Subcommittee on Consequence Assessment and Protective Actions (SCAPA)

2012 ANNUAL MEETING

Seattle, WA
May 14, 2012

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Executive Summary

The Department of Energy (DOE) Subcommittee on Consequence Assessment and Protective Actions (SCAPA) convened its annual meeting at the Marriott Renaissance Hotel in Seattle, WA, on May 14, 2012, in conjunction with the 26th Meeting of the Emergency Management Issues Special Interest Group (EMI SIG) Annual Meeting (see agenda). Thirty-four individuals from the public and private sectors participated in this year's SCAPA meeting.

The primary purpose of the annual SCAPA meeting is to provide a forum for SCAPA participants to review its accomplishments, products, and projects and to discuss its present and future missions. Sixteen technical presentations of interest to the membership, including those from the five active SCAPA Working Groups, were delivered. Each of the five SCAPA working groups (WGs) will continue their work in the coming year and will report on their activities at the next SCAPA meeting. That meeting is scheduled for May 6-9, 2013 in conjunction with the next EMI SIG Annual Meeting.

Guest speakers from the local area enhanced the overall meeting. The meeting had two distinct parts: (1) Joint session of SCAPA/DMCC and HASC; and, (2) General SCAPA meeting. The agenda for the meeting is presented below.

Meeting Agenda

	Time (EDT)
Joint Session of SCAPA/DMCC/HASC	
a. **An Emergency Response Asset: High-Resolution Regional Weather Modeling Data for the Pacific Northwest** (Cliff Mass, University of Washington)	1030-1055
b. **Global Climate Change: Facts, Myths, and Observations** (Tom Ackerman, Joint Institute for Study of the Atmosphere and Ocean, University of Washington)	1055-1130
c. **Jeopardy for Emergency Planning and Response Personnel: "I'll Take *Science-Geek* for $200, Alex"** (Chuck Rives, *and his "Trebek Team,"* Pantex)	1130-noon
SCAPA Meeting: Early-Afternoon Session	
I. **WELCOME, INTRODUCTIONS, AND DOE/NA-41 NEWS** *(25 min)*	
a. Welcome and Review of Meeting Agenda (Cliff Glantz, PNNL)	1315-1320
b. Introduction of SCAPA Members (Carl Mazzola, Shaw Environmental)	1320-1330
c. Welcome and Brief Update on DOE/NA-41 Activities (Dave Freshwater, DOE NA-41)	1330-1340
II. **CHEMICAL EXPOSURES: PAC/TEEL ACTIVITIES** *(40 min)*	
a. Implementation of PAC /TEEL Revision 27 (Dave Freshwater/DOE NA-41)	1340-1400
b. Numerical Impacts from TEEL Development Methodology Changes (Doug Craig, ATL International)	1400-1420
III. **CHEMICAL MIXTURE METHODOLOGY ACTIVITIES** *(30 min)*	
a. CMM Updates, Testing, and Potential Enhancements (Xiao-Ying Yu, PNNL and Rocky Petrocchi, Petrocchi Associates)	1420-1440
b. CMM Wizard Prototype Demonstration (Alex Booth and Cliff Glantz, PNNL)	1440-1450
SCAPA Meeting: Late-Afternoon Session	
IV. **CONSEQUENCE ASSESSMENT MODELING** *(50 min)*	
a. SCAPA Consequence Assessment Modeling Toolbox– It's Alive! (Glantz, PNNL)	1510-1520
b. ALOHA! The Latest News from the NOAA CAMEO/ALOHA Team (David Wesley, NOAA)	1520-1545
c. Lessons Learned: Utilizing GENII Version 2 for Deposition Velocity (Denny Armstrong, URS SMS SRS)	1545-1600

V. **BIOSAFETY, PROTECTIVE ACTIONS, AND SOURCE TERMS** *(75 min)*

a.	Biosafety News (Frank Roberto, INL)	1600-1610
b.	Emergency Preparedness Implications: Changes to the Globally Harmonized System of Classification and Labeling of Chemicals (Dina Siegel, LANL)	1610-1625
c.	Where are we in Developing TEEL Values for Biotoxins? (Jayne-Anne Bond, ATL)	1625-1640
d.	Shelter in Place: Is it a Valid Choice in a Haz-Mat Emergency? (Joe Terranova, BNL)	1640-1655
e.	The 35th Anniversary of the "Hanford Am-241 Incident": Lessons Learned (Gene Carbaugh, PNNL)	1655-1710
f.	Source Term News (Michele Wolfgram, ORNL)	1710-1715

VI. **WRAP UP** *(5 min)*

a.	EMI SIG Meeting Schedule and Working Group Schedule (Cliff Glantz, PNNL)	1715-1720
b.	Adjournment	1720

1.0 Reports on SCAPA Program Initiatives/Other Matters of Interest

1.1 An Emergency Response Asset: High-Resolution Regional Weather Modeling

Cliff Mass presented a discussion on high-resolution regional weather modeling and how it can be used as an emergency preparedness and response asset. He indicated that environmental forecasting is needed to prepare for and respond effectively to severe weather events, required to determine accurate trajectories of plumes and pollutants, and necessary for any adaptation to global climate change.

Cliff provided a history on the northwest real-time prediction effort, which is supported by the northwest modeling consortium. This consortium is a collection of local, state, and Federal agencies and several private sector firms that provides end-to-end environmental prediction. The roots of the northwest modeling consortium can be traced back to the early 1990s when regional air quality agencies, University of Washington (UW), and the National Weather Service (NWS) started meeting to address the problem of the lack of upper air soundings over the Puget Sound region. This matter was resolved by the commissioning of a 915 MHz profiler that is supported by several agencies.

Cliff stated that the Regional Atmospheric Modeling System (RAMS) and Mesoscale Model (MM) 4/5 modeling had revealed that with sufficient resolution, mesoscale models could reasonably simulate and predict many local weather features of importance to the air quality community and other communities requiring atmospheric transport information. Accordingly, in 1995, with consortium support, a real-time system running MM5 once per day using a 27 km grid resolution covering the entire Pacific Northwest (PNW) region was commissioned. With very promising results, the agencies decided to invest in a far larger computer and to jump to much higher resolution, forming the northwest consortium. Early members of the consortium were the Puget Sound Air Pollution Control Agency, UW, NWS, Environmental Protection Agency (EPA), Washington State Departments of Ecology and Transportation, United States Forest Service (USFS), United States Navy (USN) and Seattle City Light.

