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Total System Model Version 6.0 Validation Report

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DISCLAIMER

Total System Model Version 6.0 Validation Report:

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CHANGE HISTORY

Revision No.	Date	Description
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ACRONYMS AND ABBREVIATIONS

BSC	Bechtel SAIC Company, LLC
BWR	Boiling Water Reactor
CHF	Canister Handling Facility
CIRG	Cask Information Report Generator
CRG	Cost Report Generator
CRCF	Canister Receipt and Closure Facilities
CRWMS	Civilian Radioactive Waste Management System
CSNF	Commercial Spent Nuclear Fuel
DOE	Department of Energy
DOE SNF	DOE Spent Nuclear Fuel
DPC	Dual Purpose Canister
DRG	Dose Report Generator
DTF	Dry Transfer Facility
DVCG	DOE Valley Curve Generator
FHF	Fuel Handling Facility
GRG	GROA Report Generator
GROA	Geologic Repository Operations Area
GUI	Graphical User Interface
HLW	High Level (radioactive) Waste
IAS	Integrated Acceptance Schedule
IHF	Initial Handling Facility
IS	Initial State
kW	kilowatt
MGR	Monitored Geologic Repository
MSC	MGR Site-Specific Canisters
MTHM	Metric Tons of Heavy Metal
MTU	Metric Tons of Uranium
PWR	Pressurized Water Reactor
RF	Receipt Facility
RG	Report Generators
RRG	Results Report Generator

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SNF	Spent Nuclear Fuel
SRTC	Site Rail Transportation Carts
SSC	Site-Specific Canisters
TAD	Transportation, Aging, and Disposal
TCRRF	Transportation Cask Receipt and Return Facility
TSC	Transportable Storage Cask
TSLCC	Total System Life Cycle Cost
TSM	Total System Model
TSMCC	Total System Model Control Center
TSMPP	TSM Pre-Processor
TTRG	TAD Throughput Report Generator
UM	User Manual
VB	Visual Basic
VCG	Valley Curve Generator
WHF	Wet Handling Facility
WO	Work Order
WP	Waste Package
XML	Extensible Markup Language

1. OBJECTIVE AND BACKGROUND

1.1 INTRODUCTION AND OBJECTIVE

This validation report supports the issuance of the Total System Model (TSM) Version 6.0 (Bechtel SAIC, LLC (BSC) 2007a) that is described in the TSM User Manual (UM) (BSC 2007b) and the TSM Pre-Processor (TSMPP) UM (BSC 2007c), and other supporting documentation in References BSC 2007d, BSC 2007e, 2007f, and 2007g. This report assumes the reader has detailed, working knowledge of the TSM functions and Civilian Radioactive Waste Management System (CRWMS) operations.

The validation for TSM V5.0 that also included the validation for the use of SimCAD™ Version 7.1 is in Reference BSC 2007h. The validation method used for TSM V6.0 was considerably different than that used for TSM V5.0 so this validation report cannot be viewed as an update or a change to the TSM V5.0 validation report.

The modifications to prepare TSM V6.0 began with TSM V5.0 and the simulation file name was modified to V6.0A1 in April 2007. Revisions and refinements continued as discussed in this report culminating in V6.0F7 in October 2007. V6.0F7 was then designated and issued as TSM V6.0. Version numbers and letters were changed at the discretion of the TSM developers depending on the depth and extent of the change as in previous modifications and code development.

There were various checks of TSM elements such as the TSM Report Generators (RG) and transportation module as development progressed. These validations are documented in References BSC 2007i and BSC 2007j.

This validation was performed in accordance with AP-ENG-006, *Total System Model (TSM)-Changes to Configuration Items and Base Case.*

1.2 CHANGES IN TSM VERSION 6.0

The TSM V6.0 modifications from TSM V5.0 were extensive and the functional changes include:

- The main changes are updating the process line configurations in the Geologic Repository Operations Area (GROA) to the so called “CD-1 design” that replaces dry processing lines to transfer individual assemblies to a Transportation, Aging, and Disposal (TAD) canister with a Wet Handling Facility (WHF), and three flexible processing Canister Receipt and Closure Facilities (CRCF) to handle canistered wastes. In addition, an Initial Handling Facility (IHF) is added to process Naval Spent Nuclear Fuel (SNF).

- The Canister Handling Facility (CHF), Dry Transfer Facilities (DTF), Fuel Handling Facility (FHF), and TAD process lines have been removed. The Transportable Storage Casks (TSC) process line is retained for future use but is inactive in Version 6.0. TSCs are now processed as bare Commercial SNF (CSNF) casks and are not diverted to aging (there are few TSCs).
- Site-Specific Canisters (SSC) and Monitored Geologic Repository (MGR) Site-Specific Canisters (MSC) were removed in TSM V6.0 since they are no longer used-TADs are now used.
- The Transportation Cask Receipt and Return Facility (TCRRF) and the associated Site Rail Transportation Carts (SRTC) were removed from the design and the facility and the associated radiation doses have been removed from the simulation.
- The "Deploymenttime" process and associated routers that changed the waste routings as facilities came on line during startup have been removed. The startup facility sequencing is now simplified and handled within the other routers and within a Receipt Facility (RF) process.
- Arrival buffers have been simplified and consolidated because the need for specialized processing for criticality is no longer required.
- Several of the GROA processes along the cask return processes are no longer required in the updated GROA design. This reduces the time for the cask to be returned from the GROA.
- A new department ("DOEOV") was added to implement the so-called "basket and shell" approach for Department of Energy (DOE) canisters and transportation overpacks. The design for the DOE casks are not established and this department allows the TSM to assess the impact of unique cask designs for each type of DOE waste vs. designs where a single overpack design is used to package the waste canisters.
- A "smoothing algorithm" was added to the TSMPP to adjust the shipment timing of the codisposal waste streams. This routine takes any DOE waste stream for input to TSM and "smoothes" it such that the arrivals of the DOE Spent Nuclear Fuel (DOE SNF) and High Level radioactive Wastes (HLW) wastes in the Initial State (IS) file are in the proper ratio to make co-disposal Waste Packages (WPs). Unsmoothed streams often require long waiting times for DOE wastes at the GROA to achieve the proper waste quantities.
- A variable DSNF_Mismatch and an algorithm was implemented to allow the GROA to make co-disposal WPs in the event that the input DOE waste stream in the IS file does not have the proper ratio of HLW to DOE SNF wastes (5 HLW canisters to 1 DOE SNF canister). Previous versions of TSM only implemented the variable HLW_Mismatch to handle cases where the DOE stream has too much DOE SNF (which was the typical case). DSNF_Mismatch handles the case where there is too much HLW.
- The algorithm to automatically estimate the number of casks required in the cask fleet in the TSMPP was refined. The algorithm outputs Work Orders (WOs) that are used to introduce cask objects into the simulation. A WO algorithm for the truck rolling stock was also developed and implemented for the TSMPP.
- Adjustments were made in the TSM model extensions for doses and costs to account for the changes listed above.

