

Paper 196-27

Web Implementation of Environmental Decision-making Software

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ABSTRACT

Monitoring groundwater contamination is of great concern at operational sites in the United States Department of Energy (DOE) complex. The Aqueous Waste Software Application (AWSA) is a SAS® software application created and implemented at the Savannah River Site that has enabled more effective groundwater sampling decisions and reduced long-term monitoring costs. Specifically, AWSA provides a decision support tool for the issue of purge water containerization during the groundwater sampling process, convenient access to groundwater data in the Site's environmental database, and an enterprise-wide distribution system for summary reports of groundwater data. This paper discusses the reasons for and the benefits from the transformation of AWSA from a SAS/AF® software application on an Alpha cluster to a SAS/IntrNet® software application on a Web server.

INTRODUCTION

The Westinghouse Savannah River Company operates the Savannah River Site (SRS) for the United States Department of Energy (DOE). Current SRS missions include defense programs, non-proliferation of nuclear weapons, environmental remediation and restoration, waste management, chemical processing, research and development, and technology transfer. Groundwater contamination arising from legacy weapons work is a significant environmental issue at DOE sites.

The Aqueous Waste Software Application (AWSA) (Figure 1) uses SAS software and Internet technology to address certain aspects of groundwater monitoring. Purge water, an aqueous form of investigation-derived waste (IDW), is produced when stagnant water is purged from a well prior to sampling to ensure a representative sample. Regulations mandate treatment of purge water contaminated with hazardous and/or radioactive analytes in excess of specified concentrations. Many years of Site groundwater data exist, resulting in millions of records. However, groundwater is (obviously) ever moving and changing, and sampling data are often contradictory and filled with results below the instrument detection levels. AWSA was developed to regularly assess the analyte concentration levels in the "messy" groundwater data and determine dispositions for the purge water from monitoring wells.



Figure 1: AWSA Opening Screen

SOFTWARE DESCRIPTION

The Aqueous Waste Software Application (AWSA) is a SAS software application created by the Savannah River Technology Center in collaboration with the Environmental Restoration Division to address groundwater issues, including purge water. The main screen (Figure 1) is a GUI interface with icons for the two main functions: Containerization Analysis and Special Reports. There are also several icons for accessories to check on the Containerization Analysis files and to view limited help and contact information.

AWSA's Containerization Analysis (Figure 2) generates lists of groundwater monitoring wells that require containerization and treatment of purge water. The user selects a set of wells, and views are set up to retrieve the appropriate data. Then a batch job is submitted to apply the complex Containerization Algorithm, due to the time required for processing. The basic steps of the Containerization Algorithm are as follows: analytical, field, and QA data are retrieved for the selected wells; the data are qualified and verified; the appropriate data set is selected; the representative concentration is identified; the concentration is compared to an appropriate multiple of the analyte limit; and each well is assigned a disposition based on all the analytes. AWSA produces over twenty-five Containerization Analysis output files. These files designate the disposition of the selected wells, provide statistics to support treatment facilities' permits, assist with scheduling the handling of managed purge water, supply data details and summaries, and identify data outliers.

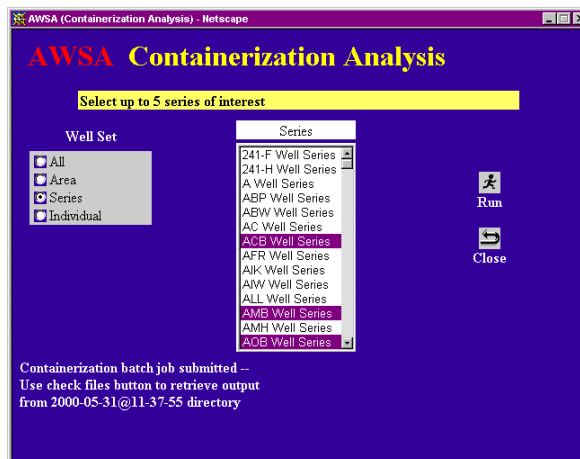


Figure 2: AWSA Containerization Analysis

AWSA's Special Reports deliver other groundwater information of interest in eighteen distinct reports. The three types of Special Reports provide reference data (Figure 3), groundwater data retrieval and analysis, and analyte concentration plots with time-trends (Figure 4). Examples include Well Inventory, Annual Purge Volumes, and Wells with Max of One Analyte. Most of the reports run very quickly, and the user can view the report results on the screen or send them to an output file.

