Subcommittee on Consequence Assessment and Protective Actions (SCAPA)

2010 ANNUAL MEETING

Las Vegas, Nevada
May 3, 2010

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EXECUTIVE SUMMARY

The DOE Subcommittee on Consequence Assessment and Protective Actions (SCAPA) convened its annual meeting at the Renaissance Hotel in Las Vegas, Nevada, on May 3, 2010, in conjunction with the Emergency Management Issues Special Interest Group (EMI SIG) Meeting (see agenda). Fifty-five 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. Twenty technical presentations of interest to the membership, including those from the five active SCAPA Working Groups and the National Atmospheric Release Advisory Capability (NARAC) User Group, were delivered. Each of the five SCAPA WGs continues its work in the coming year and will report on its activities at the next SCAPA meeting. That meeting is scheduled for May 2, 2011, in Charleston, South Carolina, in conjunction with the next EMI SIG meeting.

The following identifies individuals who signed the attendance roster for the meeting and their respective company affiliations. Additional EMI SIG members were in attendance for portions of the meeting but did not sign the roster. Individuals were given a brief opportunity to introduce themselves, discuss their background, and relate the role they play in the SCAPA program.

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2010 SCAPA MEETING AGENDA

	Time (PDT)
HASC JOINT SESSION: SELECTED CONSEQUENCE, HAZARDS, AND SOURCE TERM ASSESSMENT TOPICS	
Impact Analysis of Elevated Dense Gas Jet Releases from an ABS Plant: A Case Study (Steve Vigeant/Shaw)	1100–1115
Estimation of Hydrogen Gas Plume Behavior Due to a Postulated Pipeline Accidental Release (Steve Vigeant/Shaw and Carl Mazzola/Shaw)	1115–1135
Complex vs. Simple Models for EPHAs: A Study (John Ciolek/AlphaTRAC)	1135–1155
SCAPA WELCOME AND INTRODUCTIONS	
Introductions and Review of Meeting Agenda (Cliff Glantz)	1230–1255
Welcome and Update on DOE NA-41 Activities (Dave Freshwater)	1255–1300
SCAPA Year in Review (Carl Mazzola)	1300–1310
What's New with the SCAPA Website? (Cliff Glantz)	1310–1315
SELECTED CONSEQUENCE, HAZARDS, AND SOURCE TERM TOPICS	
Source Term Characterization Activities (Michele Wolfgram)	1315–1320
Leak Protection Factor Source, Use and Development (Chuck Rives)	1320–1340
Accounting for the Non-Respirable Source Term (Wayne Davis)	1340–1400
Is Heavy Gas Modeling Necessary? (Wayne Davis)	1400–1420
CONSEQUENCE ASSESSMENT MODELING	
SCAPA Software Quality Assurance Guidance (Cliff Glantz)	1440–1455
SCAPA Consequence Assessment Modeling Toolbox (Cliff Glantz)	1455–1505
Briefing Versions of NARAC Products (John Nasstrom)	1505–1525
NOAA HYSPLIT and Emergency Response (Kirk Clawson)	1525–1540
BIOSAFETY	
Biosafety Working Group Accomplishments (Frank Roberto)	1540–1550
HPAC as a Biosafety Modeling Tool (Frank Roberto)	1550–1610
TEEL Development for Biotoxins (Jayne-Anne Bond)	1610–1630
CHEMICAL EXPOSURES AND CHEMICAL MIXTURES	
PAC/TEEL Development and Review (Doug Craig and P. Lu)	1645–1705
Review of the TEEL Development Process (Richard Thomas)	1705–1725
Chemical Mixture Methodology Update (R. Petrocchi and X. Yu)	1725–1745
SCAPA WRAP UP	
The EMI SIG Meeting and Working Group Schedule (C. Glantz)	1745–1755
Closing Remarks (Dave Freshwater)	1755–1800

1.0 REPORTS ON SCAPA PROGRAM INITIATIVES/OTHER MATTERS OF INTEREST

1.1 Impact Analysis of Elevated Dense Gas Jet Releases from an ABS Plant: A Case Study

Steve Vigeant presented a case study of an impact analysis of elevated dense gas jet releases from an Acrylonitrile Butadiene Styrene (ABS) plant that manufactures plastic pellets for various industrial applications. The owners had a concern that the reactor emergency relief (RER) systems may accidentally release the dense gases 1,3 butadiene (MW = 54.1 g/mole) and acrylonitrile (MW = 53.1 g/mole) as vertical jets. The analytical objective of this analysis was to estimate the potential human health impacts of 1,3 butadiene and acrylonitrile releases and the potential flammable zones within the plant property. To do this, Steve evaluated various release scenarios and the effect of various meteorological conditions on the impacts.

Steve discussed the technical approach that he selected which was to use the Dense Gas Dispersion (DEGADIS) code to evaluate toxic and flammable impacts of the elevated vertical jet releases of the dense gases and the Areal Locations of Hazardous Atmospheres (ALOHA) code to test the effect of the vertical jet on ground level concentration calculations. The evaluation looked at the effect of meteorology on impacts, which included a worst case F stability @ 1.5 m/sec wind speed, a typical case of D stability @ 4.0 m/sec wind speed, and near calm conditions of F stability @ 0.2 m/sec wind speed. Steve then described the DEGADIS and ALOHA codes, noting that ALOHA does not treat elevated dense gas releases since Oom's jet model is not included in that code. Both DEGADIS and ALOHA were used to determine distances to the Emergency Response Planning Guidelines (ERPGs) and DEGADIS was also used to determine the horizontal and vertical extent of possible flammable zones within the 1,3 butadiene and acrylonitrile plumes. Three release scenarios were examined:

(1) Polybutadiene (PBL) Reactor ER Vent PBL Fire Relief Vent;

(2) Styrene Acrylonitrile (SAN) Reactor ER Vent; and,

(3) PBL Reactor ER Vent.