These functional changes above (except for those involving the TSMPP) were implemented by the programming changes indicated in Table 1. The details for the changes in Table 1 are shown in a listing of changes in the attached electronic files that compare the Visual Basic (VB) code and the simulation model settings for V5.0 and V6.0F7. The attached VB code comparison electronic file was made by copying the VB code from TSM V5.0 and TSM V6.0F7 into two MSWord documents and then using the document compare tool. The attached simulation settings electronic file shows differences in the settings of the two models that are generated by a "stripper" program that compares the SimCAD™ "Model Information/View Complete Model Detail" information under the SimCAD™ "Analysis" tab. The VB listing and stripper code results were not validated but were used by the Developer's to identify the changes and assist in detecting if the changes were consistent and for debugging. The files are also the most comprehensive list of detailed changes that can be practically generated.

The changes were implemented in a sequence where the GROA was first rebuilt for the CD-1 design. Then minor modifications for transportation, dose, and costs were made. This was followed by adding the DOE "baskets and shells" capability to complete the major changes to the TSM that were planned (this was the completion of the D series in Table 1). Work thereafter mainly involved run tests as described in Section 2 in an iterative process to assess results, debug issues or problems, rename processes to be more appropriate, refine and revise the RGs, and make changes to improve the functionality and fidelity of the simulation. The work culminated in end-to-end tests of the TSMPP, TSM simulation, RGs and the TSM Control Center (TSMCC).

In some cases, previous checks or validations were not be revised if that portion of the model was not changed. Past experience and checks have demonstrated that the code for TSM is properly structured and the modular routines are isolated such that code changes in one part of the model does not cause inadvertent changes in other parts. For example, the decay curves for GROA heat decay were be re-checked for TSM Version 6.0 since these were not changed from TSM Version 5.0.

Table 1. TSM Interim Version Changes

TSM Interim Version	Major Changes
A Series (1-9)	-A. Removed all buffers for CHF, DTF1 and DTF2 -B. Deleted old facilities CHF, DTF1, DTF2, FHF -C. Removed TAD lines and Truck TAD lines -D. Renamed FHF Buffers -E. Added facilities IHF, WHF, RF, CRCF1, CRCF2, CRCF3 -F. Removed obsolete triggers associated with removed processes -G. Removed obsolete variables associated with removed processes -H. Removed handling of waste with criticality concerns -I. Removed all Facility 'Meters' -J. Modified Extensible Markup Language (XML) file to include new parameters/remove obsolete items. New file named TSM_V6.xml
B Series (1-9)	-A. Added processing of DOE SNF within CRCF1 -B. Added DSNF_Mismatch -C. Added IHF processing, releases appropriate WP -D. Added WHF processing
C Series: C1	-A. Broken version, file corrupted
D Series (1-9) (starting from B9)	-A. Added DOE Baskets and Shells -B. Added DOE processing to CRCF3 -C. Added specialization to CRCF1 and CRCF3 to prevent facility deadlock -D. Added Buffer cask count -E. Minor map and timing changes -F. Disabled TSC Aging line
E Series (1-9)	-A. Fixed buffer cask count -B. TSC Buffer now routed to BWR or PWR Buffer -C. General bug fixes and cleanup, final time settings in many processes, revised time to complete shipment batch time in DOE site processes to 80 vs. 50 steps -D. Added variable for Dual Purpose Canister (DPC) bypass, allows user to specify ratio of DPC vs. bare casks to be processed. Also specify if DPC may be sent to aging if there is a backlog. Required changes to XML file. -E. Added TADB and TADP processes to track different TAD canisters -F. Added process and facility doses to GROA -G. Fixed problem in WHF that jammed when WP Heat set too low -H. Revised logic for WHF to route output TADs to TAD Buffer instead of RF to allow for WHF operation before RF is on-line -I. Revised many variable and process names to be consistent with current nomenclature
F Series (1-7)	-A. Revised RF extensions to handle non-zero RF start times and the logic for the DPC handling -B. Added router at WHF dispatch to send hot TADs direct to aging not TAD buffer -C. Revised logic for DSNF mismatch -D. Revised logic in RF to simplify with fewer "nested ifs" -E. Various minor corrections and changes and adjustments for GROA parameters -F. Updated TSMCC to properly interface with V6.0F7

2. METHOD

This section discusses the methods that were used to validate TSM Version 6.0.

The validation methods and acceptance criteria were similar to those used in previous checks that the TSM was behaving as expected. This included doing comparison to previously checked simulation results, verifying that when a change is made the simulation behaves as expected by observing the path and actions of a test object on the Graphical User Interface (GUI), performing mass balances and/or object count balances, observing trigger values during simulations, checking results for completed objects when there should be no completed objects for that type, assessing process throughputs/completions based on previous results, and other methods invented by the developers during the validation process. Comparisons of results accounted for run-to-run differences. For example, for object completion counts run-to-run variations were considered on the developers experience from historical studies, evaluation of the particular value in question, simulation observations, or tests for run-to-run variations on TSM V 5.0.

The validation method is shown in Figure 1. Key elements for the method in Figure 1 are described in Table 2. The approach was an iterative process to develop the TSM simulation in parallel with the RGs. Actions 1-3 in Figure 1 resulted in working versions of the simulation and RG developed using test runs. Validation using test runs is a comprehensive approach because runs exercise most of all the components and test the overall simulation as well as individual elements.

The tests that were used for the validation are shown in Table 3. Note that Table 3 is not presented in any particular order or by the order that the tests were run. The arrangement of the tests in Table 3 was selected for documentation purposes for this report. As the tests and validation were documented, the developers identified the test runs that best met the validation test objective for inclusion in this report. In some cases, additional runs were made to confirm earlier validations.

The acceptance criteria were generally that any differences in the results must be within the typical range of simulation variations in TSM simulations based on the judgment of the developer and that any major differences be explained. Specific acceptance criteria for each test are noted in Table 3.

The RGs were used to examine the runs and identify potential issues and problems. The primary figures of merit assessed by the RGs included: Results Report Generator (RRG, summarizing process totals, costs, etc.), Valley Curve Generator (VCG, illustrating similar processing rates), DOE Valley Curve Generator (DVCG, illustrating similar processing rates with DOE waste), Cost Report Generator (CRG, demonstrating similar costs), Dose Report Generator (DRG, comparing estimated exposures), GROA Report Generator (GRG, verifying conservation of assemblies), and Cask Information Report Generator (CIRG, comparing the number and operational characteristics of transportation casks). The TAD Throughput Report Generator (TTRG) was used to refine the TSM GROA settings late in the model development process.

The developers selected runs from previous TSM analyses to support the validation. The key items from the previous run that were used for the test runs were the Initial State (IS) files. The IS files are in the various run results files included in the electronic attachments to this report. The runs that were typically used in the tests included:

"25A": A typical TAD case is from *TSM System Study: Impact of a Canister-Based System on the CRWMS* (BSC 2005). This 142,000 Metric Tons of Heavy Metal (MTHM) scenario assumes that rail sites with 75 ton or lower capacity will load small TADs (12/24). All other rail sites will load medium TADs (21/44). Truck sites will continue to ship bare CSNF. A TAD/WP heat limit of 11.8 kilowatts (kW) is assumed. This run was selected to provide a good diversity of TADs and bare cask loads. The run file used in the TAD study was TSM_V30G7_Scn25A_080105.zip with the IS IS_WO_V3.0G_TAD_Scn25A_DOE_7-28.xls. However, the IS was modified to add some work orders for some TSCs and the IS file used was IS_WO_V3.0G_TAD_Scn25A_DOE_TSC_6-13.xls.

