

- PER-2004-2239, initiated April 21, 2004 – “Spreadsheet Verification Forms Not Being Used”

Observations and assessments for specific areas of interest are discussed below.

#### SQA Program and Procedures

The SQA process described in CH2M HILL’s QAPD and procedures addressed the full software life-cycle, including identification of requirements, software design, software configuration management, procurement, testing, maintenance, and retirement, and defined the documentation requirements for each life-cycle phase. However, the requirements base for the QAPD did not explicitly use NQA-1, Subpart 2.7. This is an important consensus standard defining the software life-cycle. Instead, the QAPD contained a very general statement that procedures should conform to national and consensus standards. The assessors noted that CH2M HILL’s software quality assurance procedures were generally consistent with Subpart 2.7.

CH2M HILL’s procedures presented an organized approach to software life-cycle management, and generally contained adequate detail and guidance to allow a competent user to understand the applicable documentation and control requirements. The procedures identified templates to be used in the preparation of life-cycle documentation. They also addressed items, such as Mathcad models and Excel spreadsheets, that used COTS software to generate data using calculations, formulas, algorithms, or equations. CH2M HILL’s procedures did not require that appropriate user training be identified for each software application or that formal lists of qualified users for specific software applications be maintained.

The assessors interviewed CH2M HILL’s engineering department computer software lead, as well as personnel responsible for maintaining and using individual software programs. They found that the level of understanding of software quality assurance concepts, requirements, and procedures varied widely among the individuals interviewed. Some personnel demonstrated strong knowledge of SQA processes, but others appeared to be unfamiliar with or unaware of fundamental concepts and requirements.

#### Supplier Evaluations

CH2M HILL used the services of the Fluor Hanford, Inc. (FHI) Acquisition Verification Services (AVS) organization for evaluations of suppliers of software and related services. AVS evaluated the suppliers’ QA programs against software QA requirements specified by CH2M HILL. Based on the supplier evaluation for Fluor Federal Services, Inc., (FFS) AVS placed FFS on the Hanford Site Evaluated Suppliers List (ESL). The ESL stated that FFS satisfactorily implemented the requirements of NQA-1-1994, Supplement 3S-1, but the assessors found that some requirements were not implemented. Specifically, some requirements of Supplement 3S-1, section 3.1 for documenting the use of computer programs in design analyses were not implemented.

The assessors met with AVS personnel and discussed the process and tools AVS used to evaluate FFS. They found that AVS had not adequately captured all of the applicable

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SQA requirements in the evaluation checklist for the FFS assessment. As a result, some deficiencies in FFS's SQA program were not identified.

#### Audits and Assessments

CH2M HILL performed self-assessments and management assessments to evaluate the effectiveness of their SQA program. The most recent CH2M HILL self-assessment of software control processes, documented in audit report RPP-A-03-01 in May 2003, concluded that progress had been made in identifying and controlling software applications, but that improvements were needed. CH2M HILL's audit identified three findings and two observations. CH2M HILL documented these issues in five separate PERs, and closed all of them by the start date of this assessment. In reviewing the CH2M HILL audit report and associated PERs, the assessors found that issues that CH2M HILL had previously identified and closed were not adequately resolved, as described below.

Observation #1 in the CH2M HILL audit report noted:

“...the lack of an integrated software quality assurance infrastructure constitutes vulnerability where CH2M HILL does not have an inventory of all software in use and related responsibilities for controlling configuration and status.”

CH2M HILL initiated PER-2003-0428 to address this issue. CH2M HILL management stated in the PER screening comments:

“Software control and inventory is the responsibility of the purchasing organization or system owner. No requirement exists for establishment and maintenance of a software inventory at the company level. For all systems interfaced with HLAN, HISI is the inventory system used and supported by the CH2M HILL Company and CIO. Use of HISI is endorsed and delineated in the procedures.”

