SAND2016-9216PE

Energy Storage Safety Plan Summary of Accomplishments

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Sandia National Laboratories and Pacific Northwest National Laboratory

September 20, 2016 Webinar

PNNL-SA######/SAND#######

Overview

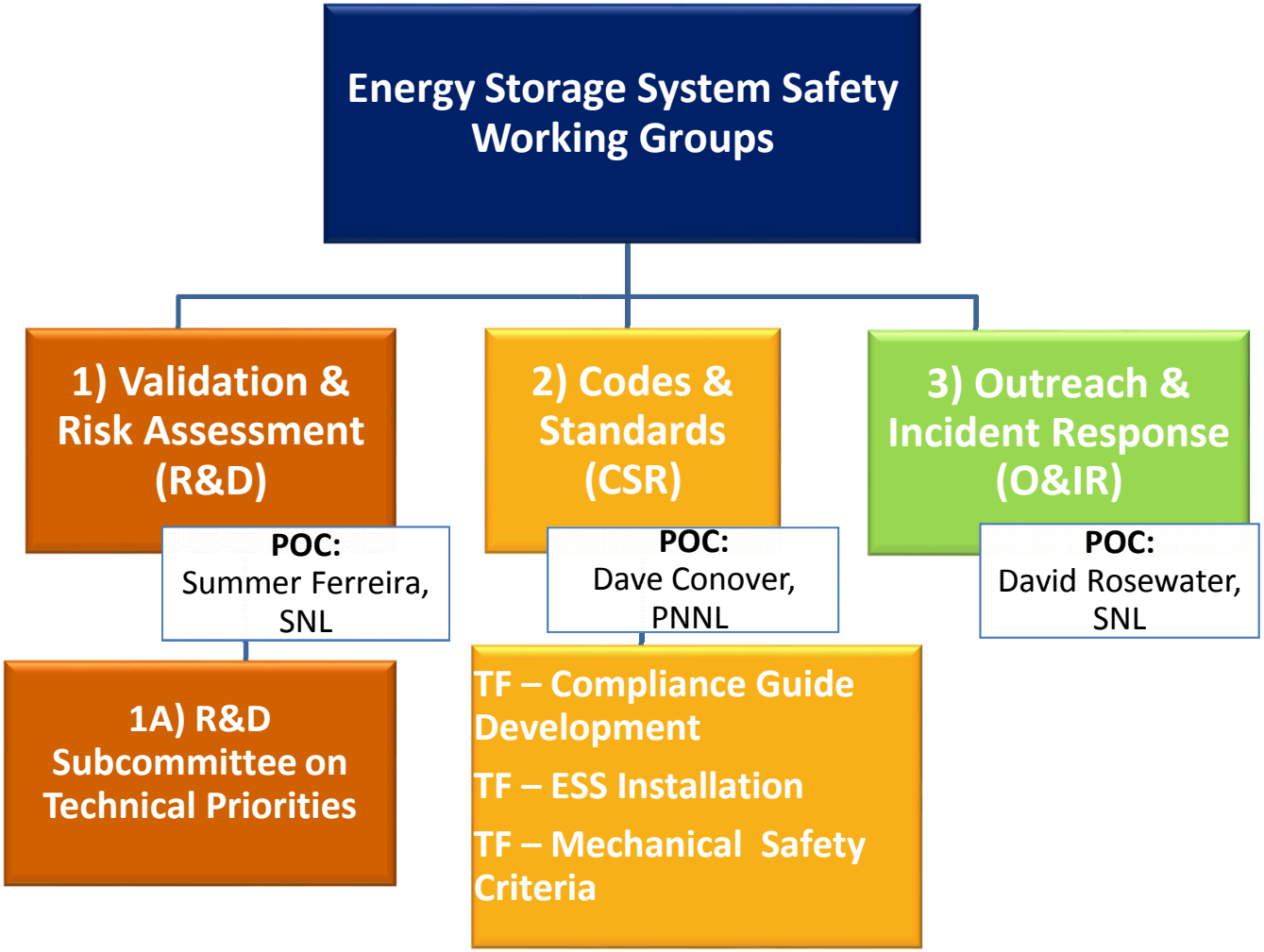
Purpose – to provide an overview of the status and accomplishments associated with the DOE ESS Safety Working Group activities that can serve as a foundation for future work to meet the stated goal

"Facilitating the timely development and deployment of safe ESS by implementing the DOE ESS Safety Plan through collaboration of all interested parties and key stakeholders"

Expected Outcomes

- Recognize key collaborative relationships
- Understand needs and what has been done to address those needs
- Identify and address ongoing challenges to meeting the above goal and how to best organize the collaboration needed to be successful

