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User Manual for the Total System Model Version 6.0

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USER MANUAL FOR THE TOTAL SYSTEM MODEL VERSION 6.0

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FIGURES

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ACRONYMS AND ABBREVIATIONS

BSC	Bechtel SAIC Company, LLC
BWR	Boiling Water Reactor
CaS	Create-a-Soft
CD	Critical Decision
CHF	Canister Handling Facility
CI	Configuration Item
CIRG	Cask Information Report Generator
CM	Configuration Management
CMMP	Configuration Management and Maintenance Plan
COTS	Commercial Off The Shelf (software)
CRCF	Canister Receipt and Closure Facilities
CRD	CRWMS Requirements Document
CRG	Cost Report Generator
CRWMS	Civilian Radioactive Waste Management System
CSNF	Commercial Spent Nuclear Fuel
DLRG	Drift Length Report Generator
DOE	U.S. Department of Energy
DPC	Dual-Purpose Canister
DRG	Dose Report Generator
DOE SNF	DOE Spent Nuclear Fuel
DTF	Dry Transfer Facility
DVCG	DOE Valley Curve Generator
EIA	Energy Information Administration
EM	U.S. DOE Office of Environmental Management
FEIS	Final Environmental Impact Statement
FHF	Fuel Handling Facility
FMF	Fleet Management Facility
FTP	File Transfer Protocol
Gb	Gigabyte
GRG	GROA Report Generator
GROA	Geologic Repository Operations Area
GUI	Graphical User Interface
HASP	Hardware Against Software Piracy
HH	Heavy Haul
HLW	High-Level (radioactive) Waste

ACRONYMS AND ABBREVIATIONS (CONTINUED)

IAS	Integrated Acceptance Schedule
IHF	Initial Handling Facility
IMF	Intermodal Facility
IS	Initial State
JIT	Just in Time
LWT	Legal Weight Truck
Mb	Megabyte
MCO	Multi-Canister Overpack
MGR	Monitored Geologic Repository
MHz	Megahertz
MSC	MGR Site-Specific Cask
MTHM	Metric Tons of Heavy Metal
MTU	Metric Tons of Uranium, variable name in TSM assumed equal to MTHM
OCRWM	Office of Civilian Radioactive Waste Management (DOE)
OFF	Oldest Fuel First
PC	Personal Computer
PWR	Pressurized Water Reactor
RAM	Random Access Memory
RF	Receipt Facility
RG	Report Generator
RRG	Results Report Generator
SNF	Spent Nuclear Fuel
SSC	Site-Specific Canister
ST	State Line Crossing Charge Resource
TAD	Transportation, Aging, and Disposal
TCRG	Transportation Cost Report Generator
TCRRF	Transportation Cask Receipt/Return Facility
TSC	Transportable Storage Casks
TSLCC	Total System Life Cycle Cost
TSM	Total Systems Model
TSMCC	Total System Model Control Center

ACRONYMS AND ABBREVIATIONS (CONTINUED)

TSMAR	Total System Model Analysis Request
TSMCR	Total System Model Change Request
TSMPP	Total System Model Preprocessor
TSRG	Transportation Shipment Report Generator
TTRG	TAD Throughput Report Generator
USB	Universal Serial Bus
VAT	Value Added Time
VB	Visual Basic code
VCG	Valley Curve Generator
VSM	Value Stream Map
WA	Waste Acceptance
WAST	Waste Acceptance, Storage, and Transportation
WHF	Wet Handling Facility
WO	Work Order
WP	Waste Package
YFF	Youngest Fuel First

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1. INTRODUCTION

The Civilian Radioactive Waste Management System (CRWMS) Total System Model (TSM), a Level 3 software, is a planning tool that estimates the logistic and cost impacts of various operational assumptions in accepting radioactive wastes. Waste forms currently tracked are commercial spent nuclear fuel (CSNF), Department of Energy (DOE) spent nuclear fuel (DOE SNF), Naval SNF, and high-level (radioactive) waste (HLW). The TSM simulates the actions for Waste Acceptance (WA) from discharge to emplacement.

The TSM is a Personal Computer (PC)-based, user-friendly, systems model that provides easy to understand Graphical User Interface (GUI) with dynamic simulation screens to serve as a decision aid for overall Office of Civilian Radioactive Waste Management (OCRWM) disposal objectives. The TSM is:

- a real-time process simulation model that achieves the established requirements and provides a rapid means to evaluate alternative approaches to achieve program and project goals,
- based on established process optimization tools and methods, usability and accepted system analysis techniques; and
- an end-to-end model with interaction of WA, transportation, and repository parameters and constraints.

As shown in Figure 1, the functional design of the TSM is to integrate the elements of the CRWMS mission. Figure 1 shows the functions after complete development. Currently most, but not all, of the systems analysis results are implemented.

The TSM described in this version of this manual is TSM Version 6.0. Version 6.0 is based on enhancements and revisions made to the previous TSM Version 5.0 and implements the so-called Critical Decision (CD) -1 design for the Geologic Repository Operations Area (GROA). Section 1.5 describes the major changes for TSM Version 6.0. See Section 1.5 for a description of the changes.

1.1 PURPOSE OF THIS MANUAL

This user manual covers the setup and use of the TSM to understand the overall systems behavior of the main elements of the CRWMS mission. This manual provides high-level information and instructions to use the TSM for evaluation. The intent is to provide information for the casual user or observer of the TSM but there are some areas that cover topics intended for advanced users as noted. This manual is complemented by many other documents (see Figure 2 and BSC 2007b through BSC 2007m) that should be consulted to understand the TSM and the associated logic and use in more detail. The *Total System Model Version 6.0 Validation Report* (BSC 2007h) confirms there are no major differences in Version 5.0 and Version 6.0 simulation results except for the expected differences caused by the new CD-1 GROA design.

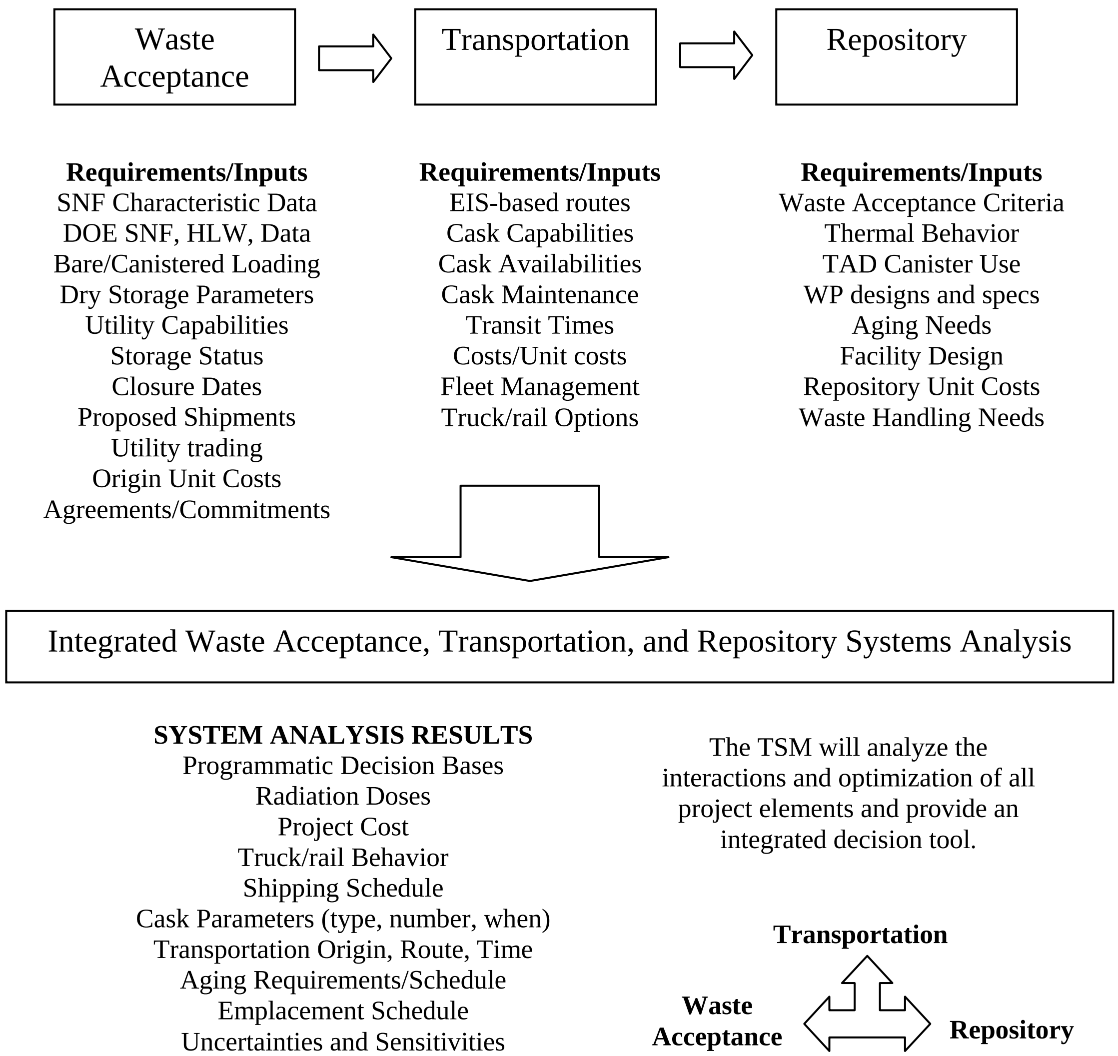


Figure 1. TSM Functional Design

Modules for the main CRWMS elements are integrated to provide a tool for systems analysis and decision-basis development.

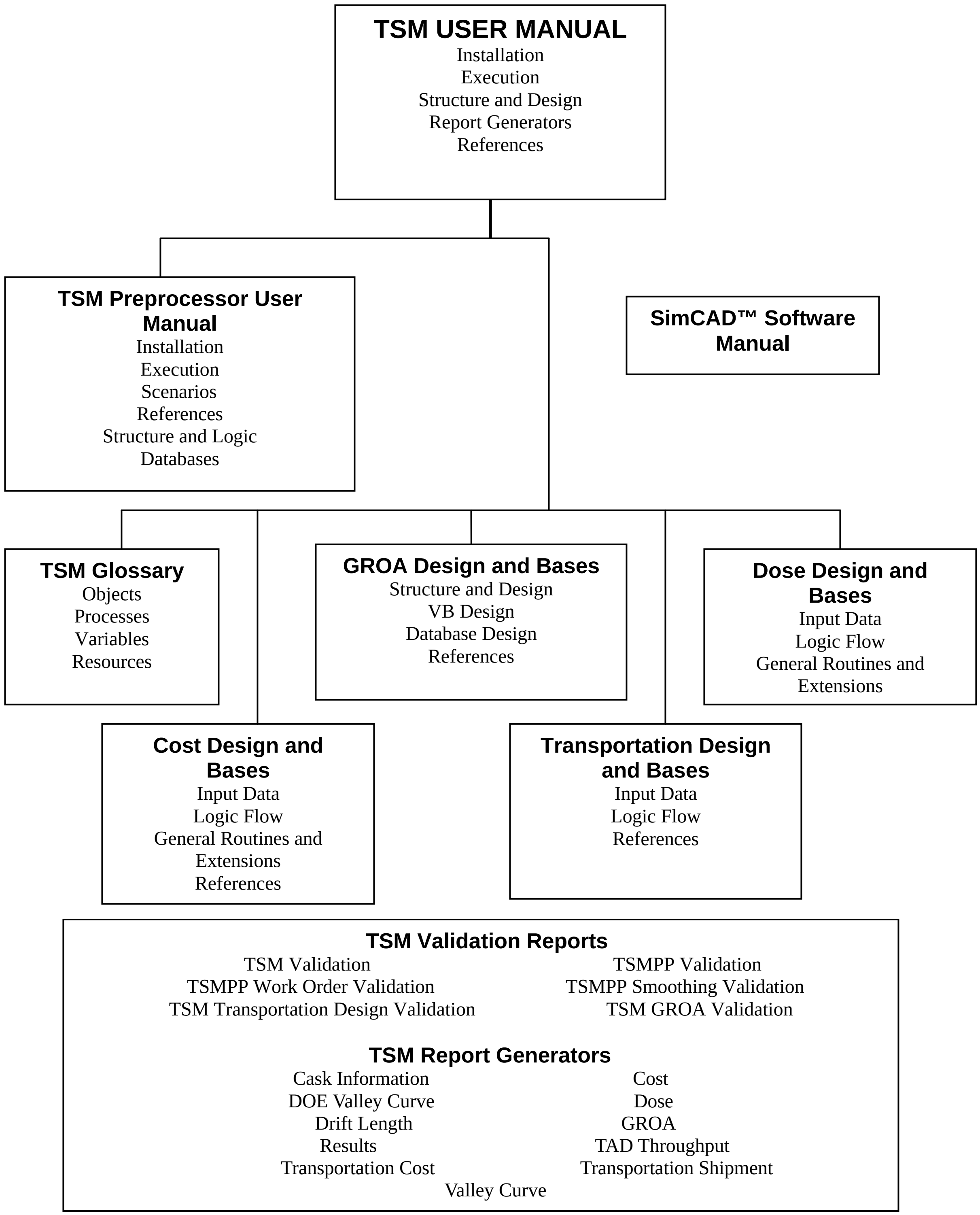


Figure 2. TSM Documentation Structure

The TSM documents are structured to provide additional details in lower tier documents to suit the user's needs.

