Date Received for Clearance Process (MM/DD/YY) 10-4-05		INFORMATION CLEARANCE FORM	
A. Information Category ☐ Abstract ☐ Journal Article ☐ Summary ☐ Internet ☐ Visual Aid ☐ Software ☒ Full Paper ☐ Report ☐ Other _____		B. Document Number HNF-27130-FP <i>Rev. 0</i> C. Title THIS IS A DRILL! (Hanford Emergency Operations Center in Action)	
		D. Internet Address http://www.2006sharingsolutions.com/	
E. Required Information			
1. Is document potentially Classified? ☒ No ☐ Yes (MANDATORY) <u>(See B.I.K.H.)</u> Manager Required (Print and Sign) If Yes _____ ☐ No ☐ Yes Classified ADC Required (Print and Sign)		3. Does Information Contain the Following: (MANDATORY) a. New or Novel (Patentable) Subject Matter? ☒ No ☐ Yes If "Yes", Disclosure No.: _____ b. Information Received in Confidence, Such as Proprietary and/or Inventions? ☒ No ☐ Yes If "Yes", Affix Appropriate Legends/Notices. c. Copyrights? ☒ No ☐ Yes If "Yes", Attach Permission. d. Trademarks? ☐ No ☒ Yes If "Yes", Identify in Document.	
2. References in the Information are Applied Technology ☒ No ☐ Yes Export Controlled Information ☒ No ☐ Yes		4. Is Information requiring submission to OSTI? ☒ No ☐ Yes 5. Release Level? ☒ Public ☐ Limited	
F. Complete for a Journal Article			
1. Title of Journal _____			
G. Complete for a Presentation			
1. Title for Conference or Meeting <u>2006 International Joint Topical Meeting: Sharing Solutions for Emergenices and Hazardous Environments</u>			
2. Group Spcnsoring <u>American Nuclear Society (ANS)</u>			
3. Date of Conference <u>02/12-15/2006</u>		4. City/State <u>Salt Lake City, Utah</u>	
5. Will Information be Published in Proceedings? ☐ No ☒ Yes		6. Will Material be Handed Out? ☐ No ☒ Yes	
H. Author/Requestor <u>Carl W. Connell</u> (Print and Sign)		Responsible Manager <u>Daniel J. Connell</u> (Print and Sign)	
Approval by Direct Report to FH President (Speech/Articles Only) _____ (Print and Sign)			
I. Reviewers			
	Yes	Print	Signature
General Counsel	☒	K.M. Norris	<u>(See Pg. 2 att.)</u>
Office of External Affairs	☒	D.J. Dunn	<u>(See Pg. 3 att.)</u>
DOE-RL	☒	Yvonne T. Sherman	<u>(See Pg. 4 att.)</u>
Other	☒	M.L. Spracklen	<u>(See Pg. 5 att.)</u>
Other	☒	Mark A. Williams	<u>J.D. Gural for M.A.W.</u>
Public Y/N (If N, complete J)			
General Counsel (Y) / N Office of External Affairs (Y) / N DOE-RL (Y) / N Other (Y) / N Other (Y) / N			
J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.			
☐ Applied Technology ☐ Protected CRADA ☐ Personal/Private ☐ Export Controlled ☐ Proprietary ☐ Procurement-Sensitive ☐ Business-Sensitive ☐ Patentable ☐ Predecisional ☐ Other (Specify) _____ ☐ UCN		Information Category Approval
K. If Additional Comments, Please Attach Separate Sheet <u>1 of 5</u>			

HNF-27130-FP
Revision 0

THIS IS A DRILL!

Hanford Emergency Operations Center in Action

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

Approved for Public Release;
Further Dissemination Unlimited

HNF-27130-FP
Revision 0

THIS IS A DRILL!

Hanford Emergency Operations Center in Action

C. W. Connell
L. R. Campbell
Fluor Hanford

Date Published
October 2005

To Be Presented at
2006 International Joint Topical Meeting: Sharing Solutions for Emergencies and Hazardous Environments

American Nuclear Society (ANS)
Salt Lake City, Utah

February 12-15, 2006

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

Copyright License

By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper.

A. D. Aardal 10/6/2005
Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

HNF-27130-FP
Revision 0

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This document is available to the U.S. Department of Energy and its contractors, in paper from the Office of Scientific and Technical Information (OSTI). It is available for sale to the public from the national Technical Information Service (NTIS).

