National Aeronautics and
Space Administration

NEPP Working Group - NEPAG
NASA Electronic Parts Assurance Group

Shri G. Agarwal
NASA – Jet Propulsion Laboratory,
California Institute of Technology
Shri.g.agarwal@nasa.gov
818-354-5598

June 19, 2019

Image Credit: NASA/JPL-Caltech

© 2019 California Institute of Technology.
Government sponsorship acknowledged.

NASA Electronic Parts Assurance program (NEPAG)

Started in the year 2000.

Goal

- NEPAG is about parts standards. It involves
  - Efficient communication with the community through leadership roles in manufacturer audits/surveys, JC-13/CE-11/CE-12 meetings,
  - New technology qualification data reviews/approvals,
  - Outreach initiatives,
  - Products evaluation,
  - Presenting at domestic and international conferences, and
  - Other activities

- The NEPAG program revolves around the weekly telecons

- Communicate, leverage

NEPAG

NASA Activities for FY18 (Detailed Slides Follow)

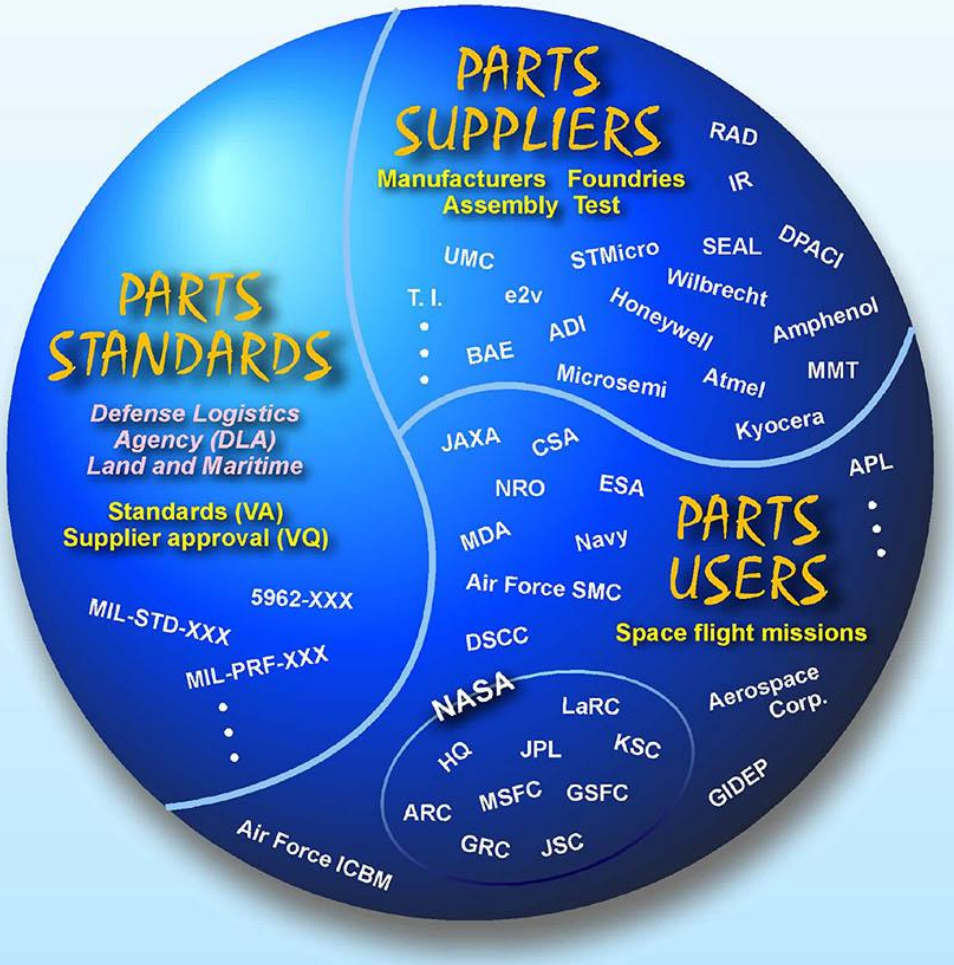
Activity	Q1	Q2	Q3	Q4	Total
DLA Audits Supported	11	7	12	12	42
NASA ESD Surveys	3	2	3	2	10
Standard Microcircuit Drawings (SMDs) & Slash Sheets	2	5	5	4	16
Domestic Telecons (Avg Attendance)	9 (31)	10 (32)	6 (32)	9 (32)	34 (32)
Intl Telecons (Avg Attendance)	3 (34)	3 (29)	3 (29)	2(26)	11 (29)
EEE Parts Bulletin	1	0	1	0	2
Learn@Lunch Webinars	4	4	7	3	18
GWG (Laird), Hybrids (Majewicz)	*	*	*	*	*
Workshops/Conferences (Agarwal)	2	1	4	1	8

* = Refer to their presentations.

NEPAG

Space Parts World

NEPAG helps to Develop/Maintain Standards for Electronic Parts



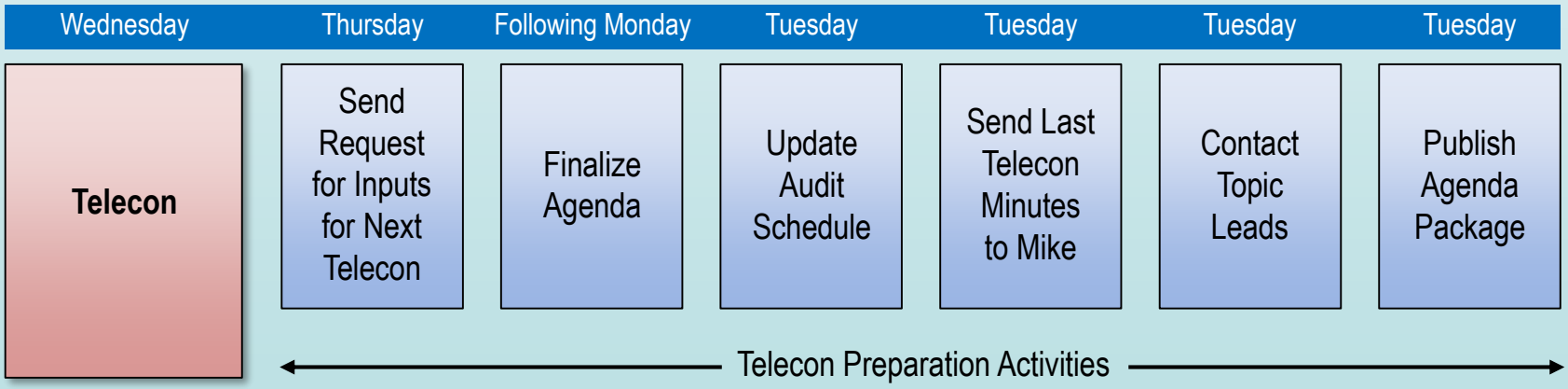
The parts users and standards organizations work with suppliers to ensure availability of standard parts for NASA, DoD, and others. **For Space microcircuits, DLA, NASA/JPL (S. Agarwal*) and the U.S. Air Force / Aerospace Corp. (L. Harzstark) form the Qualifying Activity (QA).**

*Also Systems, Standards and Technology Council (SSTC) G-12 Vice-Chair; Chair, Space Subcommittee.

