

Automating Groundwater Sampling 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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Automating Groundwater Sampling at Hanford – 9373 (An Interim Report)

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ABSTRACT

Until this past October, Fluor Hanford managed Hanford's integrated groundwater program for the U.S. Department of Energy (DOE). With the new contract awards at the Site, however, the CH2M HILL Plateau Remediation Company (CHPRC) has assumed responsibility for the groundwater-monitoring programs at the 586-square-mile reservation in southeastern Washington State. These programs are regulated by the Resource Conservation and Recovery Act¹ (RCRA) and the Comprehensive Environmental Response Compensation and Liability Act² (CERCLA). The purpose of monitoring is to track existing groundwater contamination from past practices, as well as other potential contamination that might originate from RCRA treatment, storage, and disposal (TSD) facilities. An integral part of the groundwater-monitoring program involves taking samples of the groundwater and measuring the water levels in wells scattered across the site. More than 1,200 wells are sampled each year.

Historically, field personnel or "samplers" have been issued pre-printed forms that have information about the well(s) for a particular sampling evolution. This information is taken from the Hanford Well Information System (HWIS) and the Hanford Environmental Information

System (HEIS) – official electronic databases. The samplers used these hardcopy forms to document the groundwater samples and well water-levels. After recording the entries in the field, the samplers turned the forms in at the end of the day and the collected information was posted onto a spreadsheet that was then printed and included in a log book. The log book was then used to make manual entries of the new information into the software application(s) for the HEIS and HWIS databases.

This is a pilot project for automating this tedious process by providing an electronic tool for automating water-level measurements and groundwater field-sampling activities. The automation will eliminate the manual forms and associated data entry, improve the accuracy of the information recorded, and enhance the efficiency and sampling capacity of field personnel. The goal of the effort is to eliminate 100 percent of the manual input to the database(s) and replace the management of paperwork by the field and clerical personnel with an almost entirely electronic process. These activities will include the following: scheduling the activities of the field teams, electronically recording water-level measurements, electronically logging and filing Groundwater Sampling Reports (GSR), and transferring field forms into the site-wide Integrated Document Management System (IDMS).

INTRODUCTION

Currently, project water-level measurements are scheduled and released to the field in a database for water level data capture or “DataCap.” DataCap is a Microsoft Access® database and application that supports the scheduling, collection, and entry of water-level data. Paper forms are printed and provided to field teams so they can record measurements taken at wells. The completed forms are manually entered back into DataCap in the office, and then later verified by someone else to assure the accuracy of the data entry. This manual process is tedious, slow and prone to error.

Field teams are assigned to sampling activities via Microsoft Excel® spreadsheets. Once in the field, the teams manually fill out Water Level Measurement (WLM) forms, GSR and a Logbook. The paper forms are signed in the field and then the data on the forms is manually entered into various data collection systems. These processes are also slow, redundant and prone to error.

Because water-level measurements must be taken and recorded for both project water-level measurement and groundwater sampling activities, the initial effort will focus on automating this process. An additional feature of this first area of development will include integrating electronically signed WLM forms and automatically moving those forms into IDMS. Each March, nearly 900 wells have water level measurements are taken. Therefore, the goal is to have the first phase functionality developed, tested and operational before March 2009.

Concurrently, planning and development for additional automation will be done for other activities. Key areas of development will include field-team scheduling, electronic logbooks, electronic water level measurements, electronic GSR and automated movement of the electronic forms into IDMS. Most of the effort will involve defining the integration requirements and

integrating each of the application components. The scope of changes implemented will be prioritized to meet user needs and budgetary allocations.

The presentation at the Conference will provide real-time results/feedback that cannot be provided at this time, as the field-testing is yet to be performed. However, the planning and preparation is underway and does support a February-March implementation.

PROJECT PLAN

This project will involve a six-to-eight month effort that will result in an integrated toolset available to include the following:

- Electronic Scheduling of Field Teams
- Electronic Signing of Field Paperwork
- Automated Project Water-Level Measurements
- Electronic Logbook
- Automated generation of electronic field paperwork into IDMS via integration with the IDMS loader (iLoad) (iLoad is an application that loads documents into IDMS with the *Meta* data from a database).

