Sandia National Laboratories
Waste Isolation Pilot Plant

Analysis Plan
for

Regression Testing for the Upgrade to OpenVMS Version 7.2 on the WIPP COMPAQ Alpha Cluster

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TABLE OF CONTENTS

1.0 INTRODUCTION and SCOPE

This document details a "regression test" of the Open VMS Version 7.2 operating system software on the WIPP Regulatory Compliance Department COMPAQ Alpha Cluster. The purpose of this test is to demonstrate that upgrading the Open VMS operating system software from Version 7.1 to Version 7.2 will have no significant undesirable affects on the WIPP PA application software. Portions of this test will also serve as the installation and checkout for the specific versions of the application software identified in Section 2.1 of this document. This test focuses solely on the effect of the upgrade on the WIPP PA application software. It does not address other system related issues such as possible effects on the system backup and archiving software and the Configuration Management System.

1.1 PARTICIPATING PERSONEL

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1.2 TRAINING REQUIREMENTS

There are no special training requirements for this testing. All participants, listed above, are already fully trained and will be functioning within their normal job descriptions.

1.3 ESTIMATED SCHEDULE

The testing described in this document will adhere to the following estimated schedule:

1. Begin Preparation of Testbed Machine: 12/01/99
2. Testbed machine ready for use: 12/13/99
3. Commence Testing: 12/13/99
4. Complete Testing: 01/31/00
5. Complete Analysis Package: 02/28/00

2.0 COMPAQ ALPHA CLUSTER OVERVIEW

The COMPAQ Alpha Cluster is the main calculational platform for the WIPP Regulatory Compliance Department. The performance assessment calculations for the Compliance Certification Application (CCA) (see reference [1]) were performed on the platform in 1996, and more recently, the PA Verification Test (PAVT) (see reference [2]) for the Environmental Protection Agency were performed on this platform in 1997.

The cluster consists of 11 COMPAQ Alpha 2100 computers with a total of 44 processors all of which currently run Version 7.1 of the OpenVMS operating system software. The majority of the WIPP PA application software codes execute on this platform. While version 7.1 of OpenVMS is still supported by Compaq Computer Corporation it is generally recommended that users upgrade to version 7.2 as soon as possible to minimize complications in the maintenance of software. Nuclear Waste Management Procedure NP 19-1, which is the main WIPP software QA procedure, requires that regression testing be performed whenever the operating system is upgraded. The purpose of this testing is to demonstrate that the upgrade will have no significant adverse affect on the performance of the application software. The main purpose of the testing described and documented in this document is to satisfy this requirement.

A second purpose of this testing is to serve as an installation and checkout test for the specific versions of the application software which are listed in Section 2.1 of this document. The testing performed will qualify the listed application software codes for use on the new platform, Version 7.2 of OpenVMS.

2.1 WIPP PA APPLICATION SOFTWARE

The following WIPP application software codes will be used for the testing described in Section 2. This list of codes was taken from the SNL WIPP BASELINE SOFTWARE LIST (see reference [4]) and constitutes, with three exceptions, the latest versions of all WIPP software, both PA and Non-PA, currently qualified on the COMPAQ Alpha Open VMS 7.1 platform. It is intended that the testing conducted under Test #1, Section 3.1, will constitute an Installation and Checkout for this software, to qualify it for use on the new platform.

Code list for Test #1

Code Name	Version	Executable Name
ALGEBRACDB	2.35	ALGEBRACDB_PA96.EXE
BLOTCDB	1.37	BLOTCDB_PA96.EXE
CCD2STEP	1.08	CCD2STEP_PA96.EXE
CCDFCALC	4.29	CCDFCALC_PA96.EXE
CCDFGF	4.01	CCDFGF_QB0401.EXE
CCDFSUM	2.01	CCDFSUM_QA0201.EXE
EPAUNI	1.14	EPAUNI_OCT96.EXE
FMT	2.4	FMT_QB0204.EXE
GENII-A	2.10	GENII-A_PA96.EXE
GENMESH	6.08	GM_PA96.EXE
GRASP-INV	2.01	GRASPINV_PA96.EXE
GROPECDB	2.12	GROPECDB_PA96.EXE
ICSET	2.22	ICSET_PA96.EXE
LHS	2.41	LHS_PA96.EXE
LHS2STEP	1.04	LHS2STEP_PA96.EXE
MWT3D	2.40	MWT3D_V01_3D.EXE
NONLIN	2.0	NL_NONLIN_PA96.EXE
NUCPLOT	1.19	NUCPLOT_PA96.EXE
PANEL	4.00	PANEL_QB0400.EXE
PCCSRC	2.21	PCCSRC_PA96.EXE
PATTRN	1.00	PTN_QA0100.EXE
POSTBRAG	4.00	POSTBRAG_PA96.EXE
POSTEPAUNI	1.15	POST_EPAUNI_QA0115.EXE
POSTGENII	4.20	POSTGENII_PA96.EXE
POSTLHS	4.07	POSTLHS_PA96.EXE
POSTSECOFL2D	4.04	POSTSECOFL2D_PA96.EXE
POSTSECOTP2D	1.04	POSTSECOTP2D_QA0104.EXE
PREBRAG	6.00	PREBRAG_PA96.EXE
PREGENII	6.30	PREGENII_PA96_2.EXE
PRESECOFL2D	4.05	PRESECOFL2D_PA96.EXE
PRESECOTP2D	1.22	PRESECOTP2D_QA0122.EXE
RELATE	1.43	RELATE_PA96.EXE