This report has been reproduced from the best available copy. Available in paper copy.

Printed in the United States of America

THIS IS A DRILL! (Hanford Emergency Operations Center in Action)

Carl W. Connell, Jr., Fluor Hanford
Larry R. Campbell, Fluor Hanford

Fluor Hanford, P.O. Box 1000, MSIN A0-21, Richland, Washington, 99352, carl_w_connell@rl.gov
Fluor Hanford, P.O. Box 1000, MSIN A3-05, Richland, Washington, 99352, larry_r_campbell@rl.gov

Abstract – "This is a drill!" These are the words we are directed to say before and after any verbal communication with other personnel while participating in training exercises for the Hanford Site Emergency Operations Center (EOC). The EOC has multiple components and many personnel outside of the EOC participate in training exercises. This is a Drill! describes the operations of the EOC Unified Dose Assessment Center (UDAC) and the tools used by personnel operating the UDAC.

The functions and composition of the EOC, UDAC and related organizations are governed by the Hanford Emergency Management Plan for the U.S. Department of Energy (DOE), Richland Operations Office (RL) and Office of River Protection (ORP) (DOE/RL-94-02, Hanford Emergency Management Plan). This plan presents – in a single document – an overview of the emergency-management program for the entire Hanford Site.

At the heart of the UDAC operations is the question, "How, and in what direction, would a plume of radioactivity potentially disperse in the event of an accident that released radioactive material?" Key elements of projecting or predicting the impact are the source term (what materials and how much have been released), the details of the current and projected weather conditions, and analyses models that will calculate the predicted movement of the material. This is a Drill! loosely describes the organization of the UDAC, the way the personnel go about doing their jobs, and the tools they use to get the answers required by those managing the exercise or event. Key tools are used to evaluate and predict the consequences of a release of hazardous materials: maps and atlases; environmental databases such as the Waste Information Data System (WIDS); scenario-driven weather conditions (or real weather-station information provided by personnel from the Pacific Northwest National Laboratory [PNNL]); and analysis codes like MetView (Meteorological Display and Assessment Tool) and APGEMS (models cumulative exposure and time-averaged concentrations of radionuclide releases). The MetView and APGEMS applications were developed for DOE by PNNL. The results of these calculations are shared on and off site with emergency responders, and appropriate protective action recommendations (PARs) are provided to potentially affected individuals.

The UDAC has the primary, overall responsibility for assessing consequences for the Hanford Site both on and off site. The UDAC personnel continuously assess event conditions that may include the following information:

- release source terms
- mitigation efforts
- on-site and off-site field team data
- meteorological conditions.

DOE/RL also makes provisions for representatives from Washington and Oregon to participate in the consequence assessment, field-team coordination, and the off-site PAR development process.

I. INTRODUCTION

The Hanford Emergency Management Plan for the U.S. Department of Energy (DOE) describes how the Hanford Site will implement the provisions of applicable Orders in terms of overall policies and concept of operations. The Hanford Site Emergency Management Plan has five elements:

- emergency planning
- emergency preparedness
- emergency response
- recovery
- readiness assurance.

Hanford (Figure 1) has many unique facilities and each site facility must have an Operational Emergency

Base Program that provides the framework for responding to serious events involving health and safety, the environment, safeguards, and security. Because of the diversity of facilities and processes, a graded approach is used to respond to an event depending upon the nature of a facility and/or the severity of the event. There are a number of events to which the site has to be ready to respond, including unplanned releases and spills, operations-based events, fires, natural phenomena, and security events. Since some events may require the use of resources outside a particular facility, a more general response approach is needed.

The Hanford Site emergency response organization (ERO) has two distinct components – the Incident Command (IC) Organization and the DOE Hanford Emergency Operations Center (EOC) – each with responsibilities for direction and control during an emergency. The Hanford Incident Command System coordinates the activities of all responders including those of the facility emergency response organization. Whenever there is an event at Hanford, certain notifications are required depending on the type and severity of the event: notifications of on-site management, as well as off-site agencies; and activations of emergency response personnel.