Using this manual, a user should be able to setup and install the TSM and make runs of the basic scenarios, and view results as described in Sections 1 through 3. Sections 4 and 5 provide more detailed information to allow users a deeper understanding of TSM and how the TSM simulates OCRWM mission elements. The information presented explains the characteristics of the mission elements and how the elements are abstracted into the TSM. Section 6 provides guidance on using the TSM for systems analyses. As with any sophisticated systems model, full understanding depends on the user initiative to open and use the TSM.

The other documents shown in Figure 2 can then be used for deeper understanding. After using this manual, the user may want to proceed to more sophisticated changes and analyses depending on the level of expertise and interest. Refer to AP-ENG-005 Revision 1 ICN 0, *Total System Model (TSM) – Usage* for how changes to the TSM are permitted based on user expertise.

SimCAD™ from Create-a-Soft™ (CaS) was selected as the commercial software tool based on a review of several software products. SimCAD™ is specifically designed for "top down" modular structures to allow progressive development of the overall logic and interactions as the project progresses and programmatic details are available. The SimCAD™ Users' Manual (CaS 2006) is an important complement to this manual as it describes exactly how to use the detailed features of the SimCAD™ computer simulation program. Therefore it is recommended that the software manual be used along with this manual for users that want to make changes to the program using the various drop down menus or other more sophisticated changes.

1.2 FUNCTIONAL OVERVIEW

The TSM design is shown in Figure 3. The TSM is based on a modular structure for the core program functions and requirements that are integrated by an end-to-end systems analysis. The modular structure allows independent "top down" analysis in each core module and integrated analysis using the TSM. This provides the flexibility for each core program element to continue their design and implementation projects and tasks in parallel with the TSM development and implementation.

As indicated in Figure 3, a "Black Box" technique is used for unit operations where the details are not yet available or the details are below the interest level for the TSM simulation. As an example of black box approach, the project is performing detailed time and motion studies and throughput analyses for the GROA facilities. These analyses evaluate processes and operations at the minute time-scale. However, the TSM will not include the detailed logistics nor the time and motion process design for the GROA at such small time intervals. The activities in the GROA evaluated in minutes are "rolled up" to suit the 8-hour time steps used in the TSM simulation.

The complete TSM consists of two separate programs to simulate the CRWMS mission: the TSM Preprocessor (TSMPP) and the TSM simulation. As shown in Figure 4, the TSM incorporates various elements to form a comprehensive systems analysis tool. The general approach for using these program elements to perform system assessments is shown in Figure 5. Various studies (BSC 2005, BSC 2006a, BSC 2007a) and their supporting calculations are also excellent references to show how the TSM is used to perform comprehensive system studies and typical results.

Thermal properties of the CSNF influence the actions and handling at many points in the CRWMS and the TSM covers the thermal characteristics from reactor discharge to emplacement. As shown in Figure 6, the TSM includes thermal constraints related to WA at the waste sites, transportation cask thermal limits, and emplacement thermal constraints. The TSM tracks the heat for each assembly from discharge to the reactor pool to final emplacement at the repository. So, the assembly heat is available at all points in the simulation where thermal constraints are implemented. With this beginning-to-end approach, the TSM assures that thermal constraints and system behavior are modeled with high fidelity and the repository thermal characteristics at emplacement are known.

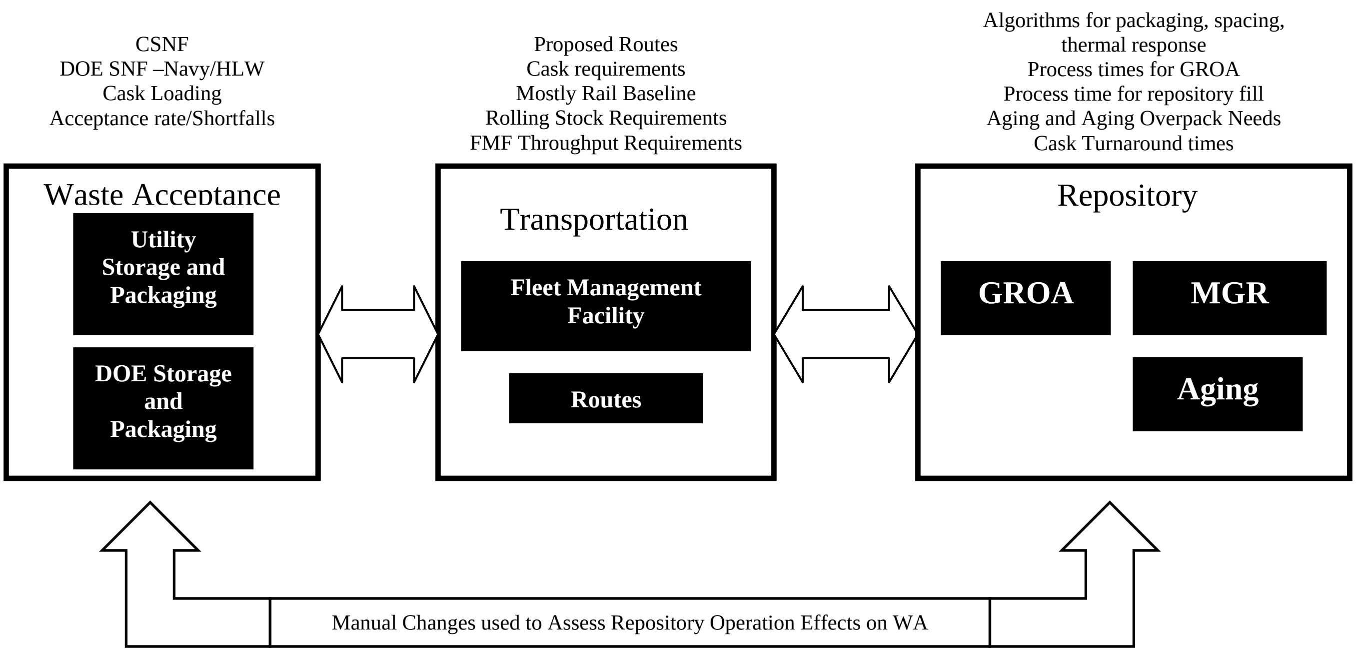


Figure 3. TSM Logic Functions and Modules

The primary CRWMS WA, Transportation, and Repository are integrated. The black boxes represent functions where the TSM uses "rollups" of the results of more detailed models and analyses to set the TSM simulation parameters such as process times.

The "feedback" shown includes manual changes to the analysis parameters to evaluate the system behavior in an iterative process to observe changes and effects. See Section 3.2 for more information on making these changes.

Note: The term "repository" means all the collective facilities and operations at the emplacement site. The term "GROA" is applied to the facilities and actions that are applied just after a shipment enters the security gate to the point where the loaded Waste Packages (WPs) are sent for emplacement. The GROA includes the aging pads. The term "Monitored Geologic Repository (MGR)" is applied to the actions after the WPs are dispatched from the GROA facilities and includes the drifts.

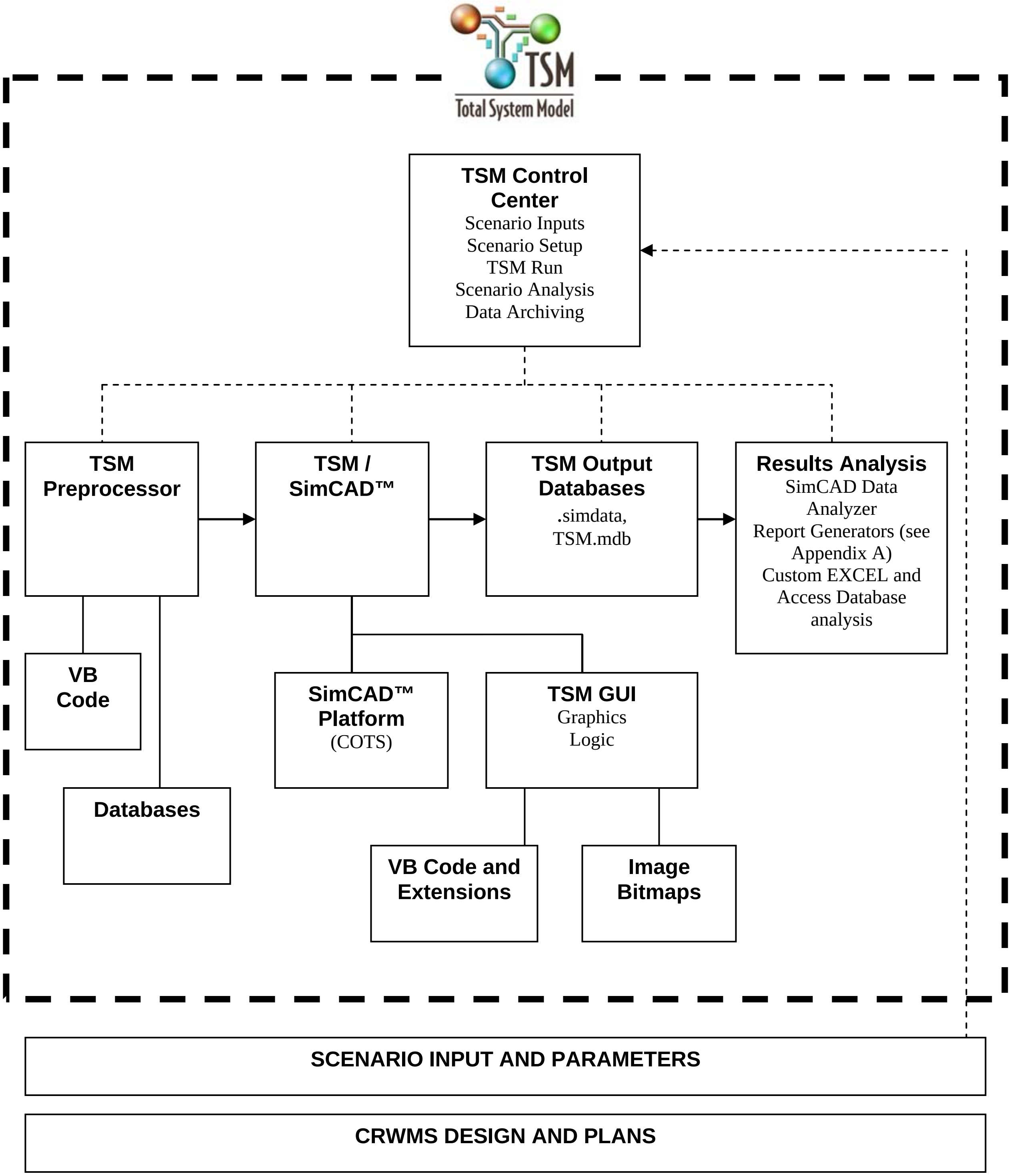


Figure 4. TSM Operating Elements

The TSM includes various programs, databases, and output files that collectively form the systems analysis capability. The key component is the SimCAD™ Commercial Off–The-Shelf software (COTS) and the other elements are designed with SimCAD™ as the central interface. CRWMS functional plans and the scenario inputs and parameters provide constraints and inputs for the TSMPP and the TSM. The TSM Control Center (TSMCC) provides a user-friendly GUI to control the key TSM elements and is designed to standardize the way in which TSM runs are created, archived, and analyzed.