SECOFL2D	3.03	SECOFL2D_PA96.EXE
SECOTP2D	1.41	SECOTP2D_QA0141.EXE
SPLAT	1.02	SPLAT_PA96_2.EXE
STEPWISE	2.21	STEPWISE_PA96.EXE
SUMMARIZE	2.20	SUMMARIZE_QA0220.EXE
TRACKER	5.02	TRACKER_QA0502.EXE

Five codes, not in the above list, will be exercised under Test #3, Section 3.3. Two of these codes, BRAGFLO and NUTS were never qualified under VMS 7.1. The other 3 codes, MATSET, PRELHS, and CUTTINGS_S need to be re-qualified because of changes that were made to SDBREAD_LIB in conjunction with the migration of the WIPP PA Parameters database from INGRES to MS SQL Server. These 5 codes will be exercised during the execution of Test #3. In addition, GRASP-INV will be used for Test #3, as well as Test #1.

Code list for Test #3

Code Name	Version	Executable Name	
BRAGFLO	4.40	BRAGFLO_VMS72.EXE	*
CUTTINGS_S	5.05	CUSP_VMS72.EXE	*
GRASP-INV	2.01	GRASPINV_VMS72.EXE	*
MATSET	9.01	MATSET_VMS72.EXE	*
PRELHS	2.21	PRELHS_VMS72.EXE	*
NUTS	2.08	NUTS_VMS72.EXE	*

* These executable names are for the test system. They are temporary and for the Open VMS 7.2 testing only. Permanent executable names will be generated if/when the executables are next built on the cluster after the upgrade.

2.2 APPLICATION SOFTWARE LIBRARIES

The following software libraries, also taken from the SNL WIPP BASELINE SOFTWARE LIST, are necessary to the building of the code executables and will be used as part of Test # 2 and 3 (Sections 3.2 and 3.3).

Code list for Test #2

Library Name	Version
CAMCON_LIB	2.19
CAMDAT_LIB	1.24
CAMSUPES_LIB	2.21
SDBREAD_LIB	2.03
PLT_LIB	2.03

3.0 TEST DESCRIPTION

The testing will consist of three test cases, which are described in the following sections. The testing will be conducted on a "testbed" machine that will be set up by the COMPAQ Alpha Systems Manager. This manager will remove one of the four-processor Alpha machines from the cluster and install Open VMS Version 7.2 on it. After upgrading, this machine will be configured to run in stand-alone mode. Thus, the testing that takes place on this machine will have no effect on the integrity of the cluster. All files needed for the tests will be extracted from CMS (on the cluster) and copied to the testbed machine. All V7.2 tests will be run on the testbed machine. If it is necessary to make some comparison runs on the V7.1 platform, these will be made on BEATLE, which is a part of the cluster. All results from the testing will be stored in the CMS by the SCMS Librarian under the class name V72_QA.

3.1 TEST #1

This test will consist of the running one or more "test cases" for each of the 38 qualified software application codes listed in Section 2.1 on the OpenVMS 7.2 system. This will be done using the currently qualified executable (unrecompiled) from the OpenVMS 7.1 platform. The purpose of this test is to demonstrate that the code executables, as currently qualified on the OpenVMS 7.1 platform, will run correctly on the new platform without recompilation. It is desirable that this be true because if the codes do require recompilation, then they must undergo a complete regression testing in order to qualify them for use. However, if they do not require recompilation, then only an Installation and Checkout test is required. This test will serve as the Installation and Checkout test for each of the listed codes, which meet the acceptance criteria.