If an event is severe enough to be classified as an Alert, Site Area Emergency, or General Emergency, state and county agencies are notified within 15 minutes of declaration of the emergency. In addition, pre-planned protective actions are implemented for site personnel and the Hanford EOC is activated to support the IC Organization and coordinate interface with off-site agencies. The DOE Hanford EOC is responsible for monitoring and providing support for the on-site response, helping to resolve issues, assessing the off-site impacts, and interfacing with off-site agencies and the public.

Within the Hanford EOC, the Unified Dose Assessment Center (UDAC) monitors and evaluates existing emergency conditions to develop additional PARs. The UDAC is responsible for field-team activities that include tracking, monitoring, and sampling the plume. Representatives from Washington and Oregon participate in developing recommendations and providing direction for off-site environmental monitoring. The UDAC is operated by site contractor personnel who are subject-matter experts in meteorology, toxicology, industrial hygiene, and health physics. The Consequence Assessment Director is responsible for all UDAC activities and reports directly to the Site Emergency Director. Specific UDAC responsibilities include the following:

- evaluating personnel radiation doses and chemical exposures
- assessing the potential for on-site and off-site consequences of a release

- assisting in on-site hazard assessment or developing on-site protective actions
- analyzing the consequences associated with evacuating versus a take-cover situation;
- developing PARs for off-site use
- coordinating and directing emergency environmental monitoring teams not assigned to the event facility.

Figure 1. The Hanford Site comprises 586 square miles in southeastern Washington state.

II. Hazardous-Material Release Strategy

A successful response begins long before the pager sounds to summon personnel to the EOC. The strategy that has been in place at DOE sites since 1991 starts with an analysis of potential accidents and their postulated consequences. The Emergency Planning Hazard Assessment (EPHA) analyzes a wide variety of potential events and divides them into severity classifications (Alert, Site Area, and General Emergencies). Emergency Action Levels are then developed to tie plant indicators and conditions to each emergency classification. Planning continues with the determination of pre-planned protective actions, the development of employee and public notification systems and protocols, the writing of emergency-response procedures, the establishment of an

EOC facility and training staff at all levels of the response team. This comprehensive strategy speeds the response by automatically implementing the pre-planned protective actions while personnel are responding to the EOC.

III. Tools Used for Consequence Assessment

At Hanford, several tools are used to predict and evaluate the consequences of a release of hazardous materials: maps and atlases; environmental databases, such as the Waste Information Data System (WIDS); scenario-driven weather conditions (or real weather-station information provided by personnel from the Pacific Northwest National Laboratory [PNNL]); and various analytical codes such as the five conventional tools discussed below.

III.A. MetView

MetView is a quick, easy-to-use system for accessing and displaying meteorological data. (Wind vectors [speed and direction] for the Hanford Site are shown in Figure 2.) It provides graphical and numerical presentations of meteorological parameters, including real-time and historical data from near-surface monitoring locations, instrumented towers, remote monitoring equipment, and meteorologist observations. MetView graphically displays measurements of near-surface winds, temperatures, precipitation, and atmospheric pressure from 30 monitoring stations on the Hanford Site.

MetView aids in the access, visualization, and interpretation of the real-time meteorological data. It is operated by meteorologists, hazard evaluators, administrative support personnel, and first-responders (i.e., the first staff members to arrive at the Emergency Operations Center [EOC] during an emergency event). Output products are routinely used by Site decision-makers, state and county representatives, field team managers, and other EOC staff members. MetView displays are used in formulating recommendations for protective action and enhancing the activities of emergency response personnel in the field.

Figure 2. MetView

III.B. APGEMS

APGEMS (Air Pollutant Graphical Environmental Monitoring System) is a custom software product that is used in the Hanford EOC for assessing the consequence of radiological releases. It was developed, and is maintained, by a team from PNNL.

APGEMS assesses the atmospheric transport, diffusion, deposition, and dose impacts of radioactive air pollutants (both particles and gases). (Plumes are illustrated in Figure 3.) The model can be used for areas with relatively uniform terrain or complex terrain environments. Two nested grids are used to cover the modeling domain. A fine-resolution grid resolves the dispersion within a few kilometers of the location of the release, and a course-resolution grid captures the transport of pollutants out to the limits of the modeling domain. Source-to-receptor transport distances can range from as little as one hundred meters to a few hundred kilometers.