In 2012, MM5 has been replaced by Weather Research and Forecasting (WRF) with much larger domains and a new high-resolution 1.3-km inner nest. The model is run on a 136-core SAGE cluster using commodity chips with over 100 terabytes of disk storage. Members of the 2012 consortium include UW, EPA, Puget Sound Clean Air Agency, Washington State Departments of Ecology, Transportation, and Natural Resources, NWS, USFS, and the City of Seattle. Model output is publicly available on the web and is provide in gridded form to all consortium members. Cliff stated that a number of organizations are using the gridded results including NWS who brought it into their interactive system, USFS to support wildfire and smoke operations, Washington State University (WSU) for air quality and smoke modeling, and KING-5 TV for on-air graphics.

In support of the nascent modeling effort in the mid-1990s, the consortium needed a lot more data than was available at NWS and Federal Aviation Administration airport sites. During that period, a number of groups established observing networks, whose data were available over

the nascent Internet. It was determined to collect these networks, decode them, and combine them to create a dense mesonet, and the Northwest Net was born. Today, there are over 72 different networks and 3,000-4,000 observations per hour over the states of Washington and Oregon that contribute data to the modeling effort.

Cliff discussed the University of Washington Mesoscale Ensemble prediction system that has 36-km and 12-km grid spacing for precipitation and ensemble post-processing using Bayesian Model Averaging.

Cliff then envisioned the long-term future of the UW modeling effort which will be based on a 64-member ensemble of forecasts at 36-km and 4-km grid spacing, WRF model, and a Data Assimilation Research Testbed (DART) Ensemble Kalman Filter (EnKF) System which can, at a frequency of every three hours, assimilate a wide range of observations to create 64 different analyses. After that, the consortium forecasts forward for 3 hours and then assimilate new observations, yielding a continuous cycle of probabilistic analyses.

Cliff went on to discuss the EnKF ensemble forecasting system which can run an ensemble of forecasts forward to give probabilistic forecasts for any period, and are now doing 24-hour forecasts four times a day. The consortium is planning to go to a 1-hr cycle and use more surface pressure observations. This will be the way to produce the best analyses and short-term forecasts for a variety of needs.

1.2 Global Climate Change: Facts, Myths, Observations, and Research

Tom Ackerman discussed global climate change and impacts on the PNW. He indicated that Greenhouse Gas (GHG) concentrations measured at the Mauna Loa Observatory, Hawaii average about 350 parts per million and are steadily increasing. Looking at Antarctic ice core data in conjunction with the Mauna Loa data, the rise in CO_2 concentrations in the atmosphere appears to be due to anthropogenic activity. This is consistent with the known use of fossil fuels and confirmed by Carbon-14 measurements.

Tom continued by stating that the earth's surface, oceans, and atmosphere absorb solar and infrared radiation. Without the atmosphere's absorption of this radiation, and the re-radiating of infrared radiation back towards the surface, the earth's surface would be some 30 °C colder. Moreover, since GHG concentrations are increasing, the absorption of infrared radiation is increasing, and this further warms earth/ocean/atmosphere system. Tom stated that the recent warming of the earth is not due to solar variability, referencing the following web page: http://solar-center.stanford.edu/sun-on-earth/600px-Temp-sunspot-co2.svg.png. Surface temperatures have risen in the last century which is consistent with our understanding of the physics and models of climate and human activity. Anthropogenic sources will continue to add GHGs to the atmosphere which will result in a warmer world. The extent of that warming is uncertain to a factor of two and scientists are still working hard to reduce that uncertainty.

Tom introduced a simple model of climate variability and change indicating that it takes time to find the climate signal in the midst of natural climate variability. Averaging provides some help but in order to detect such a signal, you need to average temperatures on a decadal time scale. He

hypothesized that there is probably little observable signal in the United States for the next 20-30 years and indicated that climate variability will probably change with a warming climate.

Tom then showed his work on projected climate changes in the PNW and graphs of projected increases in PNW annual temperature and precipitation from 2020-2080 relative to 1970-1999 averages. He noted that changes in annual precipitation averaged over all models are small (i.e., +1-2%) but some models show large seasonal changes, especially toward wetter autumns and winters and drier summers. He added that PNW is reliant on winter snowpack accumulation to meet growing, and often competing, water needs and this snowpack is extremely sensitive to warming. The Olympic Mountains and WA and OR Cascade Mountains have the highest fraction of warm snow (i.e., precipitation falling between 0°C and -3°C) in the continental United States. He emphasized that hydrologic impacts are the "rock in the pond," affecting a wide range of issues both directly and indirectly.

Tom also stated that in the PNW, spring snowpack is projected to decline as more winter precipitation falls as rain rather than snow, especially in the warmer mid-elevation basins. In addition, snowpack will melt earlier with warmer spring temperatures from global climate change. He went on to state that transient (i.e., mixed rain and snow) basins are most sensitive to projected warming due to increasing winter flows, earlier and lower peak runoff; and lower summer stream flow. The overall projection is for wetter winters and dryer summers leading to a competition for water across the state for hydroelectric power generation, irrigation, and salmon spawning. This competition for water would likely impact trans-boundary relationships in the Columbia drainage areas and could require new agreements to be put into place. One likely result is a loss of summer energy production (i.e., less energy to ship south and at higher prices) and a reduction in winter heating demand, but an increase in summer cooling demand.

Tom mentioned that the relative sea level rise may be greatest in South Puget Sound, approximately 3.3 feet by 2100 and the least sea level rise near Neah Bay, of approximately 1.3 feet. There is an increased risk of inundation of low-lying areas, loss of near-shore habitat, coastal erosion, bluff landslides, salt water intrusion into coastal aquifers and contamination from coastal landfills and toxic sites. However, one minor benefit could be improved ferry access at low tide. Such impacts are highly dependent on location and storminess, not just changes in mean sea level. Larger issues include melting ice sheets in Greenland and West Antarctica, and ocean acidification since the rate of CO_2 uptake by ocean is more than 1 million tons per hour. Tom noted that roughly half of all CO_2 emitted from fossil fuel burning ends up in the ocean and measurable acidification has been documented. This acidification has had a deleterious effect on sea life as it impacts the ability of small organisms to form carbonate shells. Puget Sound is already suffering from low pH and anoxic conditions.

