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## 1 Introduction and Objectives

This analysis plan guides the migration of computer files used in the WIPP performance assessment (PA) calculations from the HP/VMS Computing Cluster and the Linux “Alice” cluster to the Sun/Solaris cluster in preparation for the shutdown and retirement from service of those two computer systems. The transfer of these files is not done to satisfy a QA requirement since the WIPP QA program does not treat electronic media as records. The migration of files is meant to preserve for the analysts information from previous PA runs that may be of interest in the future. Most files on the VMS cluster will not be preserved; the vast majority is in a binary format incompatible with the Intel architecture of the Sun/Solaris cluster. The files that will be considered for migration include 1) utility codes not migrated from VMS under AP162 (Kirchner, Gilkey and Long 2013), 2) some input and output files from analyses run on the VMS system, 3) files associated with analyses done on other platforms, such as PCs, and other files deemed important to preserve by the current analysts and managers, and 4) codes currently qualified only on Alice. Most, if not all, of the VMS files currently reside in the CMS (Code Management System) library system on the HP/VMS platform. The Alice-qualified codes are already stored in a CVS (Concurrent Version Control) repository accessible from the Sun/Solaris cluster and merely need to be requalified on that platform.

This analysis plan describes the approach that will be used to: 1) migrate the files from VMS; 2) verify the migrated files; 3) integrate some of the output files into database tables for the LHS and CCDFGF outputs, and 4) qualify the Alice-qualified codes on Solaris. Because the codes being qualified or archived in CVS are used in performance assessment this is a compliance decision analysis.

## 2 Tasks and Schedules

There are five main tasks for the migration of PA codes to the new Solaris (UNIX) platform. The performance of Task 3 is controlled by the requirements of NP 19-1 (Long 2014a).

**Task 1:** Move to Solaris from VMS the ASCII output files from LHS, PRECCDFGF and CCDFGF from analyses including and following the CRA-2004 PABC, store those files in CVS and load the LHS and CCDFGF output data from the CRA-2004 PABC calculations into the PA\_Results database. If outputs from non-CRA analyses are subsequently required for analysis they can be added to the database from the output files. Input files may also be ported and stored in CVS but the intermediate CDB files will not be preserved as they are in an incompatible binary format.

**Task 2:** Move to Solaris from VMS files associated with analyses done on other platforms, such as PCs, and other files deemed important to preserve by the current analysts and managers. These files can include codes designed to run on PCs under Windows, databases, Excel files, document files, etc. These files may be stored in a compressed (.zip) format. These files will be moved from CMS on VMS to CVS on Solaris.

**Task 3:** The Panel Closure PA (AP161) will be run on Solaris and the mean CCDF's compared to those from the VMS run. This run is being done because it could be useful in setting up and evaluating future PAs.

**Task 4:** Move to Solaris from VMS utility codes not previously ported to Solaris. All codes will be stored in CVS. These codes will be compiled as needed.

**Task 5:** Compile on Solaris and qualify under NP 19-1 the Linux codes listed in Table 1. A Change Control form (NP 19-1-9) will be completed for each code. The codes will be modified as needed to run under the new operating system. Regression tests can be used for all validation tests although some differences may be expected due to the differences in compilers used on Linux and Solaris. Allowances for differences will be made when comparing numerical results. Results will be stored in the CVS repository of the code. Validation of a code will start following the qualified build of that code. The product of this task will be a Regression Test Report or a Validation Document for each code. If regression testing was successful for some tests but validation against the criteria of the VVP was needed for others then the Validation Document will also contain the results of the Regression Testing rather than having a separate report for each approach. Complete Installation and Checkout forms for each code that is validated. The products of this task will be a Change Control form and an executable file, stored in CVS, for each code that is converted.

**Table 1. Migrated WIPP PA application software to be regression tested.**

Code Name	Version	Executable Name
MODFLOW 2000	1.6	mf2k_1.6.release
PEST	9.11	pest.exe
DTRKMF	1.00	dtrkmf_v0100
MWT3D	2.50	mwt3d.exe

**Task 6:** A report will be written to document the completion of the migration of the codes and relevant output files from previous analyses to Solaris. This report will summarize the results of the regression and validation tests performed on the codes, including listing the documents produced. The report will also list any other files moved from CMS on VMS to CVS on Solaris. Deviations from this AP will also be discussed.

The estimated start date is May 1, 2014. However, issues related to the 2014 Performance Assessment, other performance assessments and the development work on Pflotran can take precedence over the migration tasks. The completion date for the migration is estimated to be December 31, 2014.

### 3 Infrastructure

#### 3.1 Hardware

The following hardware and operating systems are used on the cluster and support server systems. The servers that run the MySQL database and that are used for code compilation are:

Hardware: Oracle SunFire X2270 server  
Software: SunOS 5.11 11.0 i86pc i386 i86pc

### **3.2 Other PA Components/Modules**

The CVS system will be used for the file repository on Solaris. The current version of CVS is 1.12.13.

### **3.3 Software**

In addition to the codes to be migrated, the project could also use FORTRAN 90/95, C, CVS, MySQL, Python, Python scripts, UNIX shell scripts and Fortran Flint.

### **3.4 Training**

Primary training will be hands on operation of the system.

### **3.5 Project Team Members**

Jennifer Long (SMC coordinator), Amy Gilkey (run master), Bwalya Malama (the code sponsor for the Linux codes) and Tom Kirchner (run master, project coordinator) will have primary responsibility for moving the files and running the validation tests on the software ported from Alice. The code sponsor will have the responsibility of validating their codes, but as much help as possible will be provided by the authorized users (run masters) in setting up and running the tests. Amy Gilkey will be responsible for modifying and compiling all codes. Shelly Nielsen will be responsible for software QA. All participants, listed above, are already fully trained and will be functioning within their normal job descriptions.

