

**U.S. Environmental Protection Agency Board of Scientific Counselors**

**Homeland Security**

**Virtual Meeting Minutes**

**May 17-20, June 3, and June 17, 2021**

**Dates and Times:** May 17, 2021, 12:00 to 5:00 p.m.; May 18, 2021, 1:00 to 5:00 p.m.; May 19, 2021, 1:00 to 4:00 p.m.; May 20, 2021, 12:00 to 5:00 p.m. Eastern Time; June 3, 2021, 2:00 to 5:00 p.m. Eastern Time; June 17, 2021, 11:00 a.m. to 2:00 p.m. Eastern Time

**Location:** Virtual

**Meeting Minutes**

Provided below is a list of the presentations and discussions that took place during the meeting with hyperlinked page numbers. The minutes follow. The agenda is provided in Appendix A, the participants are listed in Appendix B, and the charge questions are provided in Appendix C.

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**Monday, May 17, 2021**

The meeting generally followed the issues and timing as presented in the agenda provided in Appendix A of this meeting summary.

**Introduction, Federal Advisory Committee Act Rules, Expectations, Logistics**

*Tom Tracy, Designated Federal Officer, Office of Science Advisor, Policy, and Engagement*

The meeting convened at approximately 12:05 p.m. Eastern Time. Mr. Tom Tracy reported no conflicts of interest were identified and EPA received no public comments.

**Subcommittee Chair Opening Remarks and Introductions**

*Paula Olsiewski, Chair*

Dr. Paula Olsieski welcomed participants.

Dr. Justin Teegarden encouraged the subcommittee members to take notes and engage in conversation. The subcommittee members were introduced.

**Welcome of Office of Research and Development**

*Bruce Rodan, Associate Director for Science, Office of Research and Development*

*Chris Frey, Deputy Assistant Administrator, Office of Research and Development*

Dr. Bruce Rodan commented on the implementation of Homeland Security Research Program's (HSRP) wide area research and broad portfolio. Dr. Rodan introduced Dr. Christopher Frey, who described his excitement to be at EPA and noted his background with the Agency. He expressed his appreciation for EPA staff members. He also shared the new commitments and priorities of the Biden-Harris Administration to scientific integrity, climate change and environmental justice. Dr. Frey noted HRSP's research that supports these Administration's priorities and others.

Dr. Rodan said partner engagement is a hallmark of HSRP. He discussed how the Agency has continued to produce the science needed throughout the pandemic, and he explained how HSRP scientists' research have helped address virus related issues.

**Welcome of Center for Environmental Solutions and Emergency Response**

*Greg Sayles, Center Director, Center for Environmental Solutions and Emergency Response*

Dr. Greg Sayles thanked the Subcommittee and noted how HSRP is unique in the fact that it conducts much of its research at one EPA center, the Center for Environmental Solutions and Emergency Response (CESER). Dr. Sayles discussed HRSP research related to COVID-19, including research into surface disinfection strategies. One strategy investigated uses an electrostatic sprayer for disinfecting. HSRP scientists worked with alternative disinfecting strategies such as ultraviolet lights. CESER shared these findings by hosting a series of public webinars and regularly updated the HSRP website.

## **Homeland Security Research Program Overview**

*Shawn Ryan, Acting Deputy National Program Director, Homeland Security Research Program*  
*Sang Don Lee, Acting Principal Associate National Program Director, Homeland Security Research Program*

Dr. Shawn Ryan noted that HRSP's work focuses on chemical, biological and radiological contaminants and involves program partners, such as the Office of Water (OW), Office of Land and Emergency Management (OLEM), EPA regional offices, other federal agencies, states, local communities, tribes, and territories. He mentioned the broad range of causes of possible contamination, including terrorist attacks, accidents, and natural disasters, and noted that HRSP's objective is to advance EPA's capabilities and those of state, tribal, and local partners to respond to and recover from wide-area contamination incidents. HRSP also seeks to improve the ability of water utilities to prevent, prepare for, respond to, and recover from water contamination incidents that threaten public health.

Dr. Ryan described HRSP customer-driven research, which is structured around discussing needs with consumers and collaborating with end-users to develop solutions. Dr. Ryan also discussed HRSP's seven research areas, including contaminate characterization, consequence assessment, environmental clean-up, infrastructure remediation, and system approaches to response. He explained several examples of threat scenarios, including wide area dissemination, wide area hot spot contamination, water system contamination, and oil spills. He also described incident responses and the process from sampling and analysis, decontamination, and waste management.

Dr. Ryan further discussed the HRSP facilities, assets, and laboratories across the United States, including the Idaho National Laboratory, and EPA's facilities in Cincinnati, Ohio, Washington, D.C., and Research Triangle Park, North Carolina. HRSP capabilities at some of these facilities involve specialized chambers. He then described HRSP's research approach, including modeling, and methods through bench-scale, pilot scale, and full-scale approaches. To further ensure HRSP research benefits the end-user, he shared field test and demonstration examples including bio-operational testing and evaluation, radiological mitigation, and underground transportation.

### **Charge Question 1: Overview of Sampling and Analysis Research**

*Sarah Taft, Associate Director, Center for Environmental Solutions and Emergency Response*

Dr. Sarah Taft presented an overview of her sampling and analysis research program. She explained why sampling is necessary, the needed methods, protocols, and tools, and the delivery mechanism for sampling output. She emphasized the importance of EPA researchers having a clear understanding of wide area contamination.

HRSP scientists perform sampling by developing a plan, collecting samples in the field, processing collected samples, and finally analyzing them. She described the Environmental Sampling and Analytical Methods (ESAM) tool, and its global impact by presenting the number of tool users. Dr. Teegarden asked to what extent the ESAM tool includes EPA capabilities versus analytical methods and offerings of other federal agencies. Dr. Taft explained that the tool

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incorporates and evaluates methods from a variety of sources, including other federal agencies and publications.

**Lightning Session for Characterization**

**Environmental Sampling and Analytical Methods Program Video**

*Kathy Hall, Health Physicist, Center for Environmental Solutions and Emergency Response*

Ms. Erin Silvestri presented on behalf of Kathy Hall. She described development of the Environmental Sampling and Analytical Methods (ESAM) tool in response to a need for better sampling and analysis methods during a response. ESAM supports field and laboratory efforts to characterize contaminated sites and aid remediation efforts. A user-friendly website (<https://www.epa.gov/esam>) hosts the tool, which helps facilitate a coordinated response following a wide area contamination incident. She played a YouTube video demonstrating the ESAM tool and noted that next steps involve regularly updating companion documents related to Selected Analytical Methods for Environmental Remediation and Recovery (SAM).

- **Murray Cohen:** (1) Is there a specific program for promotion and outreach to other governmental agencies around the world or to first responder nongovernmental organizations: (2) Is there a help desk available during a remediation or response? (3) Are translations available for non-English speaking countries?
  - **Erin Silvestri:** There is no help desk, but users can email questions through a Contact Us link on the website. Information is spread at conferences and via word of mouth because there is no separate strategic marketing program.
- **Murray Cohen:** Would it be helpful for BOSC to recommend these?
  - **Erin Silvestri:** Resources are better spent on evaluating current efforts and sharing with responders rather than trying to reach a broader audience.
  - **Justin Teegarden:** I agree with that comment. EPA's mandate is to serve partners.
  - **Shawn Ryan:** Although there is no help desk, technological support is always available to partners.

**Trade-Off Tool for Sampling**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe reported on Trade-Off Tool for Sampling (TOTS), which was born of a need to select a sampling design that will address site-specific objects, meet clearance goals, and not exceed available resources. TOTS is a web-based application that organizes the sample design process into steps supported by a geographic information system (GIS)-based graphical user interface for developing sampling plans. There are three takeaways: (1) A GIS platform with mapping coordinates clearly defines a location. (2) GIS teams can easily segue from design into implementation. (3) TOTS minimizes costs and time. He showed a video demonstrating TOTS, noting it is designed to be easy to use and does not require huge technical expertise. He reviewed the functionality of TOTS, describing the step-by-step process (define location, add data, create a

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plan, calculate resources, publish plan) that guides users through the design process. TOTS reduces design and implementation time from days to minutes, so it is highly cost effective and useful.

- **Justin Teegarden:** There is a question from the chat asking whether the tool allows for overlay of topography, windflow, and waterflow lines across the landscape to inform users where materials might move due to environmental forces and inform environmental sampling plans.
  - **Tim Boe:** The tool includes existing base maps and users can also add data.

**Development of Sampling and Analysis Methods for Outdoor Environments**

*Worth Calfee, Microbiologist, Center for Environmental Solutions and Emergency Response*

Dr. Worth Calfee stated that many methods have been developed for indoor environments, but their implementation in outdoor environments is questionable. He described how EPA is conducting laboratory experiments and field testing under outdoor conditions to evaluate methods performance and identify areas for optimization to address the need for new, innovative methods for outdoor sampling,

**Resuspension of *B. anthracis* Surrogates on Underground Subway Surfaces**

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

Mr. John Archer discussed a collaborative effort with national laboratories and the Department of Homeland Security (DHS) to evaluate aerosol transport of threat agents by comparing resuspension of a sugar-based deoxyribonucleic acid (DNA)-tagged threat agent with established biological surrogate spores under realistic surface and environmental conditions using a wind tunnel. He noted that tests revealed there is no statistically substantial difference in aerosol behavior of the particles when humidity is low, and this process can be used in additional field studies.

**Development of Activity-Based Aggressive-Air Contained Sampling System**

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

Mr. Archer described the Activity-Based Aggressive-Air Contained Sampling System (AACeSS) system, which is an air sampling protocol for examining exposure risk and characterization after release of an agent during a wide area scenario. The approach involves using an aerosol wind tunnel to test an indoor asbestos release remediation sampling protocol and other EPA outdoor asbestos release remediation procedures to determine feasibility in wide area biological release scenarios. Next steps involve conducting additional fields tests and developing a mobile sampler.

- **Murray Cohen:** Does EPA has the ability or desire to compare findings to similar work previously done by the Army?
  - **John Archer:** It is certainly something to consider.
  - **Shawn Ryan:** An unclassified report summarizing available information from Army was inconclusive.

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- **Larry Kaelin:** Is aggressive air sampling for particulates in a contaminated residence by re-suspending surface particulates and then using a negative air machine with filters is viable?
  - **John Archer:** It would require a simulant, but the technique is useful for any biological, chemical, or radiological contaminant.
- **Debbie Reinhart:** Has research incorporated other programs, such as Small Business Innovative Research (SBIR) or EPA’s People, Prosperity, and the Planet (P3) program, to develop technology solutions to specific sampling problems.
  - **Shawn Ryan:** Our work includes reviewing program needs to determine whether the SBIR process may be beneficial for developing innovative solutions.
- **Justin Teegarden:** Is the mobile sampling prototype innovative? Does it involve commercial off-the-shelf equipment?
  - **John Archer:** The technology is simple, and all materials used in tests are commercially available.

**Bio-Agent Analytical Methods Development**

*Sanjiv Shah, Microbiologist, Center for Environmental Solutions and Emergency Response*

Dr. Sanjiv Shah described recent efforts to develop rapid, sensitive, specific, and high-throughput analytical methods to test different types of samples from a variety of surfaces and materials for the presence of bio-agents, including biotoxins. He stated that such methods enhance the capability and capacity of the EPA Office of Emergency Management’s Environmental Response Laboratory Network (ERLN) and the EPA Office of Water’s Water Laboratory Alliance (WLA) for environmental sample analysis to respond to a bio-agent wide area contamination incident. He remarked that an effective sampling processing method for ricin biotoxins can be used for other biotoxins. He also noted that detailed sampling protocols and papers and reports of published results are posted online, and next steps involve continued evaluation to ensure methods work in real-world scenarios.

**Bio-Sampling Training Simulator**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe discussed this training simulator developed in under a year that EPA uses to train emergency responders on sampling methods for biosampling. This application uses a virtual reality platform to enhance the training experience. EPA used an existing, off-the-shelf game engine and redesigned it as a sampling training tool, which saved substantially on costs and time. He displayed a YouTube video demonstrating the tool. Swab, sponge, and vacuum sample types are available within the simulation. The simulated environment allows for training on multiple scenarios in a safe, cost-effective way. Current projects are underway to investigate ways to further enhance and share the tool with partners.

He responded to a comment in the chat, noting that EPA is working collaboratively with other researchers to develop solutions involving indoor mapping applications.