Telecons

- **NEPAG Telecons**
  - The weekly telecon cycle is shown below
  - Sensitive, Government and direct support only
  - 30-35 participants per week
  - Typical Telecon Agenda Package contains
    - ❖ List of items for discussion
    - ❖ DLA audit schedule, SMD review status, Learn@Lunch Webinars, technical meetings, list of items for discussion at next JEDEC/CE-11, CE-12.
  - We are up-to-date on compressed minutes
  - ***Return on Investment for NASA flight projects***
    - ❖ ***Coordination of parts issues with DLA and the space community***

Weekly Telecon Cycle

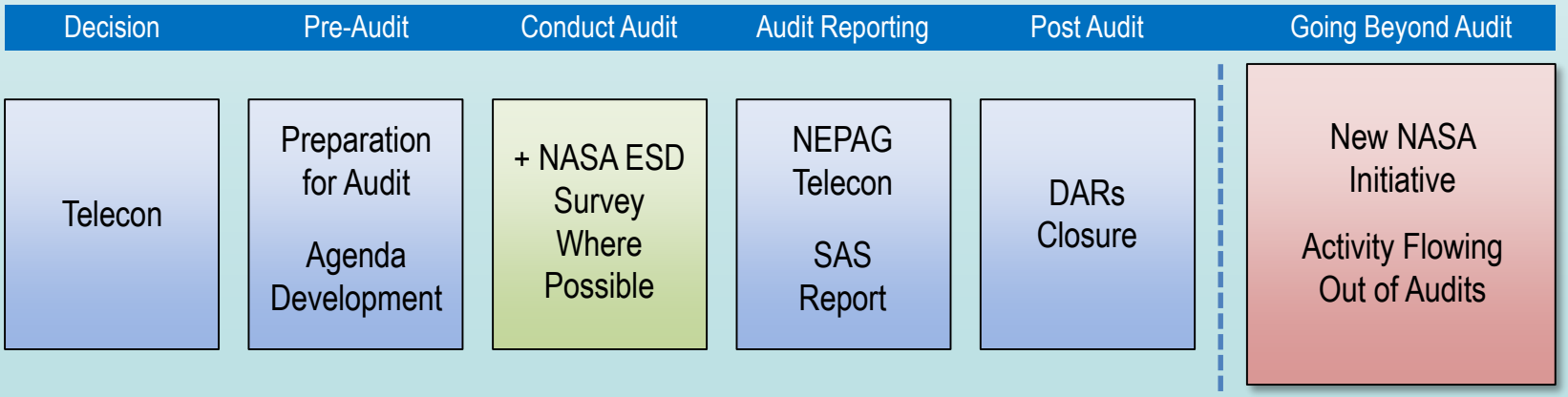


NEPAG

DLA Audits

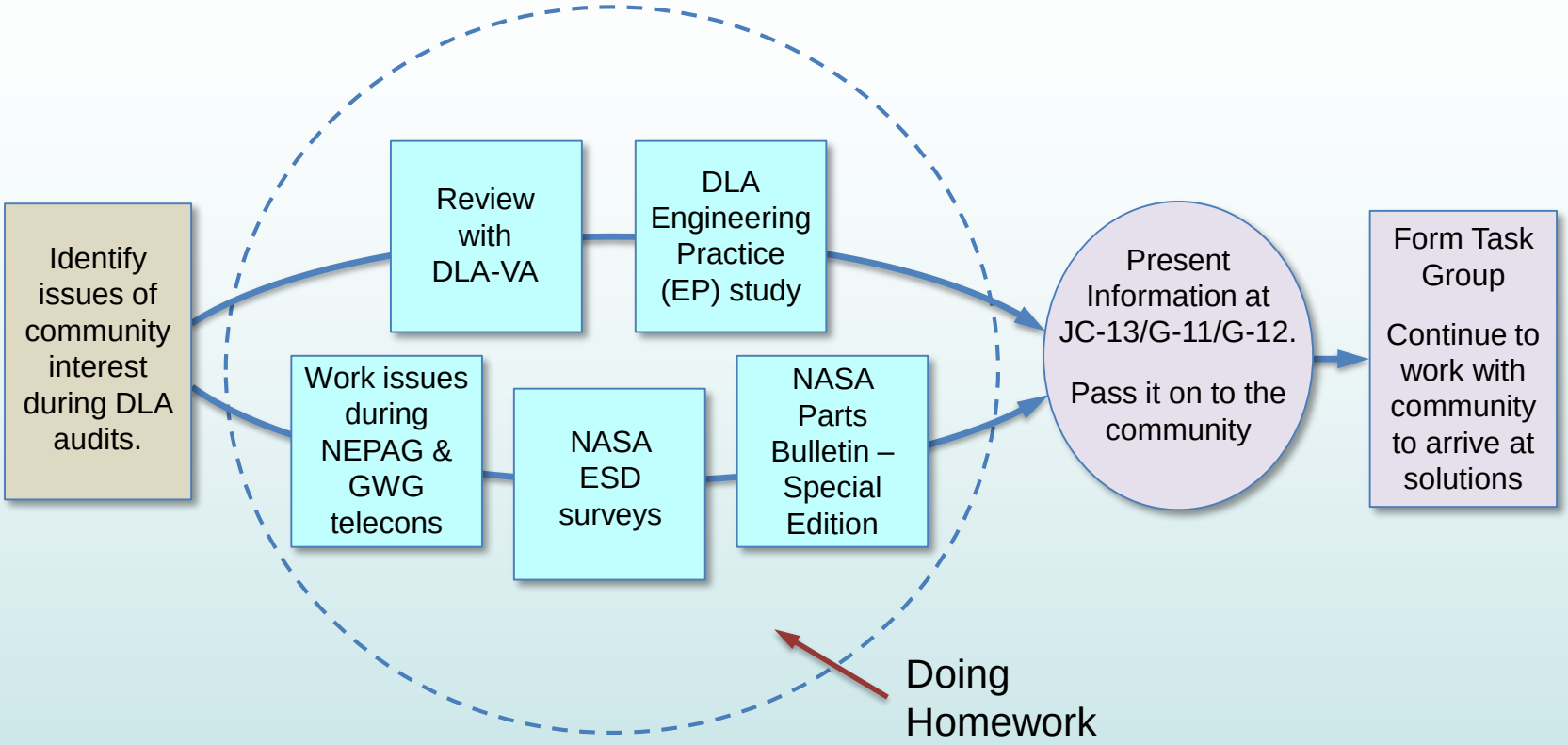
- **DLA Audits**
  - NASA supported 42 audits:
    - GSFC, JPL, LaRC, MSFC
  - Reported on NEPAG telecons. SAS (Supplier Assessment System) report sent to GSFC for posting on database maintained at JRC.
  - A major issue: TSMC asked DLA to sign an NDA before they would allow audit.
  - ***Return on investment for NASA flight projects***
    - ***Ensure that NASA inputs are incorporated into the flight part manufacturers' processes***
    - ***Review and resolve any parts issues with the manufacturers while on audit***
    - ***Develop contacts for future needs (e.g., finding critical parts)***