"CD-1": The CD-1 cases are based on runs used for *Engineering Study: TSM Analysis of Alternative CD-1 GROA Configurations* (BSC 2006). A 70,000 MTHM waste inventory (current design limit), consisting of 63,000 MTHM CSNF, 4,667 MTHM HLW, and 2,333 MTHM DOE SNF (including Naval). This inventory assumes all 104 operating reactors receive 20-year life extensions. The cases load <u>all</u> TADs to 22 kW if possible and also include teleporting HLW for proper DOE waste stream balancing. Many early runs were done with the start time for all GROA facilities set to zero. Later runs included proper start times for the facilities. The IS file used in the original CD-1 study was also modified in various ways to study the case for example, teleporting DSNF was removed for some runs and different heats were also used.

"TSLCC": The typical Total System Life Cycle Cost (TSLCC) is case from *TSM Input to the 2007 Total System Life Cycle Cost Analysis* (BSC 2007k). A 122,162 MTHM case, consisting of approximately 109,327 MTHM CSNF plus the full inventory of DOE wastes provided in the 2001 Integrated Acceptance Schedule (IAS). The CSNF inventory is based on 2002 RW-859 data with CSNF discharge projections using the 47 reactor license extensions. Utilities would try to load TADs to 11.8 kW and load to 22 kW only if the fuel was too hot. This case was selected for tests because it was the most comprehensively checked and tested case in TSM V5.0 and has a high inventory. This was the primary run used to check the DOE "baskets and shells" approach and costs.

The iterative process shown in Figure 1 converged on the TSM Version V6.0F7 that is validated in this report with a complete run of TSM including post run analysis and checks of the RG. This "end-to-end" test provides a final comprehensive validation of the TSMPP, TSM simulation, and RGs the final configuration issued as TSM V6.0.

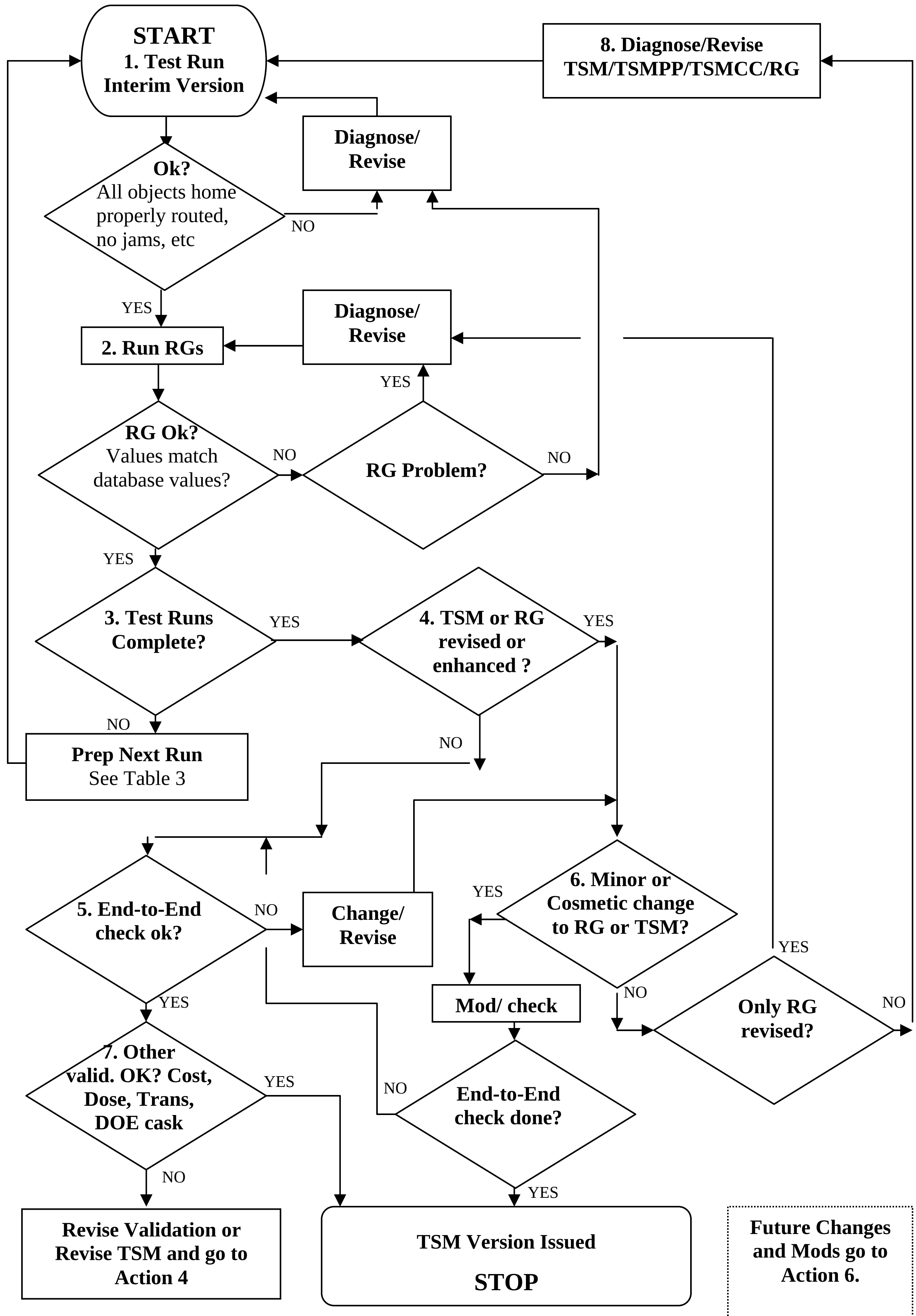

Figure 1. TSM Validation Method Flow Diagram

Table 2. Key Actions in the TSM Validation Flow

Figure 1 Action or Decision	Description and Notes
-1. Test Run Interim Version	As the TSM is revised, interim revisions numbers were assigned and TSM was run. Initially, the work focused on iterations and "looping" through actions 1 through 3 until a workable interim version was developed and the flow moves to Action 4. Notice the flow would cycle back to Action 1 if problems were discovered well downstream in the flow. In these cases, all of the TSM elements and RG did not have to be re-validated only those impacted by the changes.
-2. Run RGs:	RGs were developed in parallel with the TSM development in an iterative process. RGs were used to check if the TSM runs were ok and the runs indicate the need for changes in the RG or vice versa. The TSM run did not have to be "correct" to validate that the RG data routines were correct. The validation of the RGs is in Reference BSC 2007i.
-3. Test Runs Complete?	The list of test runs was continuously modified during development to address issues that arise or other observations. The tests shown in Table 3 were the culmination of many iterations of the TSM and RG through Actions 1 through 3.
-4. TSM or RG revised or enhanced ?	At this point, the interim version was workable and providing good results for typical cases and the changes after this point were much smaller to add refinements or features. However, notice that changes could be major enough to restart the validation flow at Action 1.
-5. End-to-End check ok?	This step was performed just before the release of the interim version. The validation flow should detect major problems before this point, but notice that serious problems could restart the validation flow at Action 1. The main goal was to validate the integration of the TSM elements that were checked or validated separately. The checks of TSM components at this point were not as detailed as the previous checks. For example, the RGs were not completely rechecked with a "bottom's up" recalculation of all the RG values. The checks were by the developers and include an overview that all the results are consistent, "make sense" for the case run, and have reasonable values. There were also some detailed checks for items like object count balance and mass balance or other checks typically performed to judge that a run is "good".
-6. Minor or Cosmetic change to RG or TSM?	Many changes were straight forward and in the judgment of the Developers cannot impact the simulation results and repeat of the previous validations of the RG or TSM were not needed. There were also changes to formatting, column headings in RG, or other "cosmetic changes". These changes were quickly checked by re-running an RG or TSM but full validation was not needed.
-7. Other valid. OK? Cost, Dose, Trans, DOE cask	There were other validations that have been performed and documented for other TSM components elements and the developers group assessed if any changes made since that validation require an update of those validations.
-8. Diagnose/Revise TSM/TSMPP/TSMCC/RG	End to end testing was used to identify issues with the TSM integration and this step provided the opportunity to address integrated issues.