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**Fentanyl Sampling and Analysis**

*Stuart Willison, Research Chemist, Center for Environmental Solutions and Emergency Response*

Dr. Stuart Willison summarized EPA's ongoing work to provide decisionmakers, law enforcement, and Hazmat with sampling and analytical capabilities to properly characterize and decontaminate fentanyl-affected areas to reduce environmental and public health concerns.

**Innovative Sampling Methods for HS Chemicals**

*Lukas Oudejans, Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

Dr. Lukas Oudejans described an effort to assess the efficiency of a wet-vacuum sampling method approach to better sample larger areas than traditional sampling methods. The approach was effective using water for water soluble chemicals and extended the approach using various organic solvents for non-water-soluble chemicals. He noted that equipment is widely available for relatively low cost and that work continues to better optimize these approaches for use in the field.

- **Paula Olsiewski:** Is a surfactant is ever used?
  - **Lukas Oudejans:** The research involves comparing results from tests using both surfactants and water alone.
- **Paula Olsiewski:** Are the surfaces tested are environmentally aged?
  - **Lukas Oudejans:** No, surfaces were clean in the tests, so there may be a need to filtrate liquids.
- **Paula Olsiewski:** An indoor surface consortium that might have some useful information to guide further developments.

**Sampling and Analysis Plan Resources**

*Erin Silvestri, Biologist, Center for Environmental Solutions and Emergency Response*

Ms. Silvestri noted that during all stages of remediation, Sampling and Analysis Plans (SAPs) document the criteria used to ensure quality data based on analytical results. EPA is developing standardized user-friendly SAP templates, which are available on the ESAM (<https://www.epa.gov/easm/sampling-and-analysis-plan-resources-pathogens>) website. Next steps involve replacing current MS Word and PDF templates with online versions that can interface with other online tools.

- **Justin Teegarden:** Do EPA SAPs specify collection and storage of metadata, which is useful supporting data to include in a database?
  - **Erin Silvestri:** Although current templates do not collect metadata, there is a section where users can describe or upload laboratory results. Future work should involve incorporating this into the SAPs.

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- **Larry Kaelin:** EPA has an MS Access database commonly used to pull GIS data and link it to sample analytical data.

**Data Visualization/Management**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe discussed EPA's use of commercial off-the-shelf applications to meet partners' needs and how processes and tools are connected and work together. He described how EPA is operationalizing data acquisition and management in an Alaska waste management field study, emphasizing how clear data management plans that include visualizations can inform real-world response and scientific studies. He stated that EPA is pursuing new technologies and constantly evaluating data acquisition tools to improve data visualization and management (e.g., examining use of quick response (QR) codes to automate information acquisition).

**Partners Round Table**

*Larry Kaelin, Chemist, EPA Office of Emergency Management*

*Leroy Mickelsen, Engineer, EPA Office of Emergency Management*

*Jim Mitchell, On-Scene Coordinator, EPA Region 5*

Mr. Kaelin, Mr. Leroy Mickelsen, and Mr. Jim Mitchell introduced themselves and described EPA partnerships focusing on traditional and emerging chemical threats and response issues, such as decontamination, sampling and analysis, and toxicity. Mr. Kaelin and Mr. Mickelsen conduct similar work in providing technical advice to On-Scene Coordinators (OSCs) related to chemical, biological, and radiological decontamination and sampling. Mr. Mitchell's experience includes extensive radiation removal and remediation.

- **Murray Cohen:** What is the status of the interesting field studies presented about last year?
  - **Leroy Mickelsen:** The research continues to extend anthrax research. Early in the COVID-19 pandemic, we developed in the laboratory several methods for decontaminating items from COVID using off-the-shelf hydrogen peroxide.
- **Murray Cohen:** There is much confusing and sometimes contradictory information available. How are findings clearly disseminated?
  - **Leroy Mickelsen:** There is no marketing team to assist with sharing results, but our research did appear in a published technical brief.
- **Murray Cohen:** Should BOSC recommend development of enhanced information sharing efforts?
  - **Joe Wood:** The published technical brief is available on the HSRP's website. There is a communications team that could fill the information sharing need.
  - **Shawn Ryan:** Research often crosses program lines, and every office is responsible for promoting its research.
- **Murray Cohen:** Is there regular communication with the Centers for Disease Control and Prevention (CDC) or the Food and Drug Administration (FDA)?

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- **Shawn Ryan:** There is communication, but collaborations often complicate the issue. Sharing broadly with the scientific community would be very helpful.
- **Debbie Reinhart:** How do you prioritize research and tools, given limited available resources? Are any of the partners able to influence those decisions?
  - **Leroy Mickelsen:** There is a Partner Process frequently used that involves EPA Office of Research and Development (ORD) reaching out to partners (first responders, EPA workgroups, and others) to determine and rank needs.
- **Justin Teegarden:** There is a balance between innovation and existing technologies. To what extent do needs require innovation versus off-the-shelf capabilities, and do responses typically include appropriate innovations?
  - **Leroy Mickelsen:** The problem is that traditional sampling methods cannot meet wide area remediation needs, so EPA's focus is on providing products easily used in the field rather than on designing expensive innovative equipment. EPA develops innovative modifications to off-the-shelf products.
  - **Larry Kaelin:** The research and development focus is on using new technologies to modify and further develop existing methods or tools.
  - **Jim Mitchell:** There are many products available that are not necessarily applicable to a wide area response, so EPA primarily applies existing products to meet needs. EPA regularly monitors industries and communicates with the private sector, sharing information about wide area event needs that might be useful in others' development work.
  - **Dana Tulis:** Focusing on innovation and creativity can lead to new product obsolescence after all regulations and requirements are met. Closely aligning research to operational needs is more important than being creative and innovative.

**BOSC Subcommittee Discussion and Question and Answer**

*Paula Olsiewski, Chair*

- **Paula Olsiewski:** Dr. Cohen noted a slide from an earlier presentation highlighted ESAM's global coverage, but upon questioning the presenter stated the mission is global. There is global collaboration, but the monetary focus is on the United States.
- **Shawn Ryan:** We conduct research to benefit partners, but we also share products with other stakeholders. Global collaboration is something to leverage as long as the focus is on developing capabilities needed by partners.
- **Justin Teegarden:** How do you determine innovation needs through analysis gaps, requests for information, or otherwise, and how can innovation lead to the development of faster, cheaper methods?
  - **Shawn Ryan:** HSRP prioritizes critical needs then assesses available resources.
  - **Sang Don Lee:** HSRP scientists determine which needs are critical needs and prioritize those. Meeting partner needs is the goal rather than innovation.

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- **Sarah Taft:** Because EPA’s Strategic Research Action Plans (StRAPs) are written in four-year spans, that could limit innovative perspectives.
- **Andrew DeGraca:** The StRAP is not constructive. I would like to see a longer-term transparent planning process assessing goal capabilities based on a gap analysis.
- **Worth Calfee:** Scope is expanded when planning for wide area incidents. Development of tools like TOTS results from a direct need.
- **Tim Boe:** Both innovation and EPA guidance informs development of software tools. We use artificial intelligence to enhance decision-making and seek to address both long-term and immediate research needs.
- **Justin Teegarden:** ESAM is a highly innovative tool.
- **Michael Wichman:** Does innovation involve methods for screening samples?
  - **Justin Teegarden:** Priority lists and broader screening approaches can lead to adoption of advancements in analytical chemistry or age identification that embrace a much broader group of agents.
  - **Sarah Taft:** EPA’s focus on priority pathogens includes a potential for developing future useful tools in chemistry and biology.
- **Justin Teegarden:** Describe the comprehensiveness and speed of determining needs for problem solving.
  - **Sang Don Lee:** There is room for improvement but surveying available resources and implementing solutions takes time. Reviewing solutions to similar problems and literature reviews are helpful.
  - **Sarah Taft:** Speed is important during emergency responses, but other situations allow for additional time.
  - **Shawn Ryan:** The process is complex and involves balancing urgent needs with those less urgent.
- **Michael Wichman:** What quality assurance measures are applied during rapid response emergencies?
  - **Sarah Taft:** Quality assurance has been important in COVID-19 work.
  - **Shawn Ryan:** COVID-19 research has required the highest level of quality assessment.
- **Monica Schoch-Spana:** What is the role of diversity and inclusion in working with partners, who tend to be white males?
  - **Shawn Ryan:** Diversity is an area that needs growth.
  - **Sang Don Lee:** HSRP incorporated social science in research after ORD reorganization, and social scientists have advanced HSRP’s community engagement, but are there gaps?
  - **Monica Schoch-Spana:** Is there collaboration between HSRP and environmental justice groups?
  - **Shawn Ryan:** There are collaborations in place that will continue.

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- **Monica Schoch-Spana:** From the perspective of my region bordering Mexico, translating ESAM into Spanish would be a social rather technical innovation.

The meeting adjourned at 5:00 p.m., Eastern Time

**Tuesday, May 18, 2021**

**Welcome – Day 2**

*Paula Olsiewski, Chair*

Dr. Olsiewski thanked EPA for yesterday's excellent presentations and reminded the committee to remember to focus on the charge questions as discussion proceeds. Please refer to Appendix C: Charge Questions for the list of charge questions.

**Charge Question 2: Overview of Wide Area Decontamination Research**

*Lance Brooks, Chief, Wide Area and Infrastructure Decon Branch, Center for Environmental Solutions and Emergency Response*

Mr. Brooks provided an overview of the charge question and reviewed the agenda. Decontamination challenges are large scale, dynamic in nature and complexity, and there are a lot of unknowns. Wide-area incidents impact residential, commercial, critical infrastructure, industrial, agricultural, natural and other areas. EPA assists state and local government in developing decontamination strategies and/or directly decontaminating areas.

Decontamination removes or inactivates contaminants and stops the spread of contaminants. Different approaches may be required due to types of contaminants, area, urgency, and other factors. Wide-area decontamination requires comprehensive systematic remediation to help impacted communities recover rapidly and safely. Capabilities for effective wide-area decontamination include expertise (knowledge of mitigation options, contaminants), methods/technologies (operational and technical information about methods), resources (equipment, material, utilities), and workers (skilled available labor; keeping in mind workers' health and safety).

Mr. Brooks reviewed high-level gaps and needs identified by EPA customers in the 2019-2022 StRAP, which include: outdoor decontamination efficacy; application parameters for anthrax and non-anthrax biological agents; waste volume reduction methods; self-help decontamination and/or risk reduction measures, tools, and practices; effective methods for porous or permeable materials for chemical warfare agents and other chemicals of concern; and nondestructive and operational decontamination methods for chemical warfare agents and toxic industrial chemicals on sensitive equipment, rolling stock, valuable items, records.

He reviewed decontamination method development approaches, including: repurposing existing capabilities and methods; use of municipal and commercial equipment; use of low-tech decontamination methods when possible; method identification via literature reviews, stakeholder communications, and market research; bench testing proof of concept, efficacy, material impact, and material compatibility; pilot testing to determine costs and time, scalability,

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level of effort, resource availability, and waste; field testing of capacity and availability, environmental impact, challenges, and lessons learned; and incident response use evaluation of lessons learned and revision of methods.

He noted that EPA Principal Investigators (PIs) have broad experience. Many have participated in actual anthrax, Ebola, pesticides, opioids, and nuclear incidents, such as Fukushima. EPA staff members participate in exercises and have been involved in myriad field studies. This experience supports collaborations and ensures that products are developed within a systems approach.

**Lightning Session for Decontamination**

**Biological Decontamination**

*Worth Calfee, Microbiologist, Center for Environmental Solutions and Emergency Response*

*Joe Wood, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

**Soil Decontamination for Non-spore Agents**

*Worth Calfee, Microbiologist, Center for Environmental Solutions and Emergency Response*

Dr. Calfee described work incorporating easily deployable decontamination approaches for non-spore-forming biological agents in soil. Spores are very difficult to decontaminate in soil, and only a few approaches are effective, so there are many challenges. He identified a need for better decontamination methods and described an incident at the Tulane National Primate Research Center, which had a biosecurity breach involving release into the outdoor animal enclosure environment of an agent being investigated at the facility. The breach resulted in an infected animal. EPA consulted on the case, reviewing needs and the need for an action plan. After a small sampling campaign, the state, CDC, and EPA decided decontamination was not needed. Decontamination options considered were not easily deployable because most methods are related to spore decontamination. Dr. Calfee emphasized the need for better methods and more viable solutions. EPA is currently focused on bench scale work to screen potential chemistries to identify methods that might work and will move through evaluations into eventual field testing.