Audit Process



NEPAG

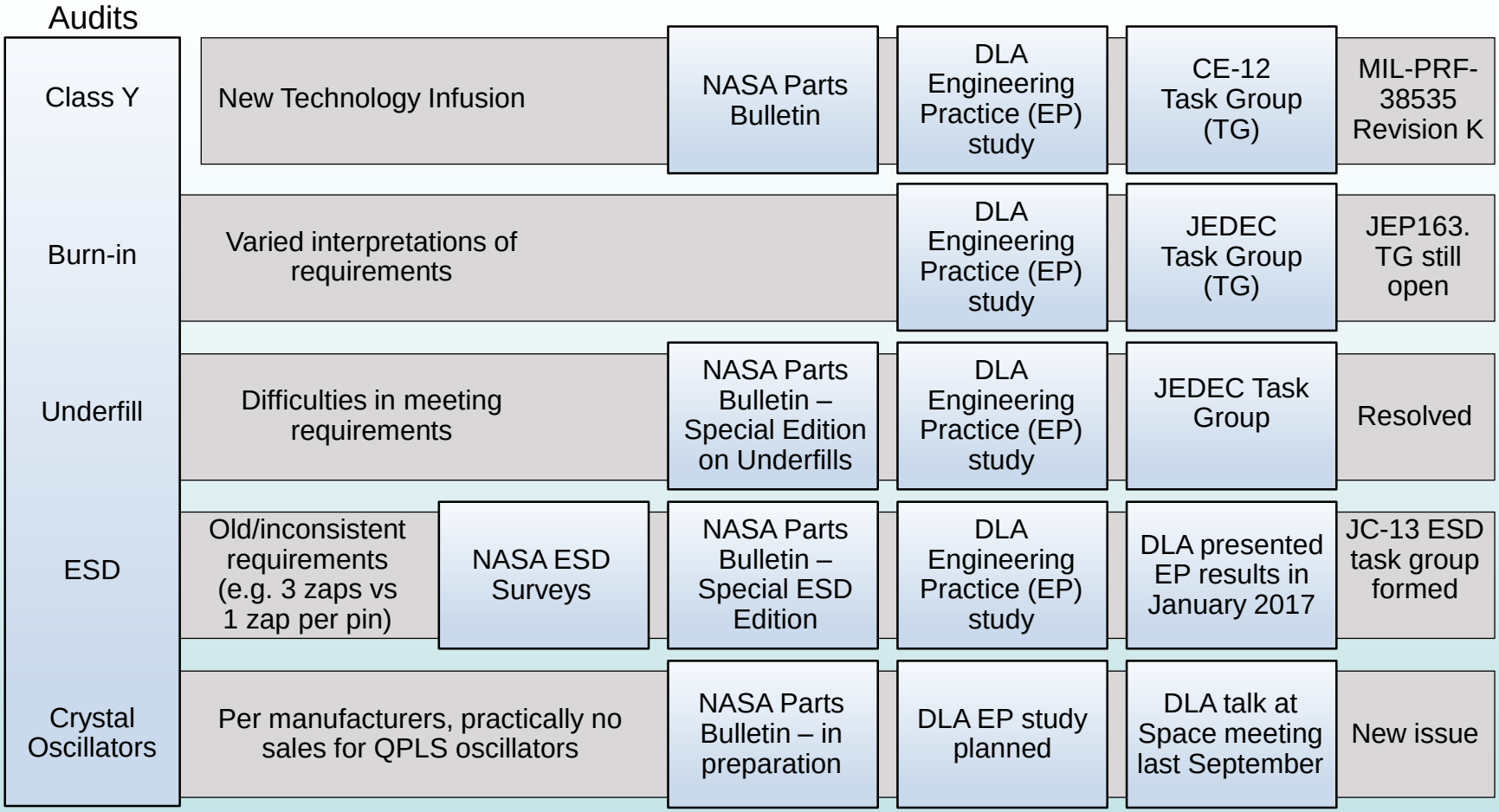
Taking Audit Findings a Step Further!



- Bring general awareness (Via NASA Bulletins, Surveys)
- Work with DLA to conduct engineering practice (EP) study
- Generate a basic proposal and related information so the potential task group (TG) has a strong starting point.
- This path has **saved time** in resolving major issues found during audits.

NEPAG

Taking Audit Findings a Step Further!
Issues from Microcircuit / Other Audits and Methods of Resolution



Process Flow:

*DLA Audits: Major issues uncovered during DLA audits

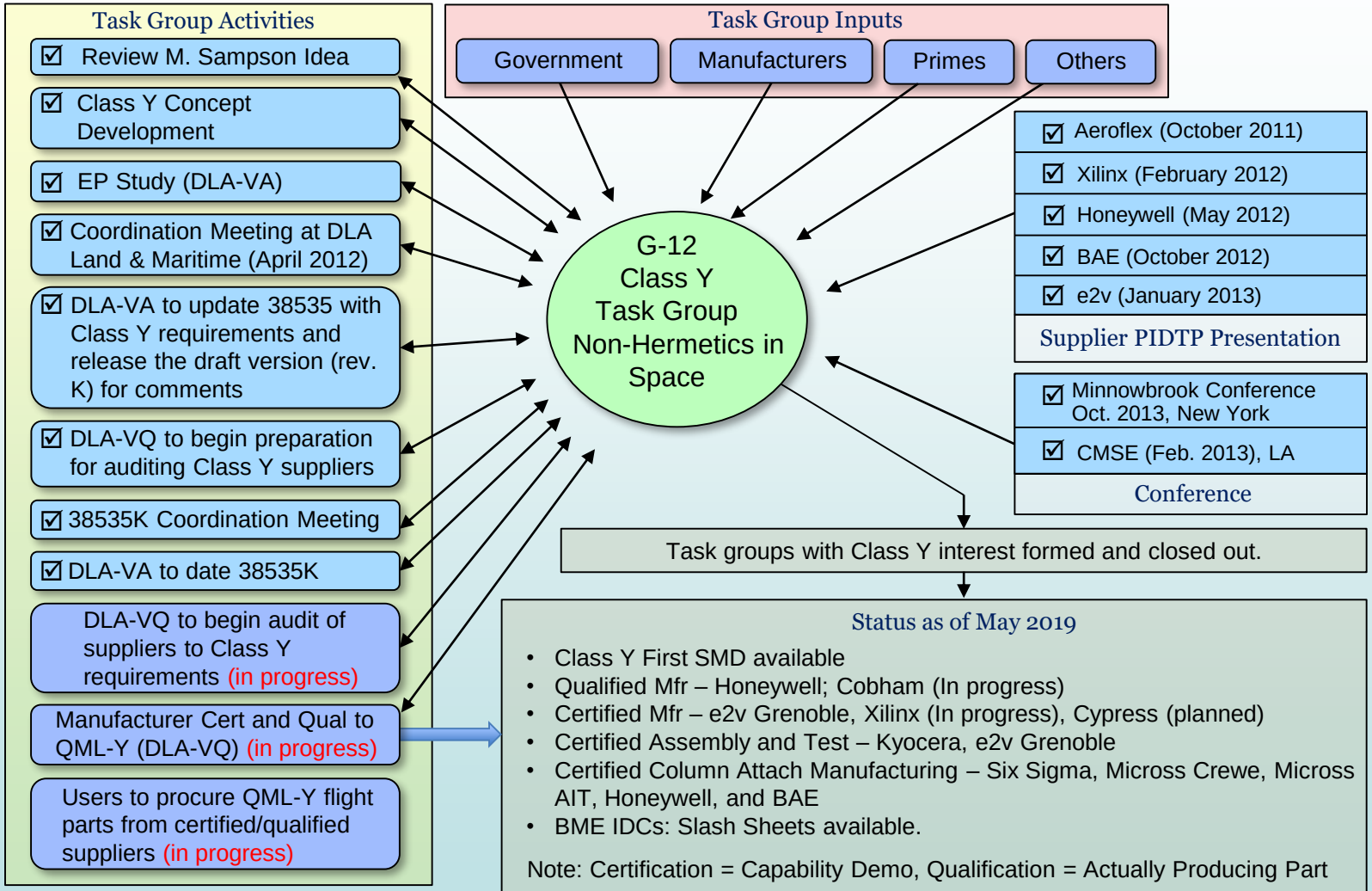
*NASA Parts Bulletin – Special Edition: Gives subject matter background. Provides results of NASA evaluations, ESD surveys, etc.

*DLA EP Study: A large survey of manufacturers, users, others.

*JEDEC/CE-11/CE-12 Meetings: Where discussions are held.

NEPAG

Infusion of the New Class (Y) Technology into the QML System for Space (Status given at JEDEC in May2019)



BGA / CGA = Ball-Grid Array / Column-Grid Array
BME = Base Metal Electrode
IDC = Inter Digitized Capacitor

PIDTP = Package Integrity Demonstration Test Plan
SMD = Standard Microcircuit Drawing

NEPAG

Electronic Parts and Electrostatic Discharge (ESD) – Gaps and Mitigation Strategies

- Gaps have evolved because of new technology and inconsistencies of standards development (e.g., three zaps vs. one zap per pin for testing). Parts have continued shrinking to smaller sizes & growing in complexity. Consequently, they are more susceptible to ESD and require more testing effort.
- Costs cannot be ignored—per unit price for advanced devices is approaching **$200K**. ESD mitigation costs are minute compared to the device unit costs.
- Mitigation strategies include (hands on) NASA ESD surveys, observations during audits, standards updates (including harmonization of standards), & outreach to the military & space communities.
- ***There is always a latency risk from ESD.***

NEPAG

Why Electronic Parts and ESD Need a Fresher Look-- Gaps

- NASA has been supporting Defense Logistics Agency (DLA) audits of the supply chain.
- During the audits, it was observed that the MIL-PRF-38535 requirements were practically nonexistent regarding ESD aspects of electronic parts.
- Current qualification standards were developed years ago with pin counts in the twenties (now approaching 2000).
- Applying these old device testing standards to modern high-pin count products can cause severe problems (e.g., testing times increase dramatically).
- Furthermore, microcircuit part production is no longer under one roof, but landscape of supply chain is multiple specialty houses (see next slide).

Need to update standards

NASA ESD Mitigation Going Forward

- **Mitigate Existing and Possible Future ESD Issues by Supporting Efforts in Six Categories:**
  1. NASA ESD surveys
     - ❖ We would like to see the requirements documented in M38535 so DLA can take over oversight responsibility at least for QML suppliers.
     - ❖ Responsibility for mitigating the risks from non QML, COTS sources will require a different approach and we know in a significant number of cases, we will not be permitted access to monitor such facilities. This is a significant gap!
  2. Independent evaluations of new technologies (e.g., high speed and high power microcircuits, GaN devices, SiC devices). Characterization of ESD thresholds per Human Body Model (HBM) and Charged Device Model (CDM) for new devices
  3. Independent evaluations of 883 vs. JEDEC test method equivalencies for HBM
  4. Low-ESD-threshold parts mitigation, e.g., GaN, very high speed ICs (GHz range) -- conduct limited tests to make recommendations
  5. Interfacing with industry groups (e.g., JC13, JC14, ESDA, EC-11, EC-12)
  6. Harmonizing ESDA 20.20, JEDEC 625, and other ESD standards

ESD and Other Tasks

- **Electronic Parts and ESD**
  - NASA Specific
    - Where possible, survey team should include a parts specialist, and an ESD expert. Paper audits are fine, but hands-on testing is where we have found problems.
    - Establish NASA survey teams on both coasts
    - Establish ESD test capabilities at GSFC, JPL and others
    - More involvement in ESDA. Lots of excellent work goes on there. The major manufacturers from around the world are involved with little participation by the user community.
    - ESD surveys/audits of COTS hardware/parts suppliers should be mandatory.
    - Outreach: Publish a guideline document, continue reporting updates at SPWG
- **Automotive Microcircuits Evaluation (Agarwal)**
  - Contract issues. Exploring alternate test facility.
- **Crystal Oscillators (Martinez)**
  - NASA/JPL worked with DLA to revise the 55310 specification for crystal oscillators. The details were discussed on NEPAG and GWG telecons. Continuing task.
- **A/D and D/A BoK (N. Ovee)**
  - Scheduling Webinars with data converter manufacturers
- **Connectors BoK (Billig)**
  - New start for FY19. Audits, bulletins planned.