Tom summarized his talk by stating that in order to get a better handle on these issues, more and better information about climate change for the PNW is needed and existing information needs to be continually updated. One solution is to develop a regional climate modeling consortium that includes the UW climate science and hydrology groups.

1.3 Jeopardy for Emergency Planning and Response Personnel: "I'll Take Science-Geek for $200, Alex"

Chuck Rives facilitated another session of his Emergency Planning and Response Jeopardy which was enjoyed by all participants; especially the prize winners. This concluded the joint Hazard Assessment Sub Committee/Subcommittee on Consequence Assessment and Protective Actions/DOE Meteorological Coordinating Council (HASC/SCAPA/DMCC) session.

1.4 Welcome and Review of Meeting Agenda

The full SCAPA meeting began when Cliff Glantz and Carl Mazzola each welcomed everyone in attendance and all individuals briefly introduced themselves and their technical backgrounds and experience.

1.5 Welcome and Brief Update on DOE/NA-41 Activities

Dave Freshwater, NA-41 SCAPA Lead, welcomed all that were in attendance and gave a brief update on the NA-41 activities associated with the SCAPA program.

Dave mentioned that one year ago, NA-40 was wrapping up its response to the Fukushima accident, caused largely by a tsunami that followed a Richter scale 9.0 offshore earthquake. Since then, NA-41 has been working on natural phenomena hazard event requirements and changes in guidance. In addition, NA-41, with participation from several offices, ran a Headquarters monitoring team for emergency response efforts associated with the Los Conchas fires that came very close to the Los Alamos National Laboratory (LANL) in July 2011.

Dave stated that the EPA recently held a meeting with the National Academy of Science Committee on Toxicology that could finalize 33 Acute Emergency Guideline Limits (AEGLs). In addition, the Emergency Response Planning (ERP) Committee will be publishing its 2012 Emergency Response Planning Guidelines (ERPGs) in June, 2012.

Dave went on to discuss Protective Action Criteria (PAC) Revision 27. He mentioned that NA-41 published PAC Revision 27 on February 29, 2012 with 2,815 PAC-3 changes, 2,640 PAC-2 changes and 2,418 PAC-1 changes. The PAC Revision 27 Frequently Asked Questions (FAQ) was also published on February 29, 2012 to provide assistance in the adjustment of Emergency Preparedness Hazard Assessments (EPHAs) and Emergency Action Levels (EALs) in response to the significant number of PAC changes. NA-41 recommended that these changes should be implemented as part of the normal review and update cycle and as directed and negotiated with field elements. However, the sites are to use the new Temporary Emergency Exposure Limits (TEELs) immediately during emergency responses.

Dave then discussed PAC Revision 28 which will incorporate the recommendations of the outside review group that could not be implemented in time for PAC Revision 27. Dave stated that the outside review panel recommendations regarding limiting the routes of exposure and species used in toxicity studies was still being implemented by the TEEL Review Panel. In

addition, the reviewers are being instructed to eliminate instances where TEELs are equal between levels which include 18 chemicals where PAC-1=PAC-2=PAC-3, 181 chemicals where PAC-2=PAC-3, and 303 chemicals where PAC-1=PAC-2. When those reviews are complete, the update process should be restarted with the Revision 14 chemicals.

Since NA-41 has shifted TEEL development to concentrate on chemicals that cause an Operational Emergency (OE), 114 chemicals that don't pose hazards that would lead to an OE declaration are candidates for removal. However, if a site determines that a removed chemical should be retained, it should provide a rationale to the PAC Development Team. Publication of PAC Revision 28 in targeted for the January-March 2013 timeframe.

1.6 Implementation of PAC/TEEL Revision 27

Dave Freshwater discussed the changes to the PAC/TEEL data base since the last SCAPA annual meeting. The outside review group recommendations were reviewed by NA-41, who promptly issued an 18-point instruction to update the PAC/TEELs and PAC/TEEL Revision 27 reflects the methodology changes.

Dave then focused his talk on the effort associated with the development of PAC/TEELs Revision 27. These included the following guidelines:

1. All TEELs are to be based on 60-minute exposure.
2. All time scaling should use the ten Berge equation (C_n x t = K) where n = 1 when extrapolating to longer times, and n = 3 when extrapolating to shorter times.
3. The AEGLs adjustment ratio for human-equivalent concentrations that have been used in the past to compare animal toxicity data to ERPG-2 or ERPG-3 should be eliminated.
4. New ratios of toxicity data to AEGLs should be computed.
5. The reference hierarchy order for consulting primary references should be changed.
6. The species hierarchy should be changed to human, monkey, dog, rat, mouse, rabbit, guinea pig, cat, and pig.
7. The routes of exposure should be inhalation, oral, dermal, intraperitoneal, and intravenous, in that order which is a significant change.
8. The default exposure times should be used when not specified for acute exposures.
9. The exposure limit priorities should be rearranged.

1.7 Numerical Impacts from TEEL Development Methodology Changes

Doug Craig discussed the numerical impacts resulting from the TEEL development methodology changes in Revision 27. He stated that NA-41 had commissioned the outside review group to perform an independent external review, and that most TEEL updates are a result of implementing their recommendations. Revision 27 of the PAC dataset has become the first revision with such extensive updates to the methodology.

Doug discussed the details to these PAC changes which also included a significant modification to the website. Areas that changed were the methodology, the hierarchies, the data extraction techniques, the data calculation techniques, and rounding rules. In addition, specific guidance was given to no longer publish TEEL-0 values, and the elimination of the upper limit maximum of 500 mg/m^3 for chemicals that are solids or particulates. This impacted approximately 900 PAC-3 values and approximately 70 PAC-2 values.

Doug mentioned the new hierarchy for exposure limits and for toxicity data sources providing additional detail to what Dave Freshwater summarized. Doug then described the toxicity data update strategy which includes a continuing annual review with the oldest chemicals looked at first, a review of the beta version of Revision 27, chemicals with a PAC-3 to PAC-2 ratio of greater than 400, and a review of chemicals with routes and species no longer used.

Doug moved on to discuss the ongoing and future updates. He indicated that Version 2.1 of the Handbook (DOE-HDBK-1046) is being developed, and a list of candidate chemicals for removal is being compiled. With respect to DOE-HDBK-1046, NA-41 has requested a draft to be ready for submission to RevCom by the time the PAC Revision 28 is ready. This draft needs to document all changes to the TEEL development process. The candidate chemicals for removal are those that may not constitute an OE per DOE O 151.1C, and potential candidates include materials that are food products or food additives recognized by the Food and Drug Administration (FDA), known pharmaceuticals or components of pharmaceuticals approved by FDA for human consumption, and laboratory reagents which may exist in only small quantities that are not likely to reach toxic concentrations in air.