The analysis concludes that the potential health effects are a concern for emergency releases with ERPG-2 being exceeded a few kilometers downwind under stable light wind conditions and flammable zones are a concern up to 200 meters downwind under stable light wind conditions but mostly at higher elevations.

Steve concluded his talk with a model comparison that indicates that the DEGADIS jet treatment results in plume rise and enhanced entrainment of ambient air that further dilutes the plume versus ALOHA results and that the downwind concentration maximizes farther downwind with DEGADIS versus ALOHA. Lastly, the distances to ERPG-1 are larger with DEGADIS than ALOHA due to the elevated release.

1.2 Estimation of Hydrogen Gas Plume Behavior Due to a Postulated Pipeline Accidental Release

Steve Vigeant presented an analysis (conducted with Carl Mazzola) associated with the estimation of hydrogen gas plume behavior due to a postulated pipeline accidental release from a commercial nuclear power plant. This nuclear facility has a gaseous hydrogen supply pipeline associated with the hydrogen water chemistry system. Since the hydrogen pipeline passes with 130 feet of a storage cask pad associated with an Independent Spent Fuel Storage Installation (ISFSI), there was a concern that under accidental release conditions, the hydrogen could be in flammable or explosive concentrations when passing over the installation. The objective of the analysis was to estimate the atmospheric dispersion and transport trajectory of a positively buoyant hydrogen gas release from a postulated rupture of gaseous hydrogen supply pipeline and then to determine the likelihood of flammable concentrations of hydrogen gas reaching the near ground-level air inlets of the 100 spent fuel storage casks at the ISFSI. Steve selected the ALOHA code to estimate the hydrogen gas emission rate due to a postulated break in the onsite pipeline and the Second Order Closure Integrated Puff (SCIPUFF) code to estimate atmospheric dispersion and transport trajectory of the positively-buoyant lighter-than-air hydrogen gas release. The analysis also looked at a range of wind speeds to determine the sensitivity of impacts with respect to wind speed.

Steve described the ALOHA and SCIPUFF codes; the latter a second-order closure integrated puff code developed for the Defense Special Weapons Agency (DSWA). It is a Lagrangian Gaussian puff atmospheric transport and dispersion model where turbulent diffusion parameterization is based on second-order turbulence closure theory. SCIPUFF relates dispersion rate to velocity fluctuation statistics and uses a collection of Gaussian puffs to represent an arbitrary three-dimensional, time-dependent concentration field. Importantly, it explicitly treats positively buoyant gases, and may be the only code available for such an application.

Steve then discussed the inputs he used and the assumptions he selected. SCIPUFF input a hydrogen gas release rate of 473 lbs/min that was calculated from ALOHA and Steve assumed meteorological parameters wind speeds of 1, 2, 3, and 5 m/sec to be a good range to determine vertical buoyancy effects. The Bowen Ratio was set equal to 0.5, albedo to 0.15, and a cloud cover was assumed to be 0. Steve then presented the results for each wind speed ranging from 1 m/sec to 5 m/sec.

The conclusions of this analysis show that worst case Lower Flammability Limit (LFL) concentration extends out approximately 15 ft horizontal distance and the SCIPUFF output for 1 m/sec case shows, due to the effects of its positive buoyancy, the hydrogen gas rises rapidly in the vertical. It is noted that there was a very small horizontal extent of hydrogen gas at ground level for all wind cases. In addition, the zero concentration is shown to be near ground level at 39.5 m minimum distance of the hydrogen supply pipe from the ISFSI storage pad downwind from hydrogen gas pipeline. Thus, a flammable concentration of the hydrogen

plume will not reach near ground-level air inlet of storage casks due to the positive buoyancy of the much lighter-than air gas under a full spectrum of meteorological conditions.

1.3 Complex vs. Simple Models for EPHAs: A Study

John Ciolek presented a study of complex versus simple models for EPHAs.

1.4 SCAPA Year in Review

Carl Mazzola presented the SCAPA highlights of the May 4, 2009, annual meeting that was held in San Francisco, California. There were more than 50 attendees and 19 technical presentations including those by Shelly DuTeaux of the California Air Resources Board (CARB), and David Lorenzetti of the Lawrence Berkeley National Laboratory (LBNL). This meeting report is posted on the SCAPA Web Page. During the interim six SCAPA teleconferences occurred with attendances ranging from 17–33, with an average of 25 attendees. There are five active SCAPA Working Groups; some of which conduct their own teleconferences. Carl then discussed what each SCAPA working group accomplished over the past year.

CHEMICAL EXPOSURES WORKING GROUP (CEWG): The CEWG developed PAC/TEELs and supporting products which included Software Quality Assurance (SQA) documentation (e.g., Configuration Management Plan), and a cookbook associated with the searchable PAC/TEEL data base. PAC/TEEL Revision 25 was published in August 2009 and PAC/TEEL Revision 26 is under development. This revision includes updates to pre-1997 concentration-dependent chemicals, pre-1997 toxicity-dependent chemicals, incorporation of new and revised AEGLs, and incorporation of new and revised ERPGs.

CHEMICAL MIXTURES WORKING GROUP (CMWG): The CMWG completed the Chemical Mixture Methodology (CMM)/HCN (Health Code Number) Cookbook. HCN Revision 25 was published in August 2009 and HCN Revision 26 is under development. The 1000 oldest HCNs are being revised. The first HCN toxicology article has been accepted by the Journal of Applied Toxicology, and the second article was drafted and will be published in a yet-to-be-named journal.

