2nd NASA Electronic Parts and Packaging (NEPP) Program
Electronic Technology Workshop (ETW)

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Co- Managers NEPP Program

http://nepp.nasa.gov
Insertion of New Electronics Technologies  
*The Big Picture Approach*

- Develop knowledge-base of existing technology information
- Determine reliability/radiation gaps
- Perform ground-based tests where appropriate
  - May be sufficient to “qualify” for a specific mission, but not generically for all
- Develop technology-specific models/test protocols
  - Performance Predictions
- Validate models with flight data
  - Requires in-situ environment monitoring

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**2nd NEPP ETW Intro presented by Kenneth A. LaBel at NASA/GSFC – June 28, 2011**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Procurement (100+ device samples for testing only)</td>
<td>$25-1000K</td>
<td>Individual device costs can run from cents to tens of thousands</td>
</tr>
<tr>
<td>“Standard” Qualification Tests</td>
<td>$300K</td>
<td></td>
</tr>
<tr>
<td>Radiation Tests and Modeling</td>
<td>$200K</td>
<td>Assumes total dose and single event (heavy ion) only</td>
</tr>
<tr>
<td>Failure Modes Analysis</td>
<td>$200K</td>
<td>Out-of-the-box look at the “hows and whats” for non-standard research required for qualification</td>
</tr>
<tr>
<td>Additional Tests, Modeling, and Analysis based on Failure Modes</td>
<td>$300K</td>
<td></td>
</tr>
<tr>
<td>Total cost for one device type</td>
<td>$1.025-2M</td>
<td>Not all new technologies will meet standard qualification levels: technology limitations document</td>
</tr>
</tbody>
</table>

Now add inflation and increased complexity and …

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NEPP:
If we used Purely Commercial parts

<table>
<thead>
<tr>
<th></th>
<th>Purely Commercial</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lifetime</strong></td>
<td>1-3 years, then replaced or thrown out</td>
<td>1-20 years and rarely replaceable</td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td>0-70C</td>
<td>-55 to +125C with extremes much higher and lower</td>
</tr>
<tr>
<td><strong>Shock</strong></td>
<td>Oops! I dropped it. Time to get an upgrade…</td>
<td>Launch vibration</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
<td>Dude, where’s my SPF?</td>
<td>Protons, electronics, galactic cosmic rays, solar, particles, plasma,…</td>
</tr>
<tr>
<td><strong>Anomaly</strong></td>
<td>Reboot or power cycle or return to dealer</td>
<td>Anomaly or failure</td>
</tr>
</tbody>
</table>

- NEPP is the only entity at NASA that
  - Trains young engineers in the difference and provides a growth path for developing project parts and radiation engineers
  - Develops and validates qualification methods
    - Military and commercial standards do not cover ALL of NASA’s interests
  - Provides knowledge allowing insertion of modern devices into space systems
  - Shares and gathers knowledge with all the industry
    - If the flight projects don’t know there’s a problem…
NEPP Overview

• NEPP supports all of NASA for >20 years
  – 7 NASA Centers and JPL actively participate
• The NEPP Program focuses on the reliability aspects of electronic devices
  – Three prime technical areas: Parts (die), Packaging, and Radiation
• Alternately, reliability may be viewed as:
  – Lifetime, inherent failure and design issues related to the electronic parts technology and packaging,
  – Effects of space radiation and the space environment on these technologies, and
  – Creation and maintenance of the assurance support infrastructure required for mission success.
• Applied research and guideline/qualification method development

Electrical overstress failure in a commercial electronic device
NEPP Works Two Sides of the Equation

• Assurance
  – *Issues that are applicable to space systems being designed and built* (i.e., currently available technologies)
  – Examples
    • Cracked capacitors
    • DC-DC converter reliability
    • Enhanced Low Dose Rate Sensitivity (ELDRS)
  – Communication infrastructure via NEPP website and working groups
    • NASA Electronic Parts Assurance Group (NEPAG)
  – Audit and review support