1.8 CMM Updates, Testing and Potential Enhancements

Xiao-Ying Yu presented the Chemical Mixture Methodology (CMM) improvements since the last SCAPA annual meeting.

Xiao-Ying first provided a status on CMM Revision 27, indicating that CMM Workbook Revision 27 will be published after the SCAPA meeting. This revision contains the PAC/TEEL data published in PAC Revision 27 to ensure that the CMM and PAC data sets are consistent. Moreover, the CMM analysis uses the most updated PAC values.

Xiao-Ying then provided a status on the Health Code Number (HCN) update task. The HCNs of more than 3,300 chemicals have been reviewed and updated, as appropriate, and all of the updated HCNs are contained in CMM Revision 27, completing a task that began in 2008. With respect to CMM Revision 28, about 500 chemicals will be reviewed annually per direction from NA-41 where the priorities will be focused on a literature review for chemicals that have not been reviewed in the past 6-7 years. The 15% independent quality assurance review process will be followed, and potential CMM enhancement options will be explored by conducting additional testing. In addition, the CMM Wizard prototype will soon be released for use.

Xiao-Ying identified the CMM Project Team that she and Cliff are directing. Juan Yao (WSU) is an experienced Masters-level intern, who will be joined by three new summer interns, Sarah Horn a National Science Foundation Science and Mathematics Teacher and Researcher (STAR)

fellow, and two undergraduate students from the Department of Homeland Security Science, Technology, Engineering and Mathematics program. She thanked departing STAR Fellow Alex Booth for all of his work on the CMM Wizard. Rocky Petrocchi is the senior mentor.

Xiao-Ying indicated that the CMM interns have conducted a detailed CMM case study involving 24 chemical mixtures and it was concluded that the HCN-based approach provides a benefit over the simple summing of all Health Indices (HIs) in cases where the significant chemicals affected different target organs.

There was somewhat less benefit seen in the 2011 version of the CMM then in the 2007 version. In fact, for some cases the 2007 version was non-conservative, while in other instances, the 2011 version was overly conservative. It is hypothesized that the differences between the 2007 and 2011 CMM versions are likely due to the more detailed assignment of HCNs to each chemical (up to 10 HCNS) and the addition of more acute HCN categories.

Xiao-Ying elaborated on the CMM enhancement project indicating that it would be beneficial to find a way to reduce the new over-conservatism in the CMM. Simply returning to using fewer HCNs is not a good solution. Last year's intern examined the application of weighting factors to the HCNs based on their potential relevance for the threshold limit value (e.g., PAC-2). Accordingly, four weighting approaches were tested:

1. "Generic": Base weighting on the rank order of the HCNs listed for a chemical
2. "Percentile": Base weighting on generic tables listing all the HCNs
3. "Exposure Routes': Base weighting on toxic effects on target organ or mode of action induced by primary or the most common routes of exposure in an emergency
4. "Combined": Base weighting on both percentile and exposure routes induced primary target organ and route of exposure

Several conclusions were reached from this evaluation:

1. The Percentile approach, employing a priority ranking of the HCNs based on their potential impact to an individual's ability to take protective actions, provides the most appropriate balance between benefit and conservatism during initial testing and warrants further study.
2. The approach incorporating exposure route information underwent limited testing and also warrants further study.
3. Enhancements to the CMM can provide more accurate estimates of health effects and this should lead to better and more cost-effective emergency planning decisions.

Xiao-Ying concluded her presentation by stating that in the next month, the 2012 summer interns will conduct further testing to explore ways to improve the CMM. This includes a new focus on biological systems (i.e., looking at target organ systems). She believes that this promising new approach will improve the technical defensibility of the CMM and provide a greater benefit to users.

Xiao-Ying then introduced Alex Booth to talk about the CMM Wizard; an on-line version of the CMM with additional features to enhance usability.

1.9 CMM Wizard Prototype Demonstration

Cliff Glantz and Alex Booth demonstrated the CMM Wizard, an online user-friendly version of the CMM Excel Workbook. They indicated that four sequential steps guide the user through the process of calculating a mixture's HIs. The Workbook's chemical data are stored in an Access database and the web-forms update dynamically based on user input.

Alex discussed the benefits of the CMM Wizard, which include:

- Enabling access to the CMM from any computer with internet access with no need to download a Workbook or enable macros.
- Allowing timely updates of chemical data base information to ensure that users will not be executing an outdated CMM version.
- Providing comparable functionality to the Workbook from a framework that is easier to use.
- Allowing a chemical to be quickly added to a mixture using a search function and drop down menu of chemicals. Chemical searches can be made based on compound name, Chemical Abstract Services Registry Number (CASRN) or Sax number.
- Providing output that is easy to read and can be printed out in a readily understandable format (Workbook spreadsheets are not designed for printing).
- Allowing the user to save input files and output products so they can be reloaded back into the Wizard for subsequent review or to serve as a starting point for evaluating new release scenarios.
- Processing output for up to six receptor distances at a time (the Workbook can only accommodate one receptor location at a time).
- Applying no limit on the number of chemicals in a mixture (the Workbook is limited to a maximum of 15 or 30 chemicals depending on the version downloaded).

1.10 SCAPA Consequence Assessment Modeling Toolbox –It's Alive!

Cliff Glantz reported that for the development or upgrading of safety-related and non-safety consequence assessment software, the SCAPA Software Quality Assurance (SQA) guidance document recommends minimum compliance levels for each of the ten SQA work activities described in DOE G 414.1-4. The SCAPA Consequence Assessment Modeling (CAM) Toolbox website will provide a repository of consequence assessment models that adhere to the SCAPA SQA guidance. The most important areas for SQA are:

1. Technical and user documentation.
2. Configuration management.

3. Verification & validation testing.
4. Problem reporting and sharing.

Cliff discussed the benefits of the SCAPA CAM Toolbox, which provides a "one-stop shopping" website for information on the key SCAPA-related consequence assessment models. The information provided for each model in the toolbox includes introductory material on the models, contact information for model developers/custodians, links to more detailed information on the model, a report on the model's quality assurance program and SQA gap analysis, and a summary status of the models SQA status.