Table 3. Test Cases

Test Description	Objective-Method-Acceptance Criteria
1. Comparison to V5.0	Objective: Compare results in TSM V5.0 and V6.0. Method: Compare results of April 2007 TSLCC run. Run RRG, CRG, DRG, VCG, DVCG. Acceptance Criteria: Exact match not possible but overall numbers of WP should be within the typical run-to-run variation seen in previous cases, <5., cost should be within 1%, doses should match for trans and site, differences in GROA doses should be within 1% or justified.
2. DPCbypass/ Truck-DPC ratio test	Objective: Checks proper operation of the DPC bypass function to allow DPC to bypass WHF when it is too busy doing truck cask loads. Method: Test various DPC/Truck ratios in a run. Run VCG. Acceptance Criteria: VCG should be worse when DPC bypass is not used. Numbers of DPC bypassed should increase with increase ratio.
3. WP Heat Range	Objective: Test functionality using a variety of WP heat limits. Method: Run cases with 0, 11.8., 18, 35 KW waste packages. Run GRG to check WP emplacement heats. Run VCG to check net in aging. Acceptance Criteria: All WP should be emplaced, number of items in aging should increase with decreasing WP heat.
4. Emplacement Timing Test	Objective: Test reduced run times for emplacement and check proper logistics. Method: Run typical case before and after timing revisions. Revise typical case to use very long emplacement time to ensure objects "push back" to buffers. Run VCG and check object timings at RF. Graph WP emplaced for cases. Acceptance Criteria: No or small difference in WP throughput to emplacement. Visually confirm that WPs pushed back into the process lines as expected.
5. Facility Date Tests	Objective: Test that logic works for a variety of facility start dates. Method: Run typical case with the facility dates from 0 to nominal dates and run GRG and TTRG. Acceptance Criteria: All cask loads smoothly processed into WPs, no jams.
6. RF Timing Test	Objective: Test the impact of process times on RF throughput-RF is the "bottleneck" for TAD and defense processes. Method: Run typical case with various RF process times and assess impacts with VCG. Acceptance Criteria: Longer RF times should increase the shipment deficits.
7. Process Balancing	Objective: Analyze the balance of the processing in the CRCFs to assess that the simulation logic is sound. All process buildings should stay steadily active commensurate with the IS file. Method: Run typical cases and analyze with TTRG. Acceptance Criteria: CRCF1 and 3 should have balanced processing and produce WP at about the same rate. CRCF2 (TAD only) should process at a higher rate. All buildings should stay busy. Depending on the IS, DOE cask loads should be steadily processed in CRCF1 and 3.
8. Run-to-Run variations	Objective: Check run-to-run variations. Method: Run a typical case with the same settings several times and use the RRG to assess repeatability. Review various runs in validation to understand variations for different cases. Acceptance Criteria: Total WP should be within 5 run to run. WHF TADs and IHF WP should match. WP processed by individual CRCFs will vary as much as 50 WP over a run due to intricate logic of buffers and RF. Total CRCF WP should match within 5.

Test Description	Objective-Method-Acceptance Criteria
9. No Bare Case – Mass Balance Test	Objective: Check model mass balance calculations for a typical case and for a case with no bare cask loads. In TSM bare cask loads processed in WHF do not retain the original Metric Tons of Uranium (MTU) for each assembly and an average value for Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR) assemblies based on the TSLCC was used. This causes small errors on the MTU per cask load processed in WHF. TAD cask loads in "no bare" cases retain the exact MTU data from the IS file. Method: Run typical case with no bare casks so MTU in process lines should match. Compare to the same case with bare to assess impact of WHF MTU approximations. Acceptance Criteria: For no bare cases, process lines MTU should match GROA input within 1 or 2 MTU. For cases with bare cask loads, process line to GROA input mass balance should be within a few percent. DOE MTU should match in all cases.
10. Run Diversity	Objective: Check runs using various previous cases to show all types of cases are accommodated. Method: Check bare case and TAD cases from TAD study, check case from CD-1 thermal tests, test TSLCC case. Cover 70k MTU and 130KMTU cases. Run RRG and VCG. Acceptance Criteria: All shipments arrive, all WP emplaced, run results look correct.
11. DOE OV Test	Objective: Test DOE OV department using DOE baskets and shells. Method: Run a typical case. Generate DOE OV IS using TSMPP. TSMPP must also generate DOE OV Cask 2XX WO. Run DVCG to check for any arrival timing differences to non-DOE OV case. Acceptance Criteria: All cask loads arrive, arrival timing differences are small.
12. DOE Smooth and Balance tests	Objective: Check run impacts from DOE smoothing. Method: Run a case using IS files with and without DOE smoothing and check with DVCG. Acceptance Criteria: Smoothing should reduce cask residence times and reduce DVCG deficits if any.
13. . HLW-DSNF Mismatch	Objective: Test HLW and DSNF mismatch to ensure "teleporting" will never be needed. Method: Run typical cases that have mismatched wastes- one case with excess DSNF and one with excess HLW. Acceptance Criteria: All DOE cask loads must be processed and buffers should clear.
14. DOE Site Timing	Objective: Check the impact of revising batching time at DOE sites from 50 steps to 80 steps. Method: Run a typical case before and after the change. Check batching times and objects complete at each site using DRG, DVCG, and RRG (for DOE shipment number). Acceptance Criteria: All DOE cask loads arrive at GROA. Longer batching times should result in fewer DOE shipments. Overall simulation results not impacted.
15. Memory Tests	Objective: Runs without a stop generally fail at some high number of steps due to PC memory errors. Check when this occurs (if ever). Method: Run a typical case with no stop limits. Acceptance Criteria: Number of steps should exceed 130,000 steps (the longest case used in historical analyses). If not, add warning to TSM UM.
16. End to End Check	Objective: Test end to end operation of entire TSM and TSMCC. Method: Run CD-1 case in TSM V6.0 delivered configuration. Using the TSMCC, generate the IS including WO with TSMPP, load the IS, run the run, archive the data, run all RGs using the archived data. Run post-run thermal analysis tool and validate shipment identifier data is retained. Acceptance Criteria: All shipments made, all return from aging, TSMCC properly operates and stops run and archives data. Simulation results match stand-alone TSM simulation within typical run-to-run variations. Thermal data reliably passed from TSMPP to post run thermal analysis.