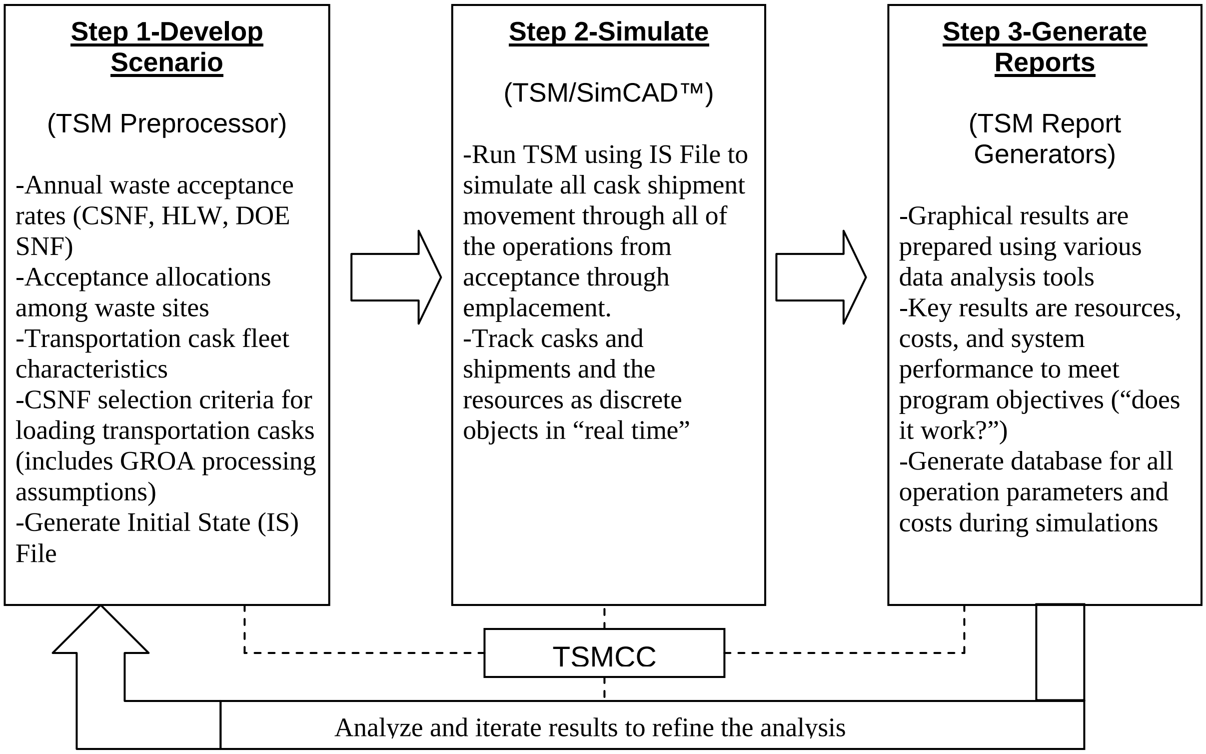


Figure 5. TSM System Analysis Steps

The overall system analysis has sequential steps to develop the scenario per the requirements of an analysis plan developed for the study, simulation of the scenario, and report generation and analyses to meet the objectives of the analysis plan. Developing the plan is the key step to successful system analyses.

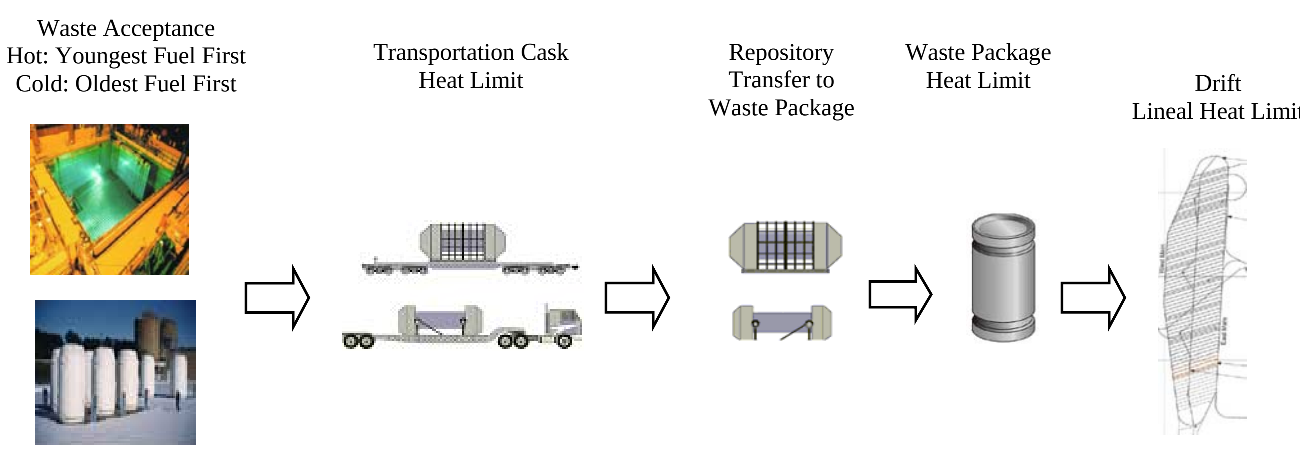


Figure 6. SNF Thermal Considerations

The TSM includes end-to-end thermal requirements from reactor discharge to emplacement.

1.2.1 TSMPP Description

The TSMPP provides the waste shipment schedule in EXCEL that is input to the TSM and drives the TSM simulation. The TSMPP uses the existing waste inventories to develop the cask loads for shipments and the target dates for the shipments from all of the waste sites based on user-input parameters for waste allocations, priorities, mission needs, and waste properties. The main result from the TSMPP is the Initial State (IS) file that represents the shipment schedule and drives the TSM simulation as shown in Figure 7. For more information on the TSMPP, consult the TSMPP User Manual (BSC 2007b).

The TSMPP models a variety of different types of dry storage casks at the reactors and the transportation casks used at the reactors and DOE waste sites. Various casks and canister technologies, such as Transportable Storage Casks (TSCs), Dual-Purpose Canisters (DPCs), and Transportation, Aging, and Disposal (TAD) canisters can be simulated. TAD canisters will not be opened on arrival at the GROA but will be placed in a WP or placed in an overpack for aging. Because the TAD canisters are not opened, the CSNF assembly itself is handled only once at the initial loading at the waste sites and the surface facilities remain "clean" as they are not exposed to the CSNF or the potentially contaminated TAD canister internals.

Fuel can be accepted in an Oldest Fuel First (OFF) methodology or in a Youngest Fuel First (YFF) greater than or equal to a specified year methodology. In addition, a priority acceptance rate can be specified, which can be used to accept fuel from overflowing pools and/or from shutdown facilities. See the TSMPP User Manual (BSC 2007b) for further explanation.

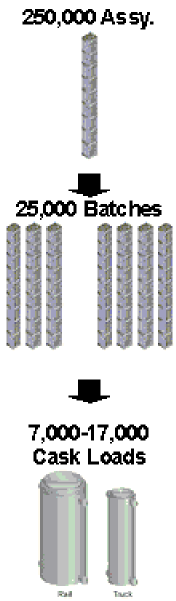
The algorithms and code in the TSMPP are deterministic and the waste loads include full consideration of the CSNF assembly element heat history from the time of reactor discharge to the time of loading. The TSMPP output is a list of cask shipments that represents all the CSNF and DOE wastes in the mission and these are input to the TSM simulation model. Typical scenarios include 300,000-500,000 commercial spent fuel elements that will be placed in 9,000-15,000 CSNF cask loads depending on the cask fleet and other scenario parameters. There are typically an additional 3,500-5,000 DOE SNF and HLW cask loads.

The TSMPP provides information that describes if, how and when assemblies will move from SNF pools to dry storage at reactor sites and then be transported to the MGR. The source data used by the TSMPP currently includes the following:

- CSNF – current inventories provided by the Energy Information Administration (EIA), coupled with future discharge projections based on current industry trends for commercial fuel.
- DOE SNF and HLW - inventories provided by an Integrated Acceptance Schedule (IAS) prepared by the U. S. DOE Office of Environmental Management (EM).

Note that the versions of the source data used are updated periodically. Scenario-specific parameters can be specified by the user for fuel selection rules, dry storage options, inventory management, and cask capacities. The details for the data to be used and TSMPP set up options are specified in the analysis plans for each system study or TSM analysis request (TSMAR).

HLW, DOE SNF, Navy



Process Connection	Object	Status	Count	Start Time	Elapsed	Create Bat	ObjectID	ParentID	Linked	Del	Buffer Typ	Cask ID	Cask_Sour	CritHeat	Crit	Heat1	Heat2	Heat3
GA-4	T-GIN	0	1	12	0	0	0	0	0	0	PWRTruck	CASK6	POOL	0	0	0	0	0
GA-9	T-INLB	0	1	12	0	0	0	0	0	0	BWRTruc	CASK1	POOL	0	0	0	5	0
HS-100B	R-INLP	0	1	12	0	0	0	0	0	0	PWRBuffe	CASK26	POOL	0	0	0	29	3
HS-HBCAN	D-HUM	0	1	12	0	0	0	0	0	0	DPCBWR	CASK242	DRY	0	0	36	14	0
HS-HBCAN	D-HUM	0	1	12	0	0	0	0	0	0	DPCBWR	CASK242	DRY	0	44	66	2	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0	DPCPWR(	CASK221	DRY	0	5	5	0	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0	DPCPWR(	CASK221	DRY	0	26	26	0	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0	DPCPWR(	CASK221	DRY	0	22	22	1	2
NAC-STCcan	D-HAD	0	1	21	0	0	0	0	0	0	DPCPWR(	CASK221	DRY	0	11	0	15	10
TN-BRPwv	R-WVB	0	1	42	0	0	0	0	0	0	BWRCritB	CASK62	POOL	0	42	8	36	0
GA-4	T-GIN	0	1	54	0	0	0	0	0	0	PWRTruck	CASK6	POOL	0	0	0	0	0
TN-REGwv	R-WVP	0	1	63	0	0	0	0	0	0	PWRCritB	CASK63	POOL	0	20	20	0	0
TN-REGwv	R-WVP	0	1	63	0	0	0	0	0	0	PWRCritB	CASK63	POOL	0	20	20	0	0

TSMPP IS EXCEL Output (partial)

Figure 7. TSMPP Function

The TSMPP uses databases with the various information for WA in a logic for CSNF that properly combines fuel aging, utility allocations, and transportation cask parameters to develop the cask loads and associated schedule for the cask load shipments. The TSMPP models how the 250,000 or more CSNF assemblies can be combined into "cask loads" depending on the acceptance scenario. The sequential EXCEL list of cask load shipment parameters and target ship date ("Start Time" in time steps) are the main input to the TSM. The individual cask loads are input to the TSM as objects in the "Object" column. The data above is input with each object and is carried by the object as it progresses through the simulation. See the TSMPP User Manual (BSC 2007b) for the object definitions.

The TSMPP also utilizes the following parameters in modeling SNF and HLW movement:

- System Operating Rules
  - Annual rates for shipping fuel from reactors/DOE sites to the repository
  - Minimum CSNF aging times

- Acceptance Rights (method by which the annual CSNF acceptance rate is allocated among the various storage locations)
  - Based on discharge order of waste (i.e., OFF)
  - Option to grant priority acceptance for pool overflow conditions and decommissioning activities
  - Option to share allocations among reactors owned by a utility
  - Option to specify annual allocations at specific pools

- CSNF Selection
  - Total accepted based on acceptance rights
  - Particular assemblies accepted determined by user-selected criteria (OFF, YFF greater than year x, Strict YFF, thermal limits, burnup/enrichment limits)
  - Option to "zone load" transportation casks
  - Option to accept casks from the dry storage pad First In – First Out or Last In-First Out order
  - Option to preferentially accept TAD canisters from the dry storage pad
  - Option to accept DPCs on or after a specific date, or to accept DPCs only from sites shut down on or before a specific date

- Reactor Management
  - Option to unload shutdown sites and to specify the number of years after shutdown to wait before unloading
  - Option to give priority to shipment of fuel from dry storage versus shipment of fuel from the pool

- Cask Specifications
  - Heat limits
  - Capacity (assemblies or canisters/cask)
  - Cask loading priority sequence
  - Burnup/Enrichment curves
  - Cavity length.