CONSEQUENCE ASSESSMENT MODELING WORKING GROUP (CAMWG): The CAMWG supported the work associated with HOTSPOT 2.07 gaining entrance into the Central Registry Toolbox, by providing three reviewers to the almost 4-year process. In addition, the Consequence Assessment Self-Assessment Guide moved closer to obtaining NA-41 approval. The SCAPA Toolbox for Safety-Related Software guidance was drafted and the associated effort of the SQA candidate Consequence Assessment Model Gap Analyses and meteorological data SQA is ready for candidate model evaluation.

BIOSAFETY WORKING GROUP (BWG): The BWG issued a report on Transport & Dispersion of Biological Agents/Toxins Modeling source terms from laboratory operational emergencies to close a gap in DOE O 151.1C. BWG also established a formal alliance with the American Biological Safety Association (ABSA) and some BWG members will be attending the ABSA Annual Meeting. PAC/TEELs for 15 biotoxins were requested from the CEWG. BWG also supported the Federal Biosecurity Working Group associated with Executive Order (EO) 13486,

"Strengthening Laboratory Biosecurity of the United States". Lastly, BWG supported the DOE Biosecurity Executive Team Associated with DOE O 434.1 which contained a policy prohibiting DOE Bio Security Level-4 (BSL) facilities.

SOURCE TERM WG (STWG): The STWG developed White Papers on the DOE TRU Waste Standard and its Application to EPHAs, compiled Criticality Source Terms, and developed a list of Leak Protection Factors (LPFs). In addition, STWG drafted a Frequently Asked Question (FAQ) on non-radiological versus radiological health effects, and developed information on ball-milled plutonium-238 source terms. Lastly, STWG began to address dose-equivalent curies to support emergency planning and plume modeling during real events.

1.5 What's New with the SCAPA Website

Cliff Glantz presented what's new with the SCAPA website and shared that there is a new EMI SIG website design.

1.6 Source Term Characterization Activities

Michele Wolfgram reported on the source-term-characterization activities that the STWG were undertaking:

- A White Paper on the DOE Transuranic (TRU) Waste Standard applicability to Emergency Preparedness Hazard Assessments (EPHAs).
- A Non-Radiological vs. Radiological Health Effects White Paper, which NA-41 is reviewing.
- A criticality-source-terms information paper was developed and is posted on the STWG website;
- A reference paper on ball-milled Pu-238 characteristics was reviewed and is posted on the STWG website.
- Non-respirable vs. respirable source terms.
- LPFs.

1.7 Leak Protection Factor Source, Use and Development

Chuck Rives presented an evaluation of LPFs and structural impacts on hazardous material releases. He started his talk with a project history background, citing, "Chuck is too dumb to duck." This refers to an EMI SIG 2009 STWG attempt to identify a project for the group to undertake. The idea was to simply compile a table of LPFs from a collection of other documents. STWG members looked extensively for several "stock" or "generic" LPFs but found very little information. One useful source was EPA 550-B-99-009, "Risk Management Program Guidance for Offsite Consequence Analysis."

One of the findings was that a mitigation factor of 55 percent (i.e., LPF = 0.45) may be used in the event of a gaseous release which does not destroy the building into which it is released.

Chuck cautioned that this factor may overstate the mitigation provided by a building with a higher ventilation rate.

Chuck then reported on the work of the participants of the Gaseous Release Inside Building Panel, who shared their perspective from site experiences. The panelists included Phillip Pfeiffer (INL), Chuck Rives (Pantex), Susan Vosburg (SNL-NM), and Michele Wolfgram (ORNL).

Chuck also presented an overview of the LPF, which is the last term of the five-factor formula:

$$ST = (MAR)(DR)(RF)(ARF)(LPF)$$

An LPF of unity indicates that there is no leak protection and the release reaches the atmosphere unabated. Chuck quoted the definition of LPF from DOE-HDBK-3010-94: "The fraction of confinement of airborne materials transported from containment of deposition or mechanism (e.g., fraction of airborne material leaving the glovebox under static conditions, fraction of material passing through HEPA filters)."

Chuck stated that the LPF is actually synonymous with filtration rate confinement filter mitigation and that structural source term effects that are not LPFs limit evaporation rates from pools due to holdup time effects of the air exchange rate. He indicated that Pantex EM-PLN-0031 allows use of LPF under two conditions:

(1) Any citable source for the LPF; and,

(2) Information that provides some indicator of whether it is still present and working.

Chuck closed with a calculation of a LPF from a Pantex Gravel Gertie cell facility.

1.8 Accounting for the Non-Respirable Source Term

Wayne Davis presented an evaluation of whether not accounting for the non-respirable source term in the five-factor formula had any significant impact in consequence assessments for certain types of accidents. Since most accidents are dominated by inhalation dose, accounting for non-respirable radionuclides is not commonly done; but in some types of release scenarios their effects may be important.

1.9 Is Heavy Gas Modeling Necessary?

Wayne Davis presented an evaluation of when heavy gas modeling is applicable and whether the entire concept of heavy gas modeling is applicable. In addition to cold temperatures and high molecular weights, the quantity of the release is important in determining whether the release exhibits heavy gas properties after its release to the atmosphere. This is why heavy gas models use the bulk Richardson number, which accounts for the mass of the cloud, to determine if the release exhibits heavy gas properties and continues to after entrainment of neutrally-buoyant air as it is transported.

