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B. Document Number HNF-24532-FP Rev. 0

C. Title
Tracking Clean Up At Hanford

D. Internet Address http://www.icemconf.com

E. Required Information

1. Is document potentially Classified? ◉ No ○ Yes (MANDATORY)
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1. Title for Conference or Meeting THE 10th INTERNATIONAL CONFERENCE ON ENVIRONMENTAL REMEDIATION AND RADIOACTIVE WASTE MANAGEMENT (ICEM05 / DECOM05)
2. Group Sponsoring American Society of Mechanical Engineers (ASME)
3. Date of Conference 09/4-8/2005
4. City/State Glasgow, Scotland
5. Will Information be Published in Proceedings? ○ No ◉ Yes
6. Will Material be Handed Out? ○ No ◉ Yes

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Approval by Direct Report to FH President (Speech/Articles Only) _____
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A-6001-401 (05/05)

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- ☐ Software
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- ☐ Other

B. Document Number: FINF-24532-FP Rev. 0

C. Title: Tracking Clean Up At Hanford

D. Internet Address: http://www.icemconf.com

E. Required Information
1. Is document potentially Classified? ◉ No ○ Yes (MANDATORY)
Manager Required (Print and Sign)
If Yes ○ No ○ Yes Classified
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5. Will Information be Published in Proceedings? ○ No ◉ Yes
6. Will Material be Handed Out? ○ No ◉ Yes

H. Author/Requestor (Print and Sign): Carl W. Connell, Jr.
Responsible Manager (Print and Sign): Bruce H. Ford
Approval by Direct Report to FH President (Speech/Articles Only) (Print and Sign)

I. Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	☒	K.M. Norris	K M Norris	(Y) / N
Office of External Affairs	☒	D.J. Dunn		Y / N
DOE-RL	☒	M.K.Thompson		Y / N
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A-6001-401 (05/05)

HNF-24532-FP
Revision 0

Tracking Cleanup at Hanford

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

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HNF-24532-FP
Revision 0

Tracking Cleanup at Hanford

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Date Published
May 2005

To Be Presented at
The 10th International Conference on Environmental Remediation and Radioactive Waste Management
(ICEM05/DECOM05)

American Society of Mechanical Engineers (ASME)
Glasgow, Scotland

September 4-8, 2005

Prepared for the U.S. Department of Energy
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Richland, Washington

Approved for Public Release;
Further Dissemination Unlimited

J. D. Aardal 5/27/2005
Release Approval Date

ICEM'05:
The 10th International Conference on Environmental Remediation and Radioactive Waste Management
September 4-8, 2005, Scottish Exhibition & Conference Centre, Glasgow, Scotland

ICEM05-ID: 1381

TRACKING CLEANUP AT HANFORD

Carl W. Connell, Jr., Fluor Hanford

ABSTRACT

The Hanford Federal Facility Agreement and Consent Order, known as the "Tri-Party Agreement" (TPA), is a legally binding agreement among the U.S. Department of Energy (DOE), the Washington State Department of Ecology, and the U.S. Environment Protection Agency (EPA) for cleaning up the Hanford Site. Established in the 1940s to produce material for nuclear weapons as part of the Manhattan Project, Hanford is often referred to as the world's largest environmental cleanup project. The Site covers more than 580 square miles in a relatively remote region of southeastern Washington state in the U.S. The production of nuclear materials at Hanford has left a legacy of tremendous proportions in terms of hazardous and radioactive waste. From a waste-management point of view, the task is enormous: 1,700 waste sites; 450 billion gallons of liquid waste; 70 billion gallons of contaminated groundwater; 53 million gallons of tank waste; 9 reactors; 5 million cubic yards of contaminated soil; 22 thousand drums of mixed waste; 2.3 tons of spent nuclear fuel; and 17.8 metric tons of plutonium-bearing material...just a partial listing.

The Agreement requires that DOE provide the results of analytical laboratory and non-laboratory tests/readings to the lead regulatory agency to help guide them in making decisions. The Agreement also calls for each signatory to preserve – for at least ten years after the Agreement has ended – all of the records in its, or its contractors, possession related to sampling, analysis, investigations, and monitoring conducted.

The Action Plan that supports the TPA requires that Ecology and EPA have access to all data that is relevant to work performed, or to be performed, under the Agreement. Further, the Action Plan specifies two additional requirements: 1) that EPA, Ecology and their respective contractor staffs have access to all the information electronically, and 2) that the databases are accessible to, and used by, all personnel doing TPA-related work.

