

# USING WEB BROWSERS TO OPERATE A DATA MANAGEMENT SYSTEM FOR THE EXCAVATION AND REMEDIATION OF THE SANDIA NATIONAL LABORATORIES CHEMICAL WASTE LANDFILL

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The Chemical Waste Landfill (CWL) at Sandia National Laboratories, New Mexico (SNL/NM) is a 1.9-acre disposal site that was used for the disposal of chemical wastes generated by many of SNL/NM research laboratories from 1962 until 1985. SNL/NM in conjunction with URS began excavating the landfill in 1998 and treatment of the excavated soils will begin in the near future. Project generated data is accumulated during all processes of these operations. That data is used to support the project during excavation, in the reporting process, and in determination of specific treatment variables. Due to the need for accurate and timely reporting, data management has become a key component of this remediation effort. The data management system uses Dynamic Hyper Text Markup Language (DHTML) and Extensible Markup Language (XML) technologies to provide an improved method for collecting and disseminating information critical for efficient remediation operations. To facilitate communication, the management system provides an interactive Web based interface that links underlying databases together. By using web browsers to submit data or query the system, multiple novice users can access pertinent data without an extensive amount of training.

Each department within the project has a need for data from the DMS. The DMS must be designed so that data can be retrieved from the system in a number of formats in order to reflect the needs of each department. One department may need to retrieve tracking data only. Another department may need to retrieve analytical data for all analytes. Yet another department may need to retrieve analytical data for only one analyte. Finally, another department may need to retrieve tracking data as well as analytical data. By using a web-based approach to data entry and data retrieval, the data management system (DMS) is able to provide specialized services to each user. Different types of web pages have been created in order to respond to the multiple users associated with the project. On the data entry side of the system, web pages have been created to allow authorized personnel to enter sample tracking information as well as complex analytical data. On the data retrieval side of the system, web pages have been created to allow authorized personnel to run pre-written queries. Web pages, which allow the user to write their own queries, have also been created.

The web-based approach allows multiple users to access the data at the same time. A data entry specialist can be entering tracking information in one office, while another person can be entering analytical data in another office. At the same time this is going on, a data management

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specialist can be retrieving data at another location. This increased functionality is not possible with a simple Microsoft (MS) Access database. MS Access works most efficiently as a one-user platform. Once a MS Access database is open, it is locked. Only the person who opened the database originally is allowed to save work. Significant administrative controls must be in place in order to have multiple data entry specialists working on one MS Access database.

In order to upgrade the data management system from a MS Access system to a web-based interface, hardware and software was obtained. A server running on MS Windows 2000 was installed. Client-server software is used in order for administrators of the database to manage the system without having to use the server as a desktop computer. A server should be located in a controlled environment, which is not always a possibility on a remediation site. Client-server software allows easy access, while maintaining the hardware in the appropriate environment. The software chosen for the database was MS SQL. Although the upgrade would work with MS Access, the size of the database was of great concern. MS Access works well for small data sets, but as the size of the database increases, the functionality of MS Access decreases. Active Server Pages (asp) was used to create the DHTML pages for the web-interface.

The original set of databases was developed in MS Access '97. In order to upgrade the system to MS SQL, the original DMS was upsized, or downloaded, into MS SQL. Minor adjustments were made to the design of the database in order to allow flexibility in the types of data managed by the database. The original DMS was inflexible in regards to naming conventions for samples. The original DMS was also set up so that there was no true connection between the tracking information and the analytical data. Because of this disconnect, the original DMS required an experienced user in order to retrieve data. By upgrading the DMS, the data management team was able to design the new DMS in a manner that would allow novice users to retrieve data in any given format.

With the original DMS, it was necessary to create large MS Excel files. The Excel files were used as intermediate data transfer files, which allowed the analytical data to be put into a form the DMS could understand. The Excel files were imported into the DMS; therefore allowing the system to reflect laboratory results. Laboratory data can be complicated and cumbersome; therefore it was necessary that at least one member of the data entry team be knowledgeable in both data entry and laboratory analyses. The DMS contains data for each sample. Each sample has data from approximately eight analyses. In designing the new DMS, it has been possible to set up web pages that will allow the laboratory analysts to enter their own data into the system. By simplifying the data entry process and allowing the laboratory to access the DMS, the amount of training necessary has decreased immensely.

With the addition of multiple users to the system, it was necessary to increase the quality control (QC) procedures associated with the DMS. QC procedures are necessary to insure data integrity. By allowing more users to access the data, the need for data integrity increased. Five levels of QC were in place with the original DMS and continue to be performed with the new system. Level A—Peer Review is performed on the analytical data by a member of the laboratory team; Level B—A review of the import file or data entry is completed by a member of the data entry team; Level C—A review of the analytical data versus the output from the database is completed by the Database/Document Control Officer; Level D—Data evaluation is completed by the

Quality Control Officer; and Level E—Validation of the data is completed by a third party assigned by SNL. In order to avoid the possibility of someone using data that has not been properly QC'ed, the system was set up with temporary tables. Data being entered into the new DMS will immediately go to a temporary table that cannot be accessed by non-authorized users. Only members of the data management team have authorized access to these tables. Once the appropriate QC has been completed, the data is transferred to the appropriate non-temporary tables and an active flag is placed in the record. An active flag is a means in which to let the DMS know that data is ready for distribution. Because access to data may be necessary before all the QC levels have been completed, each time data is retrieved the report or output clearly states the level of QC that has been performed. The end user of the data is given the key elements to determine the appropriateness of using the data retrieved from the DMS.

Upgrading the DMS has provided numerous advantages to the project. By upgrading from MS Access to MS SQL the DMS has become a more powerful, more versatile tool. By adding a web-based interface, the amount of training necessary for data entry team members has decreased. Access to data is spread throughout the project, rather than relying on one or two key people to retrieve data from the DMS. The web-based interface allows the data management team to distribute data to stakeholders using a tool that is prevalent in most offices around the world. By utilizing more powerful database software, MS SQL, and the latest in web technology, the data management team is providing the proper amount of support to the project efficiently and effectively.