1.10 SCAPA Software Quality Assessment Guidance

Cliff Glantz presented the status of the development and implementation of SCAPA SQA guidance by first reviewing the background information. In 2005, DOE issued DOE Order 414.1C and DOE Guide 414.1-4 establishing SQA requirements for safety software.

Cliff noted that consequence assessment models (CAMs) are safety software, only if they are used for hazards assessment and safety planning purposes, and emergency response purposes that provide a direct hazard control function (e.g., are used to formulate Protective Action Recommendations [PARs]).

Cliff indicated that CAMs that SCAPA members use for safety software applications are typically fast-response atmospheric transport and dispersion consequence assessment models (i.e., dose, toxic chemical) that use limited environmental data and simple, conservative algorithms. For these types of codes, SQA is a priority. In contrast, CAMs for other applications use complex algorithms and typically have many lines of code. Such codes address flows in complex terrain environments, require significant amounts of environmental data, are frequently updated to incorporate new technologies, and prioritize realism, technical accuracy and timely innovation; as well as SQA.

Cliff described the key concepts in the SCAPA SQA Guidance Document, which was developed to achieve an appropriate balance between technological development, timeliness, and SQA. This document addresses all phases of the software lifecycle, which include concept requirements design implementation, test installation, checkout, and acceptance testing, and operations maintenance and retirement.

Of the 10 SQA safety software work activities (i.e., Software Project Management and Quality Planning, Software Risk Management, Software Configuration Management, Procurement and Supplier Management, Software Requirements, Identification and Management, Software Design and Implementation, Software Safety Verification and Validation (V & V), Problem Reporting and Corrective Action, Training of Personnel), the SCAPA SQA Guidance Document sets up minimum expectations in each activity.

The document also allows more flexibility than permitted for safety software, and there is an expectation of the model developers/maintainers to evaluate the potential applications and perform additional SQA work beyond the minimum expectations, as needed. The guidance sets minimum requirements for a legacy code's technical documentation, V & V testing, and problem reporting. The guidance requires all updates and modifications to the legacy codes be conducted under the new SQA guidelines. Model developers and maintainers are encouraged to use the priority rating to focus limited resources on SQA tasks that have higher priorities. Legacy software with a proven track record in the DOE consequence assessment community is grandfathered in.

Cliff then discussed the status of the SQA Guidance Document, indicating that a review draft was circulated to select SCAPA members and model owners in summer 2009, and a near-final

draft was completed in December 2009. This draft was submitted to NA-41 for review in February 2010 with a publication goal by the end of June 2010.

1.11 SCAPA Consequence Assessment Modeling Toolbox

Cliff Glantz presented the SCAPA CAM Toolbox, which is designed to provide a set of commonly-used consequence assessment modeling codes that adhere to SCAPA SQA guidelines. Models need acceptable levels of technical and user documentation, configuration management, V & V testing, and problem reporting and sharing. It seeks to provide a one-stop-shopping website with introductory material on the models and links to more detailed information on the model's individual websites. It also seeks to support the continued use of the tried-and-true legacy codes and to spearhead the drive toward adoption of consistent, reasonable SQA practices.

After the SCAPA SQA Guidance is published as a SCAPA document, models will be selected for conditional acceptance into the toolbox. The starting set will focus on the most widely-used models for safety-related consequence assessment applications that include: NARAC, CAPARS, RASCAL, APGEMS, HYSPLIT, RAMS/LPDM, and Puff-Plume. A second set of models (e.g., ARCON96, DUSTRAN) will be considered at a later time. A web page will capture the content for each model going into the toolbox. Finally, the model developers (e.g., NARAC, AlphaTRAC) will conduct a gap analysis on their SQA program and selected CAMWG members will review and evaluate the gap analyses and work with the model developers to formulate a plan to prioritize, monitor, and close the SQA gaps.

Ultimately, it will be determined whether sufficient progress has been made to declare that the model's SQA program complies with SCAPA SQA guidance. If so, the "conditional" tag will be removed; if not, the model will be dropped from the toolbox, or the conditional tag maintained.

Cliff closed with some milestones leading to the path to success, which include publishing the SQA document and assigning SQA review roles. Jeremy Rishel is designated as the lead; and Cliff Glantz, Carl Mazzola, Wayne Davis, Hoyt Walker, Michele Wolfgram, and Denny Armstrong are the initial SQA reviewers.

1.12 Briefing Versions of NARAC Products for Communicating Consequence Assessment

John Nasstrom presented on the full suite of NARAC products for communicating consequence assessment. All standard NARAC products are designed for use by staff having a technical background. These products typically show radiological dose levels corresponding to EPA Protective Action Guides (PAGs), or chemical air concentration corresponding to Protective Action Criteria (PAC) levels (i.e., AEGLs, ERPGs, TEELs). The program assumes that the code users have familiarity with atmospheric transport and dispersion modeling concepts and dose assessment as applied to emergency response, and have previous training in application and interpretation of NARAC products.

John discussed recent work developed for the Homeland Security Council (HSC) which, motivated by experience in exercises with federal, state and local officials, tasked DOE to

produce IMAAC/FRMAC hazard area graphics so that officials with non-technical backgrounds can easily understand the effects. The effort focused on developing briefing products for use by, or in the presence of, subject matter experts (SMEs) that need to brief decision-making officials. These products are not intended for distribution to the general public. John mentioned that in communicating actions and decisions that may be warranted, the use of plain, non-technical language and existing, pertinent agency-published PACs and PAGs is essential.