FY18 YTD Listing of NASA Supported DLA Audits (42), and NASA ESD Surveys (10); Concurrently Done: 2 (1 of 3)

← Audit →						← NASA ESD Survey →			
DLA Audit Date Week of	NASA Auditors	Center	Audit SAS	Company	Location	NASA ESD Survey Participants	Survey Date	ESD SAS	Notes
				MSK, Anaren	Syracuse, NY	Monroe (LaRC)	Done 10-11-17		Multi-center usage
				Kyocera	San Diego, CA	Nelson, Agarwal, Do	Done 10-23-17	Done	Q, V, Y assembly for major mfrs
				DDC	San Diego, CA	Nelson, Agarwal	Done 10-24-17	Done	Q, V, Moved
Nov 13, '17	Haggquist	GSFC	REC	Amphenol	Sydney, NY				
Nov 13, '17	Damron	MSFC		Scientific Coating	Santa Clara				
Nov 13, '17	Damron	MSFC		UHV Splittering	Santa Clara				
Nov 27, '17	Agarwal	JPL	Yes	Microsemi	San Jose, CA	Nelson	Done 5-15-18	Done	Q, V, RTG4
Nov 27, '17	Majewicz	LaRC	REC	Cobham	Plainview, NY				
Dec 4, '17	Rosal	GSFC		Positronic	Mt Vernon, MO				
Dec 4, '17	Agarwal	JPL	Yes	AIMS	Pune, India				
Dec 4, '17	Agarwal	JPL	Yes	AII	Pune, India				
Dec 11, '17	Agarwal	JPL	Yes	Positronic	Pune, India				
Dec 11, '17	Damron	MSFC		SST Corp	Billerica, MA				
Jan 22, '18	Gutierrez	JPL		Amp Fiber	Allen, TX				
Jan 29, '18	Agarwal	JPL	REC	Cobham	CO Springs, CO	Nelson, Agarwal	Done 2-1-18	Done	Q, V, in Y Qual. (Coord w/DLA audit)
Jan 29, '18	Majewicz	LaRC		Henkel	Rancho Dominguez, CA				
Feb 12, '18	Agarwal	JPL	REC	Micross	Orlando, FL	Nelson	Done 5-1-18	Done	Q, V, FRAM for Cypress
				Micross	Raleigh, NC	Nelson, Do	Done 5-3-18	Done	Wafer Bump., IBM-like Col attach
Mar 5, '18	Majewicz	LaRC		IR	San Jose, CA				
Mar 5, '18	Gutierrez	JPL		Cirexx	San Jose, CA				
Mar 12, '18	Agarwal	JPL	REC	Teledyne-e2V	Grenoble, FR	Do, Agarwal	Done 3-15-18	Done	Q, V, initial Y. (Coord w/DLA audit)
Mar 15, '18	Agarwal, Martinez	JPL		Q-Tech	Culver City, CA	Do, Nelson	7-24-18		QPLS
				Isovac	Glendale, CA	JPL/MSFC	TBD		Kr tester had plastic tubes

NEPAG

FY18 YTD Listing of NASA Supported DLA Audits (42), and NASA ESD Surveys (10); Concurrently Done: 2 (2 of 3)

← Audit →						← NASA ESD Survey →			
DLA Audit Date Week of	NASA Auditors	Center	Audit SAS	Company	Location	NASA ESD Survey Participants	Survey Date	ESD SAS	Notes
Mar 19, '18	Laird, Schuler	MSFC, Navy Crane		Oneida Research Services	Englewood, CO				
Apr 16, '18	Damron	MSFC		Solitron Devices, Inc.	West Palm Beach, FL				
Apr 22, '18	Schuler	Navy Crane		IRC Incorporated	Corpus Christi, TX				
Apr 22, '18	Schuler	Navy Crane		Ohmite	Brownsville, TX				
Apr 25, '18	Agarwal	JPL		TI DMOS 5	Dallas, TX				S. Agarwal telephoned in partial*
Apr 30, '18	Damron, Schuler	MSFC, Navy Crane		Microsemi Lawrence	Lawrence, MA				
May 9, '18	Gutierrez	JPL		Pacific Testing Lab	Valencia, CA				
May 14, '18	Agarwal, Martinez	JPL		Q-Tech Corporation	Culver City, CA	Nelson, Do	Done July 24, '18	Done	Crystal oscillators
May 14, '18	Majewicz	LaRC		Teledyne Microelectronic Technologies	Lewisburg, TN				
Jun 11, '18	Majewicz	LaRC		Crane Electronics	Redmond, WA				
Jun 22, '18	Damron	MSF		Lite-On Semiconductor	Keelung, Taiwan				
Jun 25, '18	Haggquist, Kim	GSFC, JPL		Coil Craft Inc.	Hawarden, IA				
Jun 27, '18	Damron	MSFC		PYNMAX	Kaohsiung, Taiwan				
Jul 9, '18	Teverovsky	GSFC		Vishay Tansitor	Bennington, VT				
Jul 13, '18	Agarwal	JPL		Analog Devices GT	Manila, Phiilippines				
Jul 16, '18	Damron	MSFC		Int. Rectifier	Tijuana, Mexico				

NEPAG

FY18 YTD Listing of NASA Supported DLA Audits (42), and NASA ESD Surveys (10); Concurrently Done: 2 (3 of 3)

← Audit →						← NASA ESD Survey →			
DLA Audit Date Week of	NASA Auditors	Center	Audit SAS	Company	Location	NASA ESD Survey Participants	Survey Date	ESD SAS	Notes
Jul 18, '18	Agarwal	JPL		Team Quest	Dasmarinas, Cavite, Philippines				
Jul 19, '18	Agarwal	JPL		ON Semiconductor	Carmona Cavite, Philippines				
Jul 23, '18	Majewicz	LaRC		Microsemi	Lawrence, MA				
				Q-Tech	Cypress, CA	Nelson, Do	Done Jul 24, '18	Done	Crystal oscillators; new facility to add to Culver City, CA
Aug 12, '18	Damron	MSFC		Microsemi	Ennis, Ireland				
Aug 27, '18	Schuler	Crane		Leach Intl	Buena Park, CA				
Aug 27, '18	Agarwal	JPL		Micross AIT	Research Triangle Park, NC				
Sep 10, '18	Agarwal	JPL		Teledyne Microwave Solutions	Mountain View, CA				
Sep 10, '18	Damron	MSFC		MACOM	Lowell, MA				
Sep 17, '18	Agarwal	JPL		DPA Components	Simi Valley, CA				