• New electronics technology
  – *Issues that are applicable to the next generation of space systems in conceptualization or preliminary design*
  – Examples
    • 22-45 nm CMOS
    • SiGe
    • State-of-the-art FPGAs
  – Collaboration with manufacturers and government programs for test, evaluation, and modeling
  – Development of new predictive performance tools

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The NEPP Program

**Management**

- Ken LaBel - 561
  - Radiation Effects
  - Advanced Actives
  - NEPP Events
- Mike Sampson - 300
  - NEPAG
  - Passives
  - Packaging

**Core Elements**

- Electronic Parts Reliability
- Radiation Effects
- Parts Assurance (NEPAG)
- Advanced Packaging
- Information Dissemination

**Focus Technologies**

- Extreme Environments
- Scaled CMOS
- SiGe Mixed Signal
- Area Arrays
- Programmable Logic
- Interconnects
- Sensor Technology
- Fiber Optics
- Memories
- Discretes
- Embedded Technologies
- Radio Frequency
- Power Devices
- Lead-free
- Systems on a Chip (SOC)

**Products/Deliverables**

- Guidelines
- Specifications and Standards
- Test Methods
- Website Content
  - NASA Parts Selection List
  - Tools
  - Data
- Technical Reports
  - Bodies of Knowledge
  - Conference Papers

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Collaboration

• “Promote enhanced cooperation with international, industry, other U.S. government agency, and academic partners in the pursuit of our missions.” – Charles Bolden, NASA Administrator

• NEPP has a long history of collaboration. For radiation efforts:
  – Direct funding from DTRA (co-fund many radiation tasks) and NRO as well as in-kind from AFRL, NRL, SNL, etc…
  – Multiple universities including Vanderbilt, Georgia Tech, …
  – Too numerous manufacturers to mention!
  – International with ESA, JAXA,…

• We do not perform mission specific tasks
Commercial Evaluation – The “Rules” of Engagement

- NEPP works with many manufacturers on evaluating new and emerging product
  - However, funding does not allow us to “do it all”!
- The “rules”
  - Must be of general interest to NASA (i.e., not mission-specific)
  - Industry must be willing to:
    - Provide samples,
    - Understand NASA “data rights”, and,
    - Understand that this is evaluation, not qualification.
- We would like to test more, but are resource limited.
This meeting will provide a wide dissemination to the aerospace community beyond the parts, packaging, and radiation specialists on current and future issues impacting space system design and reliability.

Why attend? This meeting will discuss the two sides of the NEPP Program’s efforts agency-wide.

• Assurance:
  o Issues that are applicable to space systems being designed and built (i.e., currently available technologies)

• New electronics technologies:
  o Issues that are applicable to the next generation of space systems in conceptualization or preliminary design
ETW Format

- 2.5 days of presentations
  - Invited talks on specific topic areas such as counterfeit electronics and AFRL/NRO’s HiREV
  - Oral presentations from task and area leads
    - Topical: Ex., Dealing with next generation of device complexity
    - Task specific: Ex., On-Going Radiation Effects on FPGAs
- Panel sessions/discussion on topical areas of interest
- We encourage informal discussions during the breaks
- We encourage questions during the talks, however, please bear in mind that we need to keep on schedule
## ETW Program - Tuesday