John stated that DOE NA-42 funded the initial format and content design and implementation of Radiological Dispersal Devices (RDD) briefing products in FY08–FY09, with review and input from the Federal Radiological Monitoring and Assessment center (FRMAC) Assessment Working Group, the FRMAC Operations Working Group, and the CDC-EPA-FDA-USDA Advisory Team for Food and Health. The Department of Homeland Security (DHS) then sponsored a review by the IMAAC Interagency Working Group and NEMA state representatives, and as a result of these reviews and discussions, the following product types were developed:

(1) Unknown source evacuation/sheltering (cloud present/passed)

(2) Worker protection relocation

(3) Crop contamination

LLNL developed software to automatically generate PowerPoint files of briefing products based on model results.

These briefing products were used for the first time in the DOE Empire 09 RDD exercise, which is a Tier 2 National Exercise in the New England states. They predicted evacuation and sheltering areas based on EPA/DHS Guides; applicable within first hours/days while the radioactive cloud is present.

John reviewed some of the key points learned. These include that the PACs should be based on dose that can be avoided and that the greatest hazard is due to exposure to the radioactive cloud. Evacuation before the radioactive cloud arrives is clearly the best strategy, and evacuation into the radioactive cloud must be avoided. Sheltering-in-place may be preferable to evacuation in some situations, if the radioactive cloud is present or its arrival is imminent. Other factors to be taken into account are certain populations needing special consideration (i.e., hospitals, nursing homes, prisoners, elderly), and other present hazards which complicate or impede evacuation (severe weather, competing disasters).

John reviewed the results of the DOE NA-42-funded FY10 project to design content and implement expanded list of products. New products are listed below:

(1) Predicted Damage Response Zones: Immediate structural damage caused by blast

(2) Prompt Effects on Population: Effects of overpressure, heat, and immediate radiation on unprotected population producing immediate to near-term injury, illness or death

(3) Predicted Dangerous Fallout Zone: Fallout zone posing immediate threat to survivors and responder

(4) Predicted Area for Potential Fallout Casualties: Total external dose from radioactive fallout during first hours to days of exposure leading to near-term illness or death

(5) Predicted Hot Zone: Use for worker protection and to prioritize shelter/evacuation (>10 mR/h)

(6) Predicted EPA/DHS Sheltering/Evacuation Areas: Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

(7) Predicted EPA/DHS Relocation Areas: Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

(8) Predicted Areas of Concern for Agricultural Products: Areas where crops and milk may exceed FDA's default food safety guidelines based on fallout deposition

John discussed the tools planned for use in National Level Exercise 2010 (NLE10), an effort led by Kevin Foster (LLNL) and Harvey Clark (RSL). It includes DHS-funded FY09–FY10 surveys of content and design of briefing products for industrial chemical, chemical warfare (CW) agent and biological agent releases, with consistent format with RDD/IND briefing products:

(1) Predicted Isolation and Protective Action Areas: Areas to consider for restricted entry, and evacuation or sheltering based on DOT Emergency Response Guide (DOT, 2008) methodology

(2) Initial Isolation Zone: Evacuate and restrict entry to area unless protected and involved in emergency response based on 50% probability Lethal Concentration (LC_{50}) or fatality threshold from animal lethality data with minimum values based on % of Protective Action Distance (PAD)

(3) Protective Action Zone. Evacuation or sheltering should be considered due to increased risk of harmful exposure. PAD based on AEGL-2, ERPG-2 or TEEL-2

(4) Predicted Emergency Worker Protection based on 30-minute Exposure

(5) Area where maximum (Level A/B) PPE is NIOSH-recommended for emergency workers, along with careful supervision and monitoring

(6) Area where reduced (Level C) PPE is NIOSH-recommended for workers, with careful supervision and monitoring

(7) Predicted Bio-Agent Infection Areas Due To Airborne Plume–Areas exceeding potentially infectious air concentrations near-surface cloud present; continuing inhalation hazard

(8) Expect infections in most of the exposed, untreated population based on 50% probability of infection in exposed, untreated population

(9) Approximate extent where infectious levels of airborne organisms are likely based on 2% probability of infection in exposed, untreated population

1.13 NOAA HYSPLIT and Emergency Response

Kirk Clawson presented the status of National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory Field Research Division (ARLFRD) development of the HYSPLIT code for consequence assessment purposes at INL. Kirk described the NOAA HYSPLIT three-dimensional particle dispersion or splitting puffs (i.e., top-hat or Gaussian) code. This code addresses the emission of multiple simultaneous pollutant species, instantaneous or continuous emissions, and point or area sources. It contains algorithms for wet deposition, dry deposition, radioactive decay, and resuspension.

HYSPLIT can calculate single or multiple (i.e., space or time) simultaneous trajectories; and these trajectory computations can be forward or backward in time. HYSPLIT has access to forecasts and archives including NCAR/NCEP reanalysis, and can run with multiple nested input data grids. Lastly, HYSPLIT contains software to convert MM5, RAMS, COAMPS, WRF, and other data. NOAA HYSPLIT is currently being used in a wide variety of applications. These include trajectory modeling, concentrations of windblown dust, volcanic eruptions, chemical plumes, smoke and wildfire plumes, and high-altitude balloon flight forecasting.

NOAA HYSPLIT for Radiological Emergencies, which is the name of the code that ARLFRD is developing, provides radiological dose calculations, concentrations, and depositions for multiple radionuclides using diagnostic and prognostic three-dimensional wind fields. The current browser-based multiple windows for input Google Earth will be replaced with an approach where all required input/output is accessed through one window. This approach will be capable of program status output file sharing options and dynamic plume rescaling enhanced user interactivity Google Maps.