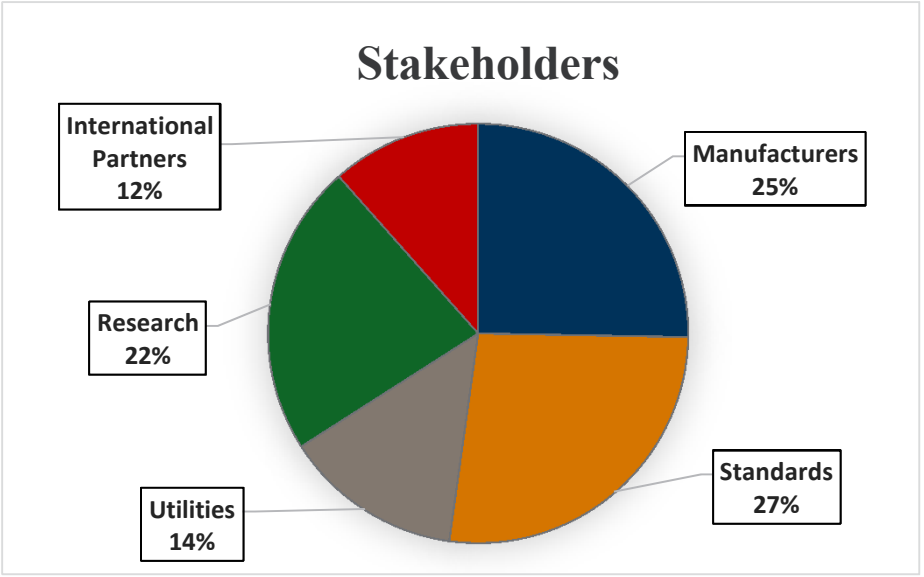
Energy Storage Safety Working Group Organizational Structure



FSR11

Collaboration

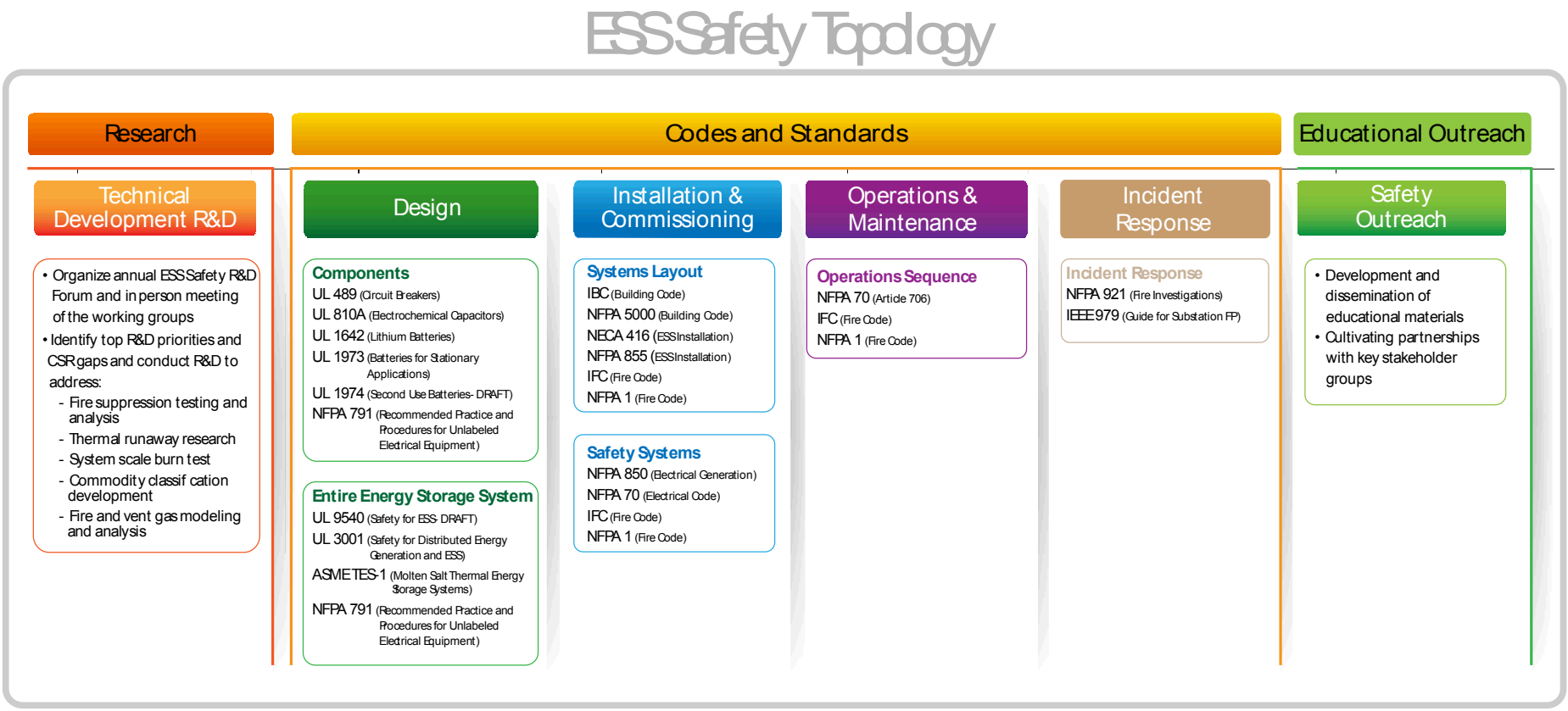
- All interested and affected parties are encouraged to participate
- Communication is directly with stakeholders as well as key organizations representing specific types of stakeholders
- The makeup of the participants of each group span the industry:
  - Safety Validation and Risk Assessment
    - ✓ 110 on the distribution list, 30 average meeting attendance
    - ✓ 25 on the Priorities and gap assessment subcommittee
  - Codes and Standards
    - ✓ 108 on the distribution list, 35 average meeting attendance
    - ✓ 6 on the mechanical safety task force (drafted input to UL 9540)
    - ✓ 18 on the ESS Compliance Guide task force
    - ✓ 11 on the ESS Installation Pre-standard task force
  - Safety Outreach and Incident Response
    - ✓ 100 People on the distribution list, 30 average meeting attendance