The Hanford Environmental Databases document and track the progress of Site cleanup – Hanford Environmental Information System (HEIS), Hanford Well Information Data System (HWIS), the Waste Information Data System (WIDS), and the Hanford Geographic Information System (HGIS). HEIS contains the date, time, location, and results from samples taken during activities such as field investigations and groundwater monitoring. HWIS contains the details of the wells and boreholes on the Site. WIDS tracks the waste sites – from discovery through cleanup. Each of the databases is supported by several applications for entering or retrieving information. HGIS keeps track of the locations for waste (WIDS) sites, wells and boreholes, and other sampling site locations.

Of the applications used to extract data from the Environmental Databases, the Hanford Map Portal (QMAP) is the newest, and perhaps the most efficient. QMAP combines the HGIS spatial information with the information from the other databases so that users may browse to, or query, the waste site or well of interest. A query of a waste site or well engages QMAP to find the object and then the user may access the appropriate database.

This paper describes the Environmental Databases and their maintenance, as well as the applications used to access them. Collectively, these databases are a critical element in formally documenting the work and associated decisions made during the cleanup of Hanford.

INTRODUCTION

Telling the story of "Tracking Cleanup at Hanford" requires briefly describing the Hanford Site and its operations, the evolution of the associated regulatory environment, and the

development of systems and processes to monitor and track the progress. The Hanford story has been written over several generations of stakeholders and during changing regulatory environments. At the same time, our knowledge of the wastes and the regulations governing their storage, treatment, and disposal have also evolved – an oddity for scientists and engineers that a particular date on the calendar changes how waste is classified for disposal.

OPERATIONAL OVERVIEW OF THE HANFORD SITE

In 1943, under the auspices of the Manhattan Project, the U.S. Army Corps of Engineers selected Hanford to site nuclear reactor and spent-fuel-processing facilities (Figure 1). Hanford's mission was to produce plutonium for national defense. This objective required a large military-industrial complex that included multiple facilities: fuel manufacturing, nuclear reactors, chemical processing, waste management, and research.

In 1944, nine production reactors, located in the Site's100 Area, began irradiating uranium to produce plutonium. These reactors irradiated approximately 100,000 metric tons of uranium fuel. Eight of the reactors, which ran until 1971, were graphite-moderated and used water from the Columbia River for once-through cooling. The ninth reactor, a dual-purpose unit (N Reactor), used recirculating water coolant and produced plutonium for defense applications, as well as steam for electricity. N Reactor, now deactivated, operated until 1987.

Two test reactors and one commercial unit were also constructed and operated at the Hanford Site: the Plutonium Recycle Test Reactor (PRTR), the Fast Flux Test Facility (FFTF), and a unit owned and operated by Washington Public Power Supply System. The PRTR was a heavy-water-moderated test reactor located in the 300 Area. The PRTR has been deactivated. FFTF, a sodium-cooled reactor located in the 400 Area, was used to test fuels and materials for advanced nuclear power plants. In 1993, the FFTF began transitioning towards permanent shutdown. The commercial nuclear power plant, WNP-2, is a boiling water reactor and still operating.

Chemical-processing operations during nuclear production generated high-level radioactive liquid wastes. About 245 million liters (65 million gallons) of high-level waste are stored at the Hanford Site in 177 large single- and double-shelled underground tanks. The tanks, divided into 18 groups (or "farms"), are located in the 200 Area. Of the original 149 single-shell tanks, 67 have leaked, or are assumed to have leaked, about 3.8 million liters (1 million gallons) of contaminated liquid to the soil column – recent estimates push the number even higher. The 28 double shell tanks built since 1968 have a tank-within-a-tank design for better containment, and have not leaked.

The solid waste generated from past operations consists of low-level radioactive waste, low-level mixed waste, transuranic waste, and hazardous waste. The current inventory of solid waste buried or stored in underground trenches and above-ground facilities is about 87,000 cubic meters (114,000 cubic yards) in the 100 Area; 379,000 cubic meters (495,000 cubic yards) in the 200 Area; and 159,000 cubic meters (208,000 cubic yards) in the 300 Area. A commercial low-level radioactive waste disposal facility, operated by US Ecology, is located southeast of the 200 East Area on land leased from Washington State.