The toolbox supports the use of our "tried-and-true" legacy codes, and spearheads the drive toward adoption of consistent, reasonable SQA practices by model developers.

Cliff then moved on to efforts associated with populating the CAM Toolbox. The first step is to select models for conditional acceptance into the toolbox. The starting set will focus on the most widely-used models for safety-related consequence assessment applications, which include:

1. CAPARS (effort complete).
2. APGEMS (effort complete).
3. NARAC (performing self-assessment gap analysis).
4. RASCAL, HYSPLIT, RAMS/LPDM, and Puff-Plume (future efforts).

CAMWG members have been selected to review and evaluate the SQA gap analyses prepared by the model developers and then work with the model development team to formulate a plan to prioritize and close any SQA gaps. Models in the toolbox will have acceptable levels of SQA with a focus on the most important aspects of SQA.

Cliff showed the toolbox webpage developed for CAPARS and APGEMS; as well as for the future toolbox models.

1.11 ALOHA! The Latest News from the NOAA CAMEO/ALOHA Team

David Wesley shared the latest news on all of the codes that have been developed and maintained by the Computer-Aided Management of Emergency Operations/Areal Locations Of Hazardous Atmospheres (CAMEO/ALOHA) team.

David presented highlights of the CAMEO software suite. The chemical module contains physical properties, Levels of Concern, response recommendations, and reactivity predictions; while the air dispersion module addresses toxic, flammable, and explosive threats. The geospatial module provides sensitive locations, facility hazardous inventories, and impacted population estimates. The CAMEO chemical module has an extensive chemical database that provides critical response information, including physical properties, health hazards, air and water hazards, and recommendations for firefighting, first aid, and spill response. It now has United Nations data sheets to provide Emergency Response Guidebook pages and shipping

information from the Hazmat Table in 49 CFR 172.101 and a chemical reactivity tool to predict what hazards could arise if chemicals were to mix together.

Future work on the CAMEO chemical module includes an improved multi-word search, updated AEGLs, ERPGs, and PACs (interim AEGLs are now included in database), and an auto-update feature. The National Oceanic and Atmospheric Administration (NOAA) plans to continue working to improve the data quality and data sources in CAMEO chemicals and to update the reactivity prediction tool.

David next described the ALOHA code which has both Gaussian and heavy gas dispersion algorithms, is designed for short-duration, short-range incidents, having multiple time-dependent chemical source models (i.e., tank, puddle, gas pipeline, and direct), and which has been upgraded to include fires and explosions models in addition to toxic gas dispersion models.

A new version of ALOHA will be released this summer with new Levels of Concerns. Recent changes include an updated chemical library, an added ability to export threat zone to .KML (for Google users) or save the .PAS file (for ESRI users using the NOAA ArcMap Import Tool) and other minor updates.

Long-term plans for ALOHA include making a web-based ALOHA that can interact with the CAMEO chemicals site and use the NOAA HYSPLIT dispersion model for large spills. The current ALOHA-HYSPLIT project will be conducted in two distinct phases:

- Phase 1: Initial integration of web version of HYSPLIT and ALOHA; and use of ALOHA for chemical selection and source strength estimates
- Phase 2: Incorporate ALOHA dispersion models into a web version for smaller-scale releases, add fires and explosions capabilities, and integrate with CAMEO chemicals for more seamless access to chemical datasheets and response recommendations

David then moved on to the Mapping Applications for Response, Planning, and Local Operational Tasks (MARPLOT) suite that has a free and easy-to-use Geographic Information System (GIS), can draw map data stored locally on your computer or streamed from online sources (e.g., aerial photos and topographical maps), can draw your own objects on the map, link objects to custom data in the CAMEO fm database, and obtain population estimates.

Recent changes to MARPLOT include updates to 2010 TIGER files (i.e., county roads etc.). Long-term plans are to revise MARPLOT to capitalize on web-based mapping capabilities and services, and a complete, browser-based revision of MARPLOT.

David discussed CAMEO fm suite which enables a user to create and place custom objects on a MARPLOT map and link those objects to user data stored in the CAMEO fm database (e.g., hospital emergency contact information, facility chemical inventory, site map, Material safety Data Sheets). He also talked about the Tier2 Submit code which can be used to generate an electronic chemical inventory Tier II facility report and can be used to automatically update the facility information in CAMEO fm. He indicated that new versions of CAMEO fm and Tier2

Submit are released annually every fall. Recent changes include State field updates, KML exports, and minor feature improvements.

1.12 Lessons Learned: Utilizing GENII Version 2 for Deposition Velocity

Denny Armstrong presented recent work that he had performed using the Generation II (GENII) Version 2 code to determine sensitivities of the dry deposition parameter on EPHA results.

1.13 Biosafety News

Frank Roberto, through Live Meeting, reviewed the 2011-2012 accomplishments of the Biosafety Working Group (BWG). Frank mentioned that the BWG is continuing its alliance with American Biological Safety Association (ABSA) and attended the ABSA annual meeting in October 2011.

Frank stated that the BWG has had active participation in the Federal Experts Security Advisory Panel (FESAP) working group for National Institutes for Health (NIH) and the United States Department of Agriculture, representing DOE and the National Nuclear Security Administration (NNSA). In addition, BWG members consulted with Office of Science and NNSA on a Memorandum of Understanding with Centers for Disease Control and Prevention to coordinate inspections.

BWG members also provided input to DOE and NNSA regarding the Graded Security Protection draft order and supported the TEEL Advisory Group (TAG) as it examines TEELs for biotoxins. Lastly, Frank reviewed 2012-2013 topics that the BWG plans to address. These include the development of TEELs for biological toxins, membership coordination with the DOE Executive Biosurety Working Group, and involvement with additional technical publications.

1.14 Emergency Preparedness Implications: Changes to Globally Harmonized System of Classification and Labeling of Chemicals

Dina Siegel discussed the emergency preparedness implications associated with changes to the Globally Harmonized System (GHS) of classification and labeling of chemicals, resulting from the revised Occupational Safety and Health Administration (OSHA) Hazard Communication (HAZCOM) rule 29 CFR 1910.1200. This is the first major technical revision of HAZCOM in 29 years. Dina reminded everyone that HAZCOM is more than just OSHA. It also includes the Department of Transportation, the Consumer Product Safety Commission, and EPA for pesticides through implementation of the Toxic Substance Control Act.