APGEMS uses a three-dimensional diagnostic wind model to compute the vertical and horizontal spatial variation in winds at each time step in the simulation. The wind field is determined by applying a mass-conserving interpolation technique to the surface and upper-air observations supplied to the model. Terrain data are used to refine the model's wind field. The model accounts for flow channeling, blocking by major terrain features, and drainage flows. The mixed layer height can change spatially and temporally just as all the other meteorological and release inputs.

APGEMS employs a Gaussian puff formulation to mathematically describe the concentration distribution of the released material as it moves in the mean wind field. Mathematical reflections of the concentration distribution from the ground and the top of a mixed layer modify the initial Gaussian distribution. The model treats wet and dry deposition, radioactive decay, and first-order chemical transformations of the released material.

Figure 3. APGEMS assesses the atmospheric transport, diffusion, deposition, and dose impacts of radioactive air pollutants.

III.C. Hotspot

The Hotspot Health Physics codes were developed at Lawrence Livermore National Laboratory (LLNL) to provide emergency-response personnel and emergency planners with a fast, field-portable set of software tools for evaluating incidents involving radioactive material. Hotspot codes are a first-order approximation of the radiation effects associated with the atmospheric release of radioactive materials.

The Hotspot codes are designed for short-term durations (less than a few hours) of release. Four general programs - Plume, Explosion, Fire, and Resuspension - estimate the downwind radiological impact following the release of radioactive material resulting from a continuous or puff release, explosive release, fuel fire, or an area contamination event.

Hotspot is a hybrid of the well-established Gaussian Plume Model, widely used for initial emergency

assessment or safety-analysis planning. Virtual source terms are used to model the initial atmospheric distribution of source material following an explosion, fire, resuspension, or user-input geometry.

Tables and graphical output can be directed to the computer screen, printer, or a disk file. The graphical output consists of dose and ground contamination as a function of plume centerline downwind distance, and radiation dose and ground contamination contours (see Figure 4.). Users have the option of displaying scenario text on the plots.

Radiation dose and ground contamination contours can also be saved as mapping files for display on geographical maps. Latitude and Longitude, Universal Transverse Mercator (UTM), and Military Grid Reference System (MGRS) geographical coordinate systems are supported for interfacing Hotspot dispersion contours with commercial mapping systems.

Figure 4. Hotspot is a compilation of fast, field-portable set of software tools for evaluating incidents involving radioactive material.

III.D. EPIcode®

EPIcode® (EPIcode is a registered trademark of Homann Associates, Inc.) was specially developed to provide emergency response personnel, emergency planners, and health and safety professionals with a software tool to help them evaluate the atmospheric release of toxic substances. EPIcode® allows fast estimation and assessment of chemical-release scenarios associated with accidents from industry and transportation.

The EPIcode® program can provide a rapid first-order check against complex and more data-intensive models. EPIcode® will provide a reasonable level of accuracy for a timely initial assessment. More importantly, EPIcode® will produce a consistent output for the same input assumptions and minimize the probability of errors associated with reading a graph incorrectly or scaling a universal nomogram during an

emergency. (A nomogram or nomograph is a graphical calculating device, a two-dimensional diagram designed to allow the approximate graphical computation of a function.)

EPIcode® uses the well-established Gaussian Plume Model, which is widely used for initial emergency assessment or safety analysis planning of a chemical release. Virtual source terms are used to more accurately model the initial distribution of material associated with explosions or fires. The Gaussian Plume Model generally produces results that agree well with experimental data.

The EPIcode® Library contains data on more than 2,000 chemical substances along with the associated exposure levels accepted by various professional organizations and regulatory agencies. Substance information is easily retrieved from the library by selecting either the substance name, or common synonym; the U.S. Department of Transportation (DOT) Number; or Chemical Abstract Service (CAS) Number.

III.E. NARAC

The National Atmospheric Release Advisory Center, NARAC, provides tools and services that map the probable spread of hazardous material either accidentally, or intentionally released into the atmosphere. NARAC provides atmospheric plume predictions in time for an emergency manager to decide if taking protective action is necessary to protect the health and safety of people in affected areas.