### Tuesday, June 28, 2011

<table>
<thead>
<tr>
<th>Start</th>
<th>Finish</th>
<th>Session</th>
<th>Topic</th>
<th>Presenter(s)</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:15</td>
<td>8:30</td>
<td>Overview</td>
<td>NEPP and the Goals of the Workshop, Logistics</td>
<td>Michael Sampson, and Kenneth LaBel</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>8:30</td>
<td>9:00</td>
<td>System Issues - Complex</td>
<td>Class Y - NEPP Championed Approached to Advanced Package Qualification</td>
<td>Shri Agrawal</td>
<td>JPL</td>
</tr>
<tr>
<td>9:00</td>
<td>9:45</td>
<td>System Issues - Complex</td>
<td>FPGA - Overview of JPL Efforts under NEPP</td>
<td>Douglas Sheldon</td>
<td>JPL</td>
</tr>
<tr>
<td>9:45</td>
<td>10:15</td>
<td>System Issues - Complex</td>
<td>Discussion: FPGAs and new Alternatives</td>
<td>Kenneth LaBel</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>10:15</td>
<td>10:45</td>
<td></td>
<td>Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:45</td>
<td>11:45</td>
<td>System Issues - Complex</td>
<td>Taming the SEU Beast - Approaches and Results for FPGA Devices and How To Apply Them</td>
<td>Melanie Berg</td>
<td>MEI</td>
</tr>
<tr>
<td>11:45</td>
<td>13:15</td>
<td></td>
<td>Lunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:15</td>
<td>14:15</td>
<td>System Issues - Complex</td>
<td>Status and Plans for Vanderbilt's SEU Tools and Research</td>
<td>Kevin Warren</td>
<td>Vanderbilt</td>
</tr>
<tr>
<td>14:15</td>
<td>14:45</td>
<td>Power</td>
<td>SEE Issue Update for Power MOSFETs</td>
<td>Jean Marie Lauenstein</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>14:45</td>
<td>15:00</td>
<td></td>
<td>Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:00</td>
<td>15:45</td>
<td>Power</td>
<td>NEPP POL Consortia Report</td>
<td>Philippe Adell, and Dakai Chen</td>
<td>JPL, NASA/GSFC</td>
</tr>
<tr>
<td>15:45</td>
<td>16:15</td>
<td>Power</td>
<td>Emerging Power Device Technologies and Radiation</td>
<td>Steve McClure</td>
<td>JPL</td>
</tr>
<tr>
<td>16:15</td>
<td>17:15</td>
<td>Power</td>
<td>Panel Session: Next Generation Power Devices and Systems</td>
<td>TBD</td>
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<tr>
<td>17:15</td>
<td></td>
<td></td>
<td>Discussion</td>
<td></td>
<td></td>
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# ETW Program - Wednesday

## Wednesday, June 29, 2011

<table>
<thead>
<tr>
<th>Start</th>
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<th>Session</th>
<th>Topic</th>
<th>Presenter(s)</th>
<th>Organization</th>
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</thead>
<tbody>
<tr>
<td>8:30</td>
<td>9:15</td>
<td>Invited</td>
<td>An Update on the NRO/AFRL's National High Reliability Electronics Virtual Center (HiREV)</td>
<td>Chris Bozada</td>
<td>AFRL</td>
</tr>
<tr>
<td>9:15</td>
<td>9:30</td>
<td>Power</td>
<td>Commercial Vendor Experience with GaN and SiC</td>
<td>Alan Tasker</td>
<td>Microsemi</td>
</tr>
<tr>
<td>9:30</td>
<td>10:15</td>
<td>Mixed Signal</td>
<td>Reliability of SiGe, SOI, and Advanced Mixed Signal Devices for Cryogenic Space Missions</td>
<td>Richard Patterson</td>
<td>NASA/GRC</td>
</tr>
<tr>
<td>10:15</td>
<td>10:30</td>
<td>Break</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>11:00</td>
<td>Memories</td>
<td>Challenges of Developing Qualification Methods for DDR class Memories - Part 1</td>
<td>Ray Ladbury</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>11:00</td>
<td>11:30</td>
<td>Memories</td>
<td>Challenges of Developing Qualification Methods for DDR class Memories - Part 2</td>
<td>Steve Guertin</td>
<td>JPL</td>
</tr>
<tr>
<td>11:30</td>
<td>12:00</td>
<td>Invited</td>
<td>Counterfeit Electronics - NASA Update</td>
<td>Phil Zulueta</td>
<td>JPL</td>
</tr>
<tr>
<td>12:00</td>
<td>13:30</td>
<td>Lunch</td>
<td></td>
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</tr>
<tr>
<td>13:30</td>
<td>14:00</td>
<td>Systems on a Chip</td>
<td>Status on Radiation Qualification Methods for SOC</td>
<td>Steve Guertin</td>
<td>JPL</td>
</tr>
<tr>
<td>14:00</td>
<td>14:30</td>
<td>System Issues - Complex Electronics</td>
<td>Reliability Testing of Advanced Area Array Packages for Space</td>
<td>Reza Ghaffarian</td>
<td>JPL</td>
</tr>
<tr>
<td>14:30</td>
<td>15:00</td>
<td>System Issues - Complex Electronics</td>
<td>NEPP Program at MSFC - Advanced Packages and CAVE Consortia</td>
<td>Jim Blanche</td>
<td>Jacobs Technology</td>
</tr>
<tr>
<td>15:00</td>
<td>15:30</td>
<td>Break</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:30</td>
<td>16:00</td>
<td>Passives</td>
<td>Capacitor Test, Evaluation, and Modeling within NEPP</td>
<td>Alexander Teverovsky</td>
<td>MEI Technologies</td>
</tr>
<tr>
<td>16:00</td>
<td>17:00</td>
<td>Passives</td>
<td>Panel: What's Next for Capacitors for Space?</td>
<td>Mike Sampson</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>17:00</td>
<td></td>
<td>Discussion</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*1st NEPP ETW Intro presented by Kenneth A. LaBel at NASA/GSFC – June 22, 2010*
## ETW Program - Thursday