The TSMPP models the discharge of CSNF assemblies into storage pools. If a pool overflows (exceeds available capacity), an appropriate number of assemblies are selected, based on input parameters, and are moved to onsite dry storage. Assemblies remain in dry storage, or in the pool, until accepted by the CRWMS. Once accepted, the assemblies are loaded into transportation casks and sent to the MGR for final emplacement.

1.2.2 TSM Simulation Description

The TSM is a planning tool that estimates the logistic and impacts of various operational assumptions in accepting radioactive wastes. TSM tracks wastes from discharge until emplacement and calculates the various costs associated with onsite storage, transportation, and emplacement. TSM also provides logistic information regarding CRWMS, including information relative to the waste stream movement and the system resources required to accomplish that movement.

The TSM is an “event driven” simulator, which means that the program models movement of objects in a sequentially connected series of processes or activities based on the events that occur. The main event that occurs in the simulation is that the “time” of the simulation is continuously incremented in 8-hour time steps. Each time step is an event and the TSM programming may indicate that certain actions should occur. For example, if the time step corresponds to a time when the CRWMS is to accept waste from a site, the object representing this waste is input to the model. When the waste enters the simulation, the process where the waste enters initiates an event (or trigger) that signals a cask distribution process to send a cask to the process. Eventually, the simulation is a complex series of events and actions for the various objects to accomplish the mission. For the TSM, the time steps are in 8-hour increments. The simulation progresses through the 8-hour steps until all waste cask loads are shipped, the cask loads and TAD canisters are processed into WPs, and the WPs are emplaced.

1.3 ASSUMPTIONS AND LIMITATIONS

The model described in this document is based on conceptual CRWMS plans and designs. Due to the preliminary nature of these plans and designs, it was necessary to make assumptions during the development of this model concerning detailed CRWMS operations. It is expected that many of these assumptions will be revised as the CRWMS facility designs and concept of operations are further developed. This section covers high-level assumptions; detailed assumptions for the TSM are covered throughout other sections.

The assumptions and inputs cover the main areas of the CRWMS: WA, transportation, and repository/surface facilities. The assumptions and inputs used in the analyses are coordinated with each of the mission elements and are based on more detailed analyses and/or data prepared by the mission elements and the requirements for the mission elements. For example, the processing times for the surface facilities in the TSM are based on more detailed systems analyses of the surface facilities when available.

The assumptions are also consistent with the existing regulatory bases when appropriate. For example the assumed transportation routes are based on considerable technical review and analysis of potential routes as part of the Final Environmental Impact Statement (FEIS) process to identify routes. The TSM can also handle alternate routes to those in the FEIS but the established FEIS routes are used for the initial TSM analysis.

The assumptions are as “realistic” as possible because the data are the best information available recognizing that there are uncertainties over the mission times that cannot be resolved. For example, during the next 50 years the overall fuel cycle strategy in the US may shift to reprocessing vs. the current "once through" strategy and this will change the waste stream content (and thermal properties) significantly. The key point is the CRWMS program and the TSM are capable of handling changes in the waste stream or other changes in the infrastructure that supports the CRWMS mission.

The TSM is a simulation model based on abstractions of actual physical processes and activities and must be considered as an approximation for the predicted behavior of a complex system.

TSM results show run-to-run variations because it does not run the processes in the same sequence run-to-run. This causes the results of the same run input to be slightly different because the trigger actions in SimCAD™ are so complex. The differences are small (for example the number of WPs produced (14,000) may vary by ±5) and are well within other uncertainties inherent in the assumptions about conditions and circumstances well into the future. Refer to the Phase 1 TAD Study Backup Calculation 5 (BSC 2006d) for more discussion of run-to-run variations. These are also the variations typically observed with TSM Version 6.0.

1.4 QUALITY ASSURANCE

The TSM and all associated documentation will not be used to drive the design or the regulatory basis for CRWMS and therefore have been determined by Bechtel SAIC Company, Limited Liability Corporation (BSC) to be "non-QA." The model is checked and peer-reviewed using non-QA procedures for calculations and software.

The TSM is maintained in accordance with the TSM Configuration Management and Maintenance Plan (CMMP, BSC 2007p). Changes to the TSM, unless temporary (for instance to address requirements for a specific assessment), are made in accordance with procedure AP-ENG-006.

1.5 MAJOR CHANGES FOR TSM VERSION 6.0

This section summarizes the major changes for the TSM Version 6.0. More detailed changes are discussed in the lower tier documentation in Figure 2. For example, changes for the cost elements are in BSC 2007e. The TSM Version 6.0 validation report (BSC 2007h) and its associated electronic attachments show all the changes in the model, extensions, report generators (RG) and visual basic (VB) code in detail. The changes from TSM Version 5.0 to Version 6.0 are summarized below:

- The main changes are updating the process line configurations in the GROA to the so called "CD-1 design" that replaces dry processing lines to transfer individual assemblies to a 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 SNF. The GROA design information was from September 2006 as described in references BSC 2006b, BSC 2007n, and BSC 2007o.
- 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 CSNF casks and are not diverted to aging (there are few TSCs).

- Site-Specific Canisters (SSC) and MGR Site-Specific Canisters (MSC) were removed in TSM Version 6.0 since they are no longer used-TAD canisters are now used. However, these acronyms may still appear in some variables and processes that are retained for potential future use or where the change would have caused many changes in flow down logic requiring major re-check of code.
- 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 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 SNF and HLW wastes in the IS file are in the proper ratio to make co-disposal WPs. Unsmoothed streams often require long waiting times for DOE wastes at the GROA to achieve the proper waste quantities. See Reference BSC 2007l for more information.
- A variable DSNF_Mismatch and an algorithm were 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 HLW (which is the typical case for "full inventory" waste streams). DSNF_Mismatch handles the case where there is too much DOE SNF (which is the typical case for 70,000 MTHM waste streams). (The TSM validation showed that the DSNF_Mismatch algorithm causes some simulation problems and even though it is implemented, it should be used with great care; 'teleporting" should normally be used instead, see Section 4.1.3.)

- 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. See Reference BSC 2007e and BSC 2007g.
- The RGs (see Appendix A) were revised and revalidated to account for the changes listed above. New RGs for transportation cost, transport shipments, and DOE valley curves were developed, validated and issued (see Section A.10 through A.12).

There are cases where the TSM Version 6.0 changes could allow the removal of some TSM objects, variables, triggers, etc. but these elements remain in the model. This is to allow possible future use and also because it appears that as items are deleted that SimCAD™ does not always clear the information and leaves “debris.” Although it is not expected that this debris may cause problems (such as eventually hitting a “memory ceiling”) the TSM developers have decided to leave these elements in. These elements will not be evident to the typical user but there may be cases where items are seen in detailed outputs. Processes that are not active are usually changed to appear only in the Value Stream Map (VSM) GUI view so they are not visible during the simulation.

1.6 UNRESOLVED ISSUES

As the TSM testing and validation was performed, several issues were noted that have not been resolved. These do not impact the usefulness of the results but users must keep these in mind while running and analyzing results:

- The TSM/SimCAD model has some fragility issues.
  - Testing showed that if the model is saved after completing a run the model is often saved with errors in routers or connectors. Users should not save the model when prompted at shutdown and keep a pristine version of the model to use for runs.
  - If the TSM simulation is running, navigating and “clicking around” the GUI to review results often causes the simulation to irretrievably lock up. The user should pause the simulation to review interim results during a simulation then continue the simulation after review.

- It is complicated to set up DOE waste streams to provide proper numbers of DOE SNF and HLW to make Codisposal WPs and also to have streams with cask arrivals to achieve timely WP filling (see Section 4.1.3). Various algorithms devised to handle the DOE waste stream have not been completely effective reducing the complexity. Until the DOE waste stream is more suitably defined, DOE streams for simulations to be used in documented analyses should be set up by the TSM Developer’s Group.

- Simulations are limited to about 148,000 time steps (about 135 years) because TSM/SimCAD reaches an undetermined memory limit.

2. INSTALLATION

2.1 HARDWARE AND SOFTWARE REQUIREMENTS

In order to install and run the TSM the following minimum setup is required:

- Operating System – Windows 98 or Windows 2000 or Windows XP,
- One Gigabytes (Gb) random access memory (RAM) - two Gb or higher is recommended,
- Free Hard Disk Space – Approximately 500 Megabytes (Mb),
- Support Software
  - Microsoft Access 2000 or Access 2003,
  - MS EXCEL,
  - WinZip utility, and
  - .NET Environment 1.1 (installed with Windows XP, install via download for other operating systems[1].

The PCs used for TSM development have 3,000 Megahertz (MHz) dual processors with 2.0 Gb RAM. Dual video cards with dual screens are suggested for advanced users that need to view variables (triggers) simultaneously with the GUI. Laptops with 1 Gb of RAM and 1,190 MHz single processors have also been successfully used but are 2-3 times slower. On fast PCs with dual processors and powerful video cards, full runs of 20,000 cask load shipments over 60-70 years using the TSM 8-hour time steps and writing data every 270 time steps requires about 12-14 hours. Less powerful PCs may require several days.

Microsoft Access is not necessary to run TSM; however, it is needed to view the database file in which the input data is stored (if desired). In addition, some input data (e.g., cask and site parameters) for the TSMPP can only be modified using Microsoft Access.

The placement of the files and templates into directories is discussed in the installation sections below.

2.2 SIMCAD INSTALLATION

System administrators can install SimCAD™. SimCAD™ is identified as Level 3 software in the BSC Controlled Software Report and has BSC software ID 611356. Version 7.1 for use with TSM Version 6.0 is 611356-7.1-00. The installation includes the SimCAD™ executable simulator and the SimCAD Data Analysis tool (see Section 5). The installation also includes various training tools and help information. The files are installed in a “SimCadPro” directory in the system local hard drive (assumed to be C: in discussions below). The installation also adds a

[1] http://www.microsoft.com/downloads/details.aspx?familyid=A8F5654F-088E-40B2-BBDB-A83353618B38&displaylang=en

“SimCadPro” group to the Windows start menu “Programs” directory to provide easy links to the SimCAD™ Programs and documentation.

The PC must have access to a Hardware Against Software Piracy device (HASP) to enable the SimCADPro™ software tools. Standalone versions of SimCAD™ must have a HASP inserted into the Universal Serial Bus (USB) port. Network users of SimCAD™ must have appropriate protocols and proxies to “see” the HASP that is installed somewhere on the local network. Local Administrators must assist to properly install the network HASP and connect.

After installation, the TSM and IS file provided as a test case that can be run to ensure that SimCAD™ is properly installed. Running the test case is the “first run” that will be performed by most users. Running the test case is covered in Section 3.1. The IS file in the installation package is similar to Scenario 8A from the phase 1 thermal envelope study (BSC 2007a).

The SimCAD™ version and build currently in use and addressed by this manual are indicated in the “Change History” table at the beginning of this manual.

2.3 TSM INSTALLATION

The suite of TSM programs, databases, tools, and documentation is available from the TSM CM Representative as prescribed in AP-ENG-005. The BSC software identification number is 50400. The suite of software, programs, templates, and supporting files for the TSM consists of several .zip files, with the following files:

- a “read first” instruction file that discusses how to update the files and the latest changes (Readme.doc),
- the latest TSM.mdb template for the Access TSM output data file (TSM.mdb),
- the latest .sim file with the test TSM model (TSM V6.0_71.sim),
- IS files for testing that the TSM is properly installed (IS V6_CD1_101707.xls),
- image files for the bitmaps that are used for the TSM GUI (TSM bitmaps.zip),
- the TSMCC (TSMCC.zip),
- tsm_v6.xml for installation testing (tsm_v6.xml),
- SimcadXML.xslt file for generating the run sheet (SimcadXML.xslt)
- TSMPP and associated database (TSM PreProcessor.zip),
- TSM RGs (TSM Tools.zip), and
- TSM UM, the TSMPP UM, and the SimCAD Users’ Manual (TSM Documents .zip).

Step 1: TSM Model Installation - Place the TSM file TSM_V6.0.sim under the C:\SimCadPro (created when SimCAD™ was installed). The TSM file is large, more than 90 Mb. This model is configured for testing that the installed TSM runs.

Step 2: TSM.mdb Template Installation - Place the TSM.mdb under the C:\SimCadPro directory. The TSM.mdb file is used to record information about the WPs and TAD canisters as they are created in the WP filling simulation.