3. USE OF COMPUTER SOFTWARE AND MODELS

The following computer software and models are used in this report:

- TSM Interim Versions from version 6.0A1 to 6.0F7 as noted in the run files in the electronic attachments listed in Section 7.1
- SimCAD™ Pro 7.1
- MS EXCEL 2003
- MS Access 2003
- TSM RGs as listed in Reference BSC 2007i and included with the electronic files in Section 7.0.

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4. RESULTS

During the course of TSM development and validation shown in Table 1, approximately 80 full runs were performed. The results for the validation runs are summarized in Table 4. The run files and other results used for the validation are also listed in Table 4 and are electronic attachments to this report (see Section 6). The run files typically have notes that explain the results and the observations for the runs. For detailed results, consult the attached files.

As expected there were various small errors that were not found until later in the revision process and the iterative process in Figure 1 was used to redo validations if needed. In some cases, the earlier versions that were validated remain valid because the check can account for this error. For example, an error in the TADB process was set to process no WPDummy objects was not noticed until Version F6. This does not have a large impact on the simulation results and can be properly taken into account when validating runs prior to F6.

As noted in Table 4, there are some cases where issues and problems were noted and deferred to a later Version of TSM. These items are also noted in the observations in Section 5 and, if necessary, appropriate warnings or discussions were added to the TSM UM (BSC 2007b). Decisions to fix or defer problems are made by the TSM User's Group lead and the TSM Developers based on the impact of the issues.

Table 4. Validation Runs and Results

Test Description	Results
1. Comparison to V5.0	Passed. Results from the RRG, CRG, DRG, VCG, DVCG indicate good agreement. TSM_V6.0E5_71_30to1_8_11_07.zip case used, WHF_TruckDPCRatio, 30, WP_HEAT, 11800, DSNF_MISMATCH, 0, HLW_MISMATCH, 1497, DPC_QBypass, 5, TAD_QBypass, 12. IS_07LCC_newNavyIAS_WO_030507.xls TSM_V3.0L5c3_07TSLCC.zip is a TSLCC case from the 2007 TSLCC (BSC 2007k). This has DPC bypass to aging (Truck DPC ratio of 30 in V6.0E5 sends most DPC go to aging) but comparison is not exact. This run is not exactly V5.0 but is V5.0 modified to do DPC bypass and with some adjustments to DTF1 timing to get better fidelity to WHF. So, the GROA actions in this case should be the best V5.0 representation of the GROA actions in V6.0E5 that was run. RRG: WP: 17,218 vs. 17,216 (-2, ok). The 30:1 ratio only sent 786 vs. 920 to aging, this decreased the 3-batching efficiency at the site and there were 2.4% more rail shipments. DOE processed slower in V6E5 (see DVCG discussion below) and this impacted the 5-batching efficiency causing 5% more DOE shipments. RCaskMaint objects complete increased by 20% attributable to the longer times in waiting. CRG: Major cost differences as expected : 64 vs. 46 TAD OV with associated rail car costs (slower return of OV, open buy), Higher rail transportation costs. Note: Discovered DOE MCO Cask Cost in TSLCC is missing 5 objects and is $21M low. Dose: V5.0 GROA 27,036 SITE 10,147 TRANS 9,277 V6.0 27,324 10,147 9,277 VCG: VC averaged about -500 MTHM average (-842 min.) vs. -150 MTHM average (-400 min.) attributable to a small valley caused by processing 134 DPC during the truck arrivals. Net in aging showed more bypass in V5.0 (judged by straight line returns) and also more to aging, 2359 vs. 2035. DVCG: DSNF VC is -50 vs. -100 for V5.0; HLW VC is -1150 vs. -200 for V5.0. This also causes more DOE shipments as seen in the RRG results and confirmed by Simdata analysis that showed cycle times were about the same or increased for V6.0 vs. V5.0: HANR 26 to 42 steps, INLR 40 to 41 steps, SRSR 33 to 40 steps. Higher steps typically means more batches left with fewer than 5 cask loads. V6.0 does not handle the DOE wastes quite as well. Both cases use HLW mismatch. The cask cycle times between TSM V5.0 and V6.0 are also comparable considering model changes, see BSC 2007j.
2. DPCbypass/Truck-DPC ratio test	Passed. Nominal TSLCC case. DPC/Truck ratios of 6, 30, 100, and 1000 showed that DPC properly bypass WHF when it is too busy doing truck cask loads. VCG analysis shows that the valley curve decreased with increasing ratio. There is not much difference in the valley curves for 30:1 vs. 1000:1 which makes sense. Not much change in aging- 1000:1- 2,033, 30:1:-2035, 6:1- 2098 as expected.

Test Description	Results
3. WP Heat Range	Passed. CD-1 cases using V6.0F7 WP Max heats of 0 kW (7383 to age), 11.8 kW (4979 to age)., 18 kW (3230 to age), and 35 kW (1338 to age) using manual checks at the end of the run showed that all WP were emplaced (except 0 heat case), and number of items in aging increased with decreasing WP heat. 0 heat cases return none from aging as expected. There were some initial runs where 0 WP heat did not work and this was later fixed, also fixed a problem in F2 where items prior to RF opening with heat >WP max did not go to aging. VCG data also shows the number to aging increased as expected with decreasing heat. GRG shows all WPs were below the set WP heat (except Max Heat =0 case with no WP emplaced except DOE).
4. Emplacement Timing Test	Passed. CD-1 in V6.0D7 cases run with longer process timings on the emplacement processes (3 at the emplacement and 6 at the emplacement) caused backups into the process lines, then into the RF, then into the GROA buffers as expected. More items sent to aging as expected at longer process times. 3 steps had 3148 in aging, 6 steps had 5248 in aging. Eventually these tests were used as the basis to set the process times for the emplacement processes downstream from the close processes in Version 6.0E9.
5. Facility Date Tests	Passed. CD-1 cases were run many months with zero for the building start times. CD-1 runs beginning late August used start times from the CD-1 plan: WHF: 0 steps, RF: 1824 steps, CRCF1: 0, CRCF2 3831, CRCF3 5838. The TSM always ran and gave logical results based on GRG and TTRG results and visual indications.
6. RF Timing Test	Passed. Nominal TSLCC case in V6.0E5 with RF=0 steps and RF=5 steps showed the VCG changed from –595 min to -39,547min. To aging increased from 2,064 to 3,536 (from bypass). TTRG shows delays in DOE TAD and DOE processing correlating to the slower arrivals. Process balance not as good: CRCF WPs are 4823, 7091, 4906 for RF=0 and 2421, 8902, and 5156 for RF=5. All behavior as expected.
7. Process Balancing	Passed. Test used the CD-1 case delivered with TSM V6.0 with teleporting to prevent issues with DSNF mismatch processing as discussed in Test 13. The case included with DPC bypass with a Truck/DPC ratio of 100 and DPC Q bypass of 5. DPC return at 26,300. The process timings in this case were also adjusted by the User's Group to provide better fidelity to the design: processing times in the CRCFs were increased and the DPC processing in WHF was decreased. TTRG analyses indicate that CRCF1 and 3 unload at about the same rate when busy. CRCF2 (TAD only) processes at a higher rate. DPC processing did not commence until 26,300 as expected. DOE cask loads were steadily processed in CRCF1 and 3. The higher processing rates allowed times when no processing was needed and this is properly reflected in the response- it was not possible for all the process lines to stay busy all the time and CRCF1 processes more WP than CRCF3.

