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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QUALITY ASSURANCE
SURVEILLANCE REPORT

PROJECT NO: 20-1402-159	**REPORT NO:** 2000-16	**PAGE** 1 **OF** 1

SURVEILLANCE SCOPE: Development and control of software

REFERENCE DOCUMENTS: TOP-018, Development and Control of Scientific and Engineering Software

STARTING DATE: November 2, 2000 **ENDING DATE:** November 13, 2000

QA REPRESENTATIVE: R. Folck

PERSONS CONDUCTING TEST/EXAM/ACTIVITY: R. Janetzke, J. Buckner, D. Ferrill, B. Mabrito G. Ofoegbu, L. Yang, N. Sridhar, S. Mohanty, R. Janetzke, D. Waiting, S. Painter, B. Dasgupta, L. McKague

SATISFACTORY FINDINGS:

Reviewed design verification report for RSAC, Version 5.2.

Performed design verification for ArcView, Version 3.1.

Reviewed ArcInfo, Version 7.0.2 validation plan and report. Technical review completed September 16, 2000.

Reviewed the draft *CNWRA Operations Plans for the Repository Program*, Revision 15, November 2000 and applicable QRAMs.

- No QRAM was developed for Repository Design and Thermal-mechanical Effects KTI.
- QRAM identified OLI Systems ESP, Version 6.4 and CSP, Version 2.0 as being under TOP-108 control. ESP, Version 6.0 and CSP, Version 1.2 are identified as being under TOP-018 control as of 04/08/98.

Both problems were corrected during the course of the surveillance.

TPA, Version 4.1 design verification was completed September 27, 2000. SCR No. 328 issued to fix minor bug. Bug fixed October 18, 2000. Testing is still required.

UNSATISFACTORY FINDINGS: None noted except as described above.

NONCONFORMANCE REPORT NO: None

ATTACHMENTS: CNWRA Internal Audit 2000-1 Software Recommendations

RECOMMENDATIONS/ACTIONS:

Place ArcView, Version 3.2 under TOP-018 control.
TOP-018 Improvement Team review and disposition CNWRA Internal Audit 2000-1 recommendation.

APPROVED: CENTER DIRECTOR OF QUALITY ASSURANCE

DATE: 12/7/2000

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Surveillance Report No. 2000-16 Attachment
CNWRA Internal Audit 2000-1 Software Recommendations

Code development in general, and TOP-018 in particular, have been the subject of continual review. Both as a result of previous audits and the efforts of CNWRA staff, significant improvements have been made in the code development process and no deficiencies in the code audited this year were observed. In the spirit of continuous process improvement, and recognizing the increasing dependency on computer codes and their sophistication, the following suggestions are offered for consideration.

1. Tracking requirements [from either the Software Requirements Description (SRD) or SCRs] is difficult. It is recommended that all requirements identified in the SRD be numbered (SCR is already numbered). This numbering should be used to track the software change in the source code, test documents, and the scientific notebooks. The number should be present in the revision block in the header of each source file and the number should appear in the source code when the software modification occurred.

2. While the specific requirements of TOP-018 [with respect to Software Development Plans (SDPs)] were achieved, it was observed that the SDPs were thought by some of the staff to be of little value to the software implementers. It is recommended that the discussion of SDPs in TOP-018 be revised to provide a more workable/usable document. Inherent with this recommendation is that once an SDP is developed and approved, a project should hold periodic internal reviews to assess how compliance to the SDP is being met.

3. In cases where multiple developers are working on computer code and the scientific notebook is the principal means of documenting the progress of code development, the EM should assign a unique notebook number to each developer. The unique number could be a breakout (e.g., 170 for TPA, 170-1, 170-2, 170-n for developers 1, 2, to n). The notebook should clearly identify the portion of the code being worked on. A summary of activities covered by the notebook should be at the end. Clear, concise, and accurate cross-references between notebooks should be made.

4. TOP-018 should be modified to require a source code review (by someone other than the developer) to assure that the software documentation requirement of TOP-018 are being implemented. This review will need to be performed by someone skilled in the implementation language and TOP-018. The QA review currently being performed is not detailed enough to verify TOP-018 compliance.