**Material Compatibility of Sporicides**

*Joe Wood, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Mr. Wood stated that EPA has identified a need to understand the impacts decontamination might have on various types of equipment and materials (e.g., computers, electronics, and metals). The scientific approach involves exposing materials and equipment to decontaminants at conditions known to inactivate spores, then monitoring for corrosion and degradation visually and by other methods, and then testing functionality over several months. The purpose of such studies is to inform decisions about sporicidal decontaminants to use for materials and equipment in the event of future wide-area anthrax releases.

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- **Justin Teegarden:** Is it viable to augment visual searches for material destruction with microscopy?
  - **Joe Wood:** Use of microscopy would be ideal. It was used in initial tests completed years ago, but cost and level of effort factors affect decisions about using microscopy.
- **Justin Teegarden:** During the response to COVID-19, there was a push for using aerosol non-destructive decontamination methods, and this resulted in multiple new entries into the field. Have these new developments guided recent work?
  - **Joe Wood:** I am on the COVID research team, and we are reviewing air filtration methods and potential new wide-area decontamination methods.
- **Paula Olsieski:** Does EPA perform risk assessments about indoor exposure to decontaminant chemicals, such as vaporized hydrogen peroxide, when evaluating what methods work with spores?
  - **Joe Wood:** Gases and liquid decontaminants for anthrax are very dangerous to health.
  - **John Archer:** There are always industrial hygienists on site when testing fumigants. Health and safety are always part of EPA's work, along with risk assessments.
- **Murray Cohen:** Is the dichlor mentioned in research next steps chlorine dioxide?
  - **Joe Wood:** Dichlor is a swimming pool chemical (dichloroisocyanurate), which has sporicidal properties.

### **Neutralization of Ricin Toxin**

*Joe Wood, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Mr. Wood described EPA research on the efficacy of methods to decontaminate materials contaminated with ricin and other biotoxins. There have been several ricin incidents in the United States. EPA was involved in one incident in Wisconsin last year. The scientific approach includes small-scale tests where various types of materials are inoculated with the toxin in crude or pure form and then exposed to the decontaminant. Following the contact time of the decontaminant, a cytotoxicity assay quantifies remaining ricin recovered from the materials. The purpose of this research is to guide decisions about which decontaminants to use in the event of a ricin contamination incident. Next steps include evaluating the use of liquid decontaminants (e.g., dilute bleach) and using low concentration hydrogen peroxide vapor.

- **Justin Teegarden:** Do you balance single experiments (one compound, one material, one question) versus investing in efficacy studies of higher throughput? Do resources allow for quicker testing of materials for compatibility with other materials outside of single experiments?
  - **Lance Brooks:** I'll hold off on answering until the end of the session.

## Personnel Decontamination Line Sprayer Options for BIO Contamination Incident Response

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

Mr. Archer described EPA's science-driven research into providing guidance to responders on methods for environmental decontamination of indoor/outdoor surfaces. He stated there is a crucial need for methods that are efficacious, minimize exposure, and minimize cross-contamination. EPA is determining decontamination efficacy, re-aerosolization potential, and optimized operational parameters using controlled spore inoculations.

He explained small-scale bench research involving small coupons covered in various personal protective equipment (PPE) surfaces. The research used both larger conventional garden backpack sprayers used to clean decks and innovative electrostatic sprayers, which have been popular during COVID-19. Historically, larger sprayers deluge personnel in water, resulting in waste and potential cross-contamination due to the large volume of liquid used. The research involved comparing the two sprayers on a coupon scale and a pilot scale using mannequins to determine whether the coupon method works on three-dimensional surfaces. Although inoculations were only in seven spots, sampling included the entire mannequin. CESER also inoculated spores as a liquid and aerosol. The study examined the efficacy of a diluted bleach decontaminant and whether re-aerosolization is achieved. Results indicated that: aerosol inoculation resulted in more re-aerosolization; liquid inoculation can result in clumping of spores and adhesion, whereas a dry format is easier to re-aerosolize and more effective in a real-life scenario; and diluted bleach works well via either method; so there are advantages and disadvantages to both methods. Next steps involve increasing the scale beyond single sprayers, optimizing procedures, and testing additional decontaminants and electrostatic sprayers. Plans include automating the process by using decontamination showers and nozzles to generate a mist rather than dousing responders in copious amounts of liquid decontaminants, which leads to waste, runoff, and cross-contamination. This research will provide EPA and other responders with scientific data on conventional and innovative options for conducting personal decontamination for biological agent response.

- **Murray Cohen:** Where can customers find information on results of studies regarding the efficacy of different sprayers and the best type of sprayer for each contaminant?
  - **John Archer:** There are various ways EPA disseminates information. An EPA report (for a coupon study) or a journal article is comprehensive, whereas a short technical fact sheet summarizing lessons learned is especially useful for the public and responders. There will be a primary method to disseminate information quickly and in a condensed form once studies are complete.
- **Debbie Reinhart:** Is there any potential for re-using PPE after decontamination to reduce the amount of waste generated?
  - **John Archer:** EPA has discussed this with OSCs, and the method of suit removal directly impacts the issue of suit re-use. Some responders remove suits by cutting them off, eliminating the possibility of re-use. Others remove suits more carefully, allowing for potential re-use, although this is not ideal, and the Occupational Safety and Health Administration (OSHA) would not promote it. Cost and supply



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factors may be an argument for re-use. More research is needed to examine different decontaminants' effects on suits.

**Chemical Decontamination**

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*  
*Lukas Oudejans, Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

**Personnel Chemical Decontamination Line Options for the Responder**

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

Mr. Archer described a technique used by the Federal Bureau of Investigation (FBI) and others – the Wipe-Spray Wipe (W-S-W) personnel decontamination process. It is innovative because the technique uses an initial wipe for gross decontamination to spread or remove contaminant, then use a sprayer as second interim method, and finally wipe again following use of the sprayer. He pointed out that there is not much scientific data to support its use, however; there have only been a few small studies on its effectiveness. EPA is working with the FBI to evaluate its efficacy for chemical and biological decontamination to determine how it physically removes contaminants. This research will be beneficial for other government agencies, as well.

EPA is also investigating better degradation options for the fentanyl/opioids issue. Initial research has begun to examine short dwell times for fentanyl on PPE and different decontamination methodologies. The research is innovative in its use of electrostatic sprayers to study runoff of liquid decontaminants, which minimizes exposure risks and cross-contamination.

- **Monica Schoch-Spana:** Does EPA consider the risk perceptions of personnel even though current research involves testing on mannequins rather than people? What are perceptions about the shift from dousing to something more efficient.
  - **John Archer:** EPA intends to conduct a field demonstration that will include obtaining feedback from responders. He agreed that risk perception is very important but argued that dissemination of good data supporting new methods to responders could change perceptions. Dr. Calfee commented there was a recent boat incident response involving feedback from responders about breaches around the neck area and volatile chemical issues.

**Surface Decontamination Methods for Pesticides**

*Lukas Oudejans, Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

Dr. Oudejans provided an overview of research on surface decontamination methods for pesticides. Over the last 10 years or so, EPA has received from regions many requests for clean-up work technical support. There are many challenges in evaluating risk and determining effective decontaminants. Incorrect cleaning can create a toxic byproduct resulting in severe health effects and contaminated properties, so multiple approaches are needed. He emphasized

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the need to avoid costly, unreasonable, or unnecessary steps when seeking a feasible and widely available approach. He described bench-scale research to evaluate the efficacy of decontaminants for various types of contaminants and emphasized the need to use realistic contamination levels application rates for decontaminants in the field. Findings identified a couple of efficacious solutions, including a method that creates a permeable material (e.g., paint) layer on a simulated porous material (e.g., drywall) and evaluates results. EPA has the capability to study on a more microscopic scale, as well.

**Decontamination of Persistent Chemical Warfare Agents and DeconST**

*Lukas Oudejans, Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

Dr. Oudejans described research on methods to decontaminate sensitive equipment and permeable/porous materials contaminated with persistent chemical warfare agents (CWAs). Science is examining the efficacy of decontaminants that do not degrade sensitive materials while degrading CWAs. There is a need to decontaminate efficiently but also ensure materials remain intact. He mentioned an instance where ambulances wound up in landfill because there was no effective method to decontaminate the ambulances. Using realistic application rates of decontaminants in a systematic approach is critical, as is transferring information to responders in the field.

He noted there will be a discussion of Operational Technical Evaluation of Chemical Remediation Activities (OTECRA) on day 4 of this BOSC meeting. He proceeded to demonstrate a tool called Decontamination Strategy and Technology Selection Tool (DoconST), which is an Excel spreadsheet that collects information regarding efficacy of a product and costs. The tool includes an input page defining whether the agent is chemical, biological, or radiological and identifies the location of contamination. It records dimensions on area size, heating and air conditioning considerations, weather information, and other facility considerations (e.g., whether a structure may be contaminated or contain asbestos). It provides a decontamination efficacy threshold and includes cost-scaling factors. Users can quickly update the tool and generate various results report summaries of approaches, sampling and materials inputs, and potentials costs waste.

**Radiological Decontamination**

*Matthew Magnuson, Research Chemist, Center for Environmental Solutions and Emergency Response*

*Kathy Hall, Health Physicist, Center for Environmental Solutions and Emergency Response*

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

*Anne Mikelonis, Environmental Engineer, Center for Environmental Solutions and Emergency Response*

## **Integrated Wash-Aid, Treatment, and Emergency Reuse System**

*Matthew Magnuson, Research Chemist, Center for Environmental Solutions and Emergency Response*

Dr. Matthew Magnuson described an on-site approach to re-use water for washing vehicles, buildings, and paved surfaces. The research investigates ways to increase safety and control wastewater runoff when using fire hoses. The technical approach focuses on using commercial off-the-shelf equipment (e.g., firehoses, induction systems containing a wash aid, berms that collect water) to help solve the problem and reduce exposure to first responders, emergency workers, and surrounding populations. Next steps involve researching specific biological and chemical contaminants and treatment needs. EPA is collaborating with DHS on a project to develop an artificial intelligence wizard to select readily available municipal equipment (e.g., street sweepers) based on site needs and evaluate efficacy data derived from actual experiments.

## **Roofing Material Decontamination**

*Kathy Hall, Health Physicist, Center for Environmental Solutions and Emergency Response*

Kathy Hall described a current, ongoing project studying roofing material decontamination methods. High doses of contamination can collect on roofs, which have a large surface area. Therefore, a cost-effective method to clean them to avoid waste and the high cost of roof replacement is needed. CESER is conducting small coupon research using cesium 137 and testing four different roofing materials at a time (standard residential asphalt shingles, wood shingles, clay shingles, and flat asphalt on business buildings) while using four different decontamination technologies. The research generates percent removal calculations and records operational data on time, cost, and training needs in an electronic application from which users can export data as a PDF report. The tool will eventually include self-help project information. Other decontamination reports and tools include information about this research. Next steps will focus on studying urban high-value interiors (arenas, offices museums, hotels, convention centers) where decontamination is needed on a larger scale. There is also a literature search in progress that will inform needs.

- **Paula Olsieski:** There is a movement in New York to make roofs white. Is EPA conducting any work on this type of roof?
  - **Kathy Hall:** White roofing is not currently included in the research and noted that the issue may be unique to New York.

## **Integrated Rad Remediation Decision Support Tool**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe described a modeling decision support tool to automate estimates of surface area contamination and determine the number of iterations of mechanical removal needed. Using work conducted by Ms. Hall, CESER created an optimization model that estimates the depth of surface contamination. The model incorporates imagery, projects it to a three-dimensional map, determines surface area, and determines the number of iterations needed to remove contaminants. The tool helps determine optimal removal methods, recommended technologies, amounts of generated waste, and cost, time, and equipment needed.

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He noted that the model currently uses an expensive gamma-ray imagery camera, which is not cost effective. There is a need to examine whether commercially available equipment or equipment that regions already have (e.g., radiation meters and detection probes) could produce the same effects and quickly be assembled in the field. He stated CESER is currently developing a prototype that uses off-the-shelf collectors and plugs into a device comparable with Raspberry Pi, a mini controller, that could be quickly assembled and used to provide the same amount of information as that generated by the more expensive camera. Using commercial off-the-shelf technologies and inventory on hand would facilitate cost-effective and easy decontamination work in the event of a large-scale event. Plans include mounting the tool on an unmanned vehicle that could enter facilities, map locations, determine location of contamination, and identify isotopes.