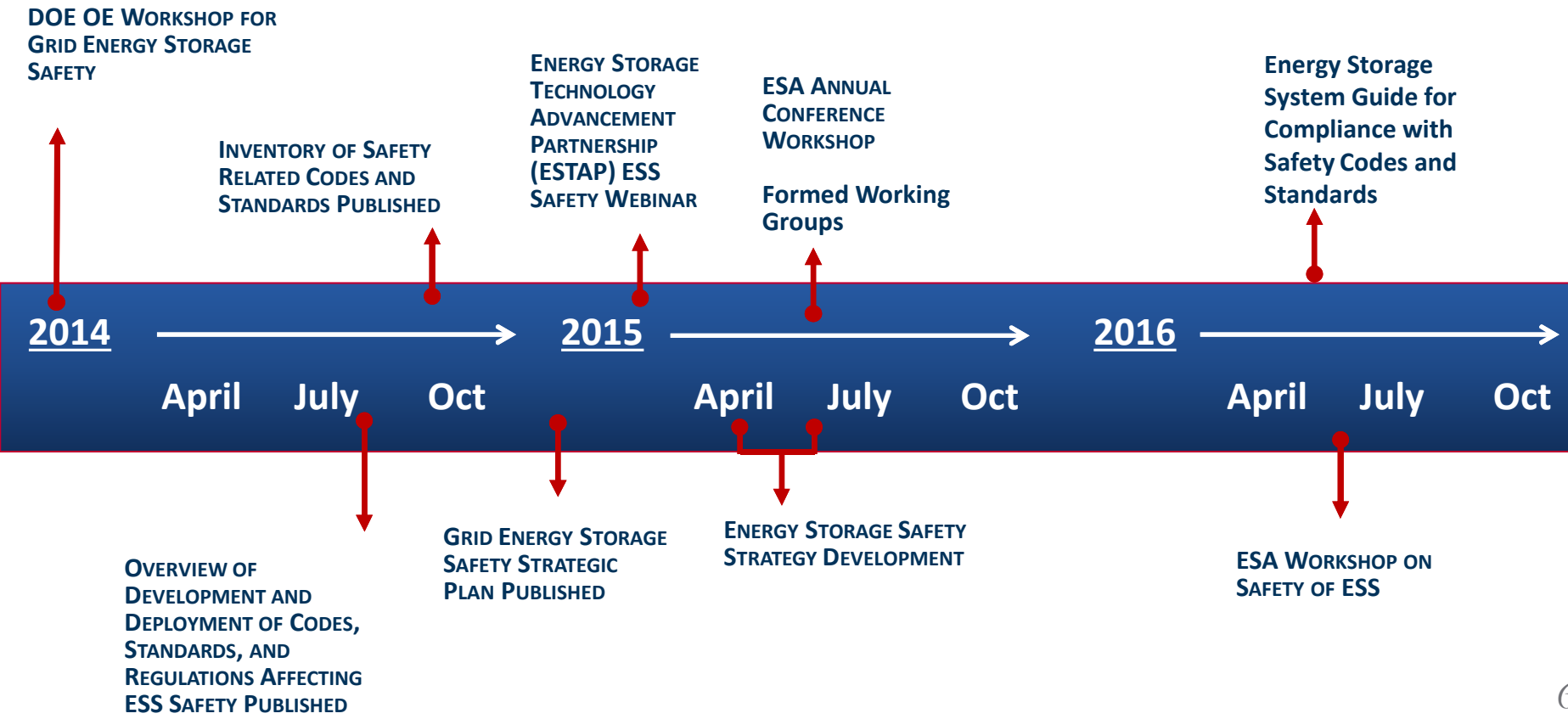
Slide 4

FSR11 use Dave's slide here
Ferreira, Summer R, 9/15/2016

Working Groups Address Safety Across the Board



Key Highlights



Publications

Development and publication of 2 articles and 7 documents

- Articles on ESS published in IAEI magazine and the NIBS Journal
- Codes 101 document that provides an overview of CSR development and deployment and background on why CSR are important to timely deployment of safe ESS
- Inventory of CSR applicable to ESS
- Compliance Guide to documenting and validating ESS safety under current CSR
- National stakeholders list white paper for outreach coordination
- Updated section on safety in the utility integration of energy storage provided to Sandia/EPRI ESS Handbook team
- ESS safety informational fact sheet for Code Officials
- ESS safety informational fact sheet for the Fire Service

R&D Prioritized List

Key need – Identify R&D efforts that will have the largest impact on the industry.