CH2M HILL took no corrective action, and closed the PER on February 27, 2003. During this ORP assessment, the assessors identified this same issue, as CH2M HILL did not effectively use the Hanford Information System Inventory (HISI) or any other inventory system to track quality-affecting and safety software. As a result, CH2M HILL management was unaware of some missing documentation.

Finding #2 in the CH2M HILL audit report stated:

“...SQAPs have not been developed for software indicated as being ‘quality-affecting’.”

CH2M HILL initiated PER-2003-1589 to address this issue, and closed the PER on April 5, 2004, indicating that all corrective actions had been completed. On the day before the start of this assessment, CH2M HILL initiated PER-2004-2192 to document that the SQAP for ANSYS 7.0, although prepared, had not been released. The assessors also noted that SQAPs did not exist for spreadsheet templates, which are quality-affecting

software. On the final day of the assessment fieldwork, CH2M HILL reopened and modified PER-2003-1589 to include spreadsheet templates.

In a previous assessment of computer software control at FHI, DOE found inadequacies in the control of software used in fire hazard analyses and documented safety analyses. FHI responded to the finding by issuing unreviewed safety question documents for each FHI facility. The authorization basis documents for the 222 -S Laboratory and the 242-A Evaporator were developed and maintained by FHI before they were transitioned to CH2M HILL. When the auditors brought this to the attention of CH2M HILL management, they documented the issue and initiated action to assure the DSAs for the 222-S Laboratory and the 242-A Evaporator were technically adequate with respect to analyses performed by computer.

#### Calculations

The assessment team reviewed a sample of design calculations performed using computer software and found that FFS, who performed the calculations, did not always document all computer software information required by NQA-1 in calculation packages. They did not identify computer type, evidence of or reference to computer program verification, or the bases supporting the application of the program to the physical problems. While this information existed, it was not documented in the required record and was not being retained. The NQA-1 requirement to document this information was not implemented in FFS's quality assurance program, and the supplier evaluation of FFS by the FHI AVS organization did not identify this noncompliance. Calculations performed by other subcontractors evaluated by the assessors included the required information.

Two subcontractors performing dome-loading calculations in staff-augmentation roles for CH2M HILL used computer programs that were not controlled under the CH2M HILL quality assurance program. These subcontractors were M&D and JLR. The subcontractors used copies of ANSYS that were licensed to, and controlled by, their own organizations, when they should have been using a copy controlled by CH2M HILL. CH2M HILL had not requested the FHI AVS organization to evaluate either M&D or JLR, so the qualification of their software quality assurance programs was unknown.

#### **Conclusion:**

CH2M HILL established and implemented an SQA program that, although adequate for many of the CRAD evaluation criteria, fell short of providing comprehensive assurance of software quality. Most of the procedures were sufficiently detailed and, when correctly executed, provided assurance that SQA activities and software practices were appropriate and complete. However, some procedures needed to contain additional guidance to ensure consistent implementation.

This assessment identified issues that were previously identified and closed by CH2M HILL but were not adequately resolved. It also identified additional issues CH2M HILL did not identify, but should have. A more aggressive program of independent and

management assessments would have found and corrected the problems identified in this assessment.

**Issues:**

- CH2M HILL should consider revising the QAPD to implement the requirements of NQA-1, Subpart 2.7.
- CH2M HILL should consider establishing authorized user lists for quality-affecting software.
- The supplier evaluation of FFS did not identify FFS's failure to implement some requirements.
- The assessment and corrective action management systems did not assure that software quality assurance issues were comprehensively identified and resolved.
- CH2M HILL should assure that all necessary safety analyses performed by the previous contractor for the 242-A Evaporator and the 222-S Laboratory were adequately controlled.
- Some personnel using quality-affecting software were inadequately trained in software quality assurance requirements and procedures.
- The FFS quality assurance program and procedures did not implement some requirements of NQA-1 for documenting the use of computer software in design work.
- Contractors performing dome-load calculations in a staff-augmentation role used software that was not controlled under the CH2M HILL SQA program.
- Software quality assurance documentation for some codes was incomplete.