NARAC is a distributed system, providing modeling and geographical information tools for deployment to an end user's computer system, as well as real-time access to global meteorological and geographical databases and advanced three-dimensional model predictions from the national center. Initial predictions using NARAC-supported tools on the end user's computer are available in less than a minute. Fully automated NARAC central system initial predictions are delivered in 5 to 15 minutes. NARAC can then provide technical and scientific support – including quality assurance of model input data and predictions – until all airborne releases are terminated, the hazardous areas are refined by combining field measurements with model predictions, and the long-term impacts are assessed.

III.F. WIDS and QMAP

In addition to the five assessment tools previously described, several other tools support emergency operations at the Hanford Site. These tools include maps and atlases and specialty databases like the Waste

Information Data System (WIDS), and portals such as the Hanford Map Portal (QMAP).

The WIDS database provides a traceable source of information about waste (WIDS) sites at Hanford. The system tracks investigation, remediation, and closure-action activities According to Section 3.5 of the TPA (Hanford Federal Facility Agreement and Consent Order [Tri-Party Agreement] (Ecology et al. 1989a) Action Plan, as described below.

“The Waste Information Data System (WIDS) is the electronic database of waste site information for the Hanford Site. The WIDS identifies all waste management units on the Hanford Site, and describes the current status of each unit (e.g., active/inactive, TSD, CERCLA past-practice or RCRA past-practice), and includes other descriptive information (e.g., location, waste types.) The system is maintained by the DOE in accordance with the WIDS change control system, which documents and traces all additions, deletions and/or other changes dealing with the status of waste management units.”

Consequence assessment associated with incidents involving waste sites may be greatly assisted with access to the information in the WIDS database. Knowing the location and estimated quantity of hazardous materials provides a head start until specific information can be obtained from field personnel.

Accessing the information in the WIDS database and other environmental databases is made easier and faster through use of the Hanford Map Portal. QMAP (Figure 5.) is a GUI (graphic user interface) that associates mapping information with data located in the database. The user may access information in the database by searching for waste sites in a particular geographic area. Or, knowing the waste information, the user may search for the corresponding location.

Figure 5. QMAP associates mapping information with data located in the database.

VI. Consequence Assessment in the EOC

The UDAC team in the Hanford EOC provides advice and recommendations to the Site Emergency Manager based on the results of consequence-assessment models and field-team readings. To the extent possible, protective actions are pre-planned based on the emergency classification level and location. However, every circumstance cannot be anticipated and the actual conditions at the time of an event will almost always be different than those assumed in the pre-accident analysis.

The primary objective of the consequence-assessment process is to provide timely, useful information to Emergency Managers for use in making informed decisions to protect people. Timely means fast enough so that decisions can be made and implemented in time to avoid or reduce consequences to people. Useful means the right information in a format that can be easily understood. Information includes those affected, the nature and magnitude of the impact, and the duration and affected area(s) of the impact. This information is provided through computer projections of the concentration of hazardous material downwind and measurements of the team in the field.

VI.A. Timely Initial Assessment (TIA)

In the first few minutes after arriving at the EOC, one of the hazard assessors or other trained UDAC staff will do an initial assessment of the event. For a known or suspected release, a computer projection of the consequences will be made using Hotspot for a radiological release and EPIcode® for a chemical release. The source term is usually obtained from the EPHA or a source-term library. The event conditions are compared with the EPHA scenarios to pick the source term that

most closely matches the event. Real-time meteorological conditions are used in the calculation instead of the assumed EPHA conditions. The purpose of the timely initial assessment is to provide a conservative identification of the areas where protective action criteria may be exceeded. The priority is to identify where there are potential early health effects (death or injury) and where the EPA criteria for evacuation and/or sheltering are exceeded.

The TIA will probably have a high degree of uncertainty because little information will be available to determine a source term and barrier status. However, decisions influenced by the TIA are some of the most important during the first phase of the emergency. The projection basis and uncertainty is explained to the emergency director. The emergency director will factor this assessment into the early emergency-management decisions.

VI.B. Refinement of the Dispersion Analysis - Continuous Assessment

The event will become better understood as additional facility information is gathered, and facility- and field-team measurement results become available. The facility conditions and weather may also change. This stage is the continuous-assessment phase of the process. APGEMS is the radiological model used during this phase. EPIcode® will continue to be used for chemicals. NARAC codes may be used to confirm or supplement the Hanford programs.

