</td>
</tr>
<tr>
<td>BNL</td>
<td>Brookhaven National Laboratory</td>
</tr>
<tr>
<td>BSA</td>
<td>Business Services Assessment</td>
</tr>
<tr>
<td>CNL</td>
<td>Crocker Nuclear Laboratory</td>
</tr>
<tr>
<td>COTS</td>
<td>Commercial-off-the-shelf</td>
</tr>
<tr>
<td>DOE</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>EEE</td>
<td>Electrical, electronic, &amp; electromechanical</td>
</tr>
<tr>
<td>GRC</td>
<td>Glenn Research Center</td>
</tr>
<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
</tr>
<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
</tr>
<tr>
<td>JSC</td>
<td>Johnson Space Center</td>
</tr>
<tr>
<td>KSC</td>
<td>Kennedy Space Center</td>
</tr>
<tr>
<td>LaRC</td>
<td>Langley Research Center</td>
</tr>
<tr>
<td>LBNL</td>
<td>Lawrence Berkeley National Laboratory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP</td>
<td>Mission Support Future Architecture Program</td>
</tr>
<tr>
<td>MGH</td>
<td>Massachusetts General Hospital</td>
</tr>
<tr>
<td>MSFC</td>
<td>Marshall Space Flight Center</td>
</tr>
<tr>
<td>NAS</td>
<td>National Academies of Sciences, Engineering, &amp; Medicine</td>
</tr>
<tr>
<td>NEPP</td>
<td>NASA Electronic Parts &amp; Packaging (Program)</td>
</tr>
<tr>
<td>NESC</td>
<td>NASA Engineering &amp; Safety Center</td>
</tr>
<tr>
<td>NSCL</td>
<td>National Superconducting Cyclotron Laboratory</td>
</tr>
<tr>
<td>NSRL</td>
<td>NASA Space Radiation Laboratory</td>
</tr>
<tr>
<td>OCE</td>
<td>Office of the Chief Engineer</td>
</tr>
<tr>
<td>OSMA</td>
<td>Office of Safety and Mission Assurance</td>
</tr>
<tr>
<td>SEE</td>
<td>Single-event effects</td>
</tr>
<tr>
<td>SEUTF</td>
<td>Single-Event Upset Test Facility</td>
</tr>
<tr>
<td>TAMU</td>
<td>Texas A&amp;M University</td>
</tr>
<tr>
<td>TCAT</td>
<td>Technical Capability Assessment Team</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>Formerly known as the Tri-University Meson Facility</td>
</tr>
</tbody>
</table>
• Background on Agency EEE parts management
  – Describe Agency operating model & capability leadership
  – Outline Agency relationships
    • Technical & institutional interfaces

• Changing radiation test facility landscape & radiation block buy
  – Preserve required capabilities
  – Establish effective & efficient access for all

• Examples of EEE parts management efforts
  – Exchange data & develop workforce

• Summary and forward work
EEE Parts Management
“Establish a more efficient operating model that maintains critical capabilities AND meets current and future mission needs”
Brief History of Agency EEE Parts Management

- Continued activities and Center discussions, Fall 2016 – Fall 2017
- Hired Agency EEE Parts Manager, November 2017

- Covers EEE parts and radiation engineering (on EEE parts) functions
  - Crosscuts engineering and safety & mission assurance
- Focuses on new ways to do business in light of workforce challenges and the demands of characterizing, qualifying, and deploying new technologies
• Manage EEE parts workforce at the Agency level
  – Radiation effects on EEE parts are in scope, as is management of the Agency radiation facility block buy (later slides)
  – GSFC is lead Center, with support from JPL

• Provide resources for Centers to acquire EEE parts workforce expertise and a forum to coordinate activities with stakeholders (e.g., OCE, OSMA, etc.) and customers

• Track the state of the Agency EEE parts workforce, including Center expertise, demand, and capacity

• Support Agency policy and technical decision-making processes

• Evolve management functions as needed
Agency Capability Relationships

Agency EEE Parts

Assurance

Development

Facilities

Customers

Office of Safety & Mission Assurance

Office of the Chief Engineer

Flight Projects

Mission Support

Partners

To be published on https://nepp.nasa.gov/
Current EEE Parts Management Team Members

- **NEPP**
- **NESC**
- **Lead Center**: GSFC
- **Agency EEE Parts Manager**: GSFC
- **Supporting Center**: JPL
- **Member Centers**
  - AFRC
  - ARC
  - GRC
  - JSC
  - KSC
  - LaRC
  - MSFC

- **Capability Leadership**
- **External Partners**

National Aeronautics and Space Administration / EEE Parts & Radiation Engineering