**Key Personnel Contacted:**

E. R. Hamm, CH2M HILL Engineering  
J. S. Davis, CH2M HILL Nuclear Safety Program  
C. Maciuca, CH2M HILL Quality Assurance  
D. J. Foust, CH2M HILL Radiological Control  
L. J. Julyk, CH2M HILL Engineering  
J. A. Lechelt, CH2M HILL Engineering  
T. K. Cordray, FHI AVS  
A. Y. Cooper, FHI AVS

Submitted By: William C. Dyk  
Date: 20 May 2004

Approved By: [Signature]  
Date: 5/20/04

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## Assessment Notes

**Assessment Note Number:** A-04-ESQ-TANKFARM-006-06

**Assessor Names(s):** David Brown, William Dey

**Dates of Assessment:** April 19 -- 26, 2004

**Area/Items(s) Assessed:** Software Procurements

**Objective and Criteria – CRAD-4.2.4.1, Rev. 3, Section 4.7:**

Vendor-supplied software, either COTS software, custom-developed or modified, requires the appropriate levels of QA commensurate with the level of risk introduced by its use.

1. Procurement documents for acquiring software programs identify the quality requirements appropriate for the level of risk introduced by their use.
2. Acquired software is verified to meet the identified quality requirements.

The assessors reviewed documentation and interviewed key personnel responsible for the software identified below to assess the quality assurance processes CH2M HILL used in procuring products and services related to or affected by software. Software applications and databases included in the assessment:

- ANSYS® 7.0 and 8.0
- AutoPIPE® 6.1 and 6.2
- Excel® 2002
- ESP® 6.5
- FLUENT® 5.5
- GXQ 4.0F
- HADCRT 1.4
- MathCAD® 11
- MicroShield® 6.02
- TWINS (Tank Waste Information Network System)

Other than TWINS, which was developed by Pacific Northwest National Laboratory to support Hanford tank waste management activities, all of the software items listed above were either commercial off-the-shelf (COTS) applications or codes developed by third-party entities for uses other than Hanford tank waste management. The software was used either directly by CH2M HILL personnel, by subcontractors working in a staff-augmentation role for CH2M HILL, or by CH2M HILL's subcontractors.

## Observations and Assessments:

The assessors reviewed or referred to the following documents:

### QA Program Description

- TFC-PLN-02, Rev. A-3, dated November 19, 2003 – *Quality Assurance Program Description*

### Procedures and Standards

- TFC-BSM-CP\_CPR-C-05, Rev. C-3, dated February 12, 2004 – “Procurement of Services”
- TFC-BSM-CP\_CPR-C-06, Rev. C, dated December 18, 2003 – “Procurement of Items (Materials)”

### Supplier Evaluation Documents

- *Evaluated Supplier Listing, Fluor Hanford*, dated April 19, 2004
- Assessment Report Memo, D. Scott (LMSI) to J. Davis (CH2M HILL) and C. Maciuca (CH2M HILL), “Assessment of John Marvin Incorporated (JMI) GOTH Application, version 5.3 to ASME NQA-1-1997 Edition ‘Quality Assurance Requirements for Nuclear Facility Applications’ with ASME NQA-1a-1999 Addends requirements,” dated September 19, 2002

### Statements Of Work

- Statement of Work, “Technical Support to NS&L Accident Analysis (FAI),” Req. # 77990, Rev. 1, CH2M HILL Hanford Group, Inc., August 30, 2002.
- Statement of Work, “Detailed Design – Immobilized High Level Waste Interim Storage Facility, Project W –464,” Req. # 94959, Rev. 0, CH2M HILL Hanford Group, Inc., November 4, 2002
- Statement of Work, “Project W-314, 241-A-A Valve Pit Bypass Definitive Design & Engineering & Inspection Services,” Req. # 95116, Rev. 0, CH2M HILL Hanford Group, Inc., December 30, 2002
- Statement of Work, “Blanket Master Agreement for DST Engineering Modeling,” Req. # 105899, Rev. 0, CH2M HILL Hanford Group, Inc., October 23, 2003

CH2M HILL and its subcontractors used COTS software to perform safety and quality-affecting work. The applications were mature products used extensively for similar tasks in a variety of industries and fields, including commercial nuclear power. The volume of commercial use of these codes and the history of acceptable performance for large numbers of users with diverse requirements provided assurance that the applications were developed and maintained under QA programs with adequate software quality assurance requirements and controls.