Dina then discussed the revised HAZCOM rule. She stated that OSHA issued this final rule as it wanted to modify the Hazard Control System (HCS) to make it consistent with the GHS. OSHA determined that adopting the GHS will result in clearer, more effective methodology for conveying information on hazardous chemicals to employers and employees, and it would provide a valuable systematic approach for employers to evaluate workplace hazards and provide employees with consistent information regarding hazards.

The major high level changes to the HAZCOM rule include:

1. Hazard classification: Chemical manufacturers and importers are required to determine the hazards of the chemicals they produce or import. Hazard classification under the new, updated standard provides specific criteria to address health and physical hazards as well as classification of chemical mixtures.
2. Labeling: Chemical manufacturers and importers must provide a label that includes a signal word, pictogram, hazard statement, and precautionary statement for each hazard class and category.
3. Safety Data Sheets: The new format requires 16 specific sections, ensuring consistency in presentation of important protection information.
4. Information and training: To facilitate understanding of the new system, the new standard requires that workers be trained on the new label elements and safety data sheet format, in addition to the current training requirements.

Some of the changes from the proposed rule to the final rule involve:

1. Maintaining the disclosure of exposure limits (Threshold Limit Values) established by the American Conference of Governmental Industrial Hygienists and carcinogen status from nationally and internationally recognized lists of carcinogens on the safety data sheets.
2. Clarification that the borders of pictograms must be red on the label.
3. Flexibility regarding the required precautionary and hazard statements to allow label preparers to consolidate and/or eliminate inappropriate or redundant statements.
4. Longer deadlines for full implementation of the standard.

In addition, the new system is being implemented throughout the world by countries including Canada, the European Union, China, Australia, and Japan. Moreover, this new rule affects other existing rules such as:

- 1910.120: Hazardous Worker Protection and Emergency Response.
- 1910.119: Process Safety Management.
- 1910.252: Welding.
- 1910.106: Flammable and combustible liquids.

Dina then went into detail regarding the Safety Data Sheet (SDS) components. The new SDSs provide items of primary interest to emergency responders at the beginning of the document, with more technical information in later sections. This includes identification, hazard(s) identification, composition information on ingredients, first aid measures, fire-fighting measures, accidental release measures, handling and storage, exposure controls/personal protection, physical and chemical properties, stability and reactivity, toxicological information, disposal considerations, transport information, regulatory information, and other information.

Dina related that this harmonization effort will assist emergency responders with their information needs, for emergency responders need accurate, detailed and sufficiently clear

information to facilitate an immediate response. Fire fighters will also be helped as they need information that can be seen and understood at a distance, such as graphical and coded information.

Dina showed that there are some issues that need to be ironed out. For example, the GHS categories conflict with National Fire Protection Association (NFPA)-established hazard ratings in NFPA 704, which has been in effect since the 1950s. NFPA recommended that the term ''combustible liquid'' not be deleted. There may be additional confusion since the rating system in NFPA 704 expresses the most hazardous as a ''Category 4'' while the GHS classification criteria, "Category 1.''

The proposed realignment of the flammable liquid categories would result in confusion among employees, emergency responders, authorities having jurisdiction, and others who have been used to the distinction between flammable and combustible liquids. Possible considerable confusion might occur among the workers who have been instructed to take specific precautions for various liquids based on whether they were identified as flammable or combustible. The International Fire Marshals Association users have been relying on the NFPA 704 Hazard Rating and the Hazardous Material Information System for a long time and would be confused by the change.

Dina closed her talk with the following five recommendations:

1. Begin communications immediately with internal and external emergency management organizations, regarding the changes to the HCS, and how organizational members/responder will need to be trained. Address use or change of building placards with the NFPA diamond.
2. Work with your chemical safety Subject Matter Experts and program leads at your site to update training materials, written hazard communication programs, and emergency management programs.
3. Investigate whether you have site employees that meet the definition of a chemical manufacturer, importer, or distributor.
4. Consider participating in the Energy Facilities Contractor Group (EFCOG) initiative on developing materials for training and hazard communication program.
5. Start planning and updating now to meet the December 2013 deadline.

1.15 Where are we in Developing TEEL Values for Biotoxins?

Jayne-Anne Bond provided the rationale as to why NA-41 is pursuing TEEL values for biotoxins. She stated that biotoxins are produced from terrestrial or marine animals, plants, fungi, or bacteria and are protein toxins, non-protein toxins, and possible warfare agents. The most potent biotoxins are neurotoxins. Initially, the following ten biotoxins were selected for TEEL development: (1) ricin; (2) abrin; (3) botulinum toxins; (4**)** Staphylococcal Enterotoxin B (SEB); (5) tetrodotoxin; (6) tetanus toxin; (7) fusariotoxin, T-2; (8) conotoxins; (9) cholera toxin; and (10) shigella.

Jayne-Anne related the process of obtaining human health effect information for determining TEELS for biotoxins. A broad search was conducted on Google Scholar to find journals and other appropriate publications for biotoxin health effects. Over 18,000 hits were identified. A second more refined search returned over 2,000 hits and the last even more refined search returned only 146 hits. However, most of the files returned were not relevant to this task since they were related to medical research.

Jayne-Anne described the process undertaken regarding the TEEL development for biotoxins which are described in draft Handbook Version 2.1. The work began with the same hierarchy of data used to develop TEEL values for other chemicals starting with exposure limits and looking for applicable toxicity data. Some guidelines for the development of a data base for biotoxins were developed.

They include human data are preferred but may not be applicable to an OE, therapeutic uses of many biotoxins, such as BOTOX®, novel advances using them for medical applications/treatments (e.g., pain, cancer), use in suicide attempts, and accidental poisonings.

Jayne-Anne related the lessons learned from this task. Much data was available, but unfortunately, most of it is not relevant. In addition, the direction of research is constantly changing and for our purposes, older research is more applicable. Moreover, biotoxins are complicated with multiple serotypes, multiple polypeptides and proteins, different functions for the toxin mode of action, cell binding, and target molecule binding.

Jayne-Anne shared the preliminary results which showed that biotoxins were far more toxic in small concentrations than most chemicals. The reasons why they are so toxic is that most are proteins with specific target molecules, and the human body is highly selective for that specific target molecule. Small amounts of SEB can incapacitate an entire army, and small amounts of botulinum and ricin can be lethal.