Step 3: IS File Installation - Place the test EXCEL IS file V6_CD1_101707.xls in the C:\SimCadPro for use and reference. This IS file is provided for testing that the installed TSM runs.

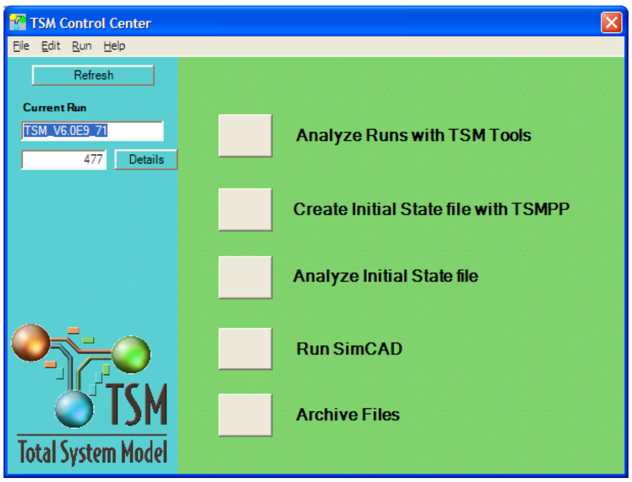
Step 4: Bitmap Installation - Place the TSM_Bitmaps.zip file under the C:\SimCadPro directory. Use the WinZip Extract button to extract all the files into the current directory. This button will automatically create a new directory C:\SimCadPro\TSM Model\TSM bmp and place all the image files into this new directory.

Step 5: TSM Report Generator Installation - Place the TSM Tools.zip file under the C:\SimCadPro directory. Use the WinZip Extract button to extract all the files into the current directory. This button will automatically create a new directory C:\SimCadPro\TSM Tools and place all the RGs into this new directory. The RGs (also referred to as "TSM Tools") are described in Section 5.3 and Appendix A. RGs are self-contained EXCEL workbooks with macros.

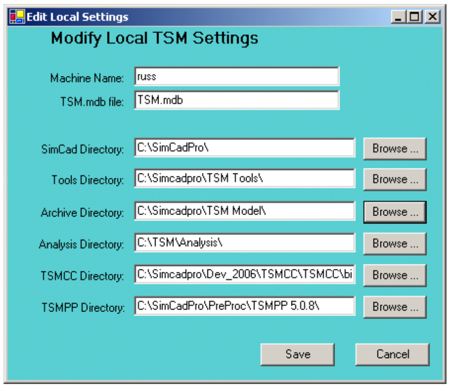
Step 6: TSMCC Installation - This step places the TSMCC files on your PC then sets the TSMCC configuration file to reflect the local directory structure:

1. Place the TSMCC.zip file under the C:\SimCadPro directory. Use the WinZip Extract button to extract all the files into the current directory. This button will automatically create a new directory C:\SimCadPro\TSMCC and place all the TSMCC files into this new directory.
2. Double-click the TSMCC.exe file to install the application. The TSMCC main menu shown below will appear.

TSMCC Windows Toolbar



3. From within TSMCC, select the menu option **Edit** from the TSMCC windows toolbar and select the option "TSMCC Settings" to open the "Edit Local Settings" screen. Assign your PC a name that will be used to identify runs that you make (first or last names are often used). File names created by TSMCC will include the PC name information.



3a. The TSM.mdb file should be designated "TSM.mdb"

3b. Browse and select directories for other file locations. Some new directories are required as noted:

- SimCAD™ Directory: C:\SimCadPro
- Tools Directory: C:\SimCadPro\TSM Tools
- Archive Directory: C:\SimCadPro\TSM Model
- Analysis Directory: C:\SimCadPro\TSM Model
- TSMCC Directory: C:\SimCadPro\TSMCC
- TSMPP Directory: C:\TSM PreProcessor

Note: The user may change the location of the archive and analysis directories in the future as described in Appendix B, Section B.3.2. This setup supports the test run of the TSM/TSMCC in Section 3.1.1.

4. Place the tsm_v6.xml in the **C:\SimCadPro** directory.

5. Place the SimcadXML.xslt in the **C:\SimCadPro** directory.

NOTE: Versions of TSM.sim prior to TSM Version 5.0 cannot be automatically configured and run using the TSMCC; they must be run manually using the instructions in the TSM User Manual for Version 4.0 (BSC 2006e). However, "old" cases can be run in TSM Version 6.0 and the TSMCC can be used to analyze data files from previous versions. SimCADPro™ Version 7.1 is required to use the TSMCC and TSM Version 6.0.

Step 7: TSMPP Installation - Unzip the delivered file, TSMPP_mmddyy.zip, where mmddyy represents the date in mm/dd/yy format. The zip file contains installation files and a TSM Access database with the site and fuel information. Run setup.exe and follow the instructions and designate the directory C:\TSM PreProcessor for use (create this directory). See the TSMPP Users Manual (BSC 2007b) for more information on the TSMPP.

Step 8: TSM UM Installation – Appropriate sections of this user manual are linked to the “help” command in the TSMCC so this user manual has to be properly installed. Remove the TSM User Manual from the TSM Documents .zip file and place it in under the C:\SimCadPro directory. The other manuals can be placed in locations as desired by the user.

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3. EXECUTION OF THE TSM

This section describes how to run the TSM after the installation steps in Section 2 are completed. It also describes how to make changes to the TSM and how to generate IS files. Sequentially completing the actions in Section 3.1 introduces the user to TSM and also tests the TSM/TSMCC installation for running simulations and archiving data. Other TSMCC operations are discussed in Appendix B.

3.1 RUNNING TSM

This section describes how to perform and observe the test run, how to test the TSMCC archiving capability using the test run data, and how to perform a typical run using the TSMCC. Error messaging and debugging self-help are limited on TSM and TSMCC. If there are problems contact the TSM Developers Group Lead defined in AP-ENG-006.

3.1.1 Test Run and Run Observations

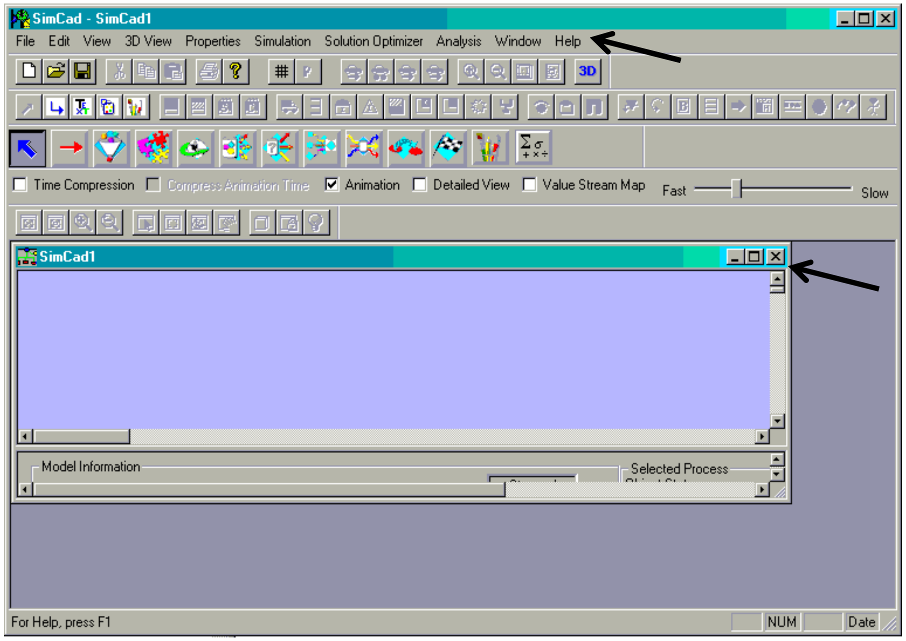
The run described in this section is the test run using the files installed in Step 6 of Section 2. This test verifies that the TSMCC is operating correctly on your PC.

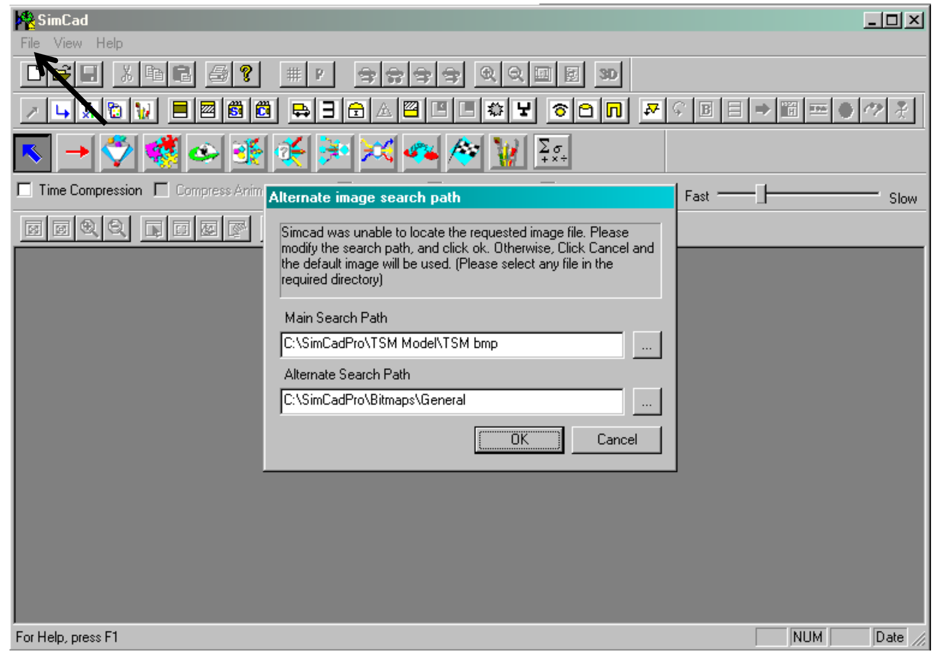
In preparation for the run, double-click on the tsm_v6.xml file in the **C:\SimCadPro\TSMCC** directory. Your web browser should open and display the contents of the tsm_v6.xml that will serve as a "run sheet" for the test case. Print the page and use it to record notes and observations on the test case.

The sequence for the test run is shown in Figure 8. These manual steps should only be needed one time; subsequent runs will use the TSMCC for these steps.

Once Step 6 in Figure 8 is complete, observe the run and allow the run to proceed to completion. For the test case the TSM should automatically pause at 70,000 steps (the test tsm_v6.xml instructed the TSM to pause at 70,000 time steps). At that point, the user can stop the simulation ("red car" in Figure 8, Step 6), shut down TSM/SimCAD™, and archive data as discussed in Section 3.1.2.

One main function of the SimCAD™ program and the TSM is to provide a GUI that indicates system behavior. While running the TSM there are a variety of visual indicators that provide the status of processes and objects and allow the user to assess the system performance. The most obvious visual indicator is the motion of the objects through the process. Examples of objects in the TSM GUI are shown in the GUI screenshots at the end of Section 4 and an example of the visual indicators is shown in Figure 9. Notice there are meters that indicate parameters like queue lengths and "stop lights" for GROA facility status, see the GROA Design and Bases (BSC 2007c).