With respect to meteorological input, HYSPLIT currently uses model-generated meteorological grids and has a restricted capacity to generate 3-dimensonal meteorological grids based on mesonet observations. ARLFRD plans to upgrade that capacity to rely primarily on 3-dimensional meteorological grids generated from mesonet observations, fully capable of utilizing model-generated meteorological grids. To support the planned meteorological input upgrade, meteorological data from the mesonet database will be acquired.

NOAA HYSPLIT for Radiological Emergencies will also be modified to calculate turbulence parameterizations (i.e., u*, T*, W*) using gradients of wind speed and temperature and bulk Richardson number relationships rather than using stability classes. It will also calculate mixing depth from turbulence parameterizations and interpolate mesonet observations at towers to surface grid using 1/r2 relationship. Lastly, it will build vertical profiles based upon interpolated values of wind, temperature, humidity, and turbulence parameters at each point and generate a 3-dimensional meteorological grid for input to HYSPLIT.

With respect to dose calculations, the current prototype is limited to using only one radionuclide and there is no provision for individual nuclide concentrations or depositions.

NOAA ARLFRD plans to calculate and sum doses for multiple radionuclides and map plumes for individual radionuclide concentrations and depositions, and radionuclide concentrations will be summed to doses and multiple radionuclides accommodated. Time-integrated doses for 10 dose types, which include total Committed Effective Dose Equivalent (CEDE), 4-day ground shine, thyroid Committed Dose Equivalent (CDE), etc will be calculated; as well as airborne and deposition concentrations for each nuclide utilizing FRMAC-2003 and ICRP-72.

1.14 Biosafety Working Group Accomplishments

Frank Roberto presented the various accomplishments of the BWG since the last SCAPA meeting:

- Authoring and publishing a report entitled "Transport and Dispersion of Biological Agents/Toxins" submitted to NA-41. This report fulfills SCAPA Action Item 06-06 and is posted at http://orise.orau.gov/emi/scapa/working-groups/biosafety/default.htm.
- Providing input through the DOE RevCom process to support the Secretarial policy on biocontainment facilities, DOE P 434.1, "Conduct and Approval of Select Agent and Toxin Work at Department of Energy Sites."
- Representing DOE/NNSA on the Federal Biosecurity Working Group established by Executive Order 13486, "Strengthening Laboratory Biosecurity of the United States."(See BWG links for the final report).

Frank also reviewed the initiatives planned for the coming year. This includes participation at American Biological Safety Association annual meeting to be held in Denver, Colorado, from September 30 through October 6.

1.15 HPAC as a Biosafety Modeling Tool

Frank Roberto presented how the HPAC code can be used as a biosafety modeling tool, as an outgrowth of the BWG work in addressing SCAPA Action Item 06-06. After discussing various aspects of this code and how it can be used to model the complex vectors of transport and dispersion of microorganisms, Frank concludes that HPAC is a comprehensive, simple-to-use modeling package which is integrated with real-time weather data that can be obtained on the Defense Threat Reduction Agency (DTRA) meteorological data server.

The speed of computation of HPAC and the ability to use the stand-alone package allows INL to test many different scenarios, and facility scenarios useful to most BWG users. Frank concludes that although the urban dispersion model of HPAC was not tested, it may be extremely useful.

1.16 TEEL Development and Biotoxins

Jayne-Anne Bond referred to the 2009 TEELs Advisory Group (TAG) meeting, which addressed, among other issues, whether the current TEEL and HCN methodologies are applicable to biotoxins, and Tom Tuccinardi, Richard Thomas, and Jayne-Anne Bond were given the task to determine if the present default methodologies are adequate for biotoxins.

In executing the task, the team selected 3 data-rich biotoxins (i.e., Botulinum, Saxitoxin, Fusariotoxin/T2- toxin) from the current PAC dataset. The task was to derive TEEL values and assign HCNs for these 3 biotoxins and compare the results and methodologies. During the process, a decision needed to be made to either modify the current methodology, or develop a completely new methodology.

With respect to the TEEL methodology, the team looked at the data used to derive the current TEEL values and determined that all 3 biotoxin TEELs were based on toxicity data where RTECS is currently the primary source of data. Human data are preferred over other species and inhalation route is preferred over other routes of exposure. The basic TEEL methodology exposure limits considered first ACGIH, EPA, OSHA, NIOSH and additional sources such as DHS, USDA, and Fort Detrick. Toxicity data were extracted if no exposure limits existed.

Jayne-Anne discussed the comparison of the current TEEL values versus the modified methodology. It was concluded that the team has more confidence in what it developed, but that this a more time-consuming process than expected. Citations, publications, and sources for future use will be compiled and catalogued for reference if questions arise.

1.17 PAC/TEEL Development and Review

Doug Craig discussed the PAC/TEEL database update and major developments that occurred since May 2009. All final and interim AEGL values for new chemicals issued by EPA to date are incorporated and all new and revised ERPG values as published in the American Industrial Hygienist Association (AIHA) 2009 ERPG and Workplace Environmental Exposure Limit (WEEL) Handbook are also incorporated. PAC/TEELs Revision 25, published in August 2009, included PAC/TEEL values for 3,373 chemicals and the addition of information on several new columns.

Doug presented some of the PAC/TEELs Revision 26 developments. These will have new columns providing PAC/TEEL information, which includes date originally derived, date completely populated, date last reviewed, populated, frequently updated, and date last revised, source(s) of the data used in PAC-TEEL derivation for chemical, and National Fire Protection Association (NFPA) Health Hazard Rating (HHR). PAC/TEEL Revision 26 will review and update toxicity data for 784 chemicals from PAC/TEEL values published through Revision 15, dated September 30, 1997. This update includes closely-related chemicals and isomers. Rigid data selection rules were adopted including species, route of entry, and exposure duration.

