MONDAY, AUGUST 20

	CRESTONE A
	RESILIENCE ENGINEERING ASSOCIATION Chair: Beth Lay
1:30-5:00	The NASA Space Station role play simulation illustrates issues studied by a branch of resilience that developed around 2000 about safety in complex human-technological systems. The case and follow up panel discussions highlight the new synthesis that lies at the intersection of cognitive, social, computational, and engineered systems. The role play is led by Beth Lay, Principle, Applied Resilience, LLC and Resilience Engineering Association, E. Asher Balkin, Cognitive Systems Engineering Laboratory, Ohio State University David D. Woods, Past-President, Resilience Engineering Association.
	Panel Discussion 1: *Does the Oroville Dam Spillway event reveal the same patterns about resilience and safety as the NASA Space Station event?* **Panelists:** Tom Seager, Arizona State University; Daniel Eisenberg, Naval Post-Graduate School; E. Asher Balkin, Ohio State University
	Panel Discussion 2: *Provocation: Engineering can build more robust systems; only people can provide the capability for resilient performance.* **Panelists:** David Alderson, Naval Post-Graduate School; Tom Seager, Arizona State University; Beth Lay and David D. Woods, Resilience Engineering Association
	Panel Discussion 3: *The missing infrastructure: digital services.* **Panelists:** David D. Woods, SNAFU Catchers, the Ohio State University; Asher Balkin, SNAFU Catchers, the Ohio State University Respondents and discussion: Daniel Eisenberg, Naval Post-Graduate School David Alderson, Naval Post-Graduate School
	CRESTONE FOYER
5:00-7:00	Registration and Sponsored Reception

TUESDAY, AUGUST 21

	CRYSTAL B/C	
7:00	Registration and Breakfast	
7:50	**Sponsor Welcome and Governor Introduction:** Zach Tudor, Associate Laboratory Director, Idaho National Laboratory	
8:00	**Resilience Week Welcome:** Donna Lynne, Colorado Lt Governor	
8:20	**Plenary Panelists Introduction:** Mark Rice, Senior Power System Research Engineer, PNNL-Facilitator	
8:30-9:30	**Plenary Panel:** *Cooperative Research* **Panelists:** Adrian Chavez, Dynamic Defense & Network Randomization, Sandia National Laboratories; Manimaran Govindarasu, Professor, Iowa State University; Dan Massey, Professor, University of Colorado-Boulder; Kevin Reifsteck, Director for Critical Infrastructure Cybersecurity, National Security Council; Doug Maughan, Director, Department of Homeland Security	
	CRYSTAL B/C	**CRESTONE B**
	CYBER NEEDS AND CURRENT TECHNOLOGIES Chairs: Nadia Carlsten, DHS S&T; Craig Rieger, INL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
9:30-10:30	**Keynote Introduction:** Nadia Carlsten, DHS S&T **Keynote:** Doug Maughan, Director, DHS S&T, *Re-inventing Cybersecurity R&D: How DHS is Innovating to Deliver More Secure Systems*	**Panel**: *The Roles of Planners, Engineers, and Economists in Urban Resilience Planning* **Moderator:** Vanessa Vargas, SNL **Panelists:** Nancy Sutley, L.A. Department of Water and Power; Katrina Kelly-Pitou, University of Pittsburgh; David Kang, University of Colorado Boulder; Ian Lange, Colorado School of Mines; Morgan Bazilian, Colorado School of Mines