NEPAG

SMD Reviews by NASA (FY18) (1 of 2)

SMD No.	Function	Mfg	Q1	Q2	Q3	
5962-03218	DC/DC converter (rad)	IR		Q2		
5962-06262	Hi-speed A/D converter (rad)	TI (NSC)			Q3	
5962-1225	Reprogrammable FPGA (rad)	Atmel/Microchip				Q4
5962-15236	Op-amp (rad)	ADI	Q1			
5962-16208	FPGA RTG4 (rad tolerant)	Microsemi			Q3	
5962-16212	DC/DC converter (rad)	VPT			Q3	
5962-17214	Differential amplifier (nonrad)	TI (NSC)		Q2		
5962-1715	DC/DC converter (rad)	VPT		Q2		
5962-7201	DC-DC converter (non-rad)	VPT				Q4
5962-17217	DC/DC converter (rad)	VPT	Q1			
5962-17218	Temperature sensor (non-rad)	TI (NSC)		Q2		
			2	**4**	**3**	**2**

NEPAG

SMD/Slash Sheet Reviews by NASA (FY18) (2 of 2)

SMD No.	Function	Mfg	Q1	Q2	Q3	Q4	
5962-17232	DC/DC converter (rad)	VPT			Q3		
5962-18202	Quad hi-speed NAND Gate (rad)	ST Microelectronics			Q3		
5962-18204	A/D Converter (rad)	ST Microelectronics				Q4	
5962-18206	DC/DC converter (nonrad)	IR		Q2			
MIL-PRF-55310/41	Oscillator, crystal controlled (nonrad)	QPL				Q4	
	Totals from previous page		2	4	3	2	
	Totals from this page			1	2	2	
	Grand Totals		**2**	**5**	**5**	**4**	**16**

S. Agarwal Workshops/Conferences Supported FY18

Date	Workshop/Conferences	Attend / Present	Q1	Q2	Q3	Q4	
10/18/2017	JAXA MEWS	Present	Q1				
10/28/2018	International Test Conference	Attend	Q1				
1/20/2018	JEDEC (Reno, NV)	Present		Q2			
4/10/2018	Space Parts Working Group	Present			Q3		
5/7/2018	CMSE	Attend			Q3		
5/21/2018	JEDEC	Present			Q3		
6/18/2018	NEPP ETW	Present			Q3		
9/24/2018	JEDEC (Columbus, OH)	Present				Q4	
	Totals		**2**	**1**	**4**	**1**	**8**

NEPAG

NASA Learn@Lunch Webinars
Improved Communication with the Supply Chain

- Suppliers are asked to present descriptions of the new EEE parts products and products under development.
  (Suppliers are asked to minimize marketing pitches.)

- Representatives from Standards organizations (e.g., DLA and ESA) have also presented on status/trends of EEE parts specifications.

- On-site and remote participants query the presenters about these issues.

- These L@Ls also are being used to develop reference documents such as the BoK for A/D and D/A converters.

Learn@Lunch NASA (FY18) (JPL unless otherwise marked, 1 of 2)

Date	Supplier/Organization	Q1	Q2	Q3	Q4	Total
10/4/2017	Criteria Labs	Q1				
10/26/2017	Kyocera	Q1				
11/1/2018	Texas Instruments	Q1				
11/8/2017	Gowanda	Q1				
1/18/2018	Microsemi (at MSFC)		Q2			
2/27/2018	Sumitomo		Q2			
2/27/2017	S&S Technology		Q2			
3/7/2018	Aeroflex (Cobham) CO		Q2			
4/4/18	Data Device Corp.			Q3		
4/12/18	Amphenol			Q3		
4/12/18	European Space Agency			Q3		
4/12/18	Defense Logistics Agency			Q3		
5/2/2018	Crane Aerospace & Electron.			Q3		
5/15/2018	Microchip Tech. Inc. (GSFC)			Q3		
6/6/2018	Solid State Devices, Inc.			Q3		

NEPAG

Learn@Lunch NASA FY18 (JPL unless otherwise marked)

Date	Supplier/Organization	Q1	Q2	Q3	Q4	Total
7/25/2018	Analog Devices				Q4	
8/8/2018	Texas Instruments				Q4	
8/22/2018	ADI				Q4	
FY2019						
10/3/2018	Kemet					
10/24/2018	Vishay					
		4	**4**	**7**	**3**	**18**

NEPAG

FY18 Papers & Presentations by S. Agarwal

Clearance No.	Title	Pub. Type	Venue
CL#18-3109	NASA/NEPAG Experience with DLA Audits-Panel Discussion	Viewgraph Presentation	ETW, June 21, 2018
CL#18-3080	Electronic Parts and ESD- Gaps and Mitigation Strategies	Mtg Paper	ETW, June 21, 2018
CL#18-1300	New Developments in Managing ESD for Electronic Components	Viewgraph Presentation	Space Parts Working Group SPWG, April 20, 2018
CL#17-4987	NASA's View on Space Electronics for the Next Decade (with M. Sampson)	Viewgraph Presentation	MEWS, Oct. 18 – 19, 2017

NEPAG

Partnering

JEDEC JC-13 (Manufacturers)

JC-13	Solid State Devices for Government Products
JC-13.1	Discrete Semiconductors for Government Products
JC-13.2	Microelectronics for Government Products
JC-13.4	Radiation Hardness
JC-13.5	Hybrids and Multi-chip Modules for Government Products
JC-13.7	New Electronic Device Insertion for Government Products

Joint meetings held
3 times a year

SAE CE-11/CE-12 (Industry Users, Primes, Subs)

SAE SSTC CE-11	Users of Passive Components
SAE SSTC CE-12	Users of Solid State Devices
	CE-12 Management:
	Chair – A. Touw
	Vice Chair – (JPL) S. Agarwal
SAE SSTC CE-11 & CE-12	Space Subcommittee Chair – S. Agarwal

NASA Centers:

ARC	JSC
GRC	KSC
GSFC	LaRC
JPL	MSFC

Weekly Telecons
(Domestic)