For evaluations of suppliers of software and related services, including custom-developed and specialty codes, CH2M HILL used the services of the Fluor Hanford, Inc., Acquisition Verification Services (AVS) organization. AVS evaluated the suppliers’ QA programs against software QA requirements specified by CH2M HILL, typically

including configuration management, verification and validation testing, and similar applicable elements of consensus standards such as NQA-1. AVS documented the evaluations and added acceptable suppliers to the Hanford Evaluated Suppliers List (ESL). The assessors reviewed the documentation prepared by AVS in support of adding John Marvin, Inc. and Fluor Federal Services, Inc., (FFS) to the ESL. AVS's evaluation reports stated the requirements against which the suppliers were evaluated, the results of the evaluations, and the reasons for adding the suppliers to the ESL. The assessors also reviewed selected statements of work and verified that the SQA requirements imposed on the suppliers were appropriate for the nature of the work and scope of supply. As noted in another assessment note, AVS did not adequately assure that FFS implemented some specific design control requirements, but these did not involve procurement of software.

While verifying that CH2M HILL and its subcontractors had maintenance agreements in place with software vendors, the assessors found that ARES, who performed work for CH2M HILL using several design and analysis codes, including AutoPIPE, was not obtaining error notices from the vendor of AutoPIPE. When asked about this, ARES managers stated that their maintenance contract with the vendor had expired, but they had not been aware of the expiration. ARES immediately initiated corrective actions.

**Conclusion:**

CH2M HILL established and implemented procurement quality assurance requirements that met the CRAD criteria stated above. The program included evaluation of suppliers to assess their capabilities to provide software and services satisfying specific requirements associated with defined tasks and scopes of work.

**Issues:**

None.

**Key Personnel Contacted:**

E. R. Hamm, CH2M HILL Engineering  
B. Groth, ARES  
D. J. Ashley, Mactec  
G. L. Parsons, CH2M HILL  
H. L. Baune, CH2M HILL  
T. Salzano, ARES  
R. Fritz, ARES  
T. K. Cordray, FHI AVS  
A. Y. Cooper, FHI AVS

Submitted By: William C. Dy  
Date: 20 May 2004

Approved By: [Signature]  
Date: 5/20/04

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## Assessment Notes

**Assessment Note Number:** A-04-ESQ-RPPWTP-003-07

**Assessor Names(s):** Clifford Ashley, David Brown, William Dey, Shiv Seth

**Dates of Assessment:** April 19 – 26, 2004

**Area/Items(s) Assessed:** Software Problem Reporting and Corrective Action

**Objective and Criteria – CRAD-4.2.4.1, Rev. 3, Section 4.8:**

Formal procedures for software problem reporting and corrective action for software errors and failures are established, maintained, and controlled.

1. Practices and procedures for reporting, tracking, and resolving problems or issues identified in both software items and software development and maintenance processes are documented and implemented.
2. Organizational responsibilities for reporting issues, approving changes, and implementing corrective actions are identified and found to be effective.

The assessors reviewed documentation and interviewed key personnel responsible for the software identified below to assess the processes used by CH2M HILL and its subcontractors for software problem reporting and corrective action. Software applications and databases included in the assessment were:

- ANSYS® 7.0 and 8.0
- AutoPIPE® 6.1 and 6.2
- Excel 2002®
- ESP® 6.5
- FLUENT® 5.5
- GXQ 4.0F
- HADCRT 1.4
- MathCAD® 11
- MicroShield® 6.02
- TWINS (Tank Waste Information Network System)

Other than TWINS, which was developed by Pacific Northwest National Laboratory to support Hanford tank waste management activities, all of the software items listed above were either commercial off-the-shelf (COTS) applications or codes developed by third-party entities for uses other than Hanford tank waste management. The software was used either directly by CH2M HILL personnel, by subcontractors working in a staff-augmentation role for CH2M HILL, or by CH2M HILL's subcontractors.