Future plans include a joint meeting with the BWG to confirm data and data sources, and submission of draft TEELs to NA-41 for its consideration.

1.16 Shelter in Place – Is it a Valid Choice in a Haz-Mat Emergency?

Joe Terranova presented a talk on whether shelter in place is always a valid choice in a hazmat emergency. He indicated that shelter in place is a commonly quoted protective action in an airborne release if it is in an interior room above grade, the Heating Ventilation and Air Conditioning (HVAC) system is shut down and windows and doors are closed and sealed with duct tape and plastic.

Joe stated that it is also important to have a means of communication and basic supplies (e.g., a minimum of 10 square feet per person for a maximum time of 3 hours). This is a short-term protective strategy, as it is intuitive to create a barrier between the hazard and the “protected” space, it is easy to implement, and buys time to develop exposure models. According to the EPA, this protective action can be 500 times safer than staying outside as long as you enter the shelter before the arrival of the contaminant and exit the shelter as soon as the contaminant passes over and begins infiltration into the building.

However, the effectiveness of this protective action diminishes when you enter the shelter too late and exit the shelter too late, and when the contaminant is present outside for a long period of time. In addition, going into a shelter after the contaminant has passed over can also be harmful.

Joe reviewed some of the important considerations that should be taken into account, which include:

1. Maximum outdoor plume concentration.
2. Interior volume.
3. Room isolation effectiveness.
4. Air exchange rate.
5. Plume arrival and departure times.
6. Air monitoring capability.

Joe referred to some studies on this topic. In "Effectiveness of expedient sheltering in place in a residence," air flow measurements were obtained for one interior room in a test house during two weather conditions. For each weather condition, nine experiments were performed with nine different participants sealing the room. Protection factors were developed for three outdoor exposure times of 15 minutes, 1 hour, and 2 hours, and four shelter occupancy times of 15 minutes, 1 hour, 2 hours, and 3 hours.

In "Effectiveness of expedient sheltering in place in commercial buildings," expedient sheltering measures (i.e., plastic sheeting, duct tape) were applied to four different rooms. The protection factors were compared for leaky, typical, and tight buildings under various occupancy times and plume passage times and these factors ranged from 1 to 3960, depending on the conditions and this clearly reinforced the importance of timing.

Joe referenced the following additional studies:

1. "Expedient Sheltering in Place – An Evaluation for CSEPP"
2. "Deciding Between In-Place Protection and Evacuation in Toxic Vapor Cloud Emergencies"
3. "Effectiveness of Urban Shelter-in-Place II: Residential Districts"

Joe then shared some research that was conducted at Brookhaven National Laboratory (BNL). The perfluorocarbon tracer study in Building 400 tracked cigarette smoke during two tests in Autumn of 2009 and Winter of 2010. Both studies were conducted under a temperature inversion and calm winds. The results showed a tenfold increase in indoor peak concentrations during the temperature inversion without HVAC changes, an in/out concentration ratio of 19%, and a maximum concentration registered at a State Implementation Plan area.

The conclusions were that lower peak indoor concentrations (compared to outdoor concentrations) are encountered after a short-term release because the building envelopes

limit indoor-outdoor air exchange. In addition, delays in notification and response, and the timing of shelter implementation and termination can impact the effectiveness of the strategy.

1.17 The 35th Anniversary of the "Hanford Am-241 Incident": Lessons Learned

Gene Carbaugh discussed lessons learned from the Hanford Am-241 accident, which happened more than 35 years ago.

Gene stated that on August 30, 1976, an americium column exploded at the Hanford Site's 242-Z Plutonium Finishing Plant which resulted in the highest contamination and uptake of americium ever incurred by a person, Harold R. McCluskey. Called the "Atomic Man" by the press, the medical treatment this patient received following the accident was highly effective and allowed him to live out a reasonably normal life. The principles of decontamination and therapy for americium uptake have not changed significantly in the 35 years since the accident, nor have there been major changes in the radiological measurement techniques or technology.

However, there have been significant changes in facilities, medical management infrastructure, and expectations of information communication. The accident was horrific, the response heroic, and the outcome probably the best that could have been expected on all fronts.

Gene showed a pre-accident photo of the glove box and another showing the blown out glove ports with much debris on the floor. On the left is the step ladder from which the affected worker was stepping down when the explosion occurred. The six-inch diameter ion exchange column is shown peeled back by the explosion.

Gene mentioned that the initial response was a skin decontamination shower in which the patient was bathed in a stainless steel decontamination tub using a hand-held sprayer. The decontamination team member is in full protective clothing, including a full-face canister respirator. Debridement included removal of crusts, scabs, and extruded foreign bodies. One such piece of glass has a length on 0.5 cm. Full-face respirators were worn during by medical personnel during the first week after the accident due to high air concentrations of Am-241 around Mr. McCloskey. Following the first week, respirators were no longer worn, and facial shields were worn during the skin decontamination bathing to prevent splash contamination. During the first day, direct skin contamination measurements exceeded the highest scale on the alpha survey instruments and a swipe/count procedure was used to monitor reduction in contamination. The patient's face would show readily detectable activity for the rest of his life, in part leading to his title in media as "The Atomic Man." Various skin decontamination agents were tried with little variation in overall effectiveness. Decontamination was extended, extensive, difficult and never complete.

Gene indicated that a vellum matrix was used to map the contamination levels of Mr. McCluskey's face using a collimated 1-inch sodium iodide (NaI) detector. The resulting color-coded map showed the highest concentration of activity over his right eye. Mapping was initially done using a gamma camera set for the 59.5 keV photon emissions of Am-241. 11 Measurements of Am-241 in the lung and liver were performed using NaI detectors. All Diethylenetriamine Pentaacetate (DTPA) therapy administrations were by slow push

intravenous injection and careful attention was paid to the injection site to make sure bruising or scarring did not occur during the repeated injections. The therapy was considered life-saving, in that without it, the radiation dose to the liver would have resulted in fatal liver failure.