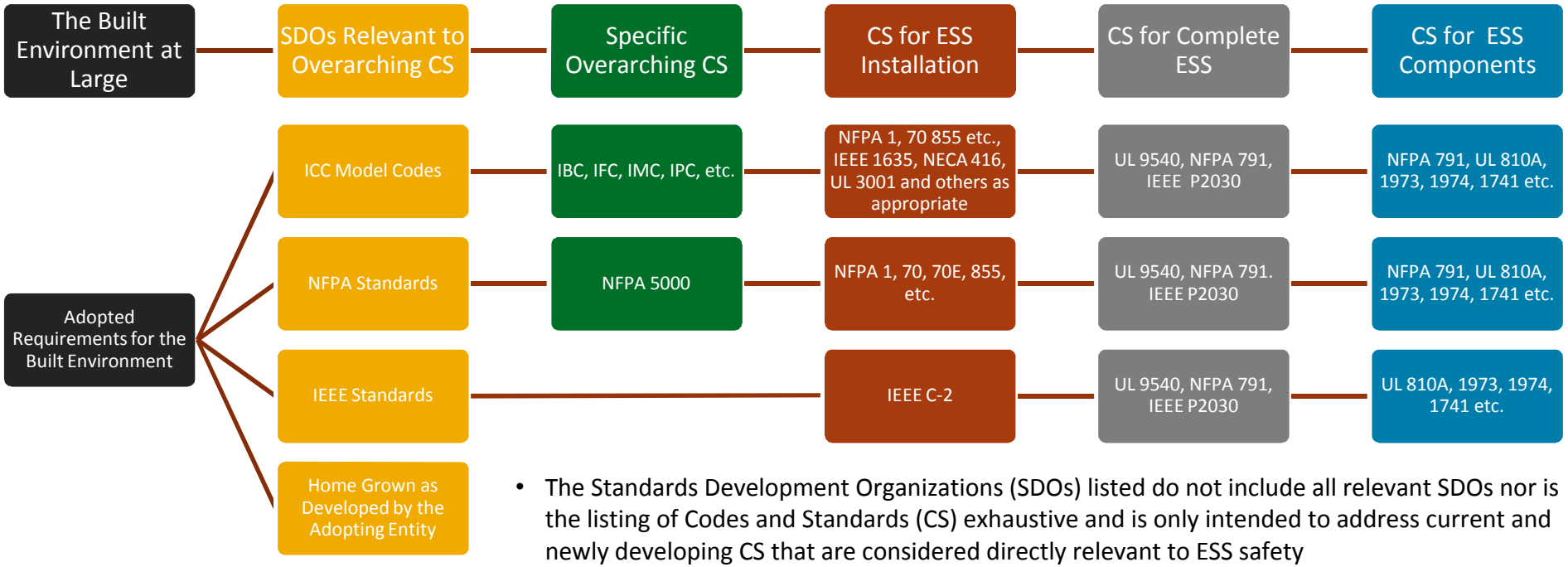
- Work to date
  - Ongoing work in labs, industry and academia address
  - safety in an ad hoc manner.
  - Focused largely on performance and failure of single cells
- Short term priorities identified:
  - **Fire Suppression testing** and analysis
  - **Thermal runaway** research
  - **System scale burn test**
  - **Commodity classification** development
  - **Fire and vent gas modeling** and analysis
- Subcommittee formed and discussed topics individually to create basis for white paper on priorities.

Slide 8

FSR13 uniform bullets in slides

Ferreira, Summer R, 9/15/2016

Codes and Standards Hierarchy for ESS



- The Standards Development Organizations (SDOs) listed do not include all relevant SDOs nor is the listing of Codes and Standards (CS) exhaustive and is only intended to address current and newly developing CS that are considered directly relevant to ESS safety
- The information reads from left (macro level) to right (micro level) covering the built environment at large, then a more specific focus on entire buildings and facilities, then the installation of an ESS, then the ESS as a complete product and finally the components (parts) of the ESS product – what is left is intended to be considered the 'parent' to what is immediately to the right
- The CS covered are developed in the voluntary sector by SDOs – those who adopt those documents (in total or in part) or who adapt them and develop their own 'home grown' provisions include Federal, state, local, territorial and tribal agencies as well as certain regulated utilities such as communications providers (on the customer side of the meter) and regulated utilities on the grid side of the meter

Codes/Standards Development

Involvement in the development of 7 standards/model codes

- Participation on a working group that developed a new Article 706 on ESS safety that will appear in the 2017 NEC
- Active participation in development of a new Chapter on ESS for the ICC International Fire Code
- Ongoing participation in development of a new UL standard 9540 on ESS safety
- Active participation in development of ASME TES-1 on molten salt thermal storage system safety
- Development of a pre-standard addressing ESS installation safety that will be used by a new NFPA committee charged with development of an NFPA 855 on ESS installation safety
- Ongoing participation in IEC TC 120 activities developing ESS safety related standards
- Ongoing participation in EPRI ESIC activities developing ESS safety guidelines for utilities
- Continued monitoring and reporting on activities associated with CSR impacting ESS

Outline of Investigation for Energy Storage Systems and Equipment

Presentations

- **NFPA/FDNY workshop** *November 2015* **–** Energy storage safety assessment and design and CSR
- **Energy Storage Safety Working Group Webinar** *July 2015* –Safety plan implementation kickoff
- **EESAT/Peer Review** *Sept 2015* –
  - ESS Working Groups Update
  - ESS safety CSR activities
- **Webinar** *October 2015*– NFPA energy storage fire service members
- **Webinar** *March 2016* – Boston City Fire and inspectors
- **CO Code Official Training Institute Workshop** *March 2015 and 2016* –ESS technology, safety and CSR
- **Materials Research Society (MRS) Conference** *March 2016*
  - ESS operational safety and thermal management
  - R&D needs and efforts to address those needs
- **ESA annual conference** *May 2015* – Moderated a safety panel
- **ESA annual conference** *May 2016* – Lead ESS safety panel (4 – presentations)
- **International Association of Electrical Inspectors (IAEI) SW regional conference** *August 2016* – Overview of ESS technology, installations and safety