## Observations and Assessments:

The assessors visited the offices where CH2M HILL and subcontractor personnel used the software and evaluated procedures, user's manuals, guides, and related documents for a sample of the software products. They also interviewed CH2M HILL, ARES Corporation (ARES), and Fluor Federal Services (FFS) personnel. The assessors reviewed or referred to the following documents:

### CH2M HILL QA Program

- TFC-PLN-02, Rev. A-3, dated November 19, 2003 – *Quality Assurance Program Description*

### CH2M HILL Procedures and Standards

- TFC-BSM-IRM\_HS-C-01, Rev. A-4, dated October 3, 2003 – “Software Development, Implementation, and Management”
- TFC-BSM-IRM\_HS-C-02, Rev. A-1, dated March 7, 2003 – “COTS Software Acquisition, Implementation, and Management”
- TFC-BSM-IRM\_HS-C-03, Rev. A-1, dated March 7, 2003 – “Custom Software Development, Implementation, and Management”
- TFC-BSM-IRM\_HS-C-04, Rev. A-1, dated March 7, 2003 – “Applications Using COTS Software Implementation and Management”
- TFC-BSM-IRM\_HS-C-05, Rev. A-1, dated March 7, 2003 – “Software Retirement, Replacement, and Data Preservation”
- TFC-BSM-IRM\_HS-C-07, Rev. A, dated June 24, 2003 – “Software Accountability”
- TFC-BSM-IRM-STD-01, Rev. A-2, dated June 4, 2003 – “Software Life Cycle Standard”
- TFC-BSM-IRM-STD-02, Rev. A-1, dated March 7, 2003 – “Software Configuration Management Standard”
- TFC-ENG-CHEM-D-33, Rev. B, dated October 31, 2003 – “Spreadsheet Verification”
- TFC-BSM-CP\_CPR-C-06, Rev. C, dated December 18, 2003 – “Procurement of Items (Materials)”

### Problem Evaluation Reports (PERs)

- PER-2003-0428, initiated January 29, 2003 – “Software Control Process Not Implemented Efficiently”
- PER-2003-1589, last changed January 9, 2004, 11:52 – “Not All Software Quality Checklist Have Been Completed”
- PER-2004-1994, last changed April 16, 2004, 10:53 – “Computer code used in their fire hazards analyses and DSAs”
- PER-2004-2034, initiated April 12, 2004 – “Software Program GXQ”
- PER-2004-2239, initiated April 21, 2004 – “Spreadsheet Verification Forms Not Being Used”

### Error Notices

- ANSYS error notice notebook compiled by ARES Corporation
- ANSYS error notice notebook compiled by CH2M HILL
- AutoPIPE error notice notebook compiled by FFS

The assessors interviewed CH2M HILL's engineering department computer software lead and reviewed CH2M HILL procedures to understand the CH2M HILL software problem reporting and corrective action processes. The computer software lead told the assessors that if a CH2M HILL employee found a problem with a software application, the employee would document it in a PER. This would become the formal vehicle for processing the issue and any associated corrective actions, including notifying the software vendor of the error. When the assessors interviewed CH2M HILL software users, however, the users stated that they would not necessarily initiate PERs to document software errors. The process for resolving software errors in CH2M HILL COTS software was specified in procedure TFC-BSM-IRM\_HS-C-02. This procedure provided a process for resolving errors in COTS software, but it did not require documenting problems, such as through the PER system. Because this process did not require documenting issues, it did not require notifying users of errors, nor did it assure that previous work would be reviewed for problems caused by the errors.