(DOE/RL-98-48, Vol. II)

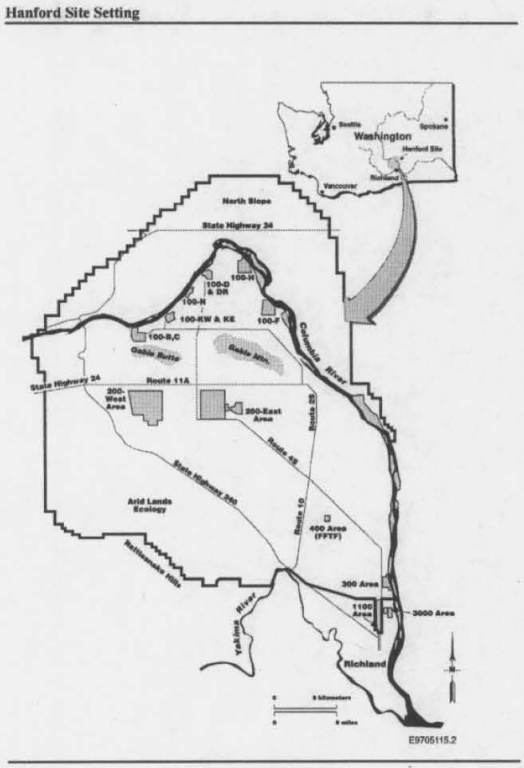

Figure 1. Hanford is a 585-square mile reservation in southeastern Washington State.

ENVIRONMENTAL LEGACY OF THE COLD WAR NTRODUCTION

Like most industrial and manufacturing operations, the nuclear-weapons complex has generated waste, pollution, and contamination. However, many problems posed by its operations are unlike those associated with any other industry. They include unique radiation hazards, unprecedented volumes of contaminated water and soil, and a vast number of contaminated structures ranging from reactors, to chemical plants for the extraction of nuclear materials, to evaporation ponds.

Early in the race to unleash the power of the atom, scientists involved with the weapons complex raised serious questions about its waste-management practices. Shortly after the Atomic Energy Commission was established, its 12-man Safety and Industrial Health Advisory Board reported that the "disposal of contaminated waste in present quantities and by present methods ... if continued for decades, presents the

gravest of problems." The imperatives of the nuclear-arms race, however, demanded that weapons production and testing be given the first priority, rather than waste management and the control of environmental contamination.

(USDOE Historical Document)

TRI-PARTY AGREEMENT

The Hanford Federal Facility Agreement and Consent Order, or the Tri-Party Agreement (TPA), is a legal agreement among the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) that addresses environmental compliance and cleanup at Hanford.

The Hanford Federal Facility Agreement and Consent Order Action Plan (Action Plan) (Ecology et al. 1989b) is an attachment to the Tri-Party Agreement. The Action Plan provides the methods and procedures for closure under the Resource Conservation and Recovery Act of 1976 (RCRA) and cleanup of the Hanford Site under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and RCRA corrective actions.

To understand "cleanup," we need to understand what is being cleaned up. Under the Action Plan, a "waste management unit" is defined:

> *A waste management unit represents any location within the boundary of the Hanford Site that may require action to mitigate a potential environmental impact. This would include all solid waste management units as specified under Section 3004(u) of RCRA. Waste management units include the following:*
>
> - *Waste disposal units (including RCRA disposal units)*
> - *Unplanned release units (including those resulting from spills)*
> - *Inactive contaminated structures*
> - *RCRA treatment and storage units*
> - *Other storage areas.*

In addition, the Action Plan calls for an electronic database that: "identifies all waste management units on the Hanford Site, and describes the current status of each unit (e.g., active/inactive, TSD [treatment, storage, and disposal], CERCLA past-practice or RCRA past-practice)." The electronic database used is referred to as the Waste Information Data System (WIDS); the waste management units tracked are, "WIDS sites."

The Action Plan also requires that Ecology and EPA have access to all data that is relevant to work performed, or to be performed, under the TPA. Further, the Action Plan specifies two additional requirements: 1) EPA, Ecology and their respective contractor staffs have access to all the information electronically, and 2) that the databases are accessible to, and used by, all personnel doing TPA-related work.

The electronic databases referred to by the Action Plan are generally thought of as the "working files" for tracking cleanup. The Action Plan also calls for an Administrative Record. "The administrative record is the body of documents and information that is considered, or relied upon,...in order to arrive at a final decision for remedial action or hazardous waste management."

HANFORD'S ENVIRONMENTAL DATABASES

To meet the Action Plan requirement for electronic databases, DOE and its contractors have established the "Hanford Environmental Information Databases," which consist of four databases and several supporting applications.