5. Much of the source code in both TPA and MULTIFLO has been developed over a number of years by a variety of scientists. One of the shortcomings of the existing code is that the style and structure widely varies. This greatly complicates the software maintenance efforts. It is recommended that the CNWRA establish a set of guidelines as to how future code changes will occur. Because much of the existing code is not TOP-018 compliant, it is recommended that *any* time a change/addition is made to a file in the future the contents of the file be brought up to compliance with the most current revision of TOP-018. This is *not* a recommendation to retrofit all of the source code, rather, it is a recommendation to update code as it is "opened" for modification with the goal of having all of the code "cleaned up" within the next five years. It is also recommended that the scientists implementing software utilize some of the software coding techniques prevalent in the industry to make the source code

more readable and maintainable (e.g., do not leave in comment-out sections of source code without significant explanations, utilize variables to establish "debug levels" so that debug code is not routinely commented out in production versions).

6. TOP-018 (section 5.5.2) should be modified to replace the word "should" with "shall." Having guidelines that are "optional" does not fit with the overall goal of TOP-018.

7. Adapt TOP-018 to include the configuration management and change control processes/procedures in NUREG/BR-0167 or ISO/IEC 12207, Section 6.0, or ASME NQA-1a-1994, Section 5. To facilitate and standardize configuration management and control of source code, it is recommended that TOP-018 adopt and require the use of a formal source code control system.

8. The basis for software engineering and development is the software development life cycle. A definitive life cycle provides the frame of reference, adds structure to software engineering and development, provides the checkpoints to verify development of quality software. The life cycle makes software engineering and development engineering traceable, provides a framework for planning, and a means of controlling development activities. TOP-018 does not embrace the idea of a software life cycle. The concept of a software life cycle is an industry standard that has no domain boundaries, (i.e., applies to scientific, mechanical, chemical, electrical, nuclear). It is recommended that TOP-018 be modified to include CNWRA's concept of a software life cycle and that computer code development activities be planned, controlled, and traceable to this life cycle.

9. TOP-018, paragraph 5.7.2, requires a technical description for each software item placed under configuration control. It gives the developer several options for documenting the technical description. However, the Software Summary Form (SSF) does not require identification of which option was chosen. Recommend adding an item to the SSF that identifies where the developer documented the software technical description.

10. The Design Verification Report (DVR) provides a checklist of relevant compliance items required by TOP-018. No objective evidence was provided or referenced to support the decision process for the answers chosen. Questions with "Yes" answers checked should provide references to surveillance reports, QA inspection results, and/or scientific notebooks (e.g., volume, page, owner, date), as supporting evidence.

11. TOP-018, paragraph 5.9.2, (Software Release) requests the software developer to report, with the new Software Release Notice (SRN), any expected deviations from past verification and benchmark data. The SRN does not have provisions for documenting these deviations. Recommend adding an item to the SRN that identifies where the developer will identify deviations or to state that no deviations is expected.

12. CNWRA should require, by amending TOP-018 and requiring as part of quality records, an installation manual, version description document, and validation test results. The installation manual and version description document can be combined into a single electronic document and included on the CD or floppy as a "readme" file

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or individual test/word processor document referenced by the DVR. The installation instructions should be a step-by-step procedure that explains to the user how to install the software, even if that software is maintained on a local CNWRA server. The version description document identifies various files comprising a software release, file dependencies, known errors/problems, and operating system/hardware requirements for execution of the software. Test procedures, input, and output files, and expected results can also be identified in the version description document. Enough test detail should be included such that anyone needing to verify the integrity of the delivered software can duplicate the test and test results and validate that the software is performing as expected. Electronic documentation, like the version description document and software validation procedure, should be delivered with the software and/or maintained on the network server providing the software.

13. Several scientific notebooks were reviewed during the software portion of the CNWRA audit. It was noted from several of the notebooks that the time (e.g., days and weeks), needed to run computer code models was lengthy. In some cases, after lengthy runs, no results or wrong results were observed. In another case, it was reported that System Acceptance Testing for TPA code could not be performed because of the dynamic dimensions/complexity and execution time required to completely test the code. The complexity of the licensing process and the dependence on computer codes to generate timely and accurate modeling results would seem to indicate that performance enhancements of computer code (specifically TPA and MULTIFLO) and upgrades to computing platforms and operating systems may be needed. It is recommended that CNWRA perform an assessment of overall computing code (e.g., MULTIFLO and TPA, others that may not have been reviewed during the audit) performance and determine if enhancements to computer code performance and/or upgrades to computer platforms and operating systems are needed.