The requirements for error reporting and resolution are contained in NQA-1, Subpart 2.7 which was not explicitly implemented in the CH2M HILL QAPD. Among CH2M HILL subcontractors performing design and analysis work for CH2M HILL, only Fauske and Associates had been evaluated for implementation of Subpart 2.7. Therefore, there were few explicit requirements governing an error reporting process for computer software.

FFS used AutoPIPE, a Microsoft® Windows® program for calculating piping code stresses, loads, and deflections under static and dynamic loading conditions. FFS used AutoPIPE to perform safety work for CH2M HILL. FFS's principal user for AutoPIPE stated that FFS's maintenance agreement with the software vendor obligated the vendor to provide error notices for AutoPIPE and to notify FFS within 24 hours if the vendor becomes aware of any significant errors in the code. He showed the assessors documentation of error notices FFS had obtained, and described the process FFS used to assess the errors and evaluate their effects on work performed for CH2M HILL. He told the assessors that many of the error notices described problems in AutoPIPE 6.1, and that these problems had been corrected in AutoPIPE 6.2. FFS was using version 6.2.

ARES performed work for CH2M HILL using several design and analysis codes, including AutoPIPE. The assessors found that ARES was not obtaining error notices from the vendor of AutoPIPE and was using version 6.1 of the code rather than version 6.2. Version 6.2 was released in October 2002 to correct errors. When asked why they were not receiving error notices for AutoPIPE, ARES managers stated that their maintenance contract with the vendor had expired, but they had not been aware of the expiration. When the assessors brought this issue to the attention of CH2M HILL and ARES, ARES management initiated action to obtain the error notices (approximately 200) and began evaluating them for impact on completed work.

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ARES also used ANSYS (Version 8.0) to perform work for CH2M HILL. For ANSYS, ARES received error reports from the software vendor in accordance with a maintenance agreement. These were logged in and faxed to the ARES office in Albuquerque, New Mexico for evaluation and assessment of the applicability to work performed by ARES for CH2M HILL.

**Conclusion:**

CH2M HILL did not have an explicit process meeting the CRAD criteria for documenting software errors, reporting errors to users, reporting errors to vendors, and assuring that completed work was still valid. Instead, they relied on the generic PER system which lacked an explicit software error resolution process. While the procedure for managing COTS software included a process for resolving errors, it did not require documenting the errors, notifying other users, or verifying that completed work performed using the software was still valid.

Because NQA-1, Subpart 2.7 was rarely invoked in contracts, CH2M HILL did not usually require subcontractors to have an error reporting and resolution process. However, the subcontractors evaluated by this assessment did have systems for error reporting and resolution. In one situation, a subcontractor inadvertently allowed a maintenance contract to expire and was not receiving error notifications for a code. The subcontractor was not using a version of the code that resolved previously identified errors.

**Issues:**

- A CH2M HILL subcontractor was not obtaining error notices for AutoPIPE software and had not upgraded to a version that corrected some errors.
- CH2M HILL did not have an explicit error reporting process that required documenting errors, notifying users, notifying vendors, and verifying completed work was still valid.
- The Contractor should consider revising the QAPD to implement the requirements of NQA-1, Subpart 2.7.

**Key Personnel Contacted:**

M. M. Ahmed, FFS Principal User  
B. Groth, ARES  
D. J. Ashley, Mactec  
G. L. Parsons, CH2M HILL  
H. L. Baune, CH2M HILL  
T. Salzano, ARES  
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L. J. Julyk, CH2M HILL Engineering  
E. R. Hamm, CH2M HILL Engineering

Submitted By: William C. Dy  
Date: 20 May 2004

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Date: 5/20/04

## Assessment Notes

**Assessment Note Number:** A-04-ESQ-TANKFARM-006-08

**Assessor Names(s):** Clifford Ashley, Shiv Seth

**Dates of Assessment:** April 19-26, 2004

**Area/Item(s) Assessed:** Software Configuration Management (SCM)

**Objective:** The software configuration management (SCM) process and related documentation for safety analysis and design software, including calculational software, are defined, maintained, and controlled.