To be published on https://nepp.nasa.gov/
Radiation Test Facilities and Block Buy

*Focus on single-event effects (SEE)*
Domestic Radiation Facilities – SEE Testing

- Distributed across the United States
  - More than 15 states
  - International facilities too

- Split into several general categories
  - Heavy ion
    - For example: BNL (NSRL & SEUTF), LBNL, and TAMU
  - (Traditional) High-energy protons
    - For example: Loma Linda Cancer Treatment Center, Massachusetts General Hospital, Northwestern Medicine, and NSRL
  - Medium-energy protons
    - For example: BNL (SEUTF), CNL, LBNL, and TAMU
  - New medical therapy facilities
    - Dynamic

- Require various procurement mechanisms and agreements
• The Department of Energy’s (DOE) Lawrence Berkeley National Laboratory (LBNL) 88-Inch cyclotron is one of the two primary facilities utilized by NASA and other U.S. government space programs for heavy ion testing of electronics – the Texas A&M University (TAMU) Cyclotron Institute being the other
• By the end of FY17, LBNL had lost sufficient funding for radiation effects testing
• DOE funding is limited to science runs and maintenance periods in between runs
  – Radiation testing operations had been buoyed by funding from other U.S. Government agencies since the mid-1990s
  – Funds were also used for technology development, university research, and assurance guideline development efforts
• Loss of access to LBNL would result in additional delays to access a heavy ion test facility – could also put undue pressure on remaining limited resources
Phased Radiation Block Buy – Spurred by National Academies Report, Feb. 2018

• Background on space environment and its effects on electronics
• Current state of single-event effects hardness assurance and infrastructure
• Future infrastructure needs and a path towards them
• National Academies debrief at the NEPP Program Electronics Technology Workshop – Tuesday, June 19

Testing at the Speed of Light – The State of U.S. Electronic Parts Radiation Testing Infrastructure

Committee on Space Radiation Effects Testing Infrastructure for the U.S. Space Program
National Materials and Manufacturing Board
Division on Engineering and Physical Sciences

The National Academies Press
Washington, DC
www.nap.edu

• NASA’s Mission Support Council approved multi-phase plan to begin coordinating access to external radiation test facilities in February 2018
  – Phase 1 centrally-funded, Phase 2+ will be PAYGO with blanket purchase agreements
  – Looking at options for international facilities too

• Assessing funding / procurement model based on needs and available budget
EEE Parts Management Efforts

Broad, crosscutting examples – not inclusive
Eee Parts Data Exchange

• Lacking centralized information for Eee parts usage – particular issue for COTS
  – Data are often stovepiped (even within single orgs.)
  – Can affect design process & quality assurance
• Tracing Eee part usage, testing, and history may be difficult
• Re-testing and/or re-ordering Eee parts with prior history may happen without *reasonable* knowledge symmetry
• Assessing different potential internal and community-based solutions
  – COTS data exchange talk, Thursday, June 21
Workforce Challenges – Next Generation

• EEE parts and radiation engineering are niche fields with crosscutting subject matter
  – Bulk of current workforce not specifically developed – mostly built with on-the-job-training
• Accelerating use of commercial-off-the-shelf (COTS) electronics and other advances (e.g., 2.5D/3D packaging, heterogeneous integration, sub-10 nm feature sizes, wide bandgap semiconductors, etc.) for flight hardware requires more commodity & discipline experts
• Among others, there is an across-the-board shortage of radiation effects (on EEE parts) engineers right now
  – 10s of job openings; preference for mid-career (global community is «1000 people)
  – Long-term needs will likely have to focus on training early career engineers and scientists while maintaining and transferring current knowledge base
Workforce Challenges – Possible Solution

RADSAGA is an Innovative Training Network under the Marie Skłodowska-Curie Actions. We will bring together industry, universities, laboratories and test-facilities in order to innovate and train young scientists and engineers in all aspects related to electronics exposed to radiation.

ESR Positions  Learn more

https://radsaga.web.cern.ch/
Summary & Forward Work

• Continuing NASA EEE parts management implementation
  – Developing capability structure, cross-Center workflow
  – Refining relationships with both internal and external stakeholders
• Proceeding with multi-phase Agency radiation block buy
  – Executing Phase 1 at LBNL; planning Phase 2 for proton test facilities
  – Evaluating facility alteration / upgrade possibilities
• Considering future strategies for workforce development and other capabilities to meet current and future mission needs
Thank you for your attention
Questions welcome!

Image credit: NASA.
International Space Station is seen in this twenty-second exposure as it flies over the Washington National Cathedral, Wednesday, Nov. 29, 2017.