10:30	Morning Break		
	CRYSTAL B/C	**CRESTONE B**	
11:00-12:00	**Invited Presenters** • Paul Ferrillo, Greenberg Traurig, *Cybersecurity 2020: Solving Today's problems for a safer and more secure tomorrow* • Marty Edwards, Automation Federation, *Think like a hacker, but act like an engineer*	**Lightning Talks:** *How to Think About Resilience* • Eliza Hotchkiss, NREL, *An Approach to Resilience: Lessons Learned and Best Practices* • Janusz Zalewski, FL Gulf Coast Univ., *Would you help me understand what resilience is? Some fundamental concepts in protecting critical systems* • Daniel Eisenberg, NPS, *Everything that's wrong with the critical functionality curve for resilience* • David Alderson, NPS, *The Nature of Surprise* • Thomas Seager, ASU, *Robustness and Extensibility in Surprise Management*	
12:00-1:30	No-host Lunch		
	CRYSTAL A	**CRESTONE A**	**CRESTONE B**
	AVOIDING SKYNET Chair: Julie Marble, JHUAPL	**NEW CYBER TECHNOLOGIES** Chairs: Nadia Carlsten, DHS S&T; Craig Rieger, INL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
1:30-3:30	• Anthony Crawford, INL, *Integrating Physiological Hand Resilience into Human Machine Interfaces* • Bill Lawless, *The fundamental social measurement problem: Perturbations, resilience, Skynet's slaved things, intelligent things, information loss and virtual mass* • Julie Marble, JHUAPL, *Platform Assessing Risk and Trust in Non-Economic Relationships* • Mollie McGuire, NPS, *Integrity Based Trust in Autonomy*	• Joel Doehle, PNNL, *SilentAlarm* • Richard Skowyra, MITLL, *Dynamic Flow Isolation* • Jason Laska, ORNL, *Real-Time Cyber Physical Attack Detection* • Adrian Chavez, SNL, *Dynamic Defense & Network Randomization* • Richard Skowyra MITLL, *Quantitative Attack Space Analysis and Reasoning* • Richard Robinson, Cynash, *Protecting Critical Systems with Nature-Inspired Cybersecurity Solutions*	**Lightning Talks:** *Student Competition* • Cynthia Lee, GT, *Updating and Evaluating System Model Parameters for Enhanced Situational Awareness and Resilience of Interdependent Critical Infrastructures* • Karl Thompson, UI at Urbana-Champaign, *Modeling Multi-modal Transportation for Improved Resilience of the US Air Transportation Network* • Maria Robson, Northeastern Univ. *Critical Infrastructure Interdependencies: Exploring Transportation and Energy Cyber Vulnerabilities Using Boston as a Case Study* • Vivek Kumar Singh, ISU, *Anomaly Detection for Wide-Area Protection and its Evaluation using Testbed Federation* • Venkatakiran Marri, GWU, *Monitoring and Mitigating Resilience Degradation in Engineered Systems*
	CRESTONE FOYER		
	RECEPTION WITH MULTIPLE PARALLEL ACTIVITIES		
	POSTER PRESENTATION	**TRANSITION TO PRACTICE DEMONSTRATION** Chairs: Nadia Carlsten, DHS S&T	**GAMING COMPETITION** Chairs: Amanda Joyce, ANL; Tim McJunkin, INL
3:30-6:00	Papers accepted for poster only Infrastructure Abstracts	Multiple technologies presented in previous sessions	Capture the Flag Maze Game Grid Game

WEDNESDAY, AUGUST 22

	CRYSTAL B/C
7:30	Registration and Breakfast
8:15	Student Competition Winners
8:20	**Plenary Panelists Introduction:** Andy Bochman, Chief Grid Strategist, Idaho National Laboratory
8:30-9:30	**Plenary Panel:** *Industry Leader Perspectives on Lifeline Sector Interdependencies and Threat* **Panelists:** Kent Kildow, Director of Business Continuity and Emergency Management, Verizon Ryan Frillman, Chief Information Security Officer, Spire Energy; Reid Fudge, CISO, Tri-State Generation and Transmission Association

	CRYSTAL A	CRESTONE A	CRESTONE B
	CONTROL R&D Chairs: Frank Ferrese, NAVSEA; Kevin Schultz, JHUAPL	**CYBER R&D** Chairs: David Manz, PNNL; Amanda Joyce, ANL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
9:30-10:30	• ***C. Birk Jones, SNL, Intrusion Detection & Response using an Unsupervised Artificial Neural Network on a Single Board Computer for Building Control Resilience*** • Nicholas Jacobs, SNL, *Measurement and Analysis of Cyber Resilience for Control Systems: An Illustrative Example*	• ***Joseph L. Loof , UND, Unsupervised Classification of Frequency Hopped Signals in Frequency-Selective Channels*** • Md Sharif Ullah, ODU *Towards Modeling Attacker's Opportunity for Improving Cyber Resilience in Energy Delivery Systems* • Leonardo De La Rosa, UDel, *Efficient Characterization and Classification of Malware Using Deep Learning*	**Lightning Talks:** *Applications of Resilience* • Christopher Dixon, INL, *Dynamics of Multilayer Complex Infrastructure Networks* • Samuel Markolf, ASU, *Vulnerabilities and Resilience within Interconnected Transportation, Energy, Water, and ICT Infrastructure Systems: An Assessment of Direct and Indirect Pathways of Disruption Posed by Climate Change and Extreme Events* • Beth Lay, Applied Resilience, *Could this Happen Again? Resilience Engineer view of Astronaut near drowning* • C.J. Unis, SNL, *Financing Resiliency, from Smart Urban Design to Reconstruction*
10:30	Morning Break		