**Stormwater and Washdown Research**

*Anne Mikelonis, Environmental Engineer, Center for Environmental Solutions and Emergency Response*

Dr. Mikelonis presented and displayed a video about research into treatment methods studied in washdown research, such as pressure washing, hosing spores, and wash-aides. The video also displayed sampling collections, including residual water collection. She explained that the research aims to understand the efficacy of wash-aids for decontaminating outdoor surfaces after a biological incident and noted that the research could contribute to creating a dataset that would aid emergency responders at sites needing spore removal.

She discussed stormwater research for emergency response and noted the need for prediction of contaminant fate and transport during emergency response and recovery efforts. CESER is conducting a mixture of modeling, laboratory, and field studies to develop new capabilities with stormwater modeling tools to support flexible contamination mapping. This Stormwater Emergency Response Framework (SERF) research will help decision makers quantify remediation technologies, site topography, and water quality. She noted that EPA is in the process of building a website that includes information on the various device's utilities. Next steps include developing case studies into table-top exercises and models. EPA will soon collaborate with the Coast Guard on a field study in which differing surfaces will be washed and evaluated. Lastly, EPA is coupling optimization algorithms with stormwater models for resource placement.

Dr. Mikelonis shared another video about a hypothetical small benzene spill contamination and a partnership with Kingbridge, Massachusetts, and Hamilton County, Ohio to evaluate methods.

- **Debbie Reinhart:** Is the angle of power washing critical?
  - **Anne Mikelonis:** We used a particular angle when power washing in the laboratory. The angle is important because it changes the energy of the washing.
- **Justin Teegarden:** Can tests be moved from a large outdoor setting to a small apparatus in the laboratory to turn the research into a higher through-put activity?

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- **Anne Mikelonis:** We conducted research in a small laboratory setting focused on brick and glass for two years prior to the outdoor testing. We were able to review more surfaces because testing was conducted indoors.

**Supporting Chemical, Biological, Radiological and Nuclear (CBRN) Cleanup Decisions**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe presented on the QR Toolbox, which EPA developed in response to a need to track QR codes during emergency response. This tool is an open-source application that uses QR codes to track equipment for emergency response. It was used in the 2018 hurricane season, which contributed substantially to EPA financial gains.

He noted that critical infrastructure modeling applications should be available in 2021. To address the most critical components for emergency response, CESER worked with DHS to prioritize infrastructure. CESER completed the GIS component of this tool to identify the connectivity of infrastructure and recovery time.

Dr. Boe discussed wide-area decontamination modeling and how it is important to estimate the demands associated with wide-area biological event to help prepare for future incidents. The model can estimate the cost of decontamination such as the time and resources required to do so, which is critical to being prepared for decontamination.

- **Justin Teegarden:** How is critical infrastructure connected?
  - **Tim Boe:** We asked DHS whether Path Aware had critical infrastructure connectivity. DHS provided EPA scientists with a matrix of data to consider the connectivity of critical infrastructure. We also considered hurricanes when researching critical infrastructure needs. EPA plans to continue conversations with DHS.
- **Justin Teegarden:** Does this model depend on efficacy?
  - **Tim Boe:** The model does account for efficacy, but we needed to prioritize the top five influencing factors related to decontamination.

**Partners Round Table**

*Mark Durno, Homeland Security Coordinator, EPA Region 5*

*Jason Musante, On-Scene Coordinator, EPA Region 9*

*Scott Hudson, Health Physicist, EPA Office of Emergency Management*

Mr. Brooks introduced the partners for the roundtable.

Mark Durno had worked in emergency response for 28 years. In 1998 he was integrated into domestic preparedness. He has assisted with EPA's partner program to evaluate and determine what research needs would help support efforts in the field. Mr. Durno discussed how collaboration is as valuable as the products that EPA develops. He developed the BioGuide for how to respond to a biological incident, and it helped bring CDC and EPA together in developing clearance guidance on when it is safe to reenter buildings.

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Scott Hudson is a Health Physicist with 26 years of experience in the field. He transferred to EPA from the Army in 2005 and had noted the collaboration between ORD and OLEM. He has worked on national planning scenarios and decontamination planning. In the last two years he has contributed to 10 EPA peer reviews. Currently, he is supporting development of a radiological workshop in collaboration with Dr. Lee. He shared how one of the efforts he considered most important was the EPA Region 2 Ebola decontamination response procedure in 2012.

Jason Musante is a Region 9 OSC, and he has worked at EPA since 2005. He supported the D.C. anthrax decontamination effort and has been the regional bio-watch coordinator for the last five years. He has considerable clean-up experience. He applauded researchers' questions about how to respond to real-world issues and investigating how to do so in advance on incidents. He described his work in biofilm research, radiological contamination in groundwater, and Los Angeles, California public transportation.

- **Justin Teeguarden:** How well does EPA adapt off-the-shelf resources to address situations and incidents?
  - **Mark Durno:** We review wide area tools, such as Rumba sweepers.
  - **Scott Hudson:** EPA should devote most monetary resources to commercial products because those are designed for consumers to work properly. Large-scale decontamination or application demonstrations that produce highly valuable research is more important than special interest, small-scale research which cannot be widely implemented.
  - **Jason Musante:** A rapid return to service is economically and sociologically what will make a city viable again. EPA relies heavily on contractors, who acquire supplies from commercial vendors. It is important to identify resources available to support a large-scale decontamination and restoration effort. Efficacy and ranking of what is available is important and needed. Future research to identify commonly and commercially available resources and the ability to supply the quantity and volume of decontamination needed is critical.
- **Justin Teeguarden:** Does EPA use a structured or ad hoc approach to finding solutions and necessary materials, and is there any room for improvement in identifying solutions?
  - **Mark Durno:** It is helpful to use a range of expertise when considering solutions. We use a robust planning process and a continuous partnering program, but there is room for improvement
  - **Jason Musante:** In addition to obtaining input from a wide range of sources, there is a nice balance of creative ad hoc brainstorming used when compiling and evaluating information. Additional input from industry or contractor corps outsiders is more helpful after initial evaluations are complete.

**BOSC Subcommittee Discussion and Question and Answer**

*Introduced by Paula Olsiewski, Chair*

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Dr. Olsieski congratulated presenters, noting the session on partners was particularly informative. She then reminded everyone about the need to answer the charge question.

- **Jason Musante:** The presentations provide a compelling argument that EPA is doing a great job at finding practical solutions for using off-the-shelf products, but are there any concerns about incorporating higher-end technologies? Do such concerns arise from needs identified by stakeholders or partners?
  - **Lance Brooks:** EPA aims to incorporate the latest cost-effective, easily deployed innovations that will result in a good mix and balanced portfolio in response to customer needs. Dr. Lee agreed that EPA's focus is on addressing partners needs for reusable and reliable tools.
- **Debbie Reinhart:** There has not been much discussion about the use of drones.
  - **Lance Brooks:** There is an ORD order prohibiting the use of drones, but it is being reversed and I anticipate drones will be used in future research. Contractors can use them, but federal employees cannot control them. Drones would be extremely useful in mapping contamination and applying contamination mitigation solutions, including actual decontamination.
  - **Paula Olsieski:** There are many uses for drones, which hopefully will be a scientific tool in the future.
  - **Sang Don Lee:** EPA's previous policy prohibited use of science and technology budgets for purchasing or operating drones or unmanned aerial vehicles. However, that policy has changed. The program has not purchased any drones, but we have been preparing by reviewing studies evaluating the current capability of drones for emergency response and reviewing current regulations. We are also reviewing examples of others' use so we are ready to work with drones when allowed.
  - **Dana Tulis:** The Coast Guard has a lot of drones and is using them for remote sensing in oil detection work. The problem is drones are Chinese products and there is a concern about data security, so we keep our data secured separately. The Coast Guard is collaborating with EPA on some projects using drones
  - **Ed Hackney:** I agree about security. In my work for a regulated water utility we are using only American-made drones from Skydio.
  - **Tim Boe:** EPA has been conducting research in using ground-based robots that can navigate, map, use GPS coordinates, and carry large, heavy sensors. We hope to apply lessons learned from using ground-based robots to use of aerial drones.
- **Paula Olsieski:** There is a comment in the chat about using a wholistic, systems approach when offering solutions.
  - **Lance Brooks:** Dr. Boe is using some artificial intelligence learning and virtual reality tools for such activities as mapping buildings that could be applied for decontamination and sampling.

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- **Sang Don Lee:** For the BOSC meeting, charge questions were separated out into research areas for administrative convenience, but a continuous response is needed. Current research planning processes review whether tools and methods used to address one need may have broader benefits.
- **Dana Tulis:** Given the amount of creativity and innovation happening now, I am having difficulty determining what advice to provide for improvement because EPA is already doing such a good job. Determining how to implement research is the challenge. How can BOSC help EPA achieve goals?
  - **Sang Don Lee:** I am also struggling with identifying improvement needs. Homeland Security started with a very clear mission to accumulate knowledge expertise and develop positive partner relationships, but we have not had much chance to test knowledge in real-world incidents and very rarely provide actual products. We are constantly trying to improve work to make it more applicable, reliable, and impactful.
  - **Paula Olsieski:** The ability to pivot and respond is crucial, and to date there have not been many real issues with response. Partners keep emphasizing the need for large-scale responses, but most incidents have not been large-scale.
- **Monica Schoch-Spana:** A cutting-edge and pragmatic program is beneficial for decision science and should incorporate an ethics perspective. There will be a scarcity of technology and of knowledgeable users of specialized technology. Decision-making frameworks touching on social conflicts that arise in a major crisis can be anticipated. EPA should consider social impacts in developing a multidisciplinary approach to mass decontamination.
  - **Worth Calfee:** Incorporating environmental justice and other social considerations in developing self-help programs and critical infrastructure work is important. There has been some progress, but there is room for improvement.
  - **Lance Brooks:** We have some social science divisions in our program, but we could emphasize that more and include more community engagement to identify gaps and needs.
  - **Ed Roehl:** I always wondered whether anyone would use our research, but we constantly receive feedback from those in the field asking technical questions. I have realized our work is preparing to help people. We can quickly adapt point solutions and a broad knowledgebase to solve problems never encountered
  - **Michael Wichman:** Expanding community engagement beyond regional offices might be beneficial for the committee.

Mr. Brooks and Dr. Lee thanked everyone and promised to seriously review all comments.

**Wednesday, May 19, 2021**

**Overview of Waste Management Research**

*Emily Snyder, Acting Deputy National Program Director, Center for Environmental Solutions*



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*and Emergency Response*

Emily Snyder provided an overview of the water management research with CESER. She discussed how water and materials management present challenges. It is important to consider the range of possible disasters. The challenges lead to gaps and needs for the waste generated and on-site waste treatment, waste staging/transport and off-site waste and disposal. It is also important to develop pre-incident planning to manage water and materials. Benefits of pre-incident planning include saving time and resources and increasing efficiency and collaboration amongst stakeholders. Dr. Snyder explained the three focus areas within the Waste Management Research program (WMM) including social science considerations, waters and materials management planning and response tools, and waste treatment and other technical data.

She shared how HSRP scientists assess methods for treatment of chemically and biologically contaminated materials through modeling, laboratory studies, and field studies, and she then reviewed WMM decision making approaches. She described the disaster debris recover tool and the incident waste decision support tool (I-WASTE). She explained how I-WASTE is a web-based tool with information on disposal and treatment facilities, relevant waste management guidance and information, and she described how I-WASTE is linked to the All-Hazards Waste Management Planning Tool. She shared how HSRP scientist consider WMM tool integration, and these tools are important in disaster planning, exercise, and responses.

Dr. Snyder noted HSRP scientists' WMM outreach activities, including working with states on tool development, developing case studies, and presenting an interactive framework to key stakeholders.

- **Debbie Reinhart:** How do you update tools?
  - **Emily Snyder:** We update I-WASTE annually, and EPA checks for broken web links (link rot).
  - **Paul Lemieux:** We do check for link rot.
- **Ed Roehl:** Is there a connection with the Federal Emergency Management Agency (FEMA)?
  - **Emily Snyder:** We have connected with FEMA, and EPA has presented tool capabilities to them.
  - **Paul Lemieux:** We have borrowed infrastructure information from FEMA but have not had a formal interaction for several years.
  - **Tim Boe:** We work with FEMA for national exercises. We are both research and operational partners who regularly communicate about capabilities and assets.
- **Mr. Roehl:** How do you define stakeholders?
  - **Emily Snyder:** We have stakeholders at both the state and local level. At the state level, stakeholders are the environmental departments or agency groups, whereas it varies at the local level.
  - **Paul Lemieux:** It is a challenge to conduct outreach for stakeholders because some states combine state and local groups.