The environmental data utilized by AWSA reside in a remote Oracle database. Pass-through SQL is used in the SAS software programs to retrieve the data.

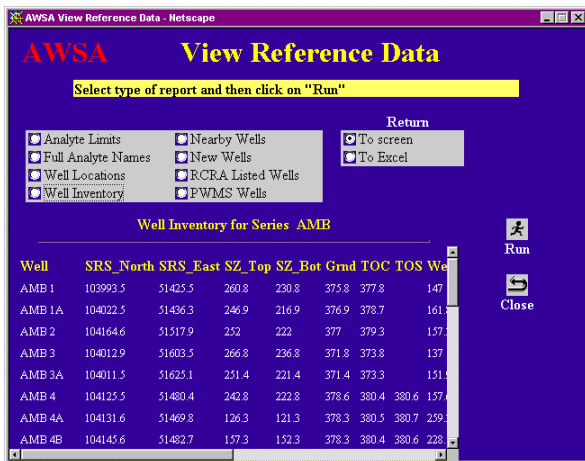


Figure 3: AWSA Special Reports - Reference Data

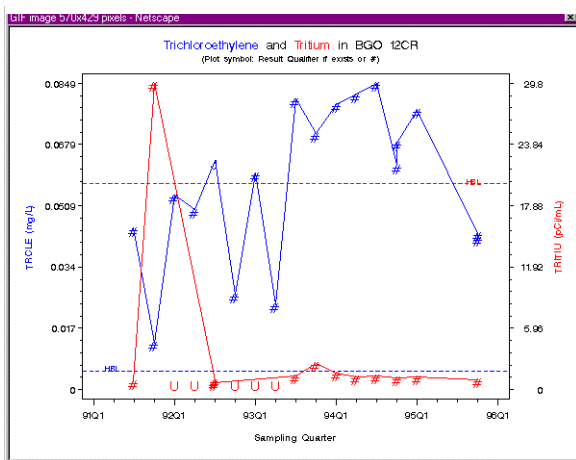


Figure 4: AWSA Special Reports - Concentration Plot

ORIGINAL CONFIGURATION

AWSA was originally designed as a SAS/AF software application on an Alpha cluster running OpenVMS. DCL command files controlled the application and the Containerization Analysis batch job. SAS software programs performed the Containerization Analysis and processed the Special Reports.

Each user was required to obtain an OpenVMS account on the cluster. Potential new users filled out the appropriate form and waited for an e-mail about account creation. The users were also charged a monthly fee for this account.

Individual licenses for Hummingbird's Exceed terminal emulator software had to be purchased for each user to access the application from the PC. In addition, the developer was required to load and set up the emulator software on each user's PC. Software upgrades were frequent and necessitated a visit to each PC for loading the new software. Maintaining the list of licenses and software versions was very inconvenient, especially with the high turnover rate of personnel and computers.

FTP (File Transfer Protocol) software was another necessity for each user in the original design of AWSA. The user retrieved the Containerization Analysis and Special Report files from the Alpha cluster to the PC via FTP.

Security requirements for the system prevented the developer from gaining information about user activity or viewing the user's files.

TRANSFORMATION AND CURRENT CONFIGURATION

As more people became aware of AWSA, the burden of establishing OpenVMS accounts, obtaining emulator and FTP software, and getting the software properly set up became overwhelming. It was obvious that AWSA should be converted to a Web application. Thus, AWSA underwent transformation from a SAS/AF software application with DCL command files to a SAS/IntrNet software application utilizing the SAS Application Dispatcher, Java servlet technology, JDBC, JavaScript, and HTML. An information technology (IT) professional set up a standard Windows NT Server running Internet Information Server and configured the SAS Application Dispatcher with four Application Servers running as NT services. This is modular technology in that more SAS Application Servers can be added as the customer base grows. The IT professional then redeveloped the screens and the report selection boxes using Java, JDBC, and JavaScript. The report selections are optimized as preprocessed Oracle queries. The Containerization Analysis and Special Reports themselves are still processed and reported back to the browser or output file(s) by SAS software programs. The conversion took several months, and the OpenVMS and Web versions of AWSA ran concurrently for a while.