	CRYSTAL A	CRESTONE A	CRESTONE B
	INFRASTRUCTURE R&D Chair: Tim McJunkin, INL	**CYBER R&D** Chairs: David Manz, PNNL; Amanda Joyce, ANL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
11:00-12:00	• ***Bjorn Vaagensmith, INL, An Integrated Approach to Improving Power Grid Reliability: Merging of Probabilistic Risk Assessment with Resilience Metrics*** • Katrina Kelly-Pitou UPitt, *Locating Microgrids to Improve Smart City Resilience*	• David Coats, ABB, *A Collaborative Defense for Securing Protective Relay Settings in Electrical Cyber Physical Systems* • Vivek Kumar Singh, ISU, *A Hierarchical Multi-Agent Based Anomaly Detection for Wide-Area Protection in Smart Grid* • Sri Nikhil Gupta Gourisetti, PNNL, *A Cyber Secure Communication Architecture for Multi-Site Hardware-in-the-Loop Co-Simulation of DER Control*	**Keynote Introduction:** Cherrie Black, INL **Keynote:** David Alderson, NPS, *Attacker-Defender Models for Assessing and Improving Infrastructure Resilience*

	CRYSTAL B/C
12:00	**Hosted Lunch**
12:25	**Plenary Introduction:** Andy Bochman, Idaho National Laboratory
12:30	**Hosted Lunch with Plenary:** Mark Weatherford, SVP & Chief Cybersecurity Strategist, vArmour, *The Cloud, IOT and Critical Infrastructure: Let's Not Forget About Resilience*

	CRYSTAL B/C	CRESTONE B	
1:30-2:30	**Keynote Introduction:** Craig Rieger, INL **Keynote:** Jeff Taft, Grid Modernization Chief Architect, PNNL, *Grid Resilience From the Perspective of Grid Architecture*	**Panel:** *Risk Communication for Mitigation and Resilience Implementation Efforts* **Moderator:** Ellie Graeden, Talus Analytics **Panelists:** Shayle Nelson, Larimer County Office of Emergency Management; Stephen Cauffman, NIST; Hussam Mahmoud, CSU; Molly O'Donnell, Disaster Recovery Project Longmont, Colorado	
	CRYSTAL A	**CRESTONE A**	**CRESTONE B**
	COGNITIVE R&D Chairs: Roger Lew, UI; Tom Ulrich, INL	**CYBER R&D** Chairs: David Manz, PNNL; Amanda Joyce, ANL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
2:30-3:30	• Thomas Ulrich, INL, *Trouble in Paradise: Mutual Awareness, Teamwork, and Hawaii False Ballistic Missile Alert* • Aditya Sundararajan, FIU, *A Tri-Modular Framework to Minimize Smart Grid Cyber-Attack Cognitive Gap in Utility Control Centers* • David A. Grimm, GTech, *Systems Level Evaluation of Resilience in Human-Autonomy Teaming under Degraded Conditions*	• Peter Hawrylak, UTul, *Methodology to Estimate Attack Graph System State from a Simulation of a Nuclear Research Reactor* • Sri Nikhil Gupta Gourisetti, PNNL, *Blockchain: Next Generation Supply Chain Security for Energy Infrastructure and NERC Critical Infrastructure Protection Compliance*	**Lightning Talks:** *Resilience in Electric Power* • Jennifer Jiménez-González, Univ. of Puerto Rico, Compound Index: Reliability, *Resilience, and Social Forces for the Sustainability of Isolated Community Microgrids After Catastrophic Weather Events* • Sean DeRosa, SNL, *Puerto Rico Microgrid Siting for Resilience* • Paul Roege, Creative Erg, *Digital Power for Resilience* • Frederic Petit, ANL, *A Decision Analytic Approach to Electric Infrastructure Resilience* • John Thomas, ASU, *How governance and decentralized applications can impact the resilience and sustainability of electric power systems with embedded blockchain technologies*
3:30	Afternoon Break		
		COMMUNICATIONS R&D Chair: Krishna Kant, Temple	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
4:00-5:30		• Joe Loof, UND, *Preamble-Free Binary Polarization Shift Keying in Frequency Selective Channels* • Daniel Sullivan, ARL, *Mission Resilience For Future Army Tactical Network* • **Invited**: Guanhua Yan, BinghamtonU-CIRI, *LEFT: A Testbed for Assessing Resiliency of LTE Mobile Communication Systems*	**Panel**: *Owners and Operators Addressing Infrastructure Risk and Resilience (Lifeline Sectors)* **Moderator:** Eliza Hotchkiss, NREL **Panelists:** Matt Ziska, Xcel Energy; Steve Kuhr, Colorado Springs Utilities; Becky Franco, Denver Water; Kelly Morrison, AT&T Disaster Recovery
5:30	Adjourn Meetings		
	HENRY'S TAVERN, 500 16TH STREET		
6:30-8:30	Sponsored Reception Highlighting Best Papers		

