Electric Grid Integration
Lead: Grant Stewart, LANL

- Impacts of the work
  - Create an awareness of the contractual relationships between Electricity Service Providers and Supecomputing Centers
  - Investigate minimizing the impact of large power loads and voltage swings on electrical distribution systems
- Prior Deliverables
  - "An Analysis of Contracts and Relationships between Supercomputing Centers and Electricity Service Providers"; pending
  - "Supercomputing Centers and Electricity Service Providers: A Geographically Distributed Perspective on Demand Management in Europe and the United States"; 2016
  - "The Electrical Grid and Supercomputing Centers: An Investigative Analysis of Emerging Opportunities and Challenges"; 2014
- Current activities
  - Gather information from LANL, NCAR/UCAR, ORNL, LLNL, ECMWF on impact of large power loads and voltage swings
- Next steps
  - Complete questionnaires/interviews, synthesize information gathered, analyze results, publish whitepaper
- Help needed
  - Additional sites to participate in questionnaire/interview
  - Expertise with electrical distribution systems and responsiveness to large power loads and voltage swings
  - Participate in Grid Integration Team

Operational Data Analytics
Lead: Ghaleb Abdulla, LLNL

- Impacts of the work
  - Share early adopter best practices of operational data analytics for HPC data centers
  - Demonstrate value of integrated operational data analytics through usage cases
- Prior Deliverables
  - Analyzed experiences from a few early adopters (LBNL, NREL, LLNL, LANL)
  - Developed detailed questionnaire w/focus on use cases, integration challenges and scalability
  - Short survey assessed interest (14/20 responses, 7 interested in detailed questionnaire)
  - Call for participation to EE HPC WG membership
- Current activities
  - Detailed questionnaire/interview sent to AIST, CINECA, Juelich, RIKEN, NCAR/UCAR, LRZ and ORNL
- Next steps
  - Complete questionnaires/interviews, synthesize information gathered, analyze results, publish whitepaper
- Help needed
  - Participate in the Operational Data Analytics Team

EPA JSRM
Lead: Greg Koenig, KPMG

- Impacts of the work
    - Share best practices of Energy and Power Aware Job Scheduling and Resource Management (EPA JSRM)
    - Identify opportunities for influencing product development
- Prior Deliverables
    - "Energy and power aware job scheduling and resource management: Global survey initial analysis"; 2018
    - Initial analysis used as input for Powerstack Seminar; 2018
    - "Energy and Power Aware Job Scheduling and Resource Management: Global Survey — An In-Depth Analysis"; 2018
- Current activities
    - Further explore motivation, requirements and vision of sites interested in energy and power management via JSRM
- Next steps
    - Continue exploration of site motivation in power/energy management
    - Stay in touch with PowerStack
    - Determine whether or not to continue the Team and, if so, define problem statement and deliverables
- Help needed

Power Measurement Methodology
Lead: Tom Scogland, LLNL

- Impacts of the work
  - Provides the functions which can monitor and record power consumption of entire system in real time
  - More accurate HPC system architectural trend data for the HPC Community
- Prior Deliverables
  - "Energy Efficient High Performance Computing Power Measurement Methodology (version 1.0)"; 2012
  - "A power-measurement methodology for large scale, high performance computing"; 2014.
  - "Node Variability in Large-Scale Power Measurements: Perspectives from the Green500, Top500 & EE HPC WG". SC15; 2015.
  - Energy Efficient High Performance Computing Power Measurement Methodology (version 2.0 RC 1.0); 2015. https://www.top500.org/green500/resources/eehpc-wg-power-measurement-methology/
  - "Submissions Open for Newly Merged TOP500 and Green500"; May 6, 2016; Rich Brueckner; Inside HPC.
- Current activities
  - Solicit and understand feedback on system-level workload power measurement methodology
  - Encourage L2/L3 measurement submissions to Green500/Top500
- Next steps
  - L2/L3 feedback at Green500 BoF
- Help needed
  - Make L2/L3 measurement submissions to Top500/Green500 List
  - Encourage extension of L2/L3 measurement submissions to other benchmarks, e.g., GreenGraph500

Procurement Considerations
Lead: Jason Hick, LANL

- Impacts of the work
  - Influence product development for energy efficient HPC systems
  - Encourage HPC sites to consider energy efficiency during procurement of HPC systems
- Prior Deliverables
  - Energy Efficiency Considerations for HPC Procurement Documents: first published 2013 and updated 2014 and 2017; EE HPC WG/Groups/Computing Systems/Procurement Considerations Documents
- Current activities
  - Updating procurement considerations document with a focus on improving document structure as well as major content updates to Cooling and Facility Integration
  - Collaborating with PRACE (Partnership for Advanced Computing in Europe) on TCO and Procurement
- Next steps
  - Continue working on updating Energy Efficiency Considerations for HPC Procurement Documents
- Help needed
  - Participate on the Procurement Considerations Team