Any Site user with an Intranet account and access to a networked PC can utilize AWSA. AWSA now features a familiar interface, the Site-licensed Netscape browser. Standard FTP is used through the browser to retrieve files to the user's PC. PIN code authentication (Figure 5) is required before a user can enter the application, and this information allows the user's activities to be logged. The user log has proven invaluable in gauging user activity and the relative importance of the different application features. The user's files, including SAS software logs, are stored in individual directories, allowing the developer to diagnose reported problems.

Figure 5: AWSA User Authentication

The PC format lent itself to the creation of a mirror PC dedicated to the production application of AWSA. The developer's work on the original PC, which can tie up or even lock up the machine, does not hamper the users. In addition, new software versions and application modifications can be thoroughly tested on the development platform before implementation in production. The system components can be managed and monitored from any networked PC. Also, the files are automatically backed up every night onto a Jaz drive. The Alpha cluster is likewise backed up nightly, but restoring files from the back-up tapes is inconvenient and time-consuming.

Another advantage of the current configuration is the availability of standard Internet formats for displaying files. The user can click on new icons to view a list of AWSA application modifications and a legend of output files from the Containerization Analysis, both created using HTML. The AWSA User Documentation has been published and can be viewed in PDF format. Designated environmental professionals use AWSA to generate the well containerization lists for the treatment facilities, which they publish periodically. The samplers use those published well lists to decide whether to dispose of the purge

water to a container for treatment or back to the ground. Now the samplers can view the most current approved well lists and modifications (Figure 6) in PDF format through AWSA, rather than obtaining a new paper copy prior to each sampling event.

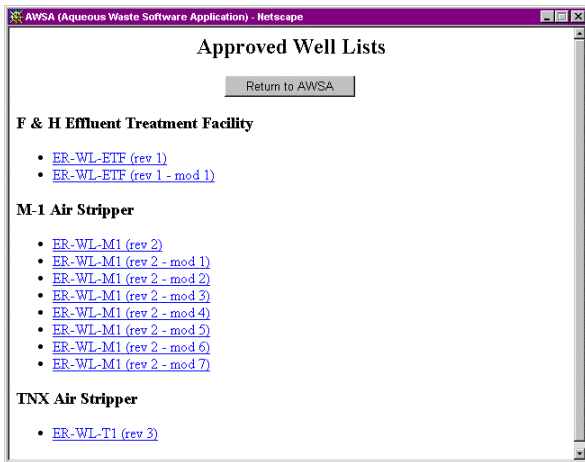


Figure 6: AWSA Approved Well Lists

Important application messages (impending outages, database problems, and such) are communicated to the user with JavaScript windows.

CONCLUSION

AWSA is an invaluable tool for the environmental decision-makers at the Savannah River Site. The application enables users to create timely, consistent, and current well containerization lists and other groundwater data reports without assistance. Web implementation has made AWSA more user-friendly and cost effective and has greatly expanded the functionality of the application. Benefits include:

- No VMS accounts (or per account charges) needed
- No individual licenses for emulator software (or software maintenance) needed
- No individual licenses for FTP software needed
- Use of a standard PC as a Web server
- Familiar interface for the application (i.e., browser)
- Ability to log users to track usage
- Ease of managing user files to investigate problems
- Capability to establish independent development and production environments
- Ease of retrieving file back-ups
- Posting of large files (list of software modifications and descriptions of output files) possible through standard HTML format
- Access to published documents (approved well lists and user documentation) possible through standard PDF format
- Facility of application communications

CONTACT INFORMATION

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