**Criteria:**

1. All software components and products to be managed are identified.
2. For those components and products, procedures exist to manage the modification and installation of new versions.
3. Procedures for modifications to those components and products are followed.

**Observations and Assessments:**

The assessors reviewed documentation and interviewed key personnel responsible for the selected quality affecting software (QAS) identified below.

- ESP® Version 6.5 (PNNL)
- FLUENT® Version 5.5 (FFS)
- HADCRT Version 1.4 (FAI)
- MathCAD® (Version 2001 B) Applications (CH2M HILL)
- Excel® Applications (CH2M HILL)
- MicroShield® Version 6.01 (CH2M HILL)
- AutoPipe® Versions 6.1 and 6.2 (ARES and FFS, respectively)
- ANSYS® Release 8.0 (ARES)

The assessors reviewed the following documents:

- TFC-BSM-IRM-STD-02, Rev A-1, dated March 7, 2003 – *Software Configuration management Standard*
- TFC-BSM-IRM\_HS-C-05, Rev A-1, dated March 7, 2003 – *Software Retirement, Replacement, and Data Preservation*
- TFC-BSM-IRM\_HS-C-01, Rev. A-4, dated October 3, 2003 – *Software Development, Implementation, and Management*
- TFC-ENG-CHEM-D-33, Rev. B, dated October 31, 2003 - *Spreadsheet Verification*
- SVF-111, R2A, dated April 1, 2004 - *Spreadsheet Verification Form (for OCD-015-10-2A)*

- SVF-111, R3, dated April 27, 2004 - *Spreadsheet Verification Form (for OCD-015-11-3)*
- ARES Quality Assurance Procedure No. 19.4, Rev. 3, dated March 12, 2004 – *Software Verification and Control*
- ARES Quality Assurance Procedure No. 3.1, Rev. 5, dated March 12, 2004 – *Engineering Calculations*
- RPP-8369, Rev.2, *Chemical Source Terms for Tank Farms Safety Analyses*
- Fluor Federal Services Practice 1342000960, dated May 1, 2002 – *Control of Engineering Software*
- RPP-14875, *Verification and Validation Documentation for HADCRT Version 1.4*

CH2M HILL had a company standard on software configuration management (TFC-BSM-IRM-STD-02) that reflected well established practices for software control. However, the assessors identified issues related to CH2M HILL's control of its QAS software. These issues are presented below.

#### Control of QAS Software and Software Quality Assurance Plans (SQAP)

CH2M HILL did not have a formal system for maintaining an inventory and status of all QAS software and its documentation. As a result, it was difficult to determine that all required quality assurance documentation existed for each application.

Shortly before the assessment fieldwork, CH2M HILL found there was no SQAP for its use of the commercial code, ANSYS. The assessment team also found there was no SQAP for two spreadsheet templates (Flammable Gas Waste Group Assignment and Waste Tank Volume Baseline). These spreadsheet templates were sufficiently complex that they could not be fully verified at each use and should therefore have been treated as applications requiring life-cycle quality assurance documentation. This issue with the software templates is discussed in the Assessment Note for V&V.

The CH2M HILL standard on software development, implementation, and management required SQAPs for spreadsheet QAS software applications. However, CH2M HILL personnel inappropriately classified some software templates as non-QAS "tools." Also, as noted in the Assessment Note for V&V, these applications did not have completed "Spreadsheet Verification Forms," as required by the spreadsheet desk instruction.

#### List of Authorized Users of Software

CH2M HILL did not maintain a formal list and qualification status of the authorized users of software. Without a formal list of authorized users, the assessors believed that the requirements for personnel training, communication of errors, validation of usage, software retirement, and other essential aspects of software control could be jeopardized. For example, when software was retired, CH2M HILL was required to assure that the application was removed from every computer on which it was installed. Without a list of authorized users, it would be difficult to identify all computers from which the software should be removed.