Monthly Telecons
(International)

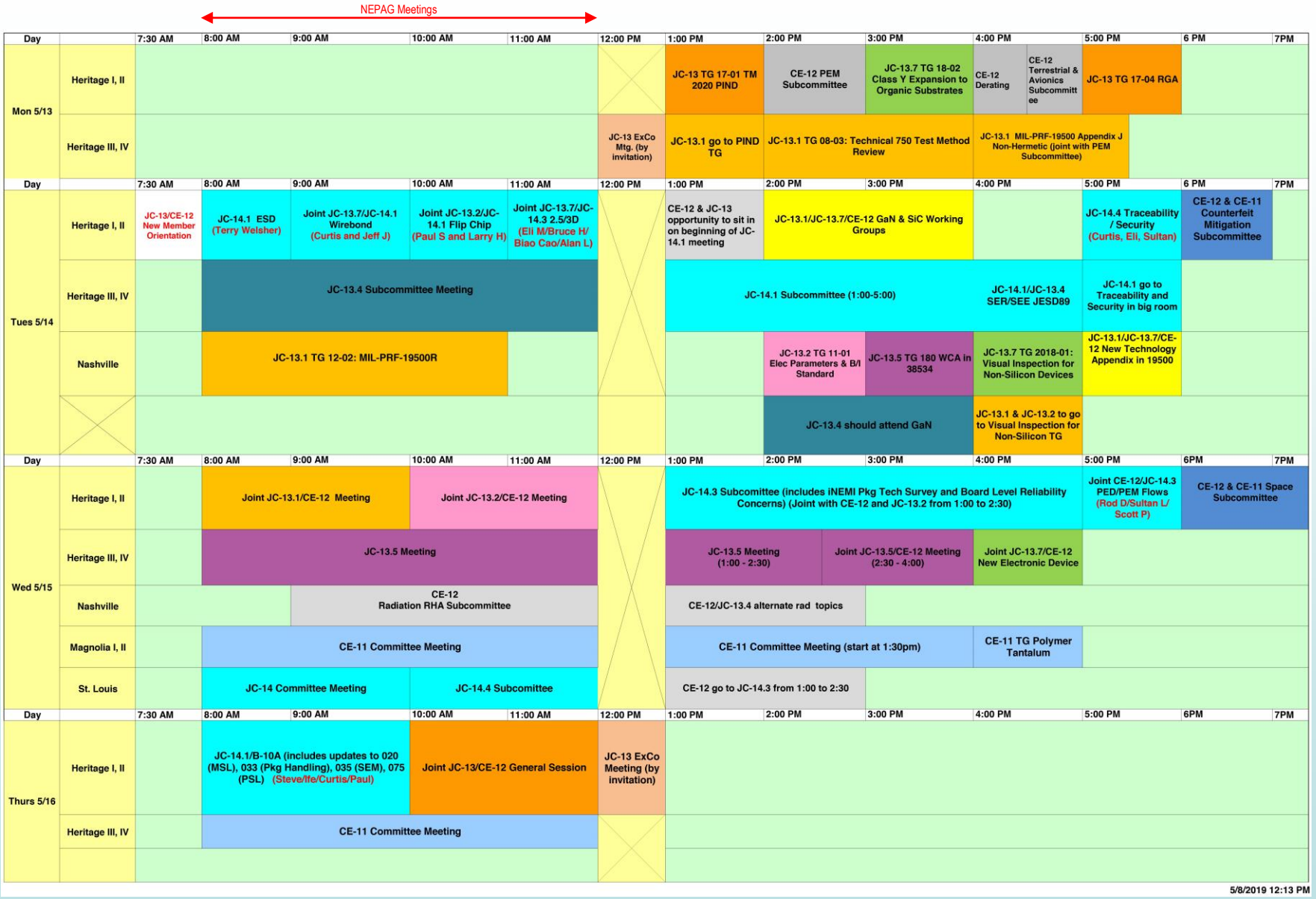
Partners from Outside NASA:

Domestic
- JHU/APL, Others
- The Aerospace Corp,
- U.S. Air Force, U.S. Navy,
- U.S. Army, DLA,

International
- ESA, JAXA, CSA

NEPAG

JEDEC/CE-11/CE-12 Grid – May 2019



NEPAG

JEDEC, Outreach Activities

- **Support to JEDEC/CE-11/CE-12**
  - May meeting in Memphis
    - ❖ It was a joint meeting with JC-14
    - ❖ Contract with hotel to hold NEPAG@JEDEC on Monday
    - ❖ Agenda for Space subcommittee meeting
      - ➢ Added a new series of Reports on Short Items
    - ❖ Present status update on Class Y
    - ❖ Support the Executive Council meetings
    - ❖ Take CE-12 meeting notes
    - ❖ Participate in task group meetings, e.g., burn-in, organic Class Y, ESD, etc.
    - ❖ Sponsor other participants

- **NASA Outreach – Electronic Parts Bulletins**
  - The parts bulletins address the current parts issues. They are distributed throughout the world.
  - Published two NASA Parts Bulletins in FY18.
  - Completed one so far in FY19, others in progress.

NASA Parts Bulletin

- ***NASA EEE Parts Bulletin (June 2018 – September 2018)***

National Aeronautics and Space Administration

EEE Parts Bulletin

Electrical, Electronic, and Electromechanical

A periodic newsletter of the NASA Electronic Parts Program / NASA EEE Parts Assurance Group and the Jet Propulsion Laboratory

June 2018 – Sept. 2018 • Volume 10, Issue 2 (Published since 2009), April 30, 2019

Compendium Special Edition on Electrostatic Discharge (ESD)

Damage from ESD is a major cost to the microcircuit industry in terms of time, money, and mission risk. The *EEE Parts Bulletin* has released three special issues on ESD, and this issue is a compendium of these three issues plus an overall view of the subject matter. The first issue dealt with the need to upgrade specifications related to ESD and suggestions for better ESD practices wherever parts are manufactured, stored, or prepared for shipment. The second ESD special issue focused on a parts failure investigation that ultimately concluded that ESD was the most likely cause of the failure. The second issue also included an important reminder about regular ESD testing. The third issue provided an example demonstrating the importance of maintaining ESD discipline and a high-level risk analysis related to electrostatic discharge. This compendium issue begins with an overview of the subject of electronic parts and ESD. Figure 1 provides a reminder that the familiar static sparking from rugs or rubber combs can generate ESD effects. ESD damage can easily go undetected.