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- **Justin Teeguarden:** What are future objectives and plans for stakeholder engagement?
- **Emily Snyder:** We are always interested in identifying new stakeholders and in communicating with decision makers. It is a struggle to keep them engaged, given chemical, biological, and radiological (CBR) incidents. It is also not a part of stakeholders' day jobs.
- **Justin Teeguarden:** Why is social science an area in which EPA is investing?
  - **Emily Snyder:** Waste managers have said that having social science expertise to draft communications about understanding how approaches and projects could be adjusted would be helpful. In CBR incidents, this would be a key to EPA's success.

**Lightning Session for Waste Management**

**Configured Fireside Simulator – Simulations for Treatment of Biologically and Chemically Contaminated Waste**

*Paul Lemieux, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Dr. Lemieux presented on the configured fireside simulator, which runs hypothetical scenarios of waste streams contaminated with chemical and biological agents using innovative computational techniques to model three-dimensional reacting flow. The simulator helps address the need for waste treatment technological for chemically and biologically contaminated materials.

- **Ed Roehl:** It could be worth exploring handling equipment to process all kinds of materials, including furniture, animal carcasses, and more.
  - **Paul Lemieux:** We investigated and considered borrowing car manufacturing equipment but determined it would result in too much of a strain on funding resources.
- **Justin Teeguarden:** Is the goal of the project to support Resource Conservation and Recovery Act (RCRA) permitting?
  - **Paul Lemieux:** The tool has licensing issues to work through. We would like to have a tool for industry use, also. The two barriers are licensing and evaluating for RCRA permitting.
  - **Shawn Gibbs:** Would the Department of Transportation (DOT) would be accepting if the RCRA portion accepts this, because in my work with Ebola waste disposal in 2014 DOT presented challenges.
  - **Paul Lemieux:** DOT is involved with biological agent waste removal. The military transports some waste.
- **Shawn Gibbs:** Do considerations include a tenting approach to misting?
  - **Paul Lemieux:** We want to reduce as many add-ons as possible and keep the process simple. If we do not mitigate aerosols, a tent approach could be the next step.

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**Biological Waste Treatment: A Scalable Approach – Analysis for Coastal Operational Resiliency**

*Paul Lemieux, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Dr. Lemieux described a biological waste treatment approach involving identifying sample waste materials to be collected, reviewing existing sampling strategies and protocols for applicability to solid wastes generated, modifying methods, and conducting bench-scale tests of modified methods in a laboratory setting. He described challenges experienced in a test of waste decontamination in a subway setting and from the 2014 Ebola incident. Transportation of Category A pathogen-containing wastes is problematic, and there are operational difficulties with scaling treatment methods for wide-area incidents. CESER worked with North Carolina State University textile researchers to develop a custom semi-permeable waste bag material that allows fumigants to enter the container but prevents spores from escaping. On-site treatment using these bags would reduce waste management costs for wide-area biological incidents, simplify waste sampling efforts, and minimize worker exposure. CESER is currently conducting laboratory tests to verify the effectiveness of this concept and plan to conduct field tests next year.

- **Ed Roehl:** It might be useful to design heavy-duty material handling equipment for processing materials.
  - **Paul Lemieux:** We considered this as an alternate for this project but decided it would be too costly to field test.
- **Justin Teegarden:** Is the goal sufficiently testing the model so that it can be used to support RCRA permitting?
  - **Paul Lemieux:** Yes.
  - **Justin Teegarden:** Are the two barriers licensing and validating the method?
  - **Paul Lemieux:** Yes.

**Carcass Management: Assessment of Methods to Support Outbreaks of Foreign Animal Disease**

*Paul Lemieux, Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Dr. Lemieux described HSRP research supporting foreign animal disease response preparation and provided the example of African Swine Fever waste size reduction. He shared how HSRP evaluated animal carcasses grinding for waste reduction, and how HSRP scientists monitor the air quality surrounding the grinding machinery.

- **Ed Roehl:** Would it be possible to transport dead infected pigs to an indoor facility for disposal?
  - **Paul Lemieux:** The goal would be not to move infected carcasses off the farm. Researchers are considering methods for disinfection.
  - **Justin Teegarden:** Why is there a need for animal carcass disposal?

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- **Paul Lemieux:** This is an immediate need identified by the U.S. Department of Agriculture (USDA), who are paying for it.

**Demo of Waste Staging and Logistics Tools**

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

Dr. Boe presented HSRP research on waste storage and staging site selection tools. HSRP scientists addressed a need to identify pilot sites and total available land surface areas for staging waste using environmental criteria by developing GIS-based models that use spatial information and analysis techniques to support suitability analysis. This tool could better inform decision makers and provide possible options to scenarios.

Dr. Boe presented the All-Hazards Waste Logistics Tool, which addresses the need to analyze resource demands and bottlenecks associated with transporting and disposing of large volumes of waste. HSRP scientists develop spatial models to analysis techniques to support evaluating resource demands associated with transporting waste. He then demonstrated two tools, the staging tool and the logistics tool.

**Social Considerations of Disaster Waste Management**

*Keely Maxwell, General Anthropologist, Center for Environmental Solutions and Emergency Response*

Dr. Keely Maxwell discussed social considerations in disaster waste and materials management and described the need to safely dispose of disaster waste and materials in ways that do not further disadvantage overburdened populations. EPA scientists plan to review scientific literature to identify key social variables that affect decisions, such as social stigmas, environmental justice, disproportionate impacts, and power and authority. Then, scientists plan to review comparative case studies that address various disasters and hold focus groups to assess decision making for different waste streams.

**Partners Round Table**

*Alan G. Woodard, Environmental Program Specialist, New York Department of Environmental Conservation*

*Catherine Young, Federal On-Scene Coordinator, EPA Region 1*

*Gary Flory, Agricultural and Stormwater Program Manager, Virginia Department of Environmental Quality*

*Kim M. Kirkland, Methods Team Leader, EPA Office of Land and Emergency Management*

Dr. Alan Woodard introduced himself and discussed his background with biohazard waste and his tenure with the New York Department of Environmental Conservation. He noted that the Department realized the need to collaborate with EPA.

Catherine Young introduced herself and discussed her role as a Federal OSC for the past 18 years. She has responded to Hurricane Katrina, Hurricane Marie, British Petroleum (BP) oil

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spills, and worked with anthrax. Her experience with ORD is with chemical warfare agents. She works to address gaps, identify challenges and manages efficacy to sampling.

Gary Flory introduced himself as the Agricultural and Stormwater Program Manager, Virginia Department of Environmental Quality. He works with biological agent responses, One Health issues, and he has engaged with EPA and other federal partners. He has worked with animal mortality, including disease outbreaks, and noted that waste management is a critical component to his work. He collaborated with EPA as a reviewer on the avian influenza response. Recently, he has worked with Dr. Lemieux and his team on animal carcass grinding.

Kim Kirkland introduced herself and her work as the Team Leader for the materials and methods for waste management division. Within her branch in EPA OLEM, she manages the homeland security and chemistry teams. A part of the team's work is providing support. For example, her team produced fact sheets on waste management, carcass management and avian influenza outbreak. Within HSRP her team participates in the partner process such as by creating tools.

- **Monica Schoch-Spana:** Will the partners please discuss tangible social, political, and other benefits.
  - **Gary Flory:** I am usually involved in disease outbreaks and have found that the social or behavioral aspect is often overlooked. For example, farmers are under considerable stress following an animal disease outbreak, and individuals affected by natural disasters may experience traumatic losses.
  - **Catherine Young:** It is important to inform people and listen to their concerns. Any tools assisting with social impacts would be useful, because this is a large piece of hazard response
  - **Kari Cutting:** Are there team members who solely focus on the social issues?
  - **Catherine Young:** EPA has people who are able to identify concerns related to social issues.
  - **Kim Kirkland:** Team members who respond to hazards are also diverse
  - **Gary Flory:** Those who deal with technical aspects of response have trainings on social issues. We also have designated contacts for people who may need additional social impact support.
  - **Alan Woodward:** Pre-planning is important to identify waste disposal sites willing to accept waste and evaluate public perceptions that could impact waste management decisions.

## **BOSC Subcommittee Discussion and Question and Answer**

*Introduced by Paula Olsiewski, Chair*

### **Questions and Answers; Final Remarks**

- **Monica Schoch-Spana:** Are there evergreen aspects to social-science associated with rapidly changing technology that the technical side of HSRP research cannot replicate (e.g., inclusive-participatory models)?

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- **Keely Maxwell:** Social science research has demonstrated that building trust and relationship is important for disaster resilience and recovery. Some of our studies on how decisions are made could inform adaptive capacity building and decision making in the field. Social science also helps with not making default assumptions about human behavior. One of the challenges is that people do not consider social science useful. A culture allowing PIs to have social science resources and teach others has helped with acceptance. Another challenge is limited training on social science tools. Social science research takes time and is not applicable to rapid research. These issues can inform practices and protocols that can improve resiliency.
- **Sarah Taft:** Access to technology is a serious challenge, as is finding and accessing topical expertise. There is also a huge limitation on the ability to recruit support. A four-year funding cycle makes it difficult to expand and dedicate time to large projects.
- **Justin Teegarden:** Summarizing the opportunity cost of limitations is key.
  - **Lance Brooks:** Are there innovations that will improve research and allow for maximizing resources? Would it be helpful if stakeholders could help define a helpful future state?
  - **Justin Teegarden:** Automation of information dissemination is key.
  - **Michael Wichman:** Are laboratories available?
  - **Tim Boe:** EPA's processes and security issues are potential roadblocks to ongoing development of simulation and modeling tools. EPA regions need to acquire drones, sensors, and other technologies to remain current.
  - **Worth Calfee:** We can slowly acquire needed equipment, but there is a limited budget, especially considering maintenance costs. We are also discussing innovation and anticipatory research.
  - **Lukas Oudejans:** On-site contractors who maintain equipment also experience challenges with personnel turnover, so in-house expertise is not always available.
  - **Michael Wichman:** Can EPA negotiate better deals on maintenance contracts, given its substantial equipment purchases?
  - **Worth Calfee:** That might be possible if ORD considered that option.
- **Debbie Reinhart:** Are the presenters currently on the call representative of the diversity of the laboratory.
  - **Sarah Taft:** CESER is actively working to include diverse populations. We have an internal group dedicated to diversity and work-life balance. Recruiting the best and brightest has been a challenge over the years.

Dr. Lee thanked BOSC members for their contributions and participation.

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**Thursday, May 20, 2021**

**Welcome**

*Paula Olsiewski, Chair*

Dr. Olsiewski opened the meeting by reading charge question # 4.

**Overview of Homeland Security Research Program Systems and Resilience Tools**

*Sang Don Lee, Acting Principal Associate National Program Director, Homeland Security Research Program*

Dr. Lee presented an overview of HSRP systems and resilience tools. He briefly described the different types of products in development and approaches including system and resilience tools. Dr. Lee explained the differences between response and recovery. He proposed a holistic approach to response. Research is needed to help decision makers have access to tools via a systems approach for the connect response elements and recovery goals. Community resilience, operation, data management, and tool integration are all approaches needed to make these tools for decision makers. Dr. Lee provided a quick summary of the new tools and information that will be presented in the lightning sessions. The lightning sessions are focused on tool integration, system tools, and resilience tools. HSRP tools development can improve emergency response and recovery.

- **Justin Teegarden:** Are there social aspects to the types of questions received from partners?
  - **Sang Don Lee:** We did not have clearly identified social science needs at first, but we are currently assessing a growing number of questions related to social science received from partners. We developed a workgroup that is related to community engagement but cannot compare current needs with those from previous years because these requests are new.

**Lightning Session for Systems and Resilience Tools**

**Simulation for Evaluating Decision Making Following a Large-Scale Incident**

*Timothy Boe, Center for Environmental Solutions and Emergency Response*

Dr. Boe presented on the simulation for evaluating decision making following a large-scale incident. There is a need to implement full-scale exercises with minimal resources and maximum control and quality with the purpose of evaluating research and technology gaps and to support training of response personnel. The sandbox simulation would be a surrogate for simulating environmental impacts of contamination in an area and be a platform to simulate tools to test them. The program can be useful for demonstrating findings, to test tools, and for training. Artificial Intelligence will be a substantial backbone for this tool.