The initial phase is anticipated to encompass a pilot of WLM forms with the following defined activities:

October 2008

- Define Initial Project Plan
- Scope of Work Created
- Define the 'As Is' and 'To Be' Process Flows
- Finalize WLM Requirements
- Create WLM Design

November 2008 – January 2009

- Create Data Structures
- Electronic Workflow (Upload/Download)
- Requirements/Design Refinement
- Initial Scheduling Interface
- Implement E-Signature
- Iload Upgrades for WLM Integration
- DataCap Changes
- Field Logging and Electronic Data Gathering (FLEDG) Design Specification
- Program FLEDG Components
- Test Case Development
- Limited Pilot Testing
- Procedure Changes, QA Approvals

February 2009

Pilot Deployment of Automated Water level Measurements

March 2009

Conduct field operation for collecting groundwater water-level measurements for some 900 wells.

RISKS, ASSUMPTIONS, AND CONSTRAINTS

- Necessary hardware/software for each phase has been or will be purchased far enough in advance of the current phase's delivery date to allow acceptable time for development, testing, and implementation.
- FLEDG contact(s) will be available for questioning, provide clear and complete answers/information, and make necessary definitive decisions regarding project in a timely manner.
- Field crews will be sufficiently trained in, or have prior knowledge of, basic computer skills including, but not limited, to the following:
 - Turning computer on/off
 - Logging on/off of computer
 - Opening/closing an application
 - Filling out an electronic form
 - Concept of electronic data collection.
- Field crew mobile workstations will be connected to the local intranet either by cable or wirelessly at least once every 24 hours for a minimum of 1 hour
- Field laptops can be securely connected to each other in the field either wired or wirelessly (Bluetooth®, IR, Private Network) for the purpose of exchanging small amounts of data to facilitate the transfer of well jobs from one team to another.
- A digital image of an electronic signature captured in the field is sufficient authentication for the replacement of a manual signature on a paper form
- The current printed WLM form accommodates all data collection necessary to complete a WLM event.
- Individual well jobs are assigned to teams on a daily basis with the option of assigning entire projects as a group of well jobs
- Project well jobs are rarely split between two different teams

- The signature on the WLM recorder (laptop) is the only signature needed on the WLM form
- Field crew has a morning meeting every workday where they receive their well assignments for the day
- Wells allowed to be scheduled are ‘released’ from DataCap application on a monthly basis
- Only wells ‘released’ by DataCap are scheduled for project water level measurement jobs
- Phase I will be complete and operational in the production environment on or before 03/01/2009
- The current printed GSR field form accommodates all data collection to complete a groundwater sampling job
-

METHODS, TOOLS, AND TECHNIQUES

- All newly created data source items will be on a structured query language server (Microsoft SQL Server®)
- The application will be written primarily in C# programming language
- As appropriate, the application will adhere to current in-house standards, procedures, and/or processes.
- Structured query language Replication will be used to ‘synch’ data between mobile database(s) and the master FLEDG database
- Mobile SQL Server® technology will be used to store application support data and field collected data
- SQL Server® replication technology will maintain a relationship between master data source and local servers for the purpose of replicating data between the two
- A high-level description of the FLEDG modules follows in Appendix A

SUMMARY

The work described in this paper is directed at increasing the efficiency, accuracy, and reliability of logged meta data to support groundwater sampling and water level measurements. Such data logging with portable computers and other “hand-held” devices has been used for years in many industries. Field sampling of environmental data has historically been by hand-written logs that are entered by a third party into an application used to load the meta data. By making the initial data entry in the field with built-in checks in the recording device is a major step in preserving the integrity of the data. The next step will be loading the actual data measured directly into the recording device *via* connected sensors.

ACKNOWLEDGMENTS

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REFERENCES

1. Resource Conservation and Recovery Act (RCRA). 1976. Public Law 94-580, as amended, 42 USC 6901 et seq.
2. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). 1980. Public Law 96-150, As Amended, 94 Stat. 2767, 42 USC 9601 Et Seq.

APPENDIX A – FLEDG HIGH LEVEL MODULE OVERVIEW

Task	Module	Notes
1. Before the field crew leaves the office, they can specify what eTapes they are using via a drop down list (this functionality is also available in the field in the event that a different eTape is needed)	FLGetInstr	Validation Data in JCS
2. Before the field crews leave the office, they can specify what team members will be ‘collector’ and ‘recorder’ (this functionality is also available in the field in the event that team member roles change)	FLSetUp	Need a setup function for equipment, validate well name/well-id. Need a table of individuals. They need to be able to change roles in the field.
3. A list of assigned well jobs and their status will be available to the field crews via the mobile application	FLAssignJobs FLRptAssign	We need a printed report for this to send a hardcopy list of scheduled wells with the team.
4. If at any time before or during the collection of WLM data for a well, the field crew determines that they are unable to complete the data collection, they will have the ability to ‘cancel’ the well job and must provide an explanation as to why	FLEnterGLM	Any changes will be logged - Database Rules will enforce. Well Trip assigned a status of cancelled.
	FLDBLog	Don't have a strategy for managing log files. Must upload and retain at least through validation steps
5. When the field crew arrives at a well they will be able to select the well from the assigned well list and validate that they are at the correct well by entering the well number/ID from the field	FLSetUp	Limit the Number of Screens- Use Setup for Misc Tasks.
6. Data cannot be collected for a well until the validation process has been completed	FLEnterGLM FLSignClose	Sign and Seal - Turn into a PDF and store in a protected share. If they change it after signed, rename the original and keep the second. Must always sign to close a well even if cancelled.