DATABASES
- Hanford Environmental Information System (HEIS)
- Hanford Well Information System (HWIS)
- Waste Information Data System (WIDS)
- Hanford Geographic Information System (HGIS)

APPLICATIONS
- Sample Data Tracking (SDT) System
- Well Maintenance Application (WMA)
- Well Survey Application (WSA)
- Web site access to HEIS and HWIS databases
- WIDS Application
- Hanford Virtual Library (VL)
- Hanford Geospatial Map Portal (QMAP)

The databases are required; the applications make the databases efficient, effective, and in some cases, easy to use.

HEIS is a consolidated set of automated resources that manage data collected during environmental monitoring and restoration. HEIS includes an integrated Oracle database that provides consistent, historical and current information for groundwater, soil, biota, air monitoring, surface water (including Columbia River and seep samples), soil gas, and miscellaneous material samples and their analytical results.

HWIS documents information about wells and manages the information – from drilling to decommissioning. The WMA is the data-entry interface to the database. Information from HWIS and scanned well documentation can be retrieved through a web interface.

The **WIDS** database provides a traceable source of information about WIDS sites at Hanford. The system tracks investigation, remediation, and closure-action activities under the TPA.

HGIS is the geospatial platform to manage, update, analyze, and display spatial-related environmental data. The HGIS contains detailed, accurate maps of the Site and its main features, such as buildings, roads, aboveground and underground services, structures, piping, topography, geology, wells, and rivers and ponds.

SDT System electronically integrates steps of the Sample and Data Management Process. SDT is used to prepare Sample Authorization Forms (SAFs) and Chain-of-Custody Forms, as well as Sample Container Labels. The program automates tracking the progress of samples through the Sample and Data Management Process. SDT is the front-end application for the HEIS database.

The **VL** is Hanford's first graphic user interface (GUI) for accessing environmental sample information from HEIS. The VL, updated nightly from the HEIS database, provides tools that helps scientists and engineers access and analyze the environmental information. The VL requires training and frequent use for the user to be proficient.

QMAP acts as a centralized geospatial data portal (Figure 2) that can be used by people with minimal geographic information system (GIS) skills to obtain environmental and other pertinent data. A data portal allows technology common to different types of geospatial applications to be implemented once and shared across applications. QMAP includes communication and feedback loops that allow users to communicate with data and profile stewards about geospatial information. In addition, it links documents, drawings, weather and other reference information to map data. Web-map applications produced for QMAP are created in a consistent form that complies with data standards. In addition, a spatial-data clearinghouse, the Hanford Geospatial Clearinghouse, has been integrated into the QMAP portal. In short, QMAP links to each of the environmental databases and gives users a common GUI to both view the location of the database objects and retrieve the information about those objects from the appropriate databases.

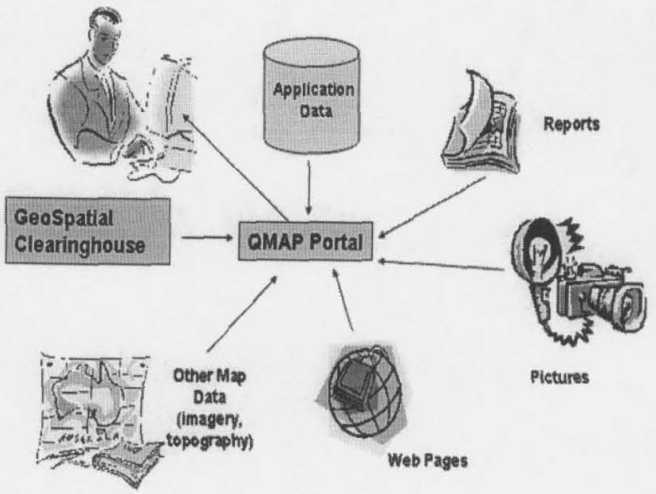

Figure 2. QMAP integrates data for easy and effective access to both geospatial and tabular data.

For example, Figure 3 illustrates the location of a facility on a map that has the location of the WIDS site included. To access a list of WIDS sites contained in the facility, a "geo-search" of the facility may be performed. To see a list of WIDS sites in and around the facility, one may perform a buffer search stipulating a particular distance away from the facility. From that list, summary reports and other information related to the WIDS sites may be listed and downloaded to suit the user's needs.