**Evaluating the Use of Commercial-off-the-shelf Three-dimensional (3D) Engines**

*Timothy Boe, Center for Environmental Solutions and Emergency Response*

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Dr. Boe presented on evaluating the use of commercial-off-the-shelf (COTS) three-dimensional engines. New modeling platforms capable of advanced physics or fluid-based simulations are needed for future modeling applications. He describes his work of using COTS 3D game engines for facilitating modeling efforts related to CBRN events by simulating radiation attenuation, blast, fate and transport, and dispersion models. COTS 3D platforms would reduce research and development cost and time and allow for high-fidelity modeling solutions when compared to traditional approaches.

- **Paula Olsiewski:** Does the tool account for heating, ventilation, and air conditioning (HVAC) systems?
  - **Tim Boe:** We are focusing on surfaces, but eventually may account for air.
- **Debbie Reinhart:** How does tool interact with other tools?
  - **Tim Boe:** This is a unique situation where feasibility approaches are not connected. Next steps in the research will focus on tool integration. It will involve obtaining an inventory of available models and evaluating the flow and type of data included in different tools.

**Tool Integration/Dashboards**

*Timothy Boe, Center for Environmental Solutions and Emergency Response*

Dr. Boe presented on tool integration/dashboards. Tools currently accessible are scattered and not integrated in one location. CESER's goal is to develop a web portal for accessing tools/models and aggregating data to create a common operating picture. The portal would provide a centralized access point for tools and a dashboard for aggregating and visualizing results. Dr. Boe hopes the dashboard will be able to provide solutions to scenarios based on the integration of all tools. The platform would be helpful resource for decision makers to access tools and possible solutions in one location. Currently cloud.gov (<https://cloud.gov/>) and Drupal are used as platforms.

- **Ed Hackney:** What is the role of cloud.gov in this work?
  - **Tim Boe:** Amazon Services hosts the sites. There are no constraints on flexibility around open-source requirements, so there is operational freedom. We are the first EPA customers of cloud.gov and are learning as we proceed.
- **Justin Teegarden:** I suggest you connect with Vicky Freedman regarding concerns about inoperability and integration of various tools. We built a program for the Department of Energy (DOE) using open source and .gov platforms that might be helpful.
- **Ed Roehl:** Much of Dr. Boe's work seems to be based on physics-based models. How do you plan to couple past physics models with current three-dimensional models?
  - **Tim Boe:** This is an issue. Our series of case studies involves dispersion modeling experts and efforts to compare models to enhance projects.
  - **Ed Roehl:** Are you planning to use simplified physics models to make them run quickly?



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- **Tim Boe:** We have found that some engines, such as unity, have QUASI CD capabilities built into them. There is another dispersion model called QUICK that is very good at accounting for geometry. We still have a lot to learn.
- **Ed Roehl:** Dr. Boe, what is your definition of artificial intelligence?
  - **Tim Boe:** Our approach is broad, and we have used artificial intelligence for over a decade to learn about an urban area quickly. We also use artificial intelligence to build scenarios and for decision making, but there are a hundred potential applications. We are presently partnering with Google in a general study evaluating potential uses of artificial intelligence.
  - **Ed Roehl:** Are you using different commercial artificial intelligence tools?
  - **Tim Boe:** We are using Tensorflow with Google and have found we need stronger computing sources to run simulations.

**Remediation Data Repository**

*Timothy Boe, Center for Environmental Solutions and Emergency Response*

Dr. Boe presented on Remediation Data Repository (RADAR). There is a need for an online service to provide quick access to information and data to support response efforts and future research. RADAR is an enhanced database solution that helps with sharing data and with understanding the footprint of that data. The goal is the ability to upload and distribute up-to-date research and provide users access to data.

**Social Science of Decontamination and Environmental Cleanups**

*Keely Maxwell, General Anthropologist, Center for Environmental Solutions and Emergency Response*

Dr. Maxwell presented on the social science of decontamination and environmental cleanups. Social science can enable EPA OCSs to build trust and social relationships with communities and other social actors in different social and cultural contexts. The project reviewed social science literature and surveyed involved actors in cleanups. The project identified 88 groups of actors with whom EPA clean-up staff members engage. These groups are mostly local but also federal and contractor groups. This work shows that applying social science can help develop resources EPA staff members on culture, engagement, and trust building. Some current products in development are the manuscripts “Figuring out who lives here” and “Building Trust with Communities and Other Stakeholders.” There is also an attempt to use a participatory design to foster peer to peer learning.

**Environmental Resilience Tools Wizard**

*Keely Maxwell, General Anthropologist, Center for Environmental Solutions and Emergency Response*

Dr. Maxwell presented on Environmental Resilience Tools Wizard (ERTW). Currently EPA resilience tools and resources are scattered across program websites. ERTW helps make these resources accessible. The tool includes keywords and filters for accessibility.

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**Equitable Resilience Builder**

*Keely Maxwell, General Anthropologist, Center for Environmental Solutions and Emergency Response*

Dr. Maxwell presented on the Equitable Resilience Builder (ERB). Regional staff members are increasingly asked to help communities build resilience using frameworks and tools. EPA responders would benefit from resources that address equity and protect marginalized or underserved Americans. HSRP and ORD's Sustainable Health Communities Research Program is developing an inclusive online tool for communities to assess resilience and vulnerability. The project uses robust social science on vulnerability and resilience and indicators science. ERB would be used by first engaging constituencies, identifying hazards with equity lens, assessing vulnerabilities and resilience, prioritize action areas, and then take actions in the sector/community. The tool can help communities be more resilient and experience fewer negative disaster impacts on critical social, natural, and built environmental systems. In the short term, the project is testing the "paper prototype" with communities by developing the online tool and test usability. In the long term CESER hopes to add features based on needs and a recovery assessment.

- **Monica Schoch-Spana:** What is the value of the tool, given the proliferation of different resilience tools?
  - **Keely Maxwell:** We are hoping communities can use the tool with limited outside support and are trying to incorporate both social and environmental values (e.g., how the history of acute and chronic disasters has shaped the conditions that increase vulnerability). Vulnerability manifests in different ways, and we hope the tool will account for that.
- **Monica Schoch-Spana:** Are CBRN hazards incorporated in this tool?
  - **Keely Maxwell:** We are identifying ways to generate interest in hazards that are not immediate and over a long-time scale.
- **Justin Teegarden:** I wish the presentation included more of a description of the database.
  - **Keely Maxwell:** Thank you for that feedback.

**Analysis for Coastal Operational Resiliency Field Study with Partners**

*Shannon Serre, Engineer, EPA Office of Emergency Management*

*Worth Calfee, Microbiologist, Center for Environmental Solutions and Emergency Response*

Dr. Calfee presented on Analysis for Coastal Operational Resiliency (AnCOR) Field Study with Partners, discussing AnCOR purposes and cross-agency coordination and leverage impacts. AnCOR's purpose is to develop and demonstrate capabilities for wide-area biological incident remediation. Dr. Calfee presented the timeline and described how it is typically a five-year program. The five major research focus areas include sampling and analysis, fate and transport, decontamination, waste management, and demonstrations or field scale projects. Dr. Worth continued by presenting work conducted for each of the five research areas.

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Shannon Serre presented on waste management and demonstrations of field projects, describing different guidance documents and tools, including tabletop exercises.

- **Sang Don Lee:** This presentation is a collaborative effort and is an example of how partners work together in the field.
  - **Worth Calfee:** CBR translates guidance and delivers it to responders.
  - **Dana Tulis:** This project is a great example of EPA and Coast Guard collaboration on guidance, which uses lanes of science.
- **Justin Teegarden:** Are there any lessons learned from unsuccessful field work?
  - **Shannon Serre:** We realized we need a tool to help with performing quality assurance reviews of large datasets.
  - **Worth Calfee:** There are numerous lessons, such as the one where using commercial equipment to clean subways was found to be not always effective.
- **Ed Roehl:** How do semi-permeable bags work? Are they feasible?
  - **Worth Calfee:** Use of semi-permeable bags may not be the solution for all scenarios, but it is useful in some settings.

**Operational Testing and Evaluation of Chemical Remediation Activities Field Study with Partners**

*Larry Kaelin, Chemist, EPA Office of Emergency Management*

*Lukas Oudejans, Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

Dr. Oudejans presented on the Operational Testing and Evaluation of Chemical Remediation Activities (OTECRA) Field Study with Partners. He shared how EPA scientists have completed considerable work on the bench-scale, pilot-scale, and then full-scale during testing. Dr. Oudejans shared the OTECRA timeline, including Fiscal Year (FY) 2020-2021 planning stages, FY21 chemical scenarios selection, FY21/FY22 surrogate selection and validation, and next steps. He thanked partners, including EPA's OLEM and ORD, EPA Region 5, and CWA Preparedness work group members.

Mr. Kaelin explained the main objectives of OTECRA, which include developing sampling strategies, assessing wipe and novel sampling approaches, conducting field-level application of decontaminants, determining efficacy, assessing personnel decontamination line approaches, performing cost analysis, considering waste management throughout, and not any adverse impacts to facility. Field samples collected from contaminants inform development of pre- and post-contaminant strategies. Mr. Kaelin explained how the technical approach includes applying developed tools and other knowledge on sampling, decontamination, and waste management to assess status at the field scale. He shared intended impacts for OTECRA, including field usability sampling methods and strategies, overall improved decision making, and lessons learned.

- **Debbie Reinhart:** Is there a plan to conduct many field tests, given the likely expense?

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- **Lukas Oudejans:** We have not completed many full-scale exercises, so it was necessary at this time to conduct at the full-scale level.
- **Shawn Ryan:** We have discussions with partners to ensure something field deployment readiness.

**Managing Research during Emerging Challenges**

*Shawn Ryan, Acting Deputy National Program Director, Homeland Security Research Program*  
*Sang Don Lee, Acting Principal Associate National Program Director, Homeland Security Research Program*

Dr. Ryan presented on the research needs for emerging challenges and discussed how decision making can be challenging with too much or too little information. He described how real-time research is important to inform ongoing response measures and help understand response. HSRP has conducted real-time research during response to characterize emerging threat agents and generate response tools and metrics. He then shared real-world examples of support with Ricin research.

Dr. Ryan shared HSRP scientists' work on COVID-19 research, regulatory topics, and responses. He then shared EPA's COVID-19 timeline from February 2020 to November 2020 and explained how the breadth of research has evolved.

- **Monica Schoch-Spana:** Is there capability for rapid response research within the program that deals with the social element?
  - **Shawn Ryan:** The problem is determining what is necessary and needed. It could be a challenge to complete social assessment and polling work in real-time.
- **Murray Cohen:** Has CDC assisted with determining how to avoid issues?
  - **Shawn Ryan:** EPA labels products, but there is much collaboration with CDC. There are daily conversations with EPA's Office of Pesticide Programs (OPP).

**Questions and Answers; Final Remarks**

*Introduced by Justin Teegarden*

- **Ed Hackney:** Are there any development standards that exist for system-related ideas?
  - **Tim Boe:** ORD mandated sharing of all EPA research data with the public and collaborated with them to determine how to accomplish this. Leadership is determining needs and reviewing research. From the data science perspective, all data is important. We hope to upload all data into RADAR and have some defined standard on how that is reported out.
- **Shawn Ryan:** It seems there are no standards?
  - **Tim Boe:** There are reporting standards, but they may need refinement. We are awaiting EPA guidance. In terms of development standards, there are guidelines we follow. At a high level, software must be transparent. RADAR has a GitHub repository that is public. We are transiting to using open-source tools that do not require licensing fees.