a. If well is 'invalid', the field crew is forced to enter an explanation but is allowed to continue to gather data for well	FLSetUp	Well Check on the setup menu
7. Application has electronic form for entering all data collected on traditional Ground Water Level Measurement form and has a visual likeness to the traditional paper WLM form		Defer to Phase II
8. Application will use lookup lists and formatted data entry whenever possible to reduce the chance of invalid data being entered	FLLookups	Misc Lookup tables 8-10 maybe - will have to be re-synchronized.
9. Comments may be associated with a well at any step during the Water Level measurement data collection	FLComment	Insert a Comment in the database- Need comment types to categorize, maintenance, etc
10. Field crew will have the ability to click button and insert current date/time where applicable		Utility function part of Setup
11. Before a value is updated in the local db, it will be verified to be with a given tolerance derived from previously collected/specified data	FLValidateGLM	
a. Should the value fall outside of an acceptable range, the system will warn the field crew and force the insertion of a comment for explanation	FIValidateGLM	Number of measurements: Last 5 years of measurements, regardless of time of year Data to use: Adjusted Depth to Water (ADJ_DTW) Not used: Any record flagged with a Review_Qualifier of Y, R, or F Allow: Three (3) Standard Deviations
b. The field crew will have the option to accept the data or edit the value		

<p>c. Once a warning has been issued and regardless of whether the final field value falls within acceptable range or not, the data is ‘flagged’ in the database and will later require review before being accepted into master data sources</p>		
<p>12. Allows for adding/deleting/editing of data entered by field crew on current electronic WLM form, without supervisor approval up to the point in time that the form is submitted and/or the field crew has left the well associated with the current electronic WLM form</p>	<p>FLEnterGLM</p>	
<p>13. Allows for adding/deleting/editing of data entered by Supervisor on any electronic WLM form that has already been submitted by field crew and/or field crew has left corresponding well. The WLM must NOT have been previously approved by Supervisor (exported out of system)</p>	<p>FLSuperGLM</p>	<p>Need supervisor logic</p>
<p>14. Ability to ‘hand-off’ well job to other field crew</p>		<p>Use the printed paper, write down the wells.</p>
<p>15. The field crew is able to record what well waste was created during job and account for the proper disposal of such waste via the mobile application</p>	<p>FLSetup</p>	<p>Lookup - Available through Setup Screen</p>
<p>16. When the laptop is brought back to the office at the end of the collection day, the field crew will be able to connect to the network and initiate the submittal (synch) of the collected data to the master FLEDG server</p>	<p>FLUpload</p>	<p>Upload Data - Error Handling DataCap/ILoad Changes</p>
<p>17. An ‘approval interface’ will be provided to those responsible for verifying collected data</p>	<p>FLSignClose</p>	

18. The field crew submitted data will not be exported out of the master FLEDG server until approved via the 'approval interface'		
19. The 'approval interface' will display a list of submitted well jobs with those jobs that had invalid or out-of-tolerance warnings 'flagged' for review	DataCAP Changes	
20. Any job 'flagged' for review must be viewed/verified/approved via the 'approval interface'		
21. All 'non-flagged' jobs have the option of being individually reviewed or batch accepted via the 'approval interface'		
22. To review a single job the ability to view an electronic version of the GLM form is available	Iload	
23. Once a job is approved via the 'approval interface' the data for the job is exported into the source database and the electronic WLM form is released to IDMS via the ILoad application	Iload	Iload should probably be the approval interface.
24. In the case of FLEDG system failure, a printed list of assigned wells will be provided to each team prior to departing office		Morning Report
25. Blank paper WLM forms will be stocked in each vehicle and in the case of FLEDG system failure or hardware failure, are to be filled out by field crew according to current procedure		

26. If manual paper forms are completed in the field, they will be signed and then submitted to approving body at the field crews return to the office		Datacap 2 in place.
Any manual paper forms submitted to approving body shall be entered into source database(s) via existing functionality of DataCap application and loaded into IDMS via iLoad application		