Test Description	Results
8. Run-to-Run variations	Passed. Run-to-run variations in 8 identical CD-1 F5 runs (run on two PCs) are much smaller than observed than in older models. This is presumably because there is much less “competition” than in older models where various process lines are used in “pull” logic. a “push” logic is now more prevalent in the GROA and process lines have specific functions (e.g. CRCF2 does TADs). WP run to run vary by 1 vs. as much as +/- 5 in V5.0. The differences in the max and min for the 8 runs for various parameters were Total WP: 10,331-10,333; WHF TAD: 2645 (no variation), IHF WP 400 (no variation), CRCF1 WP 1786-1812, CRCF2 3959-3944: 8, CRCF3 WP: 1653-1679. Note the balance of CRCF WP processing varies but the total WP is virtually the same. The TADs sent to aging that varies from 3198 to 3233 (avg. 3211 with std dev of 11). This appears to be from variations in the RF processing sequence where the RF queue fills and causes bypass slightly different run-to-run. This also causes a variation in the number of TAD objects that appear in the TADAgePrep process (recorded n the RRG as “WHF too hot”. TAD Objects here should only be hot TADs from WHF but detailed analysis shows that some cold WHF TAD are sent through this route because the RF is too busy to handle the TAD from WHF when it arrives from the TAD buffer. This manifests itself as a maximum and minimum of 33 and 19 (average 26 with std. dev. of 4) of “WHF too hot”. The transport vehicles are the only items on “open buy” but the trucks have no variation and the rail rolling stock only varies by 1 (avg. 15.5 with 0.5 std dev).
9. No Bare Case – Mass Balance Test	Passed. Runs with 25A in V6.0F2 and F4 where the IS files were modified to have no bare shows the mass balance (into the GROA vs. total MTU processed) is within 3.5 MTU. 25A is a 116,000 MTU case, a smaller difference would be expected for a 63,000 MTU case. CD-1 cases without bare assemblies shows a difference of 584 MTU 0r 0.8% (using the case in Test 16). All of the runs in the validation after this point showed good mass balance indicating the GROA is properly programmed and does not lose materials. The analysis of the TSLCC case IS was used to set the assembly masses that were from the original TSM V2.0 (see attached file in Section 7). Before this adjustment, runs could have mass balance off by 4-5% because of the WHF variations.
10. Run Diversity	Passed. The cases supporting the other tests support this test. CD-1 cases are nominal 70,000 MTHM cases, TSLCC are nominal 120,000 MTHM cases. Various Truck:DPC ratios (Test 2), WP Heats (Test 3), timings (Tests 4, 6, 7, 14), and DOE streams (HLW_Mismatch, HLW_Mismatch, teleported wastes, smoothed, baskets and shells, Tests 11, 12,13 and 14) were run. All ok except 11 and 13.
11. DOE OV Test	**Partially Failed.** Tests of the DOE OV department using DOE “baskets and shells” was not compatible with the DSNF mismatch cases. As indicated in Test 13, DSNF_Mismatch strands HLW in buffers for 8-10 years and the stranded HLW uses all the available shells. If shells are limited no further DOE shipments can be made- the simulation never clears as DSNF to free the HLW never arrives. If shells are not limited this causes a very large number of DOE shells. Baskets and shells cannot be used with DSNF_Mismatch. Case without DSNF-mismatch worked properly. A nominal TSLCC case that used HLW_Mismatch was run without baskets and shells, with open baskets and shells, and with baskets and shells limits to 30. The DVCG results indicated very similar shipments delays and all successfully ran. The unlimited case used 41 shells indicating similar behavior to open TAD shells: open shell buy processes over-buy by 20% or so.

Test Description	Results
12. DOE Smooth and Balance tests	Passed-with comment. Smoothing should reduces cask residence times but the algorithm does not provide behavior as smooth as DOE streams developed manually.
13. HLW-DSNF Mismatch	**Partially Failed.** For Cases with DSNF_Mismatch: The DSNF mismatch algorithm as implemented causes the GROA action for co-disposal WP filling to use the DOE SNF wastes represented by the DSNF_Mismatch variable before it uses the HLW cask loads that are arriving. Therefore, no HLW shipments from the waste sites are processed until the DOE SNF represented by DSNF_Mismatch is exhausted, and the casks for those HLW shipments are not released. This manifests itself as a HLW pickup delay of many years (usually 8-10 for at typical 70,000 MTHM case). For basket and shell cases this is fatal-see Test 11. Using teleporting as in the TSLCC run in Test 7 below eliminates the problem with DSNF mismatch. Cases run with HLW mismatch behave properly with and without DOE baskets and shells. See the cases in Test 11.
14. DOE Site Timing	Passed. Ran the CD-1 case delivered as the test case that uses 80 steps at DOE with 50 steps at DOE sites. Longer batching times resulted in fewer DOE shipments and overall simulation results had minor expected impacts. DOE Shipments with 50 steps increased from 651 to 742 with a drop in rail transportation costs of $3.5M. DRG shows identical doses because dose is based on the cask loads vs. shipments. (May want to consider modifying the transportation dose algorithm to per shipment.) DVCG shows negligible increases in the throughout indicating that the GROA processing remains the bottle neck for processing as expected.
15. Memory Tests	Passed. Large runs allowed to continue running typically stopped above 130,000 steps. One stopped at 131,444 and one stopped at 144,369 steps. Another run exceeded 140,000 steps. The errors appear to be related to memory problems when the tsm.mdb is trying to write a data set for a returning TAD This performance is suitable for all cases used in documented studies and calculations.
16. End to End Check	Passed. The CD-1 case that was delivered as the test case with TSM V6.0 was run using the TSMCC, TSMPP, and RG. IS properly generated and run results matched runs without using TSMCC. All RGs were run and all worked and showed good results. Post run thermal tool was run that showed batch file was properly run by TSMPP and data was carried through the simulation. All functions in TSMCC were also tested successfully separately including archiving. TSMCC also properly analyzes the IS for teleported wastes, DSNF mismatch and HLW mismatch.

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5. OBSERVATIONS

TSM Version 6.0F7 is suitable to be issued as TSM Version 6.0.

During the validation there were no cases of inadvertent changes although some unanticipated simulation results were encountered because it is not always easy to anticipate all of the down stream and synergistic effects that may result from a change. However, this is not an inadvertent effect from a program change. The experience is that SimCAD™ and TSM do what they are instructed to do.

DSNF mismatch has problems in some cases especially with DOE overpack (baskets and shells for DOE) as discussed in Test 11 and Test 13. Running using teleported HLW as a suitable work-around as demonstrated in Test 16.

There are memory crashes above 130,000 steps so a warning has been added to the TSM User Manual (BSC 2007b).

Run-to-run variations in previous versions have been greatly improved as discussed in Test 8.

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6. REFERENCES

6.1 DOCUMENTS CITED

BSC (Bechtel SAIC Company, LLC) 2005. *TSM System Study: Impact of a Canister-Based System on the CRWMS*. MIS-CRW-SE-000003 REV 00. Washington, D.C. ACC: DOC.20051213.0001.

BSC 2006. *Engineering Study: TSM Analysis of Alternative CD-1 GROA Configurations*. 000-00R-G000-00300-000-000. Washington, D.C.: BSC. ACC: ENG.20060912.0002.

BSC 2007a. *Total System Model Version 6.0*. Washington DC: BSC. Software ID: 50040.