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- **Ed Hackney:** Thank you for the explanation.
- **Paul Lemieux:** We also attempt to source data so the origin is traceable.
- **Justin Teeguarden:** Can you clarify your research questions and describe their influence on program direction?
  - **Shawn Ryan:** There were many questions that we categorized based on immediacy.
  - **Justin Teeguarden:** Will some of the questions continue to arise for similar types of events?
  - **Shawn Ryan:** They will. Most of our COVID-19 work was outside of our base program; it will be considered as a part of our program and other programs.
  - **Justin Teeguarden:** For COVID-19, we listed research needs that responded to flaws identified in field research.
  - **Shawn Ryan:** The research table referred to is publicly available.
- **Monica Schoch-Spana:** Is there any systematic evaluation of the practical use of decision support tools confirming value?
  - **Tim Boe:** In the Alaska program, we helped with development of an application for communities to use to collect field data. A few select communities will evaluate the application and provide feedback, then aggregate that and learn greatly from past events. We mostly use user-driven feedback, implement, obtain feedback, and try again.
  - **Paul Lemieux:** Creativity is necessary when responding to natural disasters. Our work in conjunction with New York City to predict the amount of waste that would be generated from a biological incident involved inventorying all the materials from an EPA region 2 building, and we found that our predictions were inaccurate. As a result, we edited and improved the model.
- **Justin Teeguarden:** Do you have feedback related to future research?
  - **Shawn Ryan:** Recommendations from the meeting will be helpful in discussions about the future of the field studies and emerging research areas.
  - **Justin Teeguarden:** I find it challenging to think about future directions because I am not a stakeholder. The focus is on the needs of EPA partners.
  - **Shawn Ryan:** We are determining whether there are any unidentified gaps or needs, not discussing priorities.
  - **Sang Don Lee:** Technological readiness is increasing, but there is no final endorsement for EPA's work. This makes it difficult to make decisions. EPA needs guidance to think beyond the field study, which is the surrogate, not the actual incident.
  - **Justin Teeguarden:** Other research problems should be a focus after completion of a field study. How do you achieve a balance between researching a new problem versus refining a response from the past?
  - **Sang Don Lee:** We are trying to improve the partner process by better identifying and evaluating needs. A new community engagement work group is now part of

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the process. We also are trying to apply what we have developed to specific scenarios versus general situations.

- **Justin Teegarden:** EPA accomplishes a lot, given it is a resource-limited organization. Does Dr. Boe have a team, or does he work independently?
  - **Sang Don Lee:** Dr. Boe is training others.
  - **Shawn Ryan:** Dr. Boe works with teams, is a part of other teams, and is a big help to spark innovation. Dr. Boe explained that his presentation mentioned multiple PIs and student contractors assisted with the research. Recent graduates often assist and should be recognized.
- **Michael Wichman:** Do you use Oak Ridge Institute for Science and Education (ORISE) fellows?
  - **Tim Boe:** I was an ORISE fellow, and I and other researchers use ORISE fellows.
  - **Kari Cutting:** Thank you, Dr. Teegarden, for leading the meeting. I also want to thank those from EPA. I am so impressed with EPA's research accomplishments with limited resources.

Dr. Teegarden thanked everyone and adjourned for committee deliberation time.

The meeting adjourned at 5:00 p.m., Eastern Time

**Thursday, June 3, 2021**

**Welcome**

*Paula Olsiewski, Chair*

Dr. Olsiewski welcomed everyone and reviewed operational aims for the report. Attendees separated into workgroups to discuss the charge questions in detail and draft recommendations and suggestions for later discussion.

**Charge Question 1**

Mr. DeGraca summarized workgroup discussion of charge question 1. There is a need to develop a research needs prioritization process that first identifies capabilities goals and then analyzes gaps in goals to determine whether innovation is needed. Engaging critical end-user professional associations in planning, developing partnerships as projects progress, and conducting formal outreach to share information about available tools is important.

- **Justin Teegarden:** Identifying stakeholder needs and determining the availability of tools and technology will inform decisions about when innovation is an appropriate response.
- **Michael Wichman:** We also discussed ESAM and the need for more rapid screening.
- **Paula Olsiewski:** What are the workgroup's key recommendations?
  - **Justin Teegarden:** We focused on two main ideas: a needs assessment process and the importance of engaging local and regional partners throughout a project's timeline. We did not decide whether these are suggestions or recommendations.

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- **Paula Olsiewski:** The action item for the team is to refine these ideas for the next meeting.

**Charge Question 2**

Ms. Tulis summarized workgroup discussion of charge question 2. Recommendations and suggestions include expanding outreach by engaging stakeholders and responders to inform them of available tools and resources and obtain feedback, incorporating social science in research to gather information on the effectiveness of ORD projects and deliverables, leveraging existing partnerships with other public and private entities to increase project scale, considering the public's ability to purchase off-the-shelf products from local suppliers, ensuring staff members have appropriate field experience and training, and researching and testing security and operational vulnerabilities of portable and wastewater utilities.

- **Murray Cohen:** Summarize the main ideas. EPA must have effective communication with responders and the public. EPA should incorporate more social science in research, especially to assess stakeholder impressions of deliverables and products. Public/private partnerships increase capabilities for larger scale projects. EPA should leverage different partners' capabilities.
  - **Bob Scudder:** An important social justice consideration is the availability of affordable materials.
- **Bob Scudder:** I am very impressed with ORD's ability to send staff members into the field, which is invaluable experience.
- **Justin Teegarden:** Stakeholder communication and interaction are themes that cross over the charge question issues.
- **Murray Cohen:** What is the difference between a recommendation and a suggestion?
  - **Paula Olsiewski:** EPA must formally respond to recommendations. A recommendation is actionable, not aspirational.
  - **Justin Teegarden:** Recommendations should be specific, actionable, and measurable. Avoiding vagueness in our report is important. We must not issue restrictive directives that prevent EPA from being able to meet the defined objectives.

**Charge Question 3**

Dr. Reinhart summarized workgroup discussion of charge question 3. The workgroup emphasized engaging with federal and local stakeholders, ensuring waste management plans are in place well before an event, and extending the capability and use of existing tools.

- **Kari Cutting:** We also discussed the importance of including social science in research.
- **Paula Olsiewski:** Please refine your recommendations for the next meeting.

**Charge Question 4**

Dr. Schoch-Spana summarized her workgroup's discussion of charge question 4. The workgroup identified multiple areas for improvement. Draft recommendations include hiring a diverse

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workforce, including social costs in algorithms, expanding partnerships to better address the needs of disadvantaged populations, improving equipment procurement process, and increasing the capability of existing tools and technology, and developing innovations to make technology accessible and cost-effective.

- **Dr. Teeguarden:** We should encourage EPA to adopt a lifecycle management plan to eliminate dependency on aging equipment.
  - **Ed Hackney:** We have a three-year replacement plan.
  - **Dana Tulis:** Mentioning this will bring it to their attention.
  - **Dr. Teeguarden:** Outlining threats to our research planning due to aging technologies should suffice.
  - **Dr. Ryan:** We do have a three-year refresh plan, but there is frustration that the refresh plan has been stalled. We do not have flexibility on what hardware we are able to use. The hardware and software need to meet Agency specifications.
  - **Justin Teeguarden:** A stalled three-year refresh plan is not a three-year refreshment plan. Keep in mind this is a recommendation that does not strictly respond to the charge.
  - **Bob Scudder:** Technological obsolescence negatively impacts EPA's ability to achieve research goals.

**Thursday, June 17, 2021**

**Welcome**

*Paula Olsiewski, Chair*

Dr. Olsiewski welcomed and thanked members for their work before directing participants to separate into breakout sessions. After members reconvened, she led discussion of workgroup recommendations in response to the charge questions.

**Charge Question 4**

Dr. Schoch-Spana reviewed Charge Question 4 and summarized recommendations of the BOSC workgroup, which include expanding partnerships with public health and water utility associations, improving procurement processes, recruiting more staff members, and increasing access to tools and training.

- **Dr. Teeguarden:** Asking the critical questions and realizing that leadership cannot act on every recommendation is important. Procurement improvements may be problematic for them.
  - **Sang Don Lee:** We cannot control procurement. We can propose changes, but regulations and policies can impact decisions as much as budget.
  - **Paula Olsiewski:** Perhaps improving procurement should be a suggestion.
  - **Sang Don Lee:** Suggestions highlight issues, allowing us to initiate a conversation.



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- **Justin Teegarden:** I propose it should be a suggestion including a statement or two about anticipated problems and a mission statement. Leaders need to know about critical issues.
- **Michael Wichman:** Yes, include a statement about financial impacts due to inadequate existing services and equipment.
- **Sang Don Lee:** Our program considers all suggestions received, so this would be constructive.
- **Kari Cutting:** The three-year replacement lease, which EPA has already approved, should take care of the.
  - **Sang Don Lee:** I am not familiar with the three-year refresh program.
  - **Lance Brooks:** There is a three-year refresh program, but it has inconsistencies. There are uncontrollable issues, such as new staff members needing computers.

**Charge Question 3**

Dr. Reinhart reviewed Charge Question 3 and summarized recommendations of the BOSC workgroup, which include prioritizing research that will lead to discovery of solutions for environmental clean-up challenges in wide-urban settings (e.g., recycling or re-using PPE), engaging earlier with stakeholders by pre-planning for incident response, reviewing and updating staffing to include diverse teams, and identifying knowledge gaps.

- **Sang Don Lee:** There are limits on staffing. The intention is clear, but we find this limiting unless there are clear suggestions on how to make improvements.
  - **Shawn Ryan:** There are options that do not require hiring of new staff members.
  - **Ed Roehl:** There are professional societies that provide an opportunity for soliciting advice that does not necessitate hiring.
  - **Lance Brooks:** I agree.

**Charge Question 2**

Dr. Scudder reviewed Charge Question 2 and summarized recommendations of the BOSC workgroup, which include incorporating social science into research, identifying common elements of different decontamination methods that would improve leveraging current knowledge, and increasing use of commonly available commercial off-the-shelf technologies.

- **Justin Teegarden:** Great suggestions, but should we repeat them across charge questions? We should avoid language implying endorsements.
  - **Bob Scudder:** I am sure there are common themes, which is okay.
  - **Sang Don Lee:** Do these recommendations address environmental justice?
  - **Paula Olsiewski:** Given the administration's focus on environmental justice we should highlight this issue where appropriate.
  - **Bob Scudder:** The recommendations do not address this specifically. The ability to self-rescue is universal and highly personal, as we have seen after several disasters, including hurricane Katrina.

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**Charge Question 1**

Dr. Teegarden reviewed Charge Question 1 and summarized recommendations of the BOSC workgroup, which include developing a formal process for analyzing and selecting solutions based on a review of performance requirements and available resources and increasing end-users' awareness of innovative and off-the-shelf capabilities in response to needs communicated by responders and identified by field experience. ESAM could provide better guidance on how to screen an unknown agent to determine analysis needs. We are not sure if this is a suggestion or recommendation.

- **Sang Don Lee:** Regarding ESAM, we are trying to clarify whether the recommendation is creating a document on known material direction.
  - **Shawn Ryan:** There are few partner needs for our program. Elsewhere, within EPA, there is more of a need for multi-pollutant and unknown chemical analyses.
  - **Shawn Ryan:** There is some need around water, but pollutants have usually settled by the time we are involved. This would cross between the wastewater resources program and us.
- **Lance Brooks:** Perhaps we can suggest connecting ESAM to other tools to improve user acceptance.