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 test
2. They will be rebuilt on the new platform once the production version of the platform is available
3. They will be scheduled for a full regression test on the new production platform in order to re-qualify them.

If problems arise that are attributed to the VMS 7.2 operating system, then:

1. The problem will be identified in the Analysis Package
2. The problem will be evaluated by the SCMS Auditor/Librarian
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 by the software tester. The criteria for this selection will be to choose one or more test cases which "touch" at least half of the required functionality. Usually, this can be accomplished with just one test case, but in

some cases multiple test cases will be needed. The tester will make this determination by consulting the "Requirements Coverage by Test Case" table in the Requirements Document / Verification and Validation Plan (RD/VVP) for each code. Note, to touch all of the required functionality would in most cases require running all the test cases which would significantly increase the amount of time and effort required for this test without delivering a corresponding significant increase in confidence.

3.1.1 Test Procedure

The following steps will be performed by the software tester:

- Examine the RD/VVP and choose the test case(s) to be run.
- Extract the executable as well as the input and out files for the test case(s) to be run from the Configuration Management System (CMS) on the cluster.
- Copy the files, which have been extracted from CMS over to the standalone OpenVMS 7.2 testbed machine.
- Execute the test case(s) on the test machine.
- Compare the output files generated on the test machine with those extracted from the CMS by using either the OpenVMS or CMS "*difference*" commands.
- Evaluate the generated *difference* output file for conformance to the Acceptance Criteria. The software tester and the code sponsor will resolve any differences which do not conform to the acceptance criteria.
- The SCMS Librarian, at the request of the tester, will store the generated test case output files and the *difference* output files into the CMS for archival. The files will be stored in the source library for the particular code being tested under the class name "V72_QA".
- After the test system is returned to the cluster, and the cluster is upgraded to Open VMS 7.2, repeat any production builds that were required on the test system, as well as all test steps for those codes that are rebuilt.

A hardcopy 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 (see reference [5]). 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.

3.1.2 Acceptance Criteria

There will be some differences between the two sets of output files. The following types of differences are expected and are completely acceptable:

- 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.
- Minor 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 or not.

3.2 TEST #2

This test consists of building the five WIPP PA application software libraries listed in Section 2.2 on the OpenVMS 7.2 testbed platform and running all of the test cases for these libraries as described in their associated RD/VVP's. The purpose of this test is to verify that the libraries function as expected on the new platform. The existing binary files for the libraries are not used for this test because any code which will be "built" on this platform in the future will be built from the ground up and this will require library files which have been built on this platform. This test will not constitute an installation and checkout test for these five libraries on the V7.2 platform. These libraries will be rebuilt and fully regression tested on the V7.2 production platform, once it is available.

3.2.1 Test Procedure

The SCMS Librarian will build the five libraries and the associated test executables that will be needed for this test. The test cases will be executed by the software tester. The procedure is as follows:

- Duplicate the entire CMS environment for the source libraries on the 7.2 platform. These libraries will not be written to or updated on the test system. All CMS updates will be copied to the cluster and entered into the CMS libraries.
- Duplicate the production environment as needed to perform the library production builds.
- Perform a build of the five libraries on the 7.2 platform.
- Execute all test cases for the five libraries as defined in the corresponding RD/VVP's.
- Extract the output files for all the test cases for the five libraries from CMS and copy to the OpenVMS 7.2 platform.
- Compare the output files generated on the 7.2 platform with those extracted from CMS using either the OpenVMS or CMS *difference* command.
- Check all differences against the acceptance criteria.
- Save the generated library OLB's and driver executables in CMS on the cluster.

- Save the generated output files and difference output files in CMS on the cluster.

A hardcopy listing of the *difference* output files as well as the conclusions from the tests will be documented in the Analysis Package for this analysis plan (see reference [5]). The Technical Reviewer will examine these listings to verify that the acceptance criteria have been satisfied.

If a library fails to meet the acceptance criteria for one or more of its test cases, the following steps will be taken:

1. the failure will be documented in the Analysis Package
2. the problem will be investigated, identified, and corrected by the code sponsor

If such a failure occurs, it would have no effect on the existing executables used in Test Case #1, because the libraries are "linked" at build time and the existing executables are not rebuilt on the new platform. However, any code that is rebuilt in the future on the new platform will have the potential for being effected by the changes to the library. However, any code that is rebuilt will undergo full regression testing according to NP 19-1 and any effects would be discovered at that time.