#### Control of Reusable Spreadsheet Tools

OCD-015-10-2A: This spreadsheet was used to perform calculations to support waste

compatibility assessments, and met the criteria for spreadsheet tools. The assessors reviewed this multiple-use spreadsheet and found that the worksheets (and associated workbook) were unprotected at \\ap016\harmony\Spreadsheet\OCD-015-10-2A. The CH2M HILL procedure, "Spreadsheet Verification," required reusable spreadsheets to be protected to assure the continuing validity of documentation. At this location the assessors were able to modify the associated workbook (by deleting the "Receiver" sheet) and worksheets (by deleting and modifying formulas). At a different location (\\ap016\harmony\FORMS) the assessors found another spreadsheet with the same name (OCD-015-10-2A). The file was read-only and the workbook was protected, but the worksheets were unprotected. (The assessors did not make any permanent changes to these files.)

OCD-015-11-3: After the above issues were brought to CH2M HILL management's attention, the spreadsheet OCD-015-10-2A was replaced with spreadsheet OCD-015-11-3. However, similar issues existed.

1. The assessors found the OCD-015-11-3 worksheet was unprotected in the following three folders:
  - \\ap016\harmony\Spreadsheet\Verified OCD-015-11-3\
  - \\ap016\harmony\Spreadsheet\ (worksheet and workbook unprotected)
  - \\ap016\harmony\FORMS\
2. Entries 104 and 105 of the OCD-015-11-3 change log showed that two corrections to formulas in this spreadsheet had not yet been checked or issued. However, these changes had already been incorporated into this spreadsheet. The spreadsheet owner explained that she thought it was better to make a corrected (but unchecked/unapproved) spreadsheet available to users than a spreadsheet with known errors in formulas.
3. Two other spreadsheets in the \\ap016\harmony\Spreadsheet\Verified OCD-015-11-3 folder had similar names: "OCD-015-11-3 Verified," and "OCD-015-11-3 Verified with Formulae," which both had unprotected workbook and worksheets. An employee could change formulas and use these spreadsheets instead of using the fully protected and validated spreadsheet.

In addition to the above conditions, the assessors noted that \\ap016\harmony\FORMS\ contained both OCD-015-11-3 and OCD-015-10-2A versions of the spreadsheet. When the assessors asked the spreadsheet owner to explain the relationship between the two versions, she told them that OCD-015-11-3 replaced and superseded OCD-015-10-2A and that only the latest version was valid; OCD-015-10-2A had been left in the "FORMS" directory by mistake. She immediately removed the OCD-015-10-2A file.

These conditions did not comply with TFC-ENG-CHEM-D-33, Rev. B.

#### Configuration Control of Software Used by CH2M HILL Subcontractors

The assessors also reviewed the configuration control processes for COTS software applied by CH2M HILL's subcontractors, ARES, FFS, PNNL, and FAI. The specific COTS software and the subcontractors using that software are identified at the start of

this Assessment Note. The software quality assurance procedures and the documentation for the specific applications showed that the subcontractors had maintained adequate software configuration baseline, change control, and configuration status.

**Conclusion:**

CH2M HILL did not have adequate configuration control of several items of quality-affecting and software in its custody, and the CRAD criteria were not met. For example, CH2M HILL did not develop an SQAP for one of its commercial codes or for some software templates used for safety-related work. An SQAP is an essential component in the definition of software configuration control and use. Also, CH2M HILL did not adequately protect certain software template applications from uncontrolled changes.

Engineering personnel inappropriately used the desktop instruction, "Spreadsheet Verification" to justify using software templates in safety applications without the required V&V, configuration control, and life-cycle quality assurance documentation.

Configuration control by subcontractors met the CRAD criteria.

**ISSUES:**

- Software quality assurance documentation for some codes was incomplete.
- The required testing of software was not always performed and documented.

**Key Personnel Contacted:**

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