## **4 Task Deliverables**

The following are QA records generated by this plan and will be submitted to the SNL WIPP Record Center:

- A report listing the results from these migration activities (by the project coordinator).
- A Regression Test Report or Validation Document for each code (by the code sponsor).
- NP 19-1, Installation and Checkout Forms (by the code sponsor)

## **5 Approach**

This section describes the approach used to perform the VMS file migration and the regression testing of the Alice-qualified software.

## **5.1 File Migration from VMS**

Files will be transferred to the shared drive of the Solaris cluster from VMS using FTP or SFTP (hereafter FTP is used to identify both codes). ASCII files moved in this way will not be identical because the two systems use different line termination characters and FTP converts the line terminators during the transfer. Therefore, the FTP output will be examined for failures in the transfer and files transferred again should any errors be noted. Files that should be transferred in binary mode, such as compressed (.zip) files, will also be verified by computing compatible checksums on each platform.

### **5.1.1 Document the Results**

Logs of the FTP output will be preserved and any errors reported in the FTP logs or any differences in the checksums of the files transferred in binary mode will be noted in the final report.

### **5.1.2 Acceptance Criteria**

The acceptance criterion is very simple: there will be no failures in the file transfer process.

## **5.2 Regression Test Software Baselines**

The purpose of this testing is to demonstrate that the change from Redhat Enterprise Linux operating system running on 32-bit Intel processors to Solaris running on 64-bit Intel processors will have no significant adverse effects on the performance of the application software. It is intended that the testing will constitute an Installation and Checkout for this software, to qualify it for use on the new Sun/Solaris platforms.

The WIPP application software codes to be used for the testing are shown in Table 1. This list of codes was taken from the SNL WIPP BASELINE SOFTWARE LIST (Long 2014b) and constitutes the latest versions of all WIPP software currently qualified on the Alice computing cluster.

### **5.2.1 Test Description**

The testing is described in the following section. The testing will be conducted on the Sun/Solaris cluster and will be set up by a user designated as Run Master. All files needed for the tests will be extracted from CVS as needed. All results from the testing will be stored in the CVS by the Run Master under the Test project of the repository for the relevant code.

### **5.2.2 Software Test**

This test will consist of the running all the “test cases” for each of the qualified software application codes listed in Table 1 on the Solaris cluster system. The purpose of this test is to demonstrate that the code executables, as currently qualified on the Alice computing cluster, will

run correctly on the Sun/Solaris cluster system. This test will also serve as the Installation and Checkout test for each of the listed codes, which meet the acceptance criteria.

If a code fails to execute then it will be recompiled and the test repeated.

If any of the codes are unable to meet the acceptance criteria, then the following steps will be taken:

1. They will be identified in the Analysis Package as having failed the regression test
2. They will be rebuilt on the new platform
3. They will be re-qualified on the new production platform in order to re-qualify them.

If problems persist after re-qualification then the problems will be resolved following the procedure described in NP 19-1 (Long 2014b), i.e.:

1. The problem will be identified in the Analysis Package
2. The problem will be evaluated by the SCMU Run Master and the code sponsor, if needed
3. The appropriate remediation will be identified and applied
4. The affected codes will be retested.

The test case(s) to be run will be selected from the validation documents. The tester will make this determination by consulting the “Requirements Coverage by Test Case” table in the Verification and Validation Plan (VVP) (Mehl and Hill 2001, McKenna and Chavez 2003, Rudeen 2003, McKenna 2003) for each code.

### **5.2.3 Test Procedure**

The following steps will be performed by the software tester:

- Examine the VVP for the test cases to be run.
- Verify access to the executable as well as the input and output files for the test cases.
- Execute the test case(s) on the test machine.
- Compare the output files generated on the test machine with those from the previous testing. The difference between the ALICE cluster and Sun/Solaris computing cluster results can be generated by extracting the Alice computing cluster test results from CVS and running a UNIX diff command, or by using the CVS “diff” command.
- Evaluate the generated difference output file for conformance to the Acceptance Criteria. The Run Master and the code sponsor will resolve any differences which do not conform to the acceptance criteria.
- The Run Master will store the generated test case output files and the difference output files into the CVS for archival. The files will be stored in the Test project of the appropriate code repository.
- A listing of the difference output files as well as the conclusions drawn from the evaluation of difference results will be documented in the analysis package for this analysis plan. The Technical Reviewer will examine these listings and evaluations to verify that the acceptance criteria have been satisfied. Any code that fails to meet the acceptance criteria will be identified in the analysis package and subsequently, the

problem which caused the failure will be identified and resolved by the code sponsor, and the code will be fully retested on the new platform.

#### **5.2.4 Acceptance Criteria**

There will be some differences between the two sets of output files. SP 19-1 (Long 2012) lists several differences that are expected and are completely acceptable. For example:

- Differences due to run dates and times
- Differences due to different file names
- Differences due to different directory names
- Differences due to different user names
- Differences due to platform and system version.

The change from running on a 32-bit CPU to a 64-bit CPU plus differences in the compilers can lead to insignificant numerical differences. It is the responsibility of the Technical Reviewer of the Analysis Package for this plan to decide whether any numerical differences are acceptable.

#### **5.3 SCM Plan**

Software Configuration Management will follow the recommendations in the report Software Configuration Management under Unix (SCMU) (Kirchner 2005) in terms of roles, responsibilities, archiving and restoring files using the CVS repositories. The SCMU Plan defines the interface between NP 19-1 (Long 2014b) for configuration identification, control, status accounting and authentication.

### **6 Special Considerations**

None

### **7 Applicable Procedures**

The migration of the software and its validation on the Sun/Solaris platform will be conducted according to NP 19-1.

## Appendix A: References

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