BSC 2007b. *User Manual for the Total System Model Version 6.0.* 50040-UM-01-6.0-00 REV 00. Washington, DC: BSC. ACC: Submit to RPC.

BSC 2007c. *User Manual for the Total System Model Version 6.0 Preprocessor.* 50040-UM-02-6.0-00 REV 00. Washington, DC: BSC. ACC: DOC.20071101.0005.

BSC 2007d. *Total System Model Version 6.0 GROA Department Design and Bases*. 50040-DD-01-6.0-00 REV 00. Washington, DC: BSC. ACC: Submit to RPC.

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BSC 2007f. *Total System Model Version 6.0 Cost Estimating Routines Design and Bases.* 50040-DD-03-6.0-00 REV 00. Washington, DC: BSC. ACC: Submit to RPC.

BSC 2007g. *Total System Model Version 6.0 Dose Estimating Routines Design and Bases*, 50040-DD-04-6.0-00, Bechtel SAIC Company, LLC, Washington, D.C. ACC: Submit to RPC.

BSC 2007h. *Total System Model Version 5.0 Validation Report.* 50040-VAL-01-5.0-00. Washington, D.C.: BSC. ACC: DOC.20070427.0006.

BSC 2007i. *Total System Model Version 6.0 Report Generators Validation Report*, 50040-VAL-03-6.0-00, Bechtel SAIC Company, LLC, Washington, D.C. ACC: Submit to RPC.

BSC 2007j. *Total System Model Version 6.0 Transportation Validation Report*, 50040-VAL-06-6.0-00, Bechtel SAIC Company, LLC, Washington, D.C. ACC: Submit to RPC.

BSC 2007k. *TSM Input to the 2007 Total System Life Cycle Cost Analysis*, 000-00C-G000-01400-000-00C, Bechtel SAIC Company, LLC, Washington, D.C. ACC: ENG.20070621.0001.

BSC 2007l. *Total System Model Version 6.0 Preprocessor Smoothing Algorithm Validation Report*, 50040-VAL-05-6.0-00, Bechtel SAIC Company, LLC, Washington, D.C. ACC: Submit to RPC.

6.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

AP-ENG-006 REV 1 ICN 0, *Total System Model(TSM) – Changes to Configuration Items and Base Case*. Washington, DC: BSC. ACC: Submit to RPC.

7. ATTACHMENTS

The files in Table 5 are included electronically. Note the file sizes are for the files as they reside on a C:drive. Sizes on a CD or in a zip may be slightly different. Move all files to the C:drive to confirm the file size.

Files are organized under subtitles in the table that describe the use for the files. Files that support the results for Table 4 are organized by the test number and title.

Table 5. Electronic Attachments

File Names	Description	Size (kB)	Date
	TSM Revision Details		
CompareV5 to V6.zip	Stripper code comparison results for V5.0 vs. V6.0F7 and text files used for Compare V5 to V6 in stripper code	632	12/7/07
VB V6.0 vs. V5.0.doc	VB Comparison of V5.0 vs. V6.0 F7.	291	12/7/07
	Table 4, Test 1. Comparison to V5.0		
2007_TSLCC_TSM_Files_R00C.zip	TSLCC run and results from March 2007 referred to as "original" TSLCC.	60,129	12/6/07
TSM_V6.0E5_71_30to1_8_11_07.zip	TSLCC Run for V6.0E5. See parameters in Table 4.	50,502	12/5/07
Test 1. All RGs.zip	All RG for both cases: CRG, DRG, DVCG, RRG, VCG. Comparisons of the cases are in V6.0E5 versions of the RG.	6,313	12/6/07
	Table 4, Test 2. DPCbypass/Truck-DPC ratio test		
TSM_V6.0E3_71TSLCC_LoRatio_Lisa_8-04-07.zip	Nominal TSLCC case with 11.8 KW WP with 6:1 Truck/DPC ratio and 5 for DPC_QBypass.	42,184	8/4/07
VC TSLCC07 6to1 VCG 071007 R1 .xls	VCG for 6:1 case.	4,694	8/6/07
TSM_V6.0E5_71_TSLCC 30to1_XPC_8_11_07.zip	Nominal TSLCC case with 11.8 KW WP with 30:1 Truck/DPC ratio and 5 for DPC_QBypass.	50,502	12/3/07
VCG_TSM_V6.0E5_71_TSLCC 30to1_XPC_8_11_07_VCG_9_21_07 .xls	VCG for 30:1 case.	5,347	12/3/07
TSM_V6.0E3_71_TSLCC-Hi ratio_Lisa_8-06-07.zip	Nominal TSLCC case with 11.8 KW WP with 1000:1 Truck/DPC ratio and 5 for DPC_QBypass.	54,000	12/3/07
VC TSLCC07 1000to1 VCG 071007 R1_all .xls	VCG for 1000:1 case. Includes 6:1, 30:1 cases in Sheet 2.	5,315	12/5/07
	Table 4, Test 3. WP Heat Range		
TSM_V6.0F7_71_CD1_Lisa_10-05-07.zip	Nominal CD-1 case with 18 KW WP Heat max.	23,871	10/5/07
TSM_V6.0F7_71_CD-1_35KW_XPC_11-29-07.zip	Case with 35 KW heat max.	32,597	11/29/07
TSM_V6.0F7_71_CD-1__11.8KW_XPC_11-28-07.zip	Case with 11.8 KW heat max.	33,544	11/28/07

File Names	Description	Size (kB)	Date
TSM_V6.0F7_71_0KW_XPC_11-30-07.zip	Case with 0 KW heat max.	19,356	11/30/07
Test 3 VCG-GRG all runs.zip	Zip file with all VCG and GRG. VCG for 35KW case compares to aging for all runs. Need GRG files	6,456	12/7/07
	Table 4, Test 4. Emplacement Timing Test		
TSM_V6.0D7_71_SloEmpL_3 step_XPC_08-06-07.zip	Nominal CD-1 case with process time of 3 steps on emplacement process.	30,516	8/6/07
VCG_TSM_V6.0D7_71_SloEmpL_3 step_XPC_08-06-07_VCG_9_21_07.xls	VCG for 3-step case.	3,491	12/3/07
TTRG_TSM_V6.0D7_71_SloEmpL_3 step_XPC_08-06-07_TTRG_9_14_07.xls	TTRG for 3-step case.	694	12/5/07
TSM_V6.0D7_71_DC Slo emp_6step_8-03-07partial.zip	Nominal CD-1 case with process time of 6 steps on emplacement process.	28,150	8/13/07
VCG_TSM_V6.0D7_71_DC Slo emp_6step_8-03-07partial_VCG_9_21_07.xls	VCG for 6-step case with 3-step results.	3,678	12/5/07
TTRG_TSM_V6.0D7_71_DC Slo emp_6step_8-03-07partial_TTRG_9_14_07.xls	TTRG for 6-step case with 3-step results	632	12/5/07
	Table 4, Test 5. Facility Date Tests		
	No files required. Files from other cases cover this.		
	Table 4, Test 6. RF Timing Test		
TSM_V6.0E5_71_TSLCC_XPC_8-08-07.zip	Nominal run with RF=0 steps.	48,553	8/8/07
VCG_TSM_V6.0E5_71_TSLCC_XPC_8-08-07_VCG_9_21_07.xls	VCG for nominal case.	5,223	12/5/07
TTRG_TSM_V6.0E5_71_TSLCC_XPC_8-08-07_TTRG_9_14_07.xls	TTRG for nominal case	775	12/5/07
TSM_V6.0E5_71_RF5_TSLCC_XPC_8-17-07.zip	Run with RF=5 steps	49,498	8/17/07
VCG_TSM_V6.0E5_71_RF5_TSLCC_XPC_8-17-07_VCG_9_21_07.xls	VCG for RF=5 case with results from nominal case.	5,058	12/5/07
TTRG_TSM_V6.0E5_71_RF5_TSLCC_XPC_8-17-07_TTRG_9_14_07.xls	TTRG for RF=5 case with results from nominal case.	1,085	12/5/07
	Table 4, Test 7. Process Balancing		
TSM_V6F7_M2_CD1_AutoWO+TADs+9_Teleport_SGG_102307.zip	Run to vary process timings.	33,555	11/20/07
TSM TTRG_V6F7_CD1_AutoWO_Telepoert_SGG_101607.xls	TTRG for test run.	704	11/16/07
GROA V6 Process Times.doc	Working notes that summarize the TTRG results.	318	11/21/07