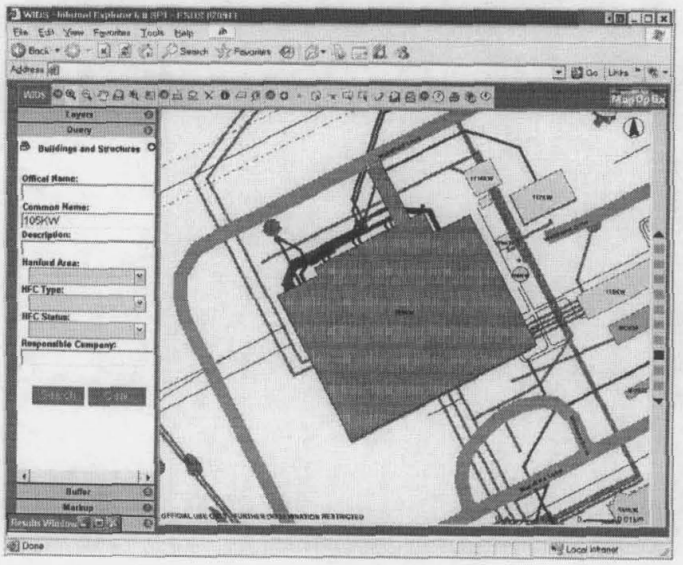

Figure 3. Users may query QMAP for various data including the location of a facility.

In Figure 4, the results for a query against a well ID produces a map of the selected well surrounded by its neighbors; the query result window (bottom of the graphic) is visible. If the well name (199-B2-12) is selected (clicked on) in the query result window, information about that well may be obtained from HWIS – history, survey, as-built summary, maintenance records, and construction information. If the well ID (A4550) is selected, information about the environmental samples taken may be obtained from HEIS. The information from HEIS may be accessed by entering either the SAF or the sample numbers, or a range of sample dates. Usually, media for the sample from a well would be soil or groundwater, and the search may be done for either specific or all constituents. At the far end of the query results window, the link marked with "INSP" allows access to the inspection reports for the well specified.

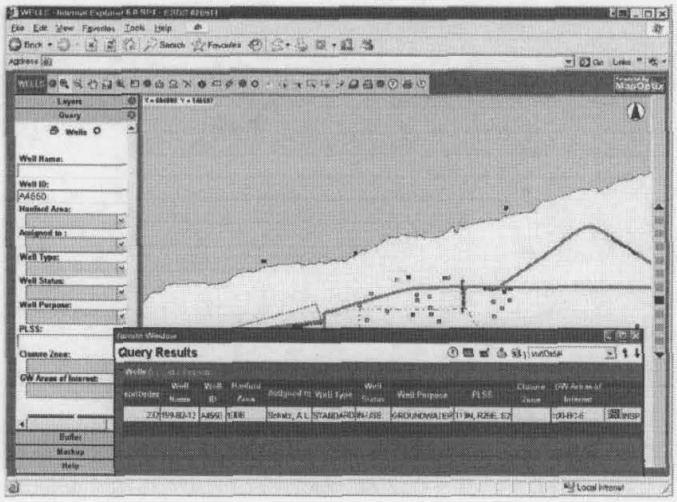

Figure 4. QMAP provides specific information for wells, including location and inspection reports.

QMAP is the next step at Hanford in making access to environmental information available for the authorized personnel. QMAP generally does not require the training and experience required for the VL, yet it provides much of the HEIS data available through the VL, as well as data from the other databases. Best of all, by the time you read this paper, the VL and QMAP will be integrated to provide even easier and more powerful access to environmental data.

IMPACT ON HANFORD

Decades have already been spent recording environmental information about the Hanford Site to track the progress of cleanup and much work is still left to be done. The environmental Information Databases and applications such as the Map Portal and the Virtual Library allow DOE employees, contractors, and regulators to monitor, track, and verify that Hanford is cleaned up to appropriate standards. With application such as the VL and QMAP, DOE has not only met the TPA requirements for monitoring and "**Tracking Cleanup at Hanford**," but has exceeded the requirements by making the data available, efficient, and easy to access.

ACKNOWLEDGMENTS

The work described herein was funded by the U.S. Department of Energy, most recently under the Project Hanford Management Contract.

The author thanks Lockheed Martin Information Technology for its role in developing the Hanford Map Portal and operating and maintaining the Hanford Environmental Information Databases.

The author also thanks the Fluor Hanford Communication organization for their many hours of support and assistance in the preparation of this paper.

Lastly, the author acknowledges the men and women of Fluor Hanford's Groundwater Remediation Project that manage the Hanford Environmental Information Databases.

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Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

RL, 1998, *Hanford Analytical Services Quality Assurance Requirements Document,* DOE/RL-98-68, Volume 2, Sampling Technical Requirements, U.S. Department of Energy, Richland Operations Office, Richland, Washington.