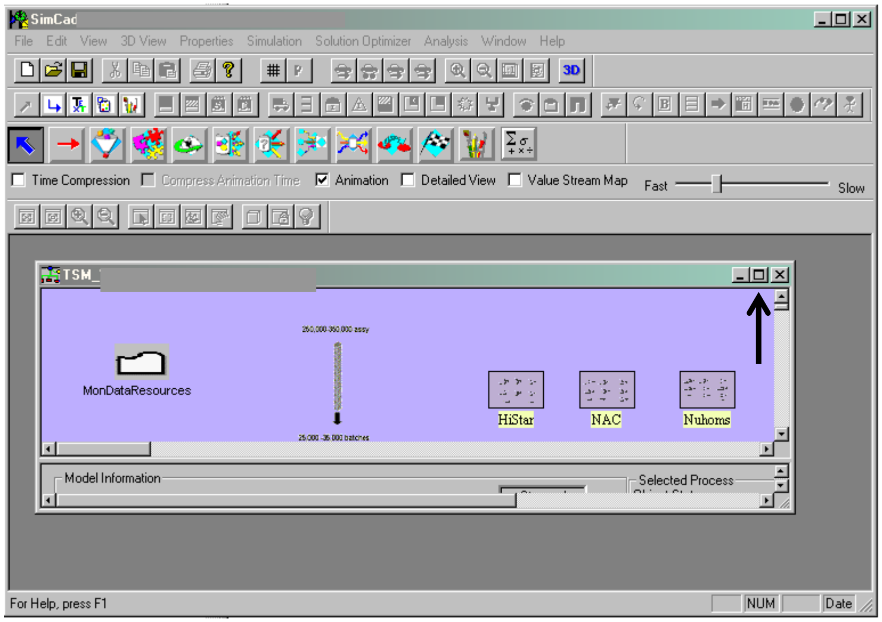


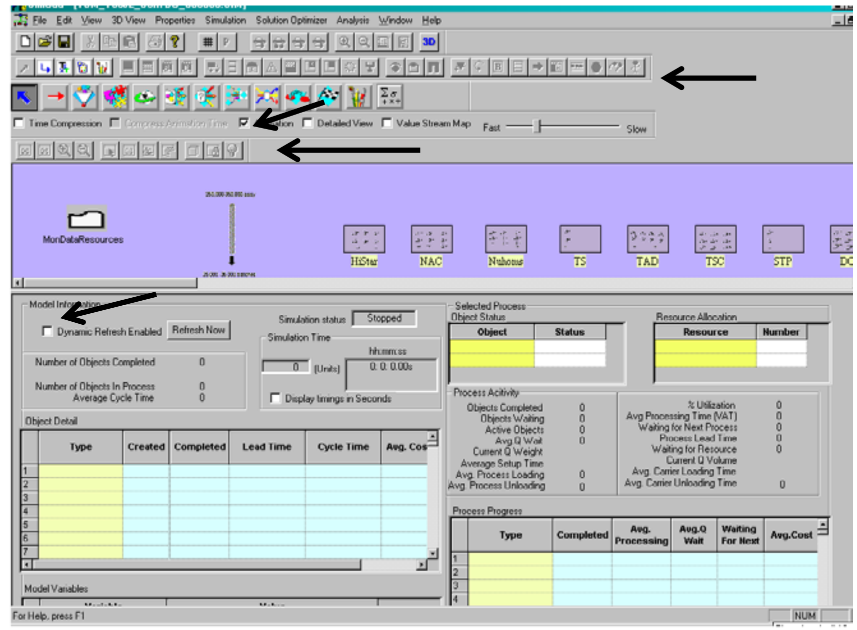
Step 1: Open the SimCAD™ executable file “SimCadPro.exe” from the SimCadPro directory. When first opened from the SimCAD file menu, the SimCAD™ screen appears as above. It opens with a default model that needs to be closed using the X button. Use the “Properties” selection in the “Help” menu to ensure the version is SimCAD 7.1. If not, the SimCAD™ application must be updated, see Section 2.2.

Step 2: Use the “file” menu to select and open TSM V6.0_7.1.sim under C:\SimCadPro\TSM Model. If all the bitmap images are not found a dialog box opens to locate the bitmaps used in the model. As discussed in Section 2, the bitmaps should be installed in C:\SimCadPro\TSMModel\TSM bmp. Browse and select the TSM bmp directory as the main search path. If properly installed, the TSM can locate the bitmaps and this dialog box does not appear. If it does appear, just click ok.

NOTE: The Windows “hour glass” display that is used in lieu of the cursor to indicate the system is busy often takes several seconds to appear in SimCAD™ operations.

Figure 8. Start and Loading of TSM: Test Case

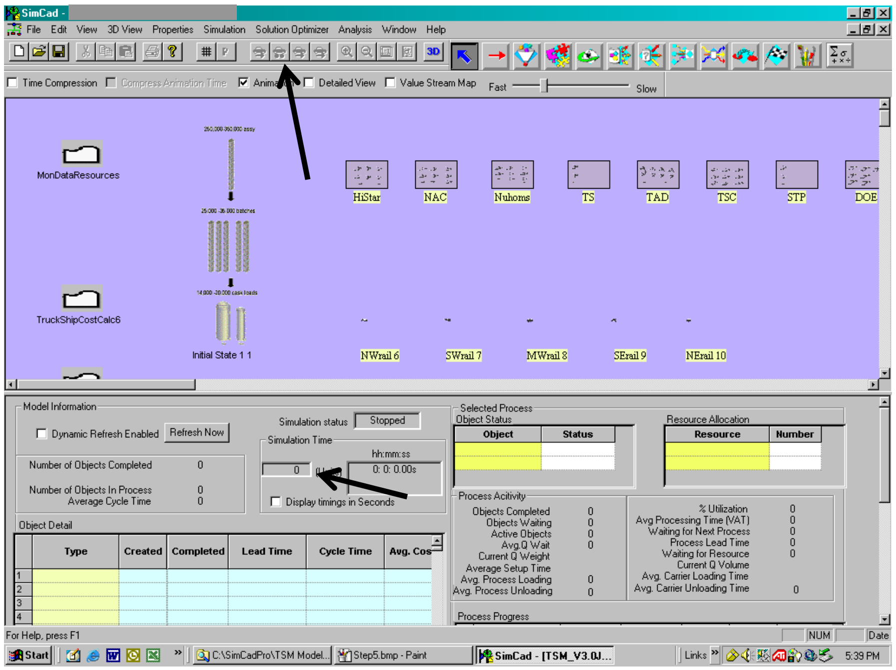


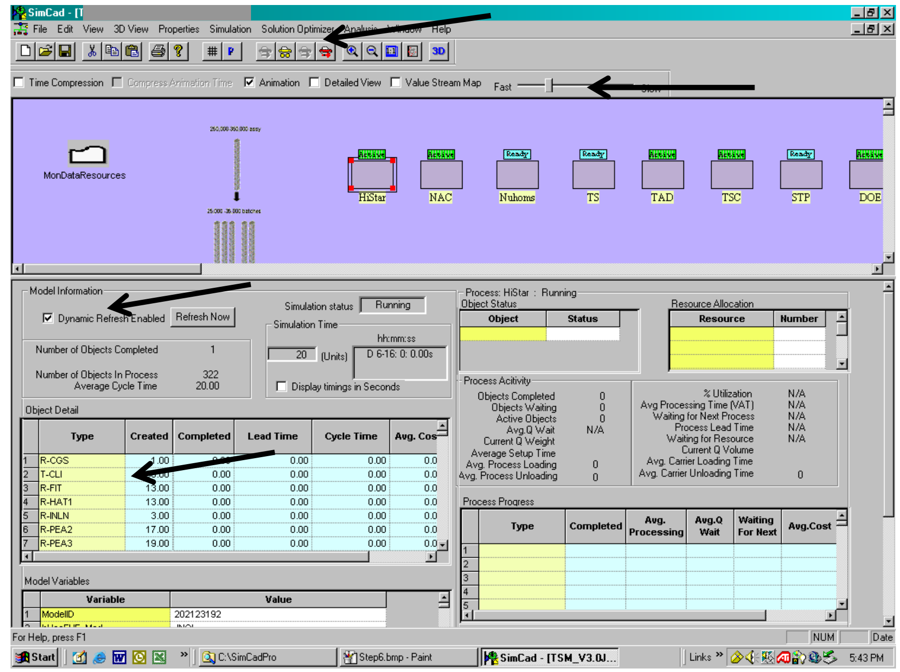


Step 3: Allow 2-5 minutes for the TSM to open in SimCAD™. The user should expand the initial canvas size shown here to full screen.

Step 4: (Optional). The VSM tool bar and other unused tool bars can be removed as in any Windows program. Click on the tool bar and select the X to remove the tool bar. Slide the Process Selection tool bar to the top. This maximizes the GUI space as shown in Step 5. Click on the “Animation” box and the “Dynamic Refresh Enabled” boxes to display GUI actions and updates of data.

Figure 8. Start and Loading of TSM: Test Case (continued)





Step 5: Start the TSM using the “go” control “green car”. If the buttons are not illuminated (active) click anywhere on the TSM canvas to activate the buttons. The green car initiates the run and the yellow car and red car will illuminate (now active). The TSMCC opens a grey window titled “Initializing Simulation Engine” that will persist for several minutes while the run initiates. After several minutes, a spreadsheet window “EXCEL@Data Import” appears indicating the tsm_v6.xml file has been properly accessed. The run will commence and the yellow car and red car will illuminate (now active) and the Simulation Time will show incrementing time steps. Occasionally on first runs an MS Windows “Error 51” occurs; if it does, contact the Developers Group.

Step 6: Adjust the speed bar to get the desired speed, usually fully to the left. Activate the Dynamic Refresh and the Animation. Watch the dynamic data display “Object Detail” to see that objects have entered the process; this indicates that the TSM is running properly. Navigate to processes and departments as desired to watch results on the GUI and in the dynamic display. See Figure 9 for other visual indicators that need to be observed.

The yellow car is used to pause and un-pause, the red car stops the simulation. Note that when the simulation is stopped with the red car, the simulation cannot be continued-it will restart at Step 0.

Figure 8. Start and Loading of TSM Test Case (continued)

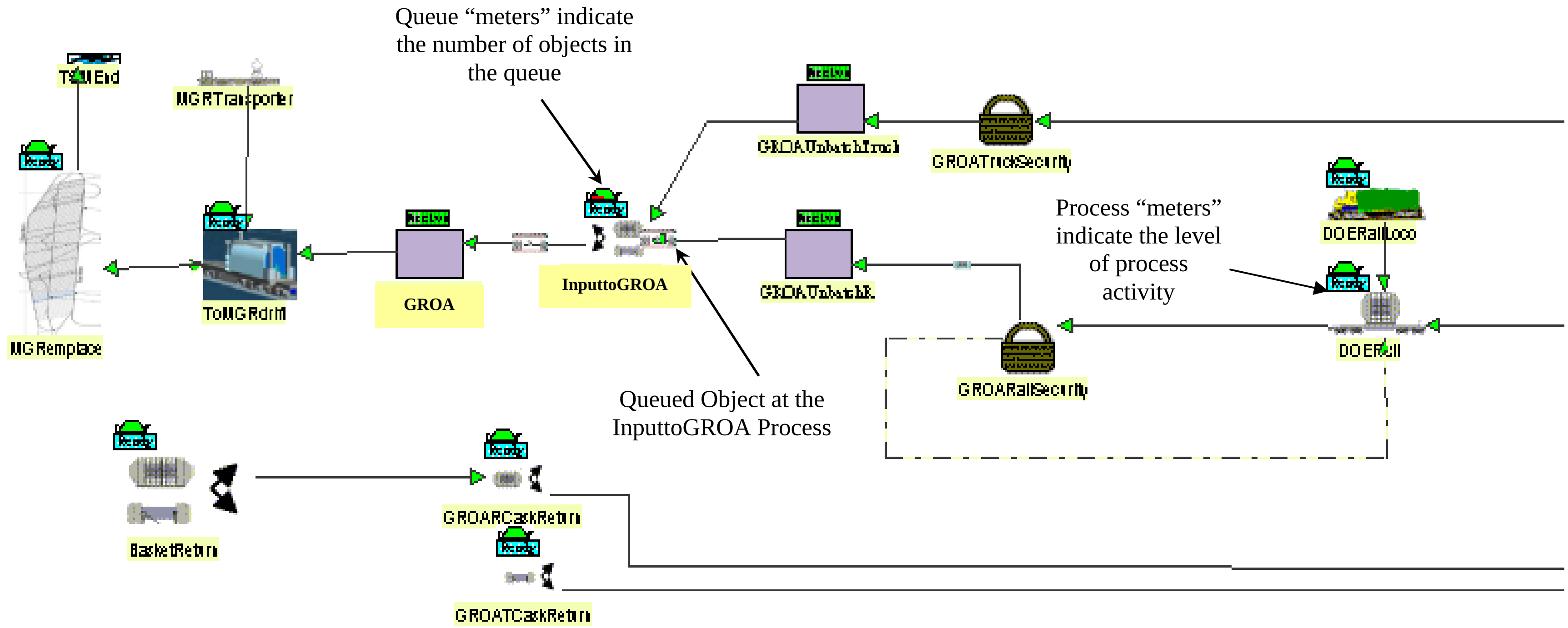


Figure 9. TSM Visual Indicators

The TSM GUI allows users to watch the progress of each object or to watch the activities at any process. Meters indicate the level in the queues (full red is a full queue, objects cannot enter the process). Process meters indicate the status (paused, active, or ready) and the activity level on the process meters indicates the activity relative to full capacity. This example is for the Repository Arrival, GROA processing, and emplacement.