The computer projection will be periodically updated to reflect the latest information and the professional judgment of the consequence-assessment staff. For an extended event, additional accident-analysis experts or other specialists such as criticality safety engineers may be brought in to assist in determining the source term. The priorities during this phase are listed in order below.

- Identify the area where there are, or may have been, potential early health effects.
- Confirm or expand the sheltering/evacuation area
- Assist the state(s) in identifying where food and water may be unsatisfactory for consumption.
- Identify the areas where Hanford workers and off-site populations may not be able to return because of residual contamination. Computer projections may be used for preliminary assessments. Final decisions on relocation will be based on actual measurements.

VI.C. Field Team Readings

Measurements are the second method of assessing the release. At Hanford, the affected facility under the direction of an IC is responsible for the local event scene, including determining the impact of the event by taking measurements. The UDAC field teams supplemented by State and Federal resources, as necessary, take radiation measurements beyond the immediate event scene.

The first measurement objective is to determine if enough radiation was released from the facility to be measured downwind, either currently in the air or deposited on the ground. If a release is detected, the field teams will initially avoid areas where they require respiratory protection to prevent equipment contamination to a level that would preclude additional measurements. The field teams will go deeper into the maximum impact area when it becomes clear that either the plume has already passed or the magnitude of the release is small.

The second field team objective is to obtain measurements that can be used to determine the areas where protective action guides are exceeded. Consequence assessment starts with computer projections and slowly transitions to measurements as the basis for additional protective actions. Computer projections are fast but uncertain, whereas measurements better reflect the conditions at the time and place that they were made. However, only a few will usually be available before the plume has passed. Adjusting the projection to better match the measurements is a way to use these initial values. This adjustment relies on the professional judgment of UDAC staff.

V. CONCLUSIONS: Hanford Consequence Assessment Challenges and Lessons Learned

Hanford is characterized by a large inventory of legacy hazardous material that includes spent nuclear fuel, various forms of plutonium, buried waste, contaminated soil and groundwater, and contaminated buildings that must be cleaned up and torn down. Determining the potential significance of an event and a dispersion analysis source term can be highly uncertain, since much of the current environmental cleanup activity takes place outdoors or in facilities that no longer have operating process instrumentation to detect and quantify a release. From necessity, a conservative approach has been established that may lead to declaring an emergency and an initial assessment that exceeds the actual impact.

Experience has shown that consequence assessment may evolve into an activity that seeks to prove that there has been no release or that there is no impact on off-site areas.

The difference between this activity and normal field team emergency objectives was illustrated during a large wildland fire that extensively burned federal, state, and private lands on and around the Hanford Site in the summer of 2000. The Hanford emergency response field teams were reporting emergency-procedure background air samples, whereas DOE Headquarter and others were expecting measurable results from burning natural radioactive sources in vegetation. Airborne activity can be measured at levels far below the protective action criteria by using long sample collection times and laboratory analysis.

The difference between environmental and emergency measurements must be understood by emergency managers to enhance credibility and provide meaning to statements that there is no off-site impact. Hanford subsequently developed procedures to engage environmental monitoring resources early in the event if there is a perceived need to measure at levels far below the emergency protective action criteria.

REFERENCES

1. DOE, 2002, Hanford Emergency Management Plan, DOE/RL-94-02 Revision 2, U.S. Department of Energy, Washington, D.C.
2. Glantz, C. S., and M. A. Pelton, K. J. Allwine, K. W. Burk. 2000. User's Guide for MetView: A Meteorological Display and Assessment Tool. PNNL-13333, Pacific Northwest Laboratory, Richland, Washington.
3. Glantz, C. S., and M. A. Pelton, K. J. Allwine, K. J. Pattison. 2002. User's Guide for the Air Pollutant Graphical Environmental Monitoring System (APGEMS). PNNL-14043, Pacific Northwest Laboratory, Richland, Washington.
4. Homann, S.G., 1994: HIOSPOT Health Physics Codes for the PC, UCRL-MA-106315, Lawrence Livermore National Laboratory, California.
5. EPIcode (2003). EPIcode Version 7.0 User Documentation, Online Help distributed with software package, Homann Associates, Inc. September 2003.
6. D. E. Barnes. 2005. Hanford GeoSpatial Map Portal (QMAP) System Design Description. HNF-17012, Lockheed Martin Information Technology, Richland, Washington.