File Names	Description	Size (kB)	Date
	Table 4, Test 8. Run-to-Run variations		
Test 8. Runs CD-1 F5.zip	Eight (8) run files using IS_CD-1_70kWS_NoTeleport_WO_083007.xls	188,719	12/5/07
8. Variability RRG and GRG all.zip	RRG and GRGs for the eight runs in the test.	6,983	12/3/07
Variability run comparison sheets 3 and 4.xls	Workbook comparing the 8 runs based on Sheet 3 and 4 in the RRG.	163	12/3/07
	Table 4, Test 9. No Bare Case – Mass Balance Test		
TSM_V6.0F2_71_case25A_no bare_LisaPC_9_17_07.zip	Run for mass balance in V6.0F2.	47,966	9/17/07
RRG 9-12-07 Validation 25A F2 No Bare.xls	Sheet 2 indicates mass balance with 3.5 MTU	363	12/5/07
TSM_V6.0F4_71_case 25A_no bare_LisaPC_9_20_07.zip	Run for mass balance in V6.0F4.	47,907	9/20/07
RRG 9-12-07 Validation 25A F4 No Bare.xls	Sheet 2 indicates mass balance with 3.5 MTU	362	12/5/07
IS_07LCC_newNavyIAS_WO_030507 ASSY MTU.xls	Analysis of this TSLCC was used to set the average assembly MTU in TSM V6.0.	13,311	9/17/07
RRG_TSM_V6F7_CD1_AutoWO+9_Teleport_SGG_112707_RRG_9_30_07_MTUbalance.xls	RRG sheet 2 indicates that typical cases with bare achieve mass balance within 1%.	342	12/5/07
	Table 4, Test 10. Run Diversity		
	No files needed.		
	Table 4, Test 11. DOE OV Test		
TSM_V6.0F7_71_TSLCC_XPC_10-08-07.zip	Nominal TSLCC run for comparison. HLW-Mismatch 1497 but no DSNF_Mismatch.	46,485	10/9/07
TSM DOE Valley Curve Generator_TSM_V6.0F7_71_TSLCC_XPC_10-08-07.xls	DVCG for nominal case.	2,053	12/4/07
TSM_V6.0F7_71_XPC_TSLCCBS-10-12-07.zip	Run with DOE Baskets and Shells.	48,731	10/12/07
TSM DOE Valley Curve Generator_TSM_V6.0F7_71_XPC_TSLCCBS-10-12-07.zip.xls	DVCG for Basket and Shell Case.	2,115	10/12/07
TSM_V6.0F7_71_BSlimit_XPC_TSLCC_10-13-07.zip	Run with DOE Baskets and Shells and limited shells (30).	44,322	10/13/07
TSM DOE Valley Curve Generator_TSM_V6.0F7_71_BSlimit_XPC_TSLCC_10-13-07.zip.xls	DVCG for Basket and Shell Case with limited shells.	2,100	12/4/07
	Table 4, Test 12. DOE Smooth and Balance tests		
	None. See BSC 2007l.		
	Table 4, Test 13. HLW-DSNF Mismatch		
TSM_V6.0F7_71_CD1_Lisa_10-05-07.zip	Run with DSNF_Mismatch that causes 9 year delay in HLW processing.	22,871	10/5/07
DVCG_TSM_V6.0F7_71_CD1_Lisa_10-05-07_DVCG_9-25-07.xls	DVCG that shows the HLW delay.	1,375	12/4/07

File Names	Description	Size (kB)	Date
	Table 4, Test 14. DOE Site Timing		
TSM_V6.0F7_71_WO_50DOE_XPC_12-4-07.zip	Run file with 50 time steps at the DOE sites.	31,889	12/4/07
RRG_TSM_V6.0F7_71_WO_50DOE_XPC_12-4-07_RRG_9_30_07.xls	RRG for 50-step case. Sheet 4 compares the runs.	344	12/4/07
DRG_TSM_V6.0F7_71_WO_50DOE_XPC_12-4-07_DRG_9_20_07.xls	DRG for 50-step case. Sheet 1 compares the runs as in V6.0.	525	12/4/07
DVCG_TSM_V6.0F7_71_WO_50DOE_XPC_12-4-07_DVCG_9_25_07.xls	DVCG for 50-step case. Compares DSNF and HLW in Sheets 3 and 4.	1,355	12/4/07
TSM_V6.0F7_71_WO_Test Case-End-to-End_XPC_12-03-07.zip	Run file with 80 time steps at the DOE sites.	38,390	12/2/07
RRG_TSM_V6F7_CD1_AutoWO+9_Teleport_SGG_112707_RRG_9_30_07.xls	RRG for 80-step case.	508	12/4/07
DRG_TSM_V6F7_CD1_AutoWO+9_Teleport_SGG_112707_DRG_9_20_07.xls	DRG for 80-step case.	639	12/4/07
DVCG_TSM_V6F7_CD1_AutoWO+9_Teleport_SGG_112707_DVCG_9_25_07.xls	DVCG for 80-step case.	1,278	12/4/07
	Table 4, Test 15. Memory Tests		
Memory error screen shots.doc	Screen shots form memory failure at 131,444 steps	1,159	9/13/07
V6.0F4 Memory test.pdf	Manual notes from memory failure at 144, 369 steps.	18	11/29/07
	Table 4, Test 16. End to End Check		
TSM_V6.0F7_71_WO_Test Case-End-to-End_XPC_12-03-07.zip	CD-1 with teleporting HLW simulation run of test file delivered with V6.0. Includes the IS file generated by the TSMPP with adjustments in WO for TAD OV.	38,390	12/2/07
TSM_V6F7_CD1_AutoWO+9_Teleport_SGG_112707_RG_all.zip	All V6.0 RG run for the simulation.	6,833	12/4/07
Thermal_Test_Run 11-27-07.zip	Results of post-run thermal analysis that verifies this toll works and batch data from TSMPP is correct.	77,206	12/3/07
BatchInfo_V6_CD1_SGG_101707.CSV	Batch info from TSMPP.	1,235	11/30/07
Testing TSMCCLisa HallCompleted.doc	Test notes for full test of TSMCC functions.	82	12/10/2007