Best Paper in Topical Area (3)

THURSDAY, AUGUST 23		
	CRYSTAL B/C	
7:30	Registration and Breakfast	
8:25	**Plenary Introduction:** Dan Elmore, Critical Infrastructure Protection Director, Idaho National Laboratory	
8:30-9:30	**Plenary:** John Garstka, Deputy Director, Cyber, Office of the Under Secretary of Defense, *Perspectives on Operating in a Cyber Contested Environment*	
	CRYSTAL A	**CRESTONE B**
	SOCIAL and COMMUNITY Chair: Kathleen Tierney, UColorado	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
9:30-10:30	**Keynote Introduction:** Craig Rieger, Idaho National Laboratory **Keynote**: Kathleen Tierny, Research Professor, UC-Boulder, *Social and Community Resilience*	**Panel**: *An Overview of FEMA's Planning Technical Assistance Program* **Moderator:** Dan Alexander, Director, National Integration Center, FEMA **Panelists:** Karen Marsh, Technical Assistance Branch Chief, FEMA; Kyle Pfeiffer, Manager – National Preparedness Analytics Group, ANL; Shane Gouker, Deputy Technical Assistance Branch Chief
10:30	Morning Break	
11:00-12:30	**Panel:** *Perspectives on Community Resilience* **Moderator:** Kathleen Tierney, UC-Boulder **Panelists:** Karen MacClune, Institute for Social and Environmental Transition (I-S-E-T); Andrew Rumbach, UC-Denver; Gregory Guibert, Gothic Mountain Ventures	**RRAP Session**: Introduction & Lightning Talks **Moderator**: William McNamara, Regional Resiliency Program Coordinator, DHS National Protection and Programs Directorate **Speakers** • Harvey Hembree, INL, *Gap Analysis and Dependency Visualization Resource* • Rob Edsall, INL, *Sleuthing for SASTI in San Diego* • Shiloh Elliott, INL, *Utilizing Subway System Map Design in System Analysis and Visualization* • Cherrie Black, INL, *Test-driving the NIST Community Resilience Planning Guide in Fort Collins Colorado* • William McNamara, DHS, *Applying Resilience Assessment Thinking to Disaster Recovery*
12:30-1:30	No-host Lunch	
	COGNITIVE Chair: Phil Bennett, SNL; Tim McJunkin, INL	**INFRASTRUCTURE** Chairs: David Alderson, NPS; Cherrie Black, INL
1:30-2:30	**Keynote Introduction:** Tim McJunkin, Idaho National Laboratory **Keynote**: Ariel Greenberg, Sr. Research Scientist, JHU/APL, *Moral-Scene Assessment for Intelligent Systems*	**Keynote Introduction:** Dan Elmore, Idaho National Laboratory **Keynote**: Juan Torres, Associate Lab Director, NREL, *All-Hazards Resilience for a Dynamic Energy Infrastructure*
2:30-4:00	**Panel:** *Case Studies on the Application of Cognitive and Social Sciences to the Cyber-Physical World* **Moderator:** Tim McJunkin, INL **Panelists:** Katya LeBlanc, INL; Phil Bennett, SNL; Tom Ulrich, INL; Aunshul Rege, Temple; David Manz, PNNL	
4:00	Adjourn Symposium	
4:30	No-host Social	

FRIDAY, AUGUST 24	
NATIONAL RENEWABLE ENERGY LABORATORY	
Chair: Martha Symko-Davies Logistics: Heather Newell, Denise Barber	
9:00-12:00	**Tours at NREL:** The Energy Systems Integration Facility (ESIF) provides a unique contained and controlled platform on which our partners can identify and resolve the technical, operational, and financial risks of integrating emerging energy technologies into today's environment.