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**Appendix A: Agenda**

**United States Environmental Protection Agency  
 Board of Scientific Counselors (BOSC)  
 Homeland Security Subcommittee**  
 Meeting Agenda – May 17–20, June 3, and June 17, 2021  
 Virtual

**Day 1: Monday, May 17, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
12:00 – 12:10	Introduction and FACA rules	<b>Tom Tracy</b> , Designated Federal Officer (DFO)
	Welcome and Opening Remarks Introduction of BOSC HS Subcommittee Members	<b>Paula Olsiewski</b> , BOSC Homeland Security (HS) Subcommittee Chair
12:10 – 12:25	ORD Welcome CESER Welcome	<b>Jennifer Orme-Zavaleta</b> , PhD ORD Principal Deputy Assistant Administrator for Science  <b>Chris Frey</b> , PhD ORD DAA for Science Policy  <b>Greg Sayles</b> , Director, Center for Environmental Solutions and Emergency Response (CESER), EPA ORD
12:25 – 12:50	Homeland Security Research Program Overview	<b>Shawn Ryan</b> , HS National Program Director  <b>Sang Don Lee</b> , HS Principal Assoc.
12:50 – 13:10	<b>Charge Question 1: Overview of Sampling and Analysis Research</b>	<b>Sarah Taft</b> , CESER
13:10 – 13:20	Break	
	<b>Lightning session for Characterization</b>	
13:20 – 14:45	<ul style="list-style-type: none"> <li>Environmental Sampling and Analytical Methods Program (ESAM) Video</li> </ul>	<b>Kathy Hall</b> , CESER  <b>Tim Boe</b> , CESER

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Time	Topic	Speaker
	<ul style="list-style-type: none"> <li>• Trade-Off Tool for Sampling (PI screen share Demo)</li> <li>• Development of Sampling and Analysis Methods for Outdoor Environments</li> <li>• Resuspension of <i>B. anthracis</i> Surrogates on Underground Subway Surfaces</li> <li>• Development of Activity-Based Aggressive-Air Contained Sampling System</li> <li>• Bio-Agent Analytical Methods Development</li> <li>• Bio-Sampling Training Simulator</li> <li>• Fentanyl Sampling and Analysis</li> <li>• Innovative Sampling Methods for HS Chemicals</li> </ul>	<p><b>Worth Calfee, CESER</b>  <b>John Archer, CESER</b>  <b>Sanjiv Shah, CESER</b>  <b>Stuart Willison, CESER</b>  <b>Lukas Oudejans, CESER</b></p>
14:45 – 14:55	Break	
14:55 – 15:10	<ul style="list-style-type: none"> <li>• Sampling and Analysis Plan Resources</li> <li>• Data Visualization/Management</li> </ul>	<p><b>Erin Silvestri, CESER</b>  <b>Tim Boe, CESER</b></p>
15:10 – 15:50	Partners Round Table	<p><b>Larry Kaelin, EPA Office of Emergency Management (OEM)</b>  <b>Leroy Mickelsen, EPA OEM</b>  <b>Jim Mitchell, EPA Region 5</b></p>
15:50 – 16:00	Break	
16:00 – 17:00	Additional Q and A, Discussion, and Subcommittee Worktime	

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**Day 2: Tuesday, May 18, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
13:00 – 13:15	<b>Charge Question 2: Overview of Wide Area Decontamination Research</b>	<b>Lance Brooks, CESER</b>
	<b>Lightning session for Decontamination</b>	
13:15 – 13:45	Biological Decontamination <ul style="list-style-type: none"> <li>• Soil Decontamination for Non-spore agents</li> <li>• Material compatibility of Sporicides Neutralization of Ricin Toxin</li> <li>• 3- Personnel Decontamination Systems</li> </ul>	<b>Worth Calfee, CESER</b> <b>Joe Wood, CESER</b> <b>John Archer, CESER</b>
13:45 – 14:10	Chemical Decontamination <ul style="list-style-type: none"> <li>• Personnel Chemical Decontamination Line Options for the Responder</li> <li>• Surface Decontamination Methods for Pesticides</li> <li>• Decontamination of persistent Chemical Warfare Agents and DeconST</li> </ul>	<b>John Archer, CESER</b> <b>Lukas Oudejans, CESER</b>
14:10 – 14:40	Radiological Decontamination <ul style="list-style-type: none"> <li>• Integrated Wash-down, Treatment, and Emergency Reuse System (IWATERS)</li> <li>• Roofing Material Decontamination</li> <li>• Integrated Rad Remediation Decision Support</li> </ul>	<b>Matthew Magnuson, CESER</b> <b>Kathy Hall, CESER</b> <b>Tim Boe, CESER</b>
	Break	
14:40 – 15:10	Radiological Decontamination	<b>Anne Mikelonis, CESER</b> <b>Tim Boe, CESER</b>

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<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
	<ul style="list-style-type: none"> <li>• Stormwater and Washdown Research</li> <li>• Supporting CBRN Cleanup Decisions</li> </ul>	
15:10 – 15:50	Partners Round Table	<b>Mark Durno</b> , EPA Region 5 <b>Jason Musante</b> , EPA Region 9 <b>Scott Hudson</b> , EPA OEM
15:50 – 16:00	Break	
16:00 – 17:00	Additional Q and A, Discussion, and Subcommittee Worktime	

**Day 3: Wednesday, May 19, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
13:00 – 13:20	<b>CQ3: Overview of Waste Management Research</b>	<b>Emily Snyder</b> , CESER
	<b>Lightning session for Waste Management</b>	
13:20 – 14:20	<ul style="list-style-type: none"> <li>• Configured Fireside Simulator – Simulations for Treatment of Biologically and Chemically Contaminated Waste</li> <li>• Biological Waste Treatment: A Scalable Approach- AnCOR</li> <li>• Carcass Management: Assessment of Methods to Support Outbreaks of Foreign Animal Disease (ASFv example)</li> <li>• Demo of Waste Staging and Logistics Tools</li> <li>• Social Considerations of Disaster Waste Management</li> </ul>	<b>Paul Lemieux</b> , CESER <b>Tim Boe</b> , CESER <b>Keely Maxwell</b> , CESER

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<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
14:20 – 15:00	Partners Round Table	<b>Alan G. Woodard</b> , Ph.D., NY Dept. of Environmental Conservation  <b>Catherine Young</b> , EPA Region 1  <b>Gary Flory</b> , VA Dept. of Environmental Quality  <b>Kim M. Kirkland</b> , EPA Office of Land and Emergency Management
15:00 – 15:10	Break	
15:10 – 16:00	Additional Q and A, Discussion, and Subcommittee Worktime	

**Day 4: Thursday, May 20, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
12:00 – 12:15	<b>CQ4: Overview of HSRP Systems and Resilience Tools</b>	<b>Sang Don Lee</b> , HS Principal Assoc.
	<b>Lightning session for Systems and Resilience Tools</b>	
12:15 – 13:00	Systems Tools <ul style="list-style-type: none"> <li>• Simulation for Evaluating Decision Making Following a Large-Scale Incident</li> <li>• Evaluating the Use of Commercial-off-the-shelf (COTS) Three-dimensional (3D) Engines</li> <li>• Tool Integration/Dashboard</li> <li>• Remediation Data Repository</li> </ul>	<b>Tim Boe</b> , CESER
13:00 – 13:30	Resilience Tools	<b>Keely Maxwell</b> , CESER

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<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
	<ul style="list-style-type: none"> <li>• Social science of decontamination and environmental cleanups</li> <li>• Environmental Resilience Tools Wizard</li> <li>• Equitable Resilience Builder</li> </ul>	
13:30 – 13:45	Break	
13:45 – 14:25	Analysis for Coastal Operational Resiliency (AnCOR) Field Study with Partners	<b>Shannon Serre</b> , EPA OEM <b>Worth Calfee</b> , CESER
14:25 – 14:45	Operational Testing and Evaluation of Chemical Remediation Activities (OTECRA) Field Study with Partners	<b>Larry Kaelin</b> , EPA OEM <b>Lukas Oudejans</b> , CESER
14:45 – 15:05	Managing Research during Emerging Challenges	<b>Shawn Ryan</b> , HS National Program Director <b>Sang Don Lee</b> , HS Principal Assoc.
15:05 – 15:20	Break	
15:20 – 16:00	Questions and Answers, Final Remarks	
16:00 – 17:00	Subcommittee Worktime	

**Day 5: Thursday, June 3, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
14:00 – 17:00	Subcommittee Worktime	

**Day 6: Thursday, June 17, 2021, Eastern Daylight Time**

<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
11:00 – 14:00	Subcommittee Worktime	



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**Appendix B: Participants**

**BOSC Homeland Security Subcommittee Members:**

Paula Olsiewski, *Chair*

Justin Teeguarden, *Vice Chair*

Charles Barton

Murray Cohen

Kari Cutting

Andrew DeGraca

Shawn Gibbs

Edward Hackney

David Klein

Debra Reinhart

Edwin Roehl

Monica Schoch-Spana

Robert Scudder

Michael Wichman

**EPA Designated Federal Officer (DFO):** *Tom Tracy, Office of Science Advisor, Policy, and Engagement*

**Presenters:**

*John Archer, Industrial Hygienist, Center for Environmental Solutions and Emergency Response*

*Timothy Boe, Geographer, Center for Environmental Solutions and Emergency Response*

*Lance Brooks, Chief, Wide Area and Infrastructure Decon Branch, Center for Environmental Solutions and Emergency Response*

*Worth Calfee, Microbiologist, Center for Environmental Solutions and Emergency Response*

*Sang Don Lee, Acting Principal Associate National Program Director, Homeland Security Research Program*

*Mark Durno, Homeland Security Coordinator, EPA Region 5*

*Gary Flory, Agricultural and Stormwater Program Manager, Virginia Department of Environmental Quality*

*Chris Frey, Deputy Assistant Administrator, Office of Research and Development*

*Alan G. Woodard, Environmental Program Specialist, New York Department of Environmental Conservation*

*Kathy Hall, Health Physicist, Center for Environmental Solutions and Emergency Response*

*Scott Hudson, Health Physicist, EPA Office of Emergency Management*

*Larry Kaelin, Chemist, EPA Office of Emergency Management*

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Paul Lemieux, *Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Kim M. Kirkland, *Methods Team Leader, EPA Office of Land and Emergency Management*

Matthew Magnuson, *Research Chemist, Center for Environmental Solutions and Emergency Response*

Keely Maxwell, *General Anthropologist, Center for Environmental Solutions and Emergency Response*

Leroy Mickelsen, *Engineer, EPA Office of Emergency Management*

Anne Mikelonis, *Environmental Engineer, Center for Environmental Solutions and Emergency Response*

Jim Mitchell, *On-Scene Coordinator, EPA Region 5*

Jason Musante, *On-Scene Coordinator, EPA Region 9*

Lukas Oudejans, *Research Physical Scientist, Center for Environmental Solutions and Emergency Response*

Bruce Rodan, *Associate Director for Science, Office of Research and Development*

Shawn Ryan, *Acting Deputy National Program Director, Homeland Security Research Program*

Greg Sayles, *Director, Center for Environmental Solutions and Emergency Response*

Shannon Serre, *Engineer, EPA Office of Emergency Management*

Sanjiv Shah, *Microbiologist, Center for Environmental Solutions and Emergency Response*

Erin Silvestri, *Biologist, Center for Environmental Solutions and Emergency Response*

Emily Snyder, *Acting Deputy National Program Director, Center for Environmental Solutions and Emergency Response*

Sarah Taft, *Associate Director, Center for Environmental Solutions and Emergency Response*

Stuart Willison, *Research Chemist, Center for Environmental Solutions and Emergency Response*

Joe Wood, *Senior Research Engineer, Center for Environmental Solutions and Emergency Response*

Catherine Young, *Federal On-Scene Coordinator, EPA Region 1*

**Other EPA Attendees:**

Mace Barron

Veera Boddu

Eletha Brady-Roberts

Helen Buse

Sandip Chattopadhyay

Robyn Conmy

Jamie Falik

Chelsea Hintz

Elise Jakabhazy

Brittany Kiessling

David Lattier

Kiara Lech

April Luke

Regan Murray

Katherine Ratliff

Mary Ross

Sanjivkumar Shah

Ramona Sherman

Matt Small

Darcie Smith

Jeff Szabo

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Vince Gallardo  
James Goodrich  
Terra Haxton

Vasudevan Nambood  
Tonya Nichols  
Kathleen Nickel

Emily Trentacoste  
Robert Weber

**Other Attendees:**

Edward A.  
Matt Alloy  
Alexis Bryant  
Joi Chu-Ketterer  
J. Corey

Francisco Javier Galindo Soria  
John Hall  
Scott Hudson  
E. Jacks  
Josh Steenbock

Dana Tulis  
Linda Wilson  
Alan Woodard

**Contractor Support:**

Canden Byrd  
Denyse Marquez Sanchez  
Megan Rooney  
Amy Scheuer  
Leah West  
Sam Whately

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**Appendix C: Charge Questions**

**Charge Question 1:** What suggestion(s) or recommendation(s) does the Subcommittee have on balancing/enhancing the use of widely available capabilities with the incorporation of innovative new approaches and technologies to address HS priority sampling and analysis needs?

**Charge Question 2:** What suggestion(s) or recommendation(s) does the Subcommittee have with respect to ensuring that the decontamination capabilities developed by the program contribute to reliable and field-usable decontamination capabilities, balancing specialized technologies with commercial off-the-shelf (COTS) equipment?

**Charge Question 3:** What suggestion(s) or recommendation(s) does the Subcommittee have on the current and planned direction of HSRP's research to provide products that contribute to reliable and field-usable capabilities for waste management in responding to HS incidents and other disasters (hurricanes, wildland fires, tornadoes, etc.)?

**Charge Question 4:** What suggestion(s) or recommendation(s) does the Subcommittee have on the current and planned direction of HSRP's research to provide products that contribute to reliable and field-usable integrated decision-support tools and ensure applicability to economically, socially, or environmentally disadvantaged communities?