### Thursday, June 30, 2011

<table>
<thead>
<tr>
<th>Start</th>
<th>Finish</th>
<th>Session</th>
<th>Topic</th>
<th>Presenter(s)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>9:00</td>
<td>Invited</td>
<td>When is Qualification not Qualification?</td>
<td>Mike Sampson</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>9:00</td>
<td>9:30</td>
<td>Advanced Electronics</td>
<td>Radiation Status on Sub-65nm Electronics</td>
<td>Jonathan Pellish</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>9:30</td>
<td>10:00</td>
<td>Photonics</td>
<td>Status of Qualification Guidelines for Fiber Optic Components and Systems</td>
<td>Melanie Ott</td>
<td>NASA/GSFC</td>
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<tr>
<td>10:00</td>
<td>10:30</td>
<td>Photonics</td>
<td>Update on Cryogenic Latchup and Detectors</td>
<td>Cheryl Marshall</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>10:30</td>
<td>11:00</td>
<td>Break</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td>11:30</td>
<td>Radiation Effects</td>
<td>SiGe Technology - Radiation Update</td>
<td>Paul Marshall</td>
<td>Consultant</td>
</tr>
<tr>
<td>11:30</td>
<td>12:00</td>
<td>Discussion</td>
<td>What Are We Missing?</td>
<td>Mike Sampson, and Ken LaBel</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td>12:00</td>
<td></td>
<td></td>
<td>End of workshop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ETW - Logistics

- Emergency Exits
- Restrooms
- Breaks
- On-line feedback
- Wireless Access
  - NASA Guest
- Cell phones/PDAs
  - PLEASE TURN OFF or on SILENT mode
- Lunches
ETW - Lunch

Lunch Options

Here on center @ GSFC (see map on other side)
Bldg. 21 Cafeteria
Bldg. 1 Cafeteria (limited menu)
Bldg 34 Café (limited menu, limited seating)

Directly across the street from NASA/GSFC
(K-Mart shopping center)
5 Guys – Hamburgers/Fries - American
Osaka – Sushi
Papa John's Pizza – (no seating)
Chicken Rico - Peruvian-style charcoal broiled (limited seating)
Maharaja - Indian Cuisine
Orion Gourmet Take-Away (Sub/sandwich deli) – limited seating
Ruby Tuesday – American casual dining
Burger King – fast food

Greenway Center
Greenbelt Road & Hanover Parkway
Turn right out of NASA/GSFC Main Gate.
Travel 2.02 miles
Greenway Center will be on your left.
Chesapeake Bagel Bakery
Chevy’s Fresh Mex Restaurant
Denny’s Restaurant
Hunan Treasure
Jasper’s
Starbucks Coffee
Subway Sandwich Shop
Wendy’s

Eastgate Shopping Center
Glenn Dale Rd & Lanham Severn Rd
Turn left out of Main Gate – approx 1.8 miles.
shopping center on Right
Chanan’s Buffet (Chinese food – Mongolian Grill)
Pizza Hut
McDonalds
QUESTIONS?