When running a TSM simulation, the user should watch for problems such as “jams” of objects at a process with inadequate throughput or excessively long wait times. “Jams” may indicate problems with the TSM setup. For example, if no casks are “purchased”, the cask loads that need those casks will accumulate in the cask allocation process waiting for a cask that will never arrive causing a jam. However, jams or excessively full queues or long cycle times may also be indicators of poor CRWMS system or element performance that may need further evaluation and understanding.

Watching the behavior of objects is one key way to check that the TSM programming and set up is correct and that actions of the objects make sense. For example, if a cask object ends up in a WP loading area where only spent fuel elements should be, this indicates an error in the logic and setup. However, observing the visual indicators can provide much more information than that the TSM logic is properly set up. Watching object behavior can also help answer the following questions that indicate proper simulation actions:

- Are objects proceeding without delay and if not why not? (Lack of resources like casks, next process busy, etc.?)
- Are objects properly batching? For example, are SNF objects properly combining with casks and rolling stock to make a rail shipment object? If not, why not? (Lack of “parts”, lack of resources, wrong logic, long process time?)
- Are objects jamming at a process? Why? (Lack of processing capacity, lack or resources, poor logistics?)

TSM provides the answers to these questions by visual GUI displays and post-run analysis and the answers lead to an understanding of the impacts of CRWMS programmatic assumptions or changes. By making changes to the model parameters that affect the impact, the TSM can also assist in forming potential solutions to the problems or alternatives to investigate.

Learning to navigate the TSM and understand the interactions is a difficult learning process because CRWMS and ergo the model are complex. However, by focusing on just small portions of the model at one time, the understanding is easier. Section 4 discusses the structure and layout of the TSM and includes screenshots that can be used to understand the TSM structure. Also see Section 6 for general guidance on understanding TSM and performing system analyses.

As SimCAD™ runs, output data will be exported to a special MS Access file (.simdata) that is automatically created and/or initialized in the C:\SimCadPro directory by SimCAD™. The TSM programming also automatically initializes the TSM.mdb MS ACCESS file to export data related to the objects created and processing actions in the GROA surface facility processes. See Section 5 for a discussion on analyzing these results. NOTE: Restarting TSM overwrites information in these output files so output files to be retained must be renamed post-run or copied from the SimCadPro directory to another directory. Also, only experienced users should run more than one simulation at a time as this can also cause overwriting problems.

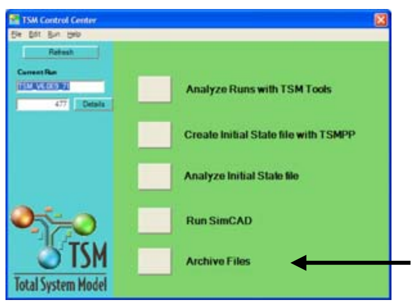
A run is complete when all shipments have been received at the GROA and all objects in aging have returned and been emplaced. The TSMCC monitors the status of these parameters and will pause the model when these situations occur. However, if there is a problem with the shipments and some never arrive or the aging return is never completed for some reason, the TSMCC will never pause the TSM run. In this case the user must inspect the simulation by navigating the GUI looking for “hung” objects. The user can also check the “return from aging” status of objects that is indicated by a “check” for all line items in the TSM.mdb ACCESS file table “MSC_Log” for the TAD canisters that have returned (see Section 5.2).

3.1.2   TSMCC Results Archiving and Test

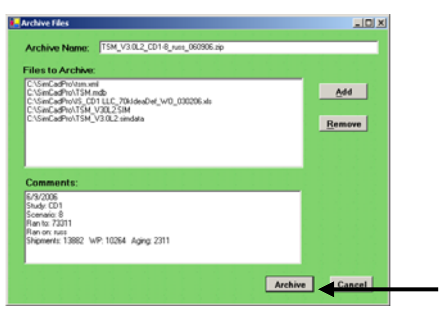
Archiving results is a key part of a TSM run. TSMCC automatically uses the TSM.mdb and the tsm_v6.xml files to determine which files need to be included in the archive .zip file. Archives include the two data files (TSM.mdb and the .simdata file), the IS file (shipment schedule), the model, and the tsm_v6.xml (run configuration). In addition, TSMCC extracts some run-time information from the data files and includes these in the archive comments. TSMCC also assigns a file name for the archive based on the Model name, the Study/Scenario, the PC name, and the current date. The only real reason to change this is if an archive by that name has already been created (unlikely).

After the run in Section 3.1.1 is complete, close SimCAD™. Archiving must be done before starting another run. Partial runs can also be archived; for example, if you stopped the test run before completion, you can still archive the data and test the archiving function.

1. Start TSMCC by double clicking the TSMCC.exe and press the “Archive Files” button.



2. The archive screen opens and automatically collects the files for archiving and lists them (.xml, .mdb, IS file .xls, .sim, .simdata). The archive screen also automatically lists data about the run in the “Comments” section. Edit the “Comments” section to include other relevant information if desired (perhaps “my first run”) and press the “Archive” button.



3. A “Please Wait” screen will be displayed while the archive is created.

4. Once the ZIP file is created, you will be prompted if you would like to upload it to a File Transfer Protocol (FTP) site. Select “No” unless permission has been granted to access the FTP site by the TSM Developers Group (requires a user name and password).

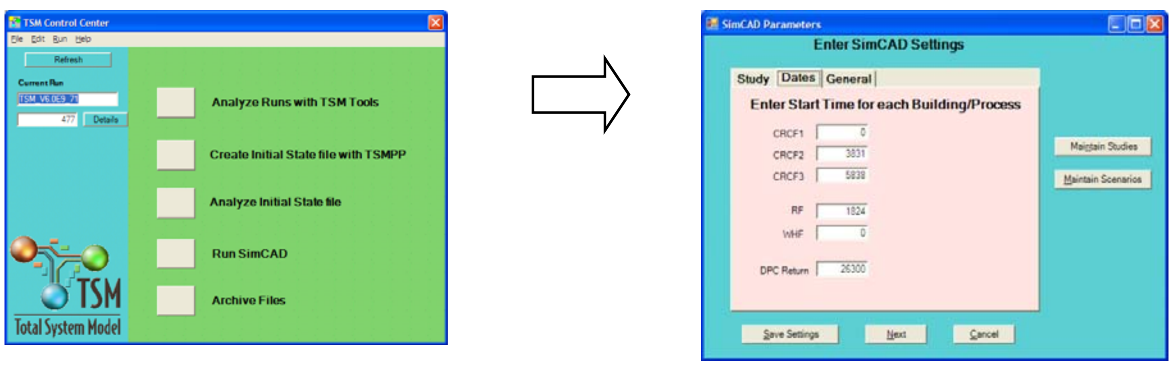
5. You will also be prompted to enter information about the run to make it easier to find the archive in the future. Pressing “Yes” will display the Edit Run screen with most of the fields already filled in. Make any necessary changes and press the “Save” button.

3.1.3 Using TSMCC to Run TSM

This procedure will duplicate the Test Run in Section 3.1.2 but uses the TSMCC to perform all the steps. This is the typical way that runs will be performed. More details and images of the TSMCC screens are provided in Appendix B. Appendix B is set up to be extracted from this manual as a stand-alone quick reference for making and analyzing runs.

The example below assumes that the Test Case in Section 3.1.1 has just been run. Note that the setup information from that run is retained in the tsm_v6.xml file and the tsm_v6.xml file settings are entered in the setup screens as the defaults.

1. Start TSMCC by double clicking the TSMCC.exe file and press the “Run SimCAD” button.



2. Ignore the Study Tab for this example; refer to Section B.2.5 on how this tab is used.

3. The Dates tab will show the dates (actually time steps) from the Test Run in section.

4. The General tab will have data from the Test run. Verify that the times (in time steps) are set to CRCF1=0, CRCF2=3831, CRCF3= 5838, RF=1824, WHF=0, and DPC Return=26,300. Press “Next” to save these settings and move to the next screen.

5. On the Select Shipment Schedule screen, press the “Browse” button to open the file dialog, click on the C:\SimCadPro\V6_CD1_101707.xls file, and press “Open”. This will close the file dialog and put the name of the file into the selection box. Press “Next” to continue.

6. On the Select SimCAD Model File screen, press the “Browse” button to open the file dialog, click on the C:\SimCadPro\TSM_V6.0_7.1.sim file and press “Open”. This will close the file dialog and put the name of the file into the selection box. Press “Next” to continue.

7. On the SimCAD Simulation Settings screen, select the Run Until: “Completion” option, and the When Stopped: “Just Pause” option. This will pause the run when all shipments are into the GROA and all items are back from aging. Press “Next” to continue.

8. Pressing the *Run SimCAD* button will write all these parameters out to the tsm_v6.xml file, start up SimCAD, load the model, and start a run. Make sure that SimCAD™ is not running before pressing this button.

9. TSM should run as in the Test Case above.

10. Users should observe the run as described in Section 3.1.1.

As discussed in Appendix B, experienced users often perform many of the TSMCC actions manually by adjusting the tsm_v6.xml file, running the TSM manually from within SimCAD™, and manually archiving the results when the run is complete. It is recommended that the TSMCC be used by less experienced users or when multiple runs are made to support a study to ensure proper archiving and data management.

3.2 MAKING CHANGES TO TSM

A key objective of the TSM is to analyze changes to the assumptions and OCRWM programmatic parameters and to assess the impact of those changes. The impacts of interest are increases/decreases in resources, cost impacts, changes in thermal constraints, and ability to meet the WA requirements depending on the scenario, and others.

The TSM is a very flexible model and the design intent was to allow users to make changes to reflect various scenarios. The use of selection menus for process parameters such as those shown in Figure 10 make it easy for a user to make changes to things like the process capacities, processing times, queue capacities, or other basic process parameters to see the impact. To make the changes, the user should have a basic working knowledge of SimCAD™ and the TSM. The TSMCC also makes it easy to change many key simulation and configuration parameters; the difficulty for inexperienced users is knowing how to select the proper parameters values. This knowledge is developed as experience with the CRWMS mission and with TSM simulations is obtained.

As noted in the TSM CMMP (BSC 2007p) all of the items in the TSM are Configuration Items (CI) except for the following:

- Inputs in the TSMCC that are reflected in the variable values in tsm_v6.xml file.
- Unit costs, times, and dose rates (input as process variables)
- Processes (general)
  - Timing
  - Q Length
  - Cost
  - Resources
  - Setup times
- Connection Lines

    - Resources
    - Transfer times/speeds
- "Buy" processes (casks, rolling stock, etc.)
    - Object creation options (WO, single object)
    - WO input (cask purchases)

The TSMCC settings can be adjusted as desired or as dictated by study or analysis plans. However, any other changes to the TSM should be done by the TSM Developers in accordance with AP-ENG-005 and AP-ENG-006.

Elaborate changes or running difficult scenarios should be done only by experienced TSM developers and users. The TSM is designed with considerable flexibility and with "switches" at key locations or variables to allow for changes. Changes to the model "structure" (i.e., processes, connections, objects, extensions, and VB code) that are to be used in published analyses should be reviewed by the TSM Developers Group.