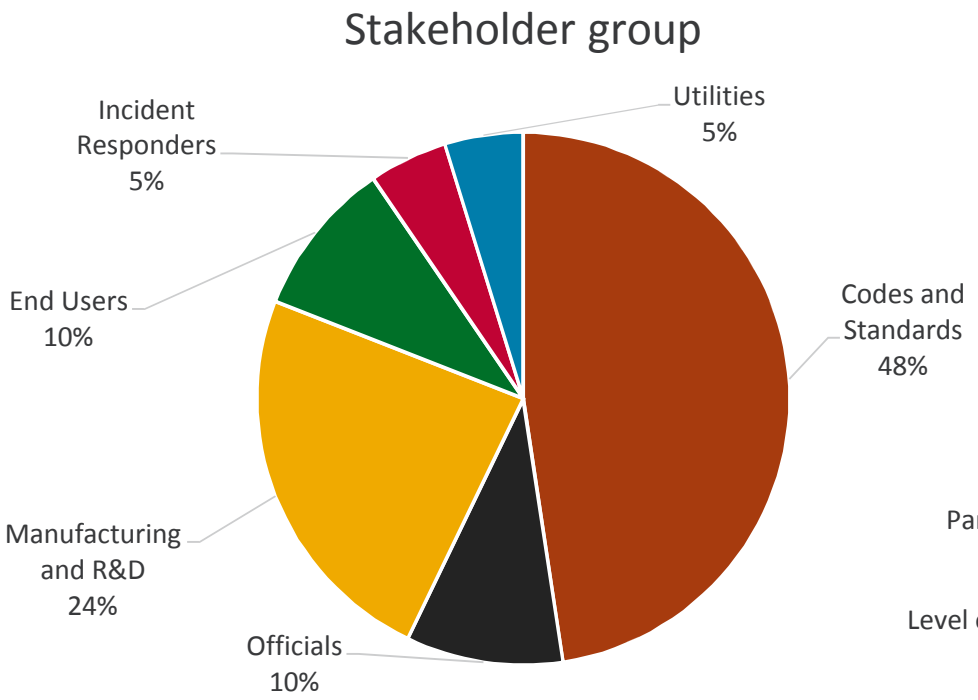
ESS Working Group Meetings

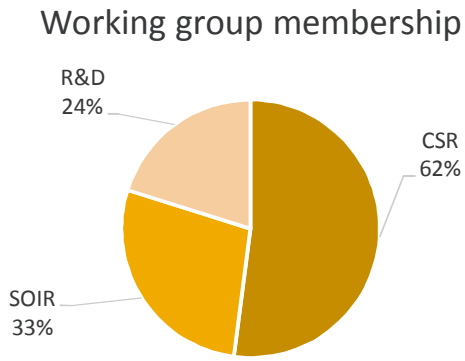
- Web conferences held in the past year:
  - 10 Codes and Standards
  - 9 Safety Validation and Risk Assessment
  - 6 Safety Outreach and Incident Response
- R&D met every 2-3 months for reviews, with targeted subgroup meetings in the spring to discuss technical topics
- CSR met monthly over the past year; task forces under CSR worked on specific projects
- SOIR met every 2 months to discuss work products, distribution planning, and the outreach opportunities calendar

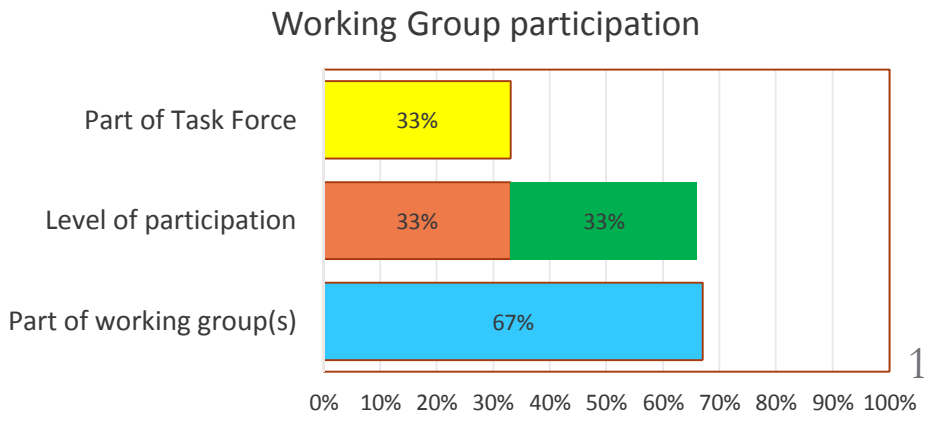
Questionnaire – Makeup of Respondents

Didn't take it? Please do:

http://energy.sandia.gov/energy-storage-safety-workgroup-questionnaire/

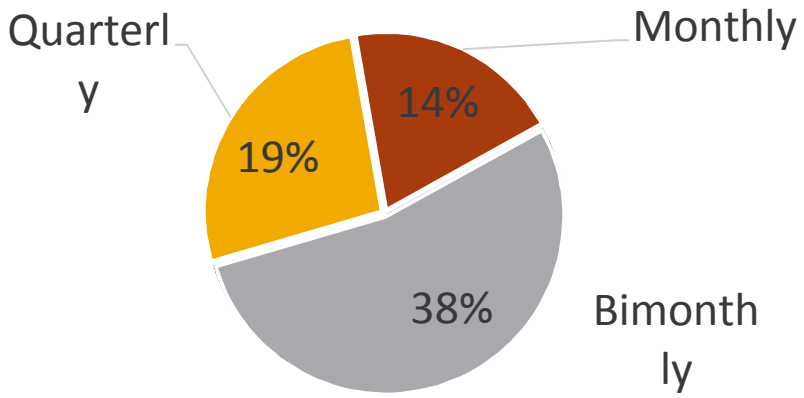






What You Told Us

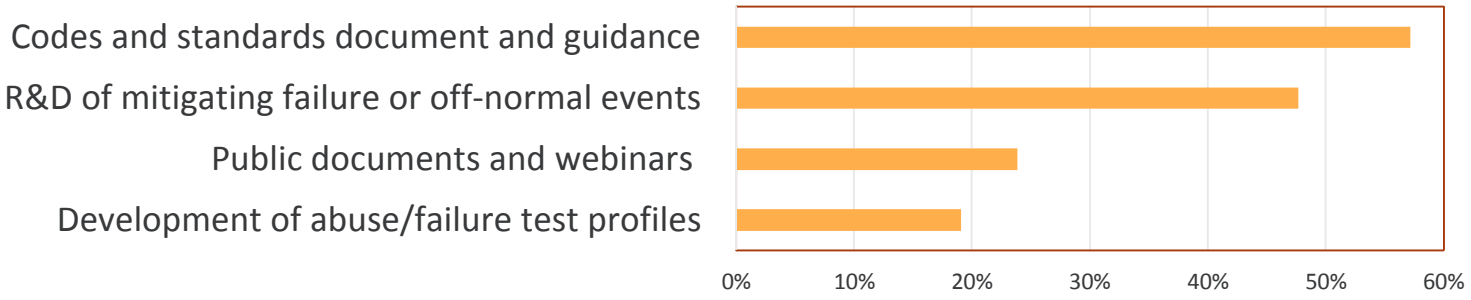
Ideal Frequency of Meetings



Understand the mission	We are meeting the mission
93%	50%

	CSR	SOIR	R&D
Usefulness of Working Groups	3.4/5	2.7/5	2.6/5

Preferred Priorities

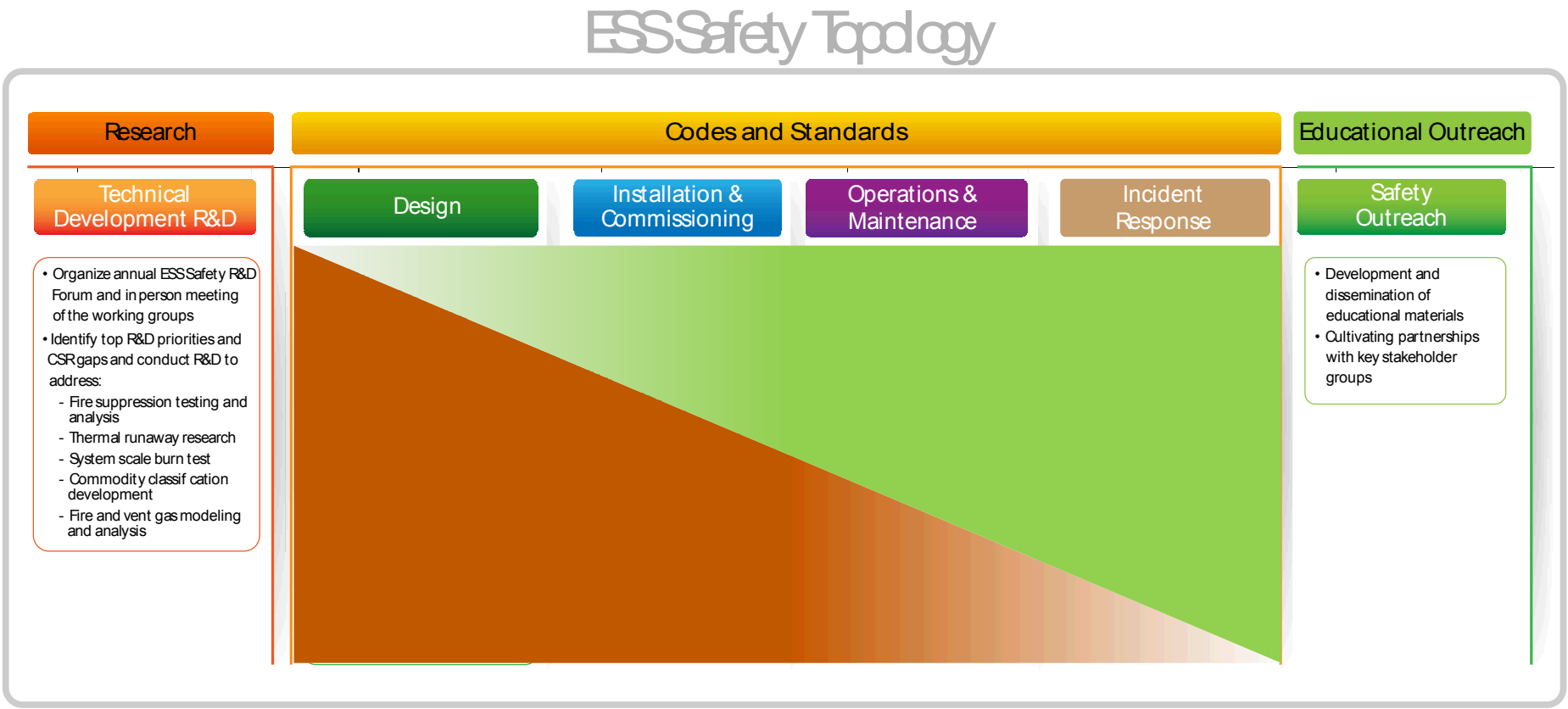


What's Next for Activities

- Conduct of a second national **ESS Safety Forum – February 22-24, 2017**
- The call for papers is open https://share.sandia.gov/ess/ess-safety-forum-2017
- Continued work on **ongoing CSR activities** and identification of **new CSR opportunities**
- Facilitate **R&D on identified top priorities**
- **Update Update published documents** as warranted due to changes in ESS technology, availability of research results, stakeholder needs and/or updates to CSR including the **2014 safety strategy** document
- Publish a document containing **case studies of ESS safety compliance documentation** and validation
- Develop and implement a **more effective approach to identifying needs**, securing stakeholder participation and fostering activities to address those needs
- Creating an **improved web presence** that is easy to navigate and provides useful information to the public
- **Increase stakeholder participation**

How to Accomplish our 2017 Goals

Consolidating into one working groups 'ESS Safety Working Group' because the silo approach to our goals puts up artificial boundaries



How to Accomplish our 2017 Goals

Consolidating into one working groups 'ESS Safety Working Group' because the silo approach to our goals puts up artificial boundaries

- ESS Safety WG will meet bimonthly
- Task forces (TF) will form around specific goals and challenges, and dissolve when concluded. i.e.
  - R&D priority list TF will form each spring to update the list over a couple of months
  - CSR TF groups will form as documents come up that need comments
  - TF groups will be convened to develop outreach documents, guides or other materials as there is need and interest
  - TF will be formed to update the Safety Strategy document
- We brought on additional staff in the national laboratories to support activities—***However***, we need strong participation from all stakeholders to be able to engage in a range of activities
  - Alice Muna (Sandia) – Fire Protection Engineer with 5 year experience (MS Fire Protection Eng., BS EE)
  - Dr. Chris LaFleur, PE (Sandia) – Fire Protection Engineer with 25 years experience in fire codes and risk analyses
  - Pam Cole (PNNL) -- 16 years involved in codes and standards for residential and commercial construction

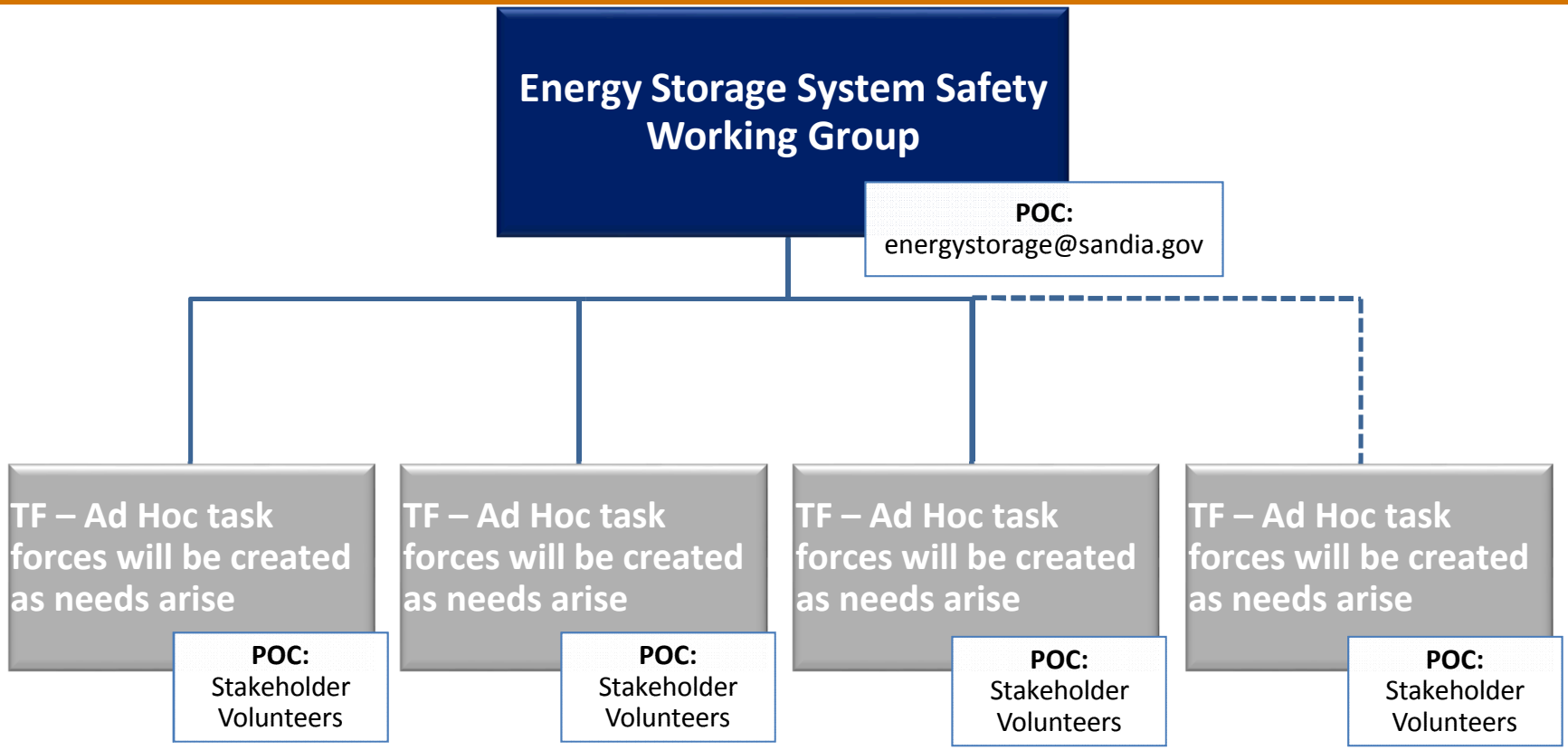
This activity is intended to support the timely development and deployment of safe ESS technology – all those with a stake in this goal would logically be interested in active participation as we move forward

Slide 17

t7 DRC do we want to update the safety plan? If we have done things in the last plan then maybe we can check them off as done and ID ongoing and new items to work on.
test, 6/16/2016