Doug concluded that a few new exposure limits have been added, which includes 17 new AEGLs and 1 ERPG. In addition, 3-5 PAC/TEELs were derived for a few chemicals for which values were requested since Revision 25, a few chemicals were combined (e.g., Ar, Ar-cryogenic) as PAC/TEEL values were identical in each case. Every aspect of data used in PAC/TEEL derivation was subjected to extensive Quality Assurance (QA) review and all changes to input data were documented.

1.18 Review of the TEEL Development Process

Richard Thomas presented recommendations to DOE on the TEEL development process, where 3 SMEs were selected to review the process and supporting documentation for TEELs. The following reviewers were selected:

(1) Susan Ripple, Dow Chemical Company, Chair ERP Committee, member of AEGL Committee

(2) George Rusch, Honeywell Corporation, Chair AEGL Committee, Past-Chair ERP Committee, Founding Member of ERP and AEGL Committees

(3) Richard Thomas, Intercet, Ltd., Past-Chair ERP Committee, Founding Member of ERP and AEGL Committees, Developed Guidelines for AEGL Committee while at National Academy of Sciences National Research Council

The review began in early 2009 and several documents were reviewed, which included:

(1) PAC/TEEL Derivation Instructions and Information (July 2009).

(2) DOE Handbook "Temporary Emergency Exposure Limits for Chemicals: Methods and Practice (August 2008).

(3) DOE O 151.1C, Comprehensive Emergency Management System (11/2/05).

(4) DOE G 151.1-2, Technical Planning Basis.

(5) Alternative Guideline Limits for Chemicals without Environmental Response Planning Guidelines (two articles by Craig et al. published in 1995 and 2000).

Additional questions by NA-41 were fielded and interactions with others on SCAPA were conducted.

The review team made the following conclusion about the TEELs: Overall it was the reviewers' opinion that, "the TEEL process has produced guidance for potential accidental exposure to thousands of chemicals that are realistic and protective."

The review team made the following recommendations to improve the TEEL process:

- Incorporate Improvements in the TEEL process from current risk assessment approaches (e.g., $C_n t=k$).
- Limit the use of HEC Calculations.
- Utilize current AEGL and ERPG data bases, they contain about 160 ERPGs and 270 AEGLs. These could be used as a basis for the derivation in the ratio approach for default TEEL values.
- TEELs should be based on 1-hour exposures.
- When TEEL-2 is larger than TEEL-3, rather than using TEEL-3 for TEEL-2 the data for both derivations should be examined.

- TEEL-2 and TEEL-3 should never be equal. One approach used by ERPG and AEGL Committees is to divide TEEL-3 by 3 for to produce a TEEL-2.
- Establish a small expert review committee to resolve technical issues.
- Caution should be exercised in using RTECS. It is recommended that the priority for the primary data bases is HSDB, Sax, and then RTECS.
- IDLH values should only be used when no other information is available.
- TLVs and WEELs are updated on a regular basis, as Permissive Exposure Limits (PELs) date back to 1986. Threshold Limit Values (TLVs) and WEELs should be used before PELs.
- Develop detailed process maps for others to follow in development of TEEL values.
- Continue to use rat data as the primary data. It is most abundant. However, dog and monkey data may be available for a few substances. These data should be considered before rat data.
- Two different starting points (i.e., points of departure) may be used for TEEL development based on two different studies. For example, a chemical may have both irritant and systemic toxicity.

Richard concluded that the TEEL program has been a very successful program that has produced guidance for potential accidental exposure to thousands of chemicals used by DOE. New approaches are available that can improve the TEEL process and produce more consistent and justifiable results.

1.19 Upcoming Changes in the TEEL Development Process

Dave Freshwater discussed some of the upcoming changes in the TEEL development process based on the results of the independent review and some identified issues that have occurred since the program was initiated almost 20 years ago when the DOE 5500-series Order change that added chemicals to emergency planning consideration. At this point, this mature program has addressed most of the important chemicals at DOE facilities, thus there is a drop off in number of new TEEL requests. This provides an opportunity to look at things from an overall perspective.

Dave emphasized that the TEEL process goal is to mirror the AEGL and ERPG development processes, without going to the time and effort that those responsible committees employ in examining studies and calculations.

The path forward to PAC/TEELs Revision 26 will be published this summer according to the “old” process. There is still some data and information needed before decisions about the “new” process are finalized, and these may be made by the end of the summer. It is likely that there will be a phased implementation of changes to any of the existing programs.

Dave emphasized that the TEEL process has produced guidance for potential accidental exposure to thousands of chemicals that are realistic and protective. The TEEL development

process is protective and the process can be improved, as there is a need to keep up with changes in the toxicology field.

1.20 Chemical Mixture Methodology Update

Xiao-Ying Yu and Rocky Petrocchi presented an update to the CMM. The CMM Workbook Revision 25, published in October 2009, contains the PAC/TEEL data published in PAC/TEEL Revision 25 CMM and these PAC/TEEL data sets are consistent. With respect to the CMM Workbook, Revision 26 will include HCNs for 6 new chemicals, updated HCNs for 1,040 chemicals, and new and revised PAC/TEEL data. This will be posted on the SCAPA website shortly after PAC/TEEL Revision 26 is published.

Xiao-Ying discussed the status of the HCN update for 2,346 “older” chemicals which required review and updating. This multi-year effort started in June 2009 and approximately 1,040 (i.e., 44%) chemicals are updated to date.