3.2.2 Acceptance Criteria

The acceptance criteria for this test are exactly the same as for Test #1 (see Section 3.1.2).

3.3 TEST #3

This test consists of building the WIPP PA application codes BRAGFLO (Version 4.40), NUTS (Version 2.08), GRASP-INV (Version 2.01), MATSET (Version 9.01), PRELHS (Version 2.21), and CUTTINGS_S (Version 5.05) on the OpenVMS 7.2 testbed platform and running a significant selection of their test cases. The purpose of this test is to verify that executables built on the new platform will perform as expected. BRAGFLO and NUTS were chosen for this test because they are two of the largest and most complex of the WIPP PA codes. GRASP-INV was chosen because it is relatively complex and was successfully tested during the previous upgrade from Open VMS 6.1 to 7.1. MATSET, PRELHS, and CUTTINGS_S were included in Test #3 instead of Test #1 as they had to be rebuilt in order to access the migrated PA Parameters database.

3.3.1 Test Procedure

The SCMS Librarian will execute the build of BRAGFLO, NUTS, and GRASP-INV for this test and the software tester will execute the test cases. The procedure is as follows:

- Duplicate the CMS source code libraries for BRAGFLO , NUTS, GRASP-INV, MATSET, PRELHS, and CUTTINGS_S on the V7.2 platform. These libraries will not be written to or updated on the test system. Rebuild the executables from the proper class, linking as needed with the new object libraries created as part of Test #2.

- Select a subset of test cases for each code as per Test #1.
- Execute the selected test cases.
- Extract from CMS the output files for the test cases as generated previously on V7.1.
- Compare the output files generated on the 7.2 platform with those extracted from CMS using either the OpenVMS or CMS *difference* command.
- Verify that all differences are acceptable.
- Load the generated output files into the CMS.

Since BRAGFLO and NUTS were never qualified on the V7.1 platform, it will be necessary to execute the selected test cases on that platform in order to have output files with which to compare the V7.2 results.

A hardcopy listing of the *difference* output files as well as the conclusions from the tests will be documented in the Analysis Package for this analysis plan (see reference [5]). The Technical Reviewer will examine these listings to verify that the acceptance criteria have been satisfied. If any of the test case results fail to meet the acceptance criteria, this will be reported in the Analysis Package, the problem(s) which caused the failure will be identified and corrected by the code sponsor, and the code will be scheduled for full testing in order to validate it for the new platform.

3.3.2 Acceptance Criteria

The acceptance criteria for this test are exactly the same as for Test #1 (see Section 3.1.2).

4.0 OVERALL ACCEPTANCE CRITERIA

The testing described in this document is attempting to accomplish two different purposes simultaneously. First, it evaluates the effect of the upgrade of the OpenVMS operating system software from Version 7.1 to Version 7.2 on the WIPP PA application software codes. It is expected that such effects will be very minor. Tests #1 through #3, taken together, provide the basis for this evaluation. Secondly, Test #1 is intended to serve as an Installation and Checkout (I&C) for the actual WIPP PA application software codes and versions listed in Section 2.1 of this document. The acceptance criteria for each of the three tests is documented in Sections 3.1.2, 3.2.2, and 3.3.2.

If any code does not meet the acceptance criteria specified for Test #1, then it fails the I&C and it will undergo full testing later, after the problem has been resolved, in order to validate it for use on the new platform.

The decision as to whether to go ahead with the operating system upgrade for the cluster will be a judgment based upon the number and severity of problems encountered by this testing. The following will be the guidelines for this decision:

1. The vast majority of the codes in Test #1 should satisfy the acceptance criteria and therefore pass the I&C.
2. The test of the five libraries in Test #2 should meet the specified acceptance criteria.
3. The test of BRAGFLO, NUTS, GRASP-INV, MATSET, PRELHS, and CUTTINGS_S in Test #3 should meet the specified acceptance criteria.

5.0 REFERENCES

1. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant, October 1996, United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office, Carlsbad, New Mexico.
2. SNL Fulfillment of the EPA-Mandated Performance Assessment Verification Calculation, August 1997, ERMS # 246854.
3. OpenVMS Alpha Version 7.2 New Features and Release Notes Manual, Order Number AA-RHZKA-TE, Compaq Computer Corporation, Houston, Texas.
4. SNL WIPP Baseline Software List, ERMS # 248640.
5. Analysis Package for Regression Testing for the Upgrade to OpenVMS Version 7.2 on the WIPP COMPAQ Alpa Cluster, AP-065.