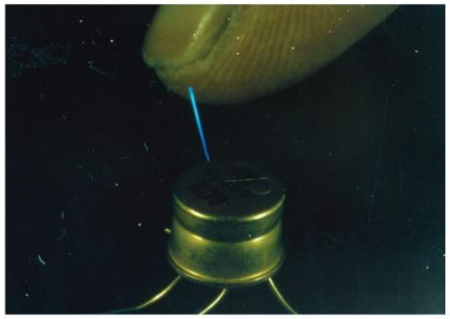


Figure 1. Electrostatic discharge is everywhere (image courtesy of Hi-Rel Laboratories).

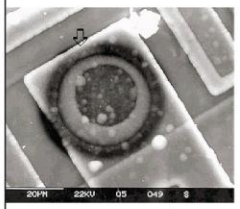
Gaps and Mitigation Strategies for ESD

Progressively smaller and more complex microelectronic parts have grown steadily more susceptible to ESD. Consequently, they require more testing effort.

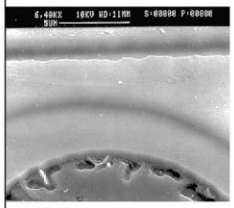
Furthermore, ESD damage can easily be too small for detection by many typical methods. As Figure 2 shows, serious ESD damage can be invisible to optical viewing and even to 6400 X by scanning electron microscope (SEM). In this instance, only a 33,000 X SEM view made the damage visible.

1

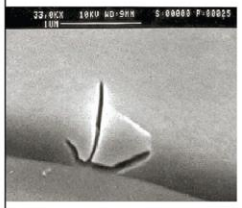
Damage Is Not Optically Visible



Not Visible at 6400 x In SEM



Damage Visible at 33,000 x In SEM



ESD damage to most semiconductors is often so subtle that it cannot be seen without very high magnification (image courtesy of Hi-Rel Laboratories).

Such ESD damage affects all types of commodities for both military and commercial parts, and the less-controlled commercial-off-the-shelf (COTS) parts may be affected more severely than the military.

The parts community must promote an ESD-safe environment. Such efforts must extend from parts fabrication, through shipping, and all the way through installation of parts in the final products.

NASA has supported this effort first by bringing ESD concerns to the attention of the parts community. Mitigation strategies have been developed in response to this rising threat. Mitigation strategies include NASA ESD surveys, observations during audits, standards updates (including harmonization of standards), and outreach to the military and space communities.

NASA has been supporting Defense Logistics Agency (DLA) audits of the supply chain for many years. During the audits in recent years, the auditors observed that the MIL-PRF-38535 requirements were practically non-existent regarding ESD aspects of electronic parts.

Hence, integrating ESD requirements into MIL- PRF- 38535 has become a key goal for the electronic parts community. The current qualification standards for MIL-PRF-38535 and related standards were developed years ago with pin counts in the twenties. Now, pin counts are in the hundreds or more. For instance, Virtex field-programmable gate arrays (FPGAs) have 1752 columns, and manufacturers are striving for even higher counts.

Applying the old device testing standards to modern high-pin count products can cause severe problems. Testing times and costs can increase dramatically. However, costs also drive the need for adequate quality assurance. Per-unit prices for advanced devices are approaching $200K, and the costs would multiply for failures discovered after a part was mounted or (worse) was in the field… or worst of all, in space.

Another issue is that multiple organizations have developed ESD mitigation standards/specifications. Gaps have evolved not just because of new technology, but also because of inconsistencies of standards development.

For the military and space community, the most glaring issues are as follows:

MIL-STD-883, Test Method 3015 Issues:

- Too old
- Does not include the charge device model (CDM), only the human body model (HBM)
- The test method needs to be revisited for smaller feature sizes down to 30 nm.
- The test method needs to be revisited for large numbers of contacts/pins, and vastly increased

2

- Continuing to conduct NASA ESD surveys.
- Interfacing with industry standards groups (e.g., JC-13, JC-14, ESDA, EC-11, EC-12).
- Working especially with the JC-13 newly-formed task group to address ESD issues. [JC-13 defined in the bullet above—just added standards.]
- Harmonizing ESDA 20.20, JEDEC 625, and other ESD standards.

Final ESD Reminders

- ESD is a serious and growing risk for electronic parts use.
- Updated standards are coming, and they will help mitigate ESD risks.
- However, the most important point to remember is that mitigation of ESD risk requires continuous vigilance in identification of risks and discipline in maintaining safeguards.

References

ANSI/ESDA/JEDEC JS-001-2014, ESDA/JEDEC Joint Standard for Electrostatic Discharge Sensitivity Testing–Human Body Model (HBM)–Component Level.

ANSI/ESD S20.20-2014, Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices), Electrostatic Discharge Association, 2014.

JESD 625, Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices. JEDEC Solid State Technology Association, 2012.

MIL-STD-883K, *Test Method Standard*, *Microcircuits*, Defense Logistics Agency, Columbus Ohio, April 25, 2016.

MIL-PRF-38535K, *Integrated Circuits (Microcircuits) Manufacturing, General Specification for*, Defense Logistics Agency, Columbus Ohio, Dec. 20, 2013. (Revision L is in review).

For more information, contact

Shri Agarwal 818-354-5598

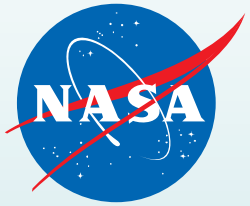
3

NEPAG

Standards Activities FY19

- **Few Standards Activities So Far**
  - Fruitful NASA/ESA meeting in Noordwijk (Pellish/Agarwal)
    - Parts compatibility – starting with microcircuits
  - INST-002 Update (Majewicz)
    - Will be a leaner document
  - DLA EP Study on non-hermetic microcircuits (DLA)
    - To address Cubesats/smallsats, new technology
    - Redefine Class N, add a new technology appendix (Appendix K) to cover Class Y and extend coverage to 2.5D/3D packaging
    - Review by Organic Class Y Task Group
  - Release of updated microcircuits specification, MIL-PRF-38535, Rev L (DLA)
    - Clarified/added ESD requirements including requirements to test per CDM (Charged Device Model)
  - Release of revised specification for crystal oscillators, MIL-PRF-55310 (DLA)
    - No one was procuring standard parts, they were buying catalog parts instead
    - Aligned specification with catalog parts
    - Was reviewed by GWG
  - And others…

http://nepp.nasa.gov



ACKNOWLEDGMENTS
The research described in this publication was carried out, in part, at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. Help is gratefully acknowledged from Melissa Klose, Nazia Ovee, Mohammad Mojjaradi, Joon Park, and Michael Sampson.
Government sponsorship acknowledged.

NEPAG