The surrogate source term method will be introduced as an interim method for real-time application of the CMM. Candidate journals are the Journal of Applied Toxicology and Atmospheric Environment. The first draft was completed in November 2009, and revisions are being discussed between lead authors, John Ciolek and Xiao-Ying Yu. This technical paper is targeted for journal submission by end of FY2010.

Xiao-Ying completed the presentation by demonstrating the CMM Wizard. The user can implement the wizard to select chemicals by Chemical Abstract Services Registry Number (CASRN), chemical name or Sax number, then enter the concentration at the receptor point and choose the concentration limit. The wizard outputs a summary of Hazard Indices (HIs) by mode and HIs by target organ.

2.0 ACRONYMS and INITIALIZATIONS

A

ABS	Acrylonitrile Butadiene Styrene
ABSA	American Biological Safety Association
ACGIH	American Conference of Industrial Hygienists
AEGL	Acute Exposure Guideline Limit
AIHA	American Industrial Hygienist Association
ALOHA	Areal Locations of Hazardous Atmospheres
ANL	Argonne National Laboratory
APGEMS	An atmospheric transport and dispersion model
ARCON96	An atmospheric transport and dispersion model
ARF	Airborne Respirable Fraction
ARLFRD	Air Resources Laboratory Field Research Division
ATL	Advanced Technology Laboratory

B

BSL	Bio Security Level
BWG	Biosafety Working Group
B&W	Babcox & Wilcox

C

CAM	Consequence Assessment Models
CAMWG	Consequence Assessment Modeling Working Group
CAPARS	An atmospheric transport and dispersion model
CARB	California Air Resources Board
CASRN	Chemical Abstract Services Registry Number
CDC	Centers for Disease Control and Prevention
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CEWG	Chemical Exposure Working Group
CMM	Chemical Mixture Methodology

CMWG	Chemical Mixtures Working Group
COAMPS	Navy prognostication model
CW	Chemical Warfare

D

DEGADIS	Dense Gas Dispersion
DHS	Department of Homeland Security
DOE	Department of Energy
DOT	Department of Transportation
DR	Damage Ratio
DTRA	Defense Threat Reduction Agency
DSWA	Defense Special Weapons Agency
DUSTRAN	An atmospheric transport and dispersion model

E

EMI SIG	Emergency Management Issues Special Interest Group
EO	Executive Order
EPA	Environmental Protection Agency
EPHA	Emergency Preparedness Hazard Assessment
ERPG	Emergency Response Planning Guideline

F

FAQ	Frequently Asked Question
FDA	Food and Drug Administration
FRMAC	Federal Radiological Monitoring and Assessment Center

G-H

G	Guide
HASC	Hazards Assessment Subcommittee
HCN	Health Code Number
HDBK	Handbook
HEC	Human Equivalent Concentration
HEPA	High Efficiency Particulate Absorber
HHR	Health Hazard Rating

HI	Hazard Index
HOTSPOT	An atmospheric transport and dispersion model
HPAC	An atmospheric transport and dispersion model
HSC	Homeland Security Council
HSDB	Hazardous Substances Data Base
HYSPLIT	An atmospheric transport and dispersion model

I

ICRP	International Council for Radiation Protection
IMAAC	Interagency Monitoring and Atmospheric Assessment Center
INL	Idaho National Laboratory
ISFSI	Independent Spent Fuel Storage Installation

J-L

LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
LC_{50}	Lethal Concentration 50%
LFL	Lower Flammability Limit
LLNL	Lawrence Livermore National Laboratory
LPF	Leak Protection Factor

M

MAR	Materials At Risk
MM5	NCEP prognostication model
MW	Molecular Weight

N

NA-41	DOE Office of Emergency Management
NA-42	DOE Office of Emergency Response
NARAC	National Atmospheric Release Advisory Capability
NCAR	National Center for Atmospheric Research
NCEP	National Center for Environmental Predictions
NLE10	National Level Exercise 2010
NEMA	National Emergency Management Association

NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration

O

O	Order
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration

P

PAC	Protective Action Criteria
PAG	Protective Action Guides
PAD	Protective Action Distance
PAR	Protective Action Recommendation
PBL	Polybutadiene
PEL	Permissive Exposure Limit
PPE	Personal Protective Equipment

Q-R

QA	Quality Assurance
RAMS	NCEP prognostication model
RAMS/LPDM	An atmospheric transport and dispersion model
RASCAL	An atmospheric transport and dispersion model
RDD	Radiological Dispersal Devices
RER	Reactor Emergency Relief
RF	Respirable Fraction
RSL	Remote Systems Laboratory
RTECS	Registry of Toxic Effects of Chemical Substances

S

SAIC	Science Applications International Incorporated
SAN	Styrene Acrylonitrile

SCAPA	Subcommittee on Consequence Assessment and Protective Actions
SCIPUFF	Second Order Closure Integrated Puff; a transport and dispersion model
SEI	Shaw Environmental Incorporated
SME	Subject Matter Expert
SNL-CA	Sandia National Laboratory/California
SNL-NM	Sandia National Laboratory/New Mexico
SPRO	Strategic Petroleum Reserve Operations
SQA	Software Quality Assurance
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
STWG	Source Term Working Group

T

TAG	TEELs Advisory Group
TEEL	Temporary Emergency Exposure Level
TLV	Threshold Limit Value
TRU	Transuranic

U-V

URS-SMS	(From affiliations)
USDA	United States Department of Agriculture
V & V	Verification & Validation

W-Z

WEEL	Workplace Environmental Exposure Limit
WG	Working Group
WRF	NCEP prognostication model
WSMS	Washington Safety Management Solutions