Gene showed a figure of in vivo measurements which showed several interesting trends. The facial tissue showed a two-component exponential decrease as skin was sloughed off, dropping from 7000 µCi at day 100 to 3 µCi at 9 years. The bone showed a relatively constant Am-241 burden dropping slightly from about 7 µCi at day 100 to 6 µCi at day 900, indicating that bone deposition was essentially permanent and not significantly removed by DTPA chelation therapy. Upon termination of DTPA therapy at day 934, the bone showed a gradual increase to 9 nCi at 9 years post-exposure. The liver data showed a dramatic drop while undergoing daily chelation therapy, from 40 µCi early on to 1 µCi at day 100 with the drop leveling off at about 0.2 µCi by day 300. Upon termination of chelation therapy at day 934, the liver burden rapidly increased to 0.4 µCi by day 1100, after which it showed a slow but steady increase to 0.6 µCi by day 3500.

Gene concluded his presentation by stating that Harold R. McCluskey passed away at age 75 in 1987 of coronary artery disease that was not associated with his radiological exposure. He was considered the “perfect patient” during his treatment. His vision became impaired after the accident but improved significantly after acid-induced cataracts were removed and a cornea transplant performed.

1.18 Source Term Working Group News

There wasn’t sufficient time left for Michele Wolfgram to present the highlights of the work that was performed by the Source Term Working Group (STWG) since May 2011. Michele will be providing a more detailed update at the Tuesday STWG meeting.

1.19 EMI SIG Meeting Schedule and Working Group Schedule

Just before the close of the meeting, Cliff reviewed the remaining schedule of events. With respect to SCAPA, the following Tuesday activities were scheduled:

- 7:00 AM– 8:00 AM: Source Term Working Group (Salon A)
- 11:30 AM – 1 PM: NARAC/HOTSPOT User’s Group (Salon A)
- 5:00 PM – 6:00 PM: Chemical Exposures/Chemical Mixtures Working Group (Salon A)
- 6:30 PM – 8:30 PM: SCAPA Dinner at Benihana

The following Wednesday activities were scheduled:

- 7:00 AM – 8:00 AM: Biosafety Working Group (Salon A)
- 11:30 AM – 1:00 PM: TEEL Advisory Group (TAG) (Salon A)

Lastly, Thursday activities included:

- 8:00 AM – Noon: Tour of Seattle EOC

- 8:00 AM – 5:00 PM; HOTSPOT 2.07.2 Workshop and Computer Practicum
- 8:00 AM – 5:00 PM: EOTA Exercise Design/Exercise Builder Course

2.0 Meeting Attendees

The following individuals signed the meeting attendance roster, and their respective company affiliations are listed. Additional EMI SIG members were in attendance for portions of the meeting but did not sign the roster. Several SCAPA members participated via webinar/teleconference. Each attendee was given a brief opportunity to introduce themselves, discuss their background, and relate what role they played in the SCAPA program.

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3.0 Acronyms and Initializations

A

ABSA	American Biological Safety Association
AEGL	Acute Exposure Guideline Limit
ALOHA	Areal Locations of Hazardous Atmospheres
APGEMS	Air Pollutant Graphical Environmental Modeling System
ARL FRD	Air Resources Laboratory Field Research Division
ATL	Advanced Technology Laboratories

B

BNL	Brookhaven National Laboratory
BWG	Biosafety Working Group

C

CAM	Consequence Assessment Modeling
CAMEO	Computer-Aided Management of Emergency Operations
CAMWG	Consequence Assessment Modeling Working Group
CAPARS	Computer-Assisted Protective Action Recommendation System
CASRN	Chemical Abstract Services Registry Number
CEWG	Chemical Exposure Working Group
CFR	Code of Federal Regulations
CMM	Chemical Mixture Methodology
CMWG	Chemical Mixtures Working Group

D

DART	Data Assimilation Research Testbed
DMCC	DOE Meteorological Coordinating Council
DOE	Department of Energy
DTPA	Diethylenetriamine Pentaacetate

E

EAL	Emergency Action Level
EFCOG	Energy Facilities Contractor Group
EMG	Emergency Management Guide

EMI	Emergency Management Issues
EnKF	Ensemble Kalman Filter
EOC	Emergency Operations Center
EOTA	Emergency Operations Training Academy
EPA	Environmental Protection Agency
EPHA	Emergency Preparedness Hazard Assessment
ERP	Emergency Response Planning
ERPG	Emergency Response Planning Guideline
ESRI	Environmental Systems Research Institute

F

F

FAQ	Frequently Asked Question
FDA	Food and Drug Administration

G

G	Guide
GHG	Greenhouse Gas
GHS	Global Harmonization System
GIS	Geographic Information System

H

HASC	Hazards Assessment Subcommittee
HAZCOM	Hazard Communication
HAZWOPER	Hazardous Worker Protection and Emergency Response
HCN	Health Code Number
HCS	Hazard Control System
HDBK	Handbook
HI	Hazard Index
HOTSPOT	A radiological consequence assessment code
HVAC	Heating Ventilation and Air Conditioning
HYSPLIT	HYbrid Single-Particle Lagrangian Integrated Trajectory

I

INL	Idaho National Laboratory

J-K

keV	kilo electron volt
KML	Keyhole Markup Language

L

LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory

M

MARPLOT	Mapping Application for Response, Planning and Local Operational Tasks
MM	Mesoscale Model
MM5	Generation 5 Penn State State/NCAR Mesoscale Model

N

NA-41	DOE Office of Emergency Management
NARAC	National Atmospheric Release Advisory Capability
NCAR	National Center for Atmospheric Research
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NWS	National Weather Service

O

O	Order
OE	Operational Emergency
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory

P

PAC	Protective Action Criteria
PNNL	Pacific Northwest National Laboratory
PNW	Pacific Northwest

Q-R

RAMS	Regional Atmospheric Modeling System
RASCAL	NRC's Radiological Assessment System for Consequence Analysis

S

SAIC	Science Applications International Incorporated
SCAPA	Subcommittee on Consequence Assessment and Protective Actions
SDS	Safety Data Sheet
SEB	Staphylococcal Enterotoxin B
SEI	Shaw Environmental Incorporated
SIG	Special Interest Group
SMS	Safety Management Systems
SNL-NM	Sandia National Laboratory/New Mexico
SQA	Software Quality Assurance
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
STAR	Science and Mathematics Teacher and Researcher
STWG	Source Term Working Group

T

TAG	TEELs Advisory Group
TEEL	Temporary Emergency Exposure Level
TIGER	Topologically Integrated Geographic Encoding and Referencing

U-V

USFS	United States Forest Service
USN	United States Navy
UW	University of Washington

W-Z

WG	Working Group
WRF	Weather Research and Forecasting model
WSU	Washington State University