Liquid Cooling "Standards"
Lead: Dale Sartor, LBNL

- Impacts of the work
  - Encourage liquid-cooled solutions that do not require compressors
  - Increase ease of deployment by "standardizing" facility and HPC equipment
  - Set the bar for more opportunities to reuse waste heat
- Prior Deliverables
  - Wx temperature classes developed, presented, and published (e.g. SC11), and included in ASHRAE TC9.9 Liquid Cooling Guidelines for Datacom Equipment Centers
- Current activities
  - Input to next edition of ASHRAE TC9.9 Liquid Cooling Guidelines for Datacom Equipment Centers.
  - Input to "Open" specification for warm water liquid cooled rack
- Next steps
  - Forming Team to provide input on "open" specification for warm water liquid cooled rack specification
  - Announce Liquid Cooling "Standards" Team formation and solicit participants
- Help needed
  - Participate in ASHRAE TC9.9 Committee activities and coordinate with EE HPC WG
  - Participate on Liquid Cooling "Standards" Team

Liquid Cooling Controls
Lead: David Grant, ORNL

- Impacts of the work
  - Increase ease of deployment for liquid cooling controls
  - Improve energy efficiency of the cooling system and reduce costs of cooling
- Prior Deliverables
  - Whitepaper: EE HPC WG Liquid Cooling Controls Team; 2017 EE HPC WG/Groups/Infrastructure/Controls
  - Presented to PowerAPI and put in their queue for future attention
  - ASHRAE included data inputs for HPC systems in their recommendations to Redfish
- Current activities
  - On-going discussions with Redfish and Power API on incorporating these data inputs
- Next steps
  - Inclusion of data inputs in ASHRAE, Redfish and Power API
- Help needed
  - Advocates for EE HPC WG liquid cooling controls to work on Redfish and Power API Committees

Power API
Lead: Ryan Grant, Sandia NL

- Impacts of the work
  - Ease of deployment
  - Cost reduction
- Prior Deliverables
  - Comprehensive specification that covers multiple interfaces for many roles/levels of system
  - Reference implementation, a community effort – multiple stakeholders
  - R&D100 Award Winner and Special Recognition
- Current activities
  - Soliciting feedback and queue of recommendations for improving specification
  - Re-engineering portions of the reference implementation
- Next steps
  - Next version of the specification
- Help needed
  - Participate in PowerAPI Team – Specification and implementation - **https://eehpcwg.llnl.gov/power-api.html**
  - Ask for PowerAPI compliance

- Impacts of the work
  - Increase energy and operational efficiency by improving Reliability Availability Serviceability and Maintainability (RAS-M) beyond the HPC system to facility infrastructure
- Prior Deliverables
  - (8) major US Supercomputing sites respond to questionnaire on RAS and maintainability
  - Decision to create RAS-M Team
- Current activities
  - Forming RAS-M Team with deliverables to 1) define metrics, 2) document best practices for bringing together diverse groups of people for RAS-M and 3) document best practices for predictive and condition based preventative maintenance
- Next steps
  - Announce RAS-M Team formation and solicit participants
- Help needed
  - Participate on the RAS-M Team
  - Share best practices/lessons learned

Dashboards
Lead: Natalie Bates, EE HPC WG

- Impacts of the work
  - Strive for consensus on HPC center dashboard energy efficiency elements and metrics
- Prior Deliverables
  - Whitepaper: Current Use Dashbaords Survey; 2017. EE HPC WG/Groups/Infrastructure/Dashboard
  - "Re-examining HPC Energy Efficiency Dashboard Elements"; 2016
  - "General Recommendations for High Performance Computing Data Center Energy Management Dashboard Display"; 2013
- Current activities
  - Transitioning team to focus on operational data analytics – the stuff behind dashboards
- Next steps
- Help needed

Liquid Cooling Commissioning
Lead: TBD

- Impacts of the work
    - Encourage decreased costs and improve energy efficiency with effective liquid cooling commissioning
- Prior Deliverables
    - Whitepaper: Systematic approach for commissioning liquid cooling infrastructure to support liquid cooled HPC systems; 2015. EE HPC WG/Groups/Infrastructure/Liquid Cooling Commissioning
- Current activities
- Next steps
    - ASHRAE TC9.9 to incorporate liquid cooling commissioning in commissioning guideline
    - Reconvene Team- interest expressed by several people at SC18
- Help needed
    - Include commissioning as part of your HPC system procurement considerations
    - Technical expert w/strong technical writing skills to finalize whitepaper with ASHRAE TC9.9 Committee

iTUE and TUE
Lead: Natalie Bates, EE HPC WG

- Impacts of the work
  - Combines with PUE to provide a TOTAL view of where the inefficiencies are. Adds a "server PUE". Precludes miscounting power and cooling losses on the wrong side of the equation.
- Prior Deliverables
  - " TUE, a new energy-efficiency metric applied at ORNL's Jaguar"; 2013.
- Current activities
- Next steps
- Help needed
  - Ask HPC vendor for capability to measure iTUE
  - Explore your ability to measure or estimate your iTUE and TUE and contribute case studies/lessons learned