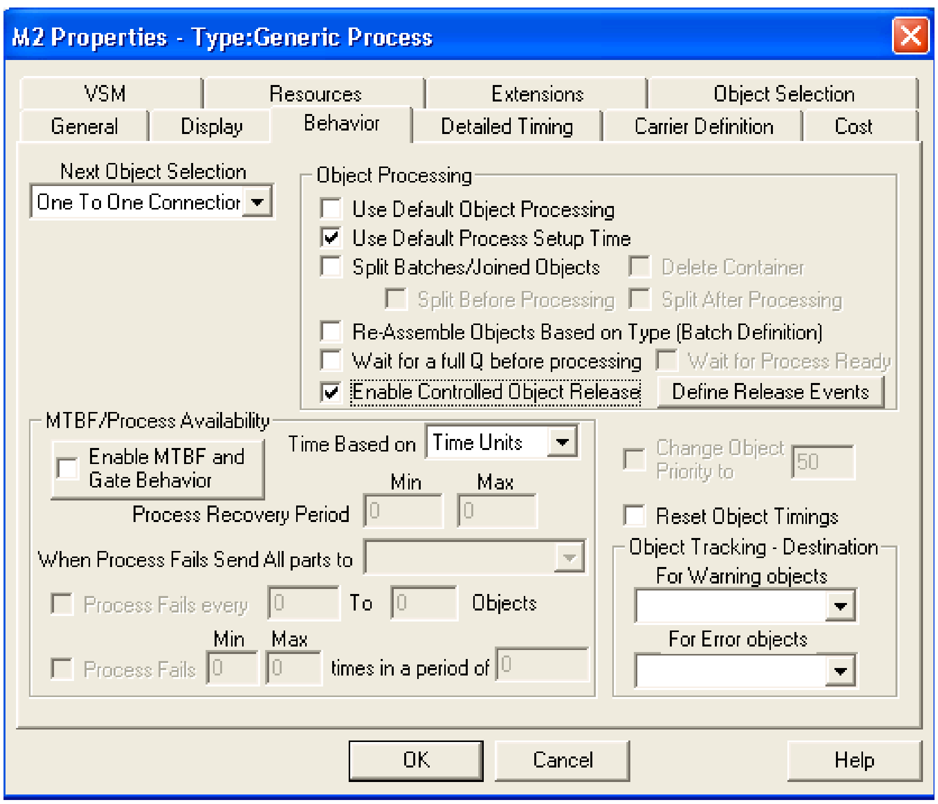


Figure 10. Process Dialog Box and Menu

This is the Process Menu that opens by double-clicking any process. This menu allows users to easily change basic process parameters and see the impact on the system performance. Note the tabs here indicate places to change items such as timing (including failure and availability parameters), basic behavior, carrier behavior, and the extensions. Use the SimCAD™ software manual or the TSM to view the various process parameters available. Note that changes on menus like this influence CIs and must be in accordance with AP-ENG-006.

3.3 GENERATING IS FILES

Studies and analyses typically involve the development of cases or scenarios that cover a broad range of WA parameters that can be adjusted following the processes in the TSMPP User Manual (BSC 2007b). These changes are reflected in the IS file generated by the TSMPP. The resulting IS files are then run using the TSM simulation. See the TSMPP User Manual for more information on generating the EXCEL file to use as the TSM IS file for various WA scenario options or other cases. The TSMPP can be run from the TSMCC, see Appendix B.

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4. TSM STRUCTURE AND DESIGN

This section describes the structure and design of the TSM IS and GUI elements. The annotated "screen shots" at the end of the section are intended as the key tool for understanding the structure and TSM elements. These are an essential guide for new users to learn the locations of various functions and processes. When using this section, it may be best to follow along on the TSM model and also to consult the TSM Glossary (BSC 2007f).

4.1 INITIAL STATE FILE STRUCTURE

Sub-section 4.1.1 describes how the IS file data meet TSM input requirements; sub-sections 4.1.2 and 4.1.3 discuss modification that can be made to the IS file; and 4.1.4 discusses analyses that can be performed directly on the IS file.

4.1.1 Cask Loads

As previously discussed, the IS file generated by the TSMPP is the "engine" that drives the simulation. The IS file inputs the cask loads into the TSM GUI, and this event is the initiator for subsequent simulation actions on the cask load object. A sample of an EXCEL IS file is shown in Figure 11. Definitions for the custom variables in the example IS file are given in Table 1. The information in this table includes:

- Variable name: TSM variable name.
- Units: Measurement units.
- Where used: The Department and Process where the variable is used or defined. ("Departments" are a TSM convention for grouping processes).
- Description: The general function or purpose of the variable in the TSM. More details such as the programming extensions that use the object variables are covered in the TSM Glossary (BSC 2007f), the Transportation Design and Bases (BSC 2007d), and the GROA Design and Bases (BSC 2007c).

Setting custom variables with each cask load object is a key design component of the TSM. Object variables travel with the object throughout the model and these variables are local to each object and can be queried by the processes. Since processes can query the objects, the process can use any of the variable information to select the appropriate process action, appropriate route, or make calculations.

In the object context objects can use variables that are not true physical attributes of the object itself. For example, CSNF cask load objects use variables Heat1-Heat10 to bin the heats for the assemblies in the cask load. However, cask objects that do not have heat attributes use Heat01-Heat04 for parameters related to maintenance needs such as the time since the last maintenance or the number of trips since the last maintenance. The typical TSM variables used in TSM are (the variable is not listed if it is not used):

- Process Connection: TSM process where the cask load enters the TSM simulation.
- Object: The cask load to be accepted. The naming conventions and definitions are in the TSM Glossary (BSC 2007f) and include the waste type (rail, truck) and an abbreviation for the waste site.

- Count: Always 1. The TSMPP shows each cask load. Even though CSNF shipments are batched 3 cask loads per rail shipment and DOE waste shipments are batched 5 cask loads per shipment, the TSM is programmed to list each cask load since the heats are different.
- Start time: The time step (1 time step = 8 hours) for the shipment to enter the TSM GUI. This is the desired time for accepting the cask load based on the various WA parameters set in the TSMPP. This is also referred to as "ship no earlier than" because even though the cask load enters the simulation, the CRWMS system may not be able to ship it, for example because of a lack of the needed resources like a transportation cask. Refer to the TSMPP User Manual (BSC 2007b) and the Backup Calculation 1 for the Phase 1 TAD Study (BSC 2005) for the ways the IS file can be manipulated to set up and analyze various scenarios.

Table 1. Object Custom Variables Used in the IS File

IS Variable Name	Units	Where Used	Description
Buffer_Type	None	Routers at buffer areas	The buffer type for a waste cask load
Cask_ID	None	Routers at cask areas, process extensions for casks triggers	The cask required for a waste cask load
Cask Source	None	Post-run analyses to compare to other CRWMS models.	The source for the cask load can be from the reactor pool or from dry storage.
CritHeat	watts	Not used in TSM Version 6.0	For later enhancements of criticality algorithms
Crit	None	GROA surface facility buffer routers	Signals that cask contains waste with criticality concerns
Heat1	Number Time steps	SNF cask load: GROA operations VB Transportation cask: cask maintenance	SNF: Number of assemblies in the Heat Bin 1 Cask: Time steps since cask was purchased, "cask lifetime"
Heat2	Number Time steps	SNF cask load: GROA operations VB Transportation cask: cask maintenance	SNF: Number of assemblies in the Heat Bin 2 Cask: Time steps since last maintenance
Heat3	Number	SNF cask load object: GROA operations VB	SNF: Number of assemblies in the Heat Bin 3
Heat4	Number Time steps	SNF cask load object: GROA operations VB Transportation cask object: cask maintenance	SNF: Number of assemblies in the Heat Bin 4 Cask: Time steps since last maintenance
Heat5-Heat10	Number	SNF cask load object: GROA operations VB	Number of assemblies in the Heat Bin 5 through Heat Bin 10
MTU	Tons	Various processes to record weight processed or received	Metric Tons of Heavy Metal (MTHM) in a waste cask load. "Metric Tons of Uranium (MTU " is used in TSM variable names vs. "MTHM" for mass.
Site_ID	N/A	Cask allocation departments "load" processes that join cask loads and casks	Identifies process destination following cask and cask load join
TotalHeat	Watts	GROA "TADHeatok" process to determine if TAD needs aging	Total heat in cask load calculated exactly by the TSMPP
Waste_Type	N/A	GROA surface facilities	Determines type of WP

Process Connection	Object	Status	Count	Start Time	Elapsed	Create Batch	ObjectID	ParentID	Linked	Del
GA-4	T-GIN	0	1	12	0	0	0	0	0	0
GA-9	T-INLB	0	1	12	0	0	0	0	0	0
HS-100B	R-INLP	0	1	12	0	0	0	0	0	0
HS-HBCAN	D-HUM	0	1	12	0	0	0	0	0	0
HS-HBCAN	D-HUM	0	1	12	0	0	0	0	0	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0
NAC-STCcan	D-HAD	0	1	12	0	0	0	0	0	0
NAC-STCcan	D-HAD	0	1	21	0	0	0	0	0	0
TN-BRPwv	R-WVB	0	1	42	0	0	0	0	0	0
GA-4	T-GIN	0	1	54	0	0	0	0	0	0

Buffer Type	Cask ID	Cask_Source	CritHeat	Crit	Heat1	Heat2	Heat3	Heat4	Heat5
PWRTruckBuffer	CASK6	POOL	0	0	0	0	0	0	4
BWRTruckBuffer	CASK1	POOL	0	0	0	5	0	0	0
PWRBuffer	CASK26	POOL	0	0	0	29	3	0	0
DPCBWRBuffer	CASK242	DRY	0	0	36	14	0	0	0
DPCBWRCritBuffer	CASK242	DRY	0	44	66	2	0	0	0
DPCPWRCritBuffer	CASK221	DRY	0	5	5	0	0	0	0
DPCPWRCritBuffer	CASK221	DRY	0	26	26	0	0	0	0
DPCPWRCritBuffer	CASK221	DRY	0	22	22	1	2	1	0
DPCPWRCritBuffer	CASK221	DRY	0	11	0	15	10	1	0
BWRCritBuffer	CASK62	POOL	0	42	8	36	0	0	0
PWRTruckBuffer	CASK6	POOL	0	0	0	0	0	0	4

Heat6	Heat7	Heat8	Heat9	Heat10	MTU	Site_ID	TotalHeat	Waste_Type
0	0	0	0	0	1.3862	GINT	2560	PWR
0	0	0	0	0	0.647829	INLT	186	BWR
0	0	0	0	0	14.67005	INLR	9712	PWR
0	0	0	0	0	3.837963	HUMR	1202	BWR
0	0	0	0	0	4.824257	HUMR	765	BWRCrit
0	0	0	0	0	1.927078	HADR	635	PWRCrit
0	0	0	0	0	10.0096	HADR	3259	PWRCrit
0	0	0	0	0	9.917431	HADR	5704	PWRCrit
0	0	0	0	0	9.462998	HADR	8836	PWRCrit
0	0	0	0	0	5.914	WVR	1438	BWRCrit
0	0	0	0	0	1.3862	GINT	2560	PWR

Figure 11. IS File Structure

The IS file generated by the TSMPP includes the object-based variables used for the cask load “objects”. Grey column heads indicate the variables used by SimCAD™ in all IS files and white column heads are “custom variables” added for the TSM design. See Table 1 for the definitions of the TSM custom variables. (Note: The actual IS is a 30-column EXCEL worksheet; it is “wrapped” here for presentation purposes). **Note:** Some TSMPP runs include additional columns beyond the 30 used for the simulation. One column typically included is “Year” that indicates the shipment time in years. This is used by the TSMPP analyst to review the IS file but is ignored in the simulation. Another is “xShipment_ID,” which is used to support special analyses such as the thermal analysis (BSC 2007a).

4.1.2 IS Cask Work Orders

The IS file is also used to set the WOs for the transportation casks. As discussed in Section 4.2.2.1, WOs are typically used to set the number and type of casks to buy vs. time. Like the cask loads, line items in the IS file can include the desired cask objects (by cask type such as "CASK1") and the associated Start Process, Count, and Start Time (time steps). When the IS file is loaded and the simulation commences, the cask will be sent to the Start Process specified and enter the simulation as part of the cask fleet at the time specified.

WOs are added to the IS file by the TSMPP and are typically listed at the end after all the cask load line items. The WOs are set using an algorithm added to the TSMPP for use with TSM Version 5.0 and later. The algorithm is based on manual methods developed over several years by the TSM Users Group and the TSM Developers Group. See the TSMPP User Manual, Section A.2 (BSC 2007b) for more discussion about the WO algorithm. The TSMPP WO Algorithm Validation Report (BSC 2007k) shows that the algorithm provides a cask fleet that is very similar to those using the manual methods and also provides a similar simulation response for typical bare and TAD scenarios. Like the manual method, the WO algorithm cannot produce an optimized cask fleet because feedback is required from several simulations to prepare an optimum cask fleet (minimum number of casks that meet a particular WA commitment). However, the results will provide a reasonable and workable cask fleet for initial analyses.

Having the WOs in the IS file offers the advantage that all of the WO information for all the casks is captured in one model location vs. being placed in the 40 or more cask start processes used for the cask "buys." The user can then easily view and make adjustments much more quickly than opening each start process.

A sample of the WOs in an IS file is shown in Figure 12. Notice that the WOs do not need all 30 columns of IS file information; just the key object variables are needed as shown.

Process Connection	Object	Status	Count	Start Time