CR16 Seems to me in presenting to the client this is where we might cover briefly how we feel things have gone so far (good), the survey results and then present the Forum concept. The data to support the move from WGs to a Forum is really how the WGs to some degree are not separated in black and white but are somewhat merged (e.g. R&D feeds into CSR and then that drives E&O). Example of CSR and E&O is the compliance guide.
Conover, David Richard, 8/22/2016

New ESS Safety WG Organizational Structure



Resources

U.S. DEPARTMENT OF ENERGY Energy Storage Systems Program

http://www.sandia.gov/ess/

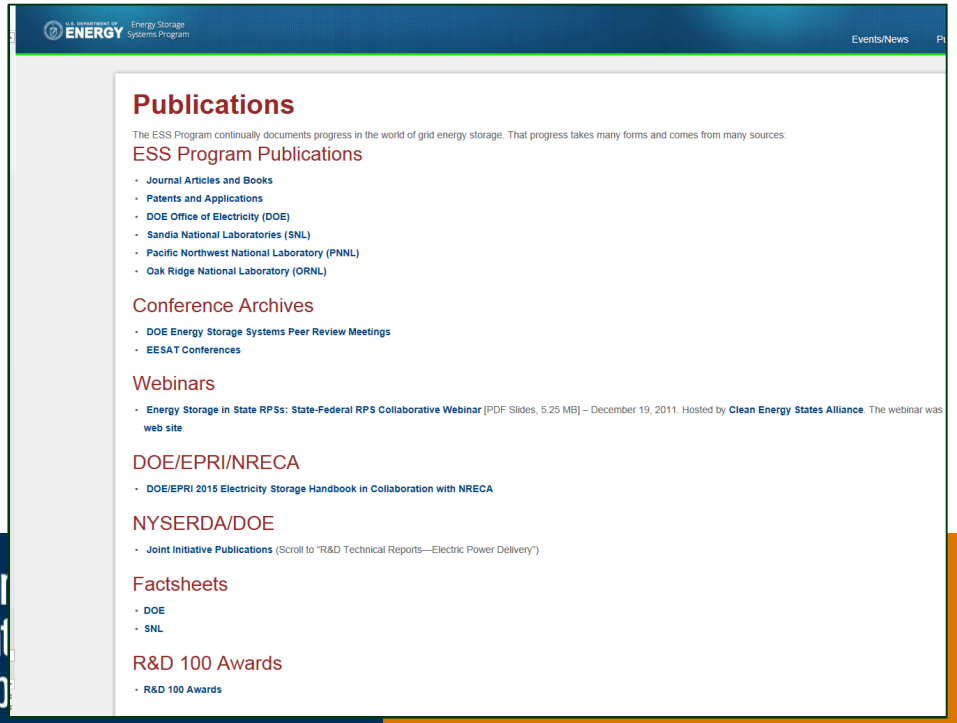
Events/News | Publications | Tools | Resources | Projects | Awards

Tools

The ESS Program continually documents progress in the world of energy storage. That progress takes many forms and comes from many sources.

ESS Program Tools

- **DOE/EPRI 2015 Electricity Storage Handbook in Collaboration with NRECA** – The DOE/EPRI 2015 Electricity Storage Handbook in Collaboration with NRECA is a how-to guide for utility and rural cooperative engineers, planners, and decision makers to plan and implement energy storage projects.
- **PUC Handbook** – A perspective on issues pertaining to the deployment of utility procured electrical energy storage resources. The intended audience includes state electric utility regulatory authorities, their staffs and the planning personnel in the utilities they regulate.
- **DOE Global Energy Storage Database** – Free, up-to-date information on grid-connected energy storage projects and relevant state and federal policies. All information is vetted through a third-party verification process. All data can be exported to Excel or PDF.
- **ES-Select Tool™** – The ES-Select™ Tool aims to improve the understanding of different electrical energy storage technologies and their feasibility for intended applications in a simple, visually comparative form. It treats the uncertainties in technical and financial parameters as statistical distributions.
- **Protocols** — A listing of DOE-published protocols for download.



ESS Safety WORKING GROUP

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Acknowledgement

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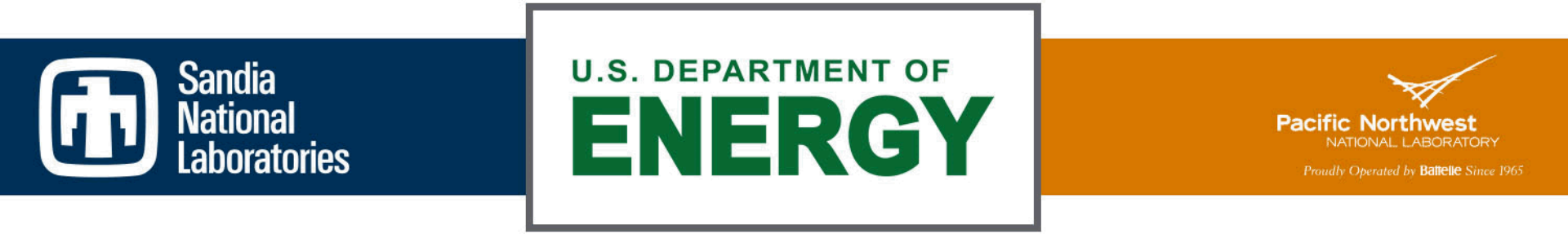
Thanks

Dave Rosewater
Summer Ferreira
Sandia

Pam Cole
Dave Conover
PNNL



For more information on DOE OE ESS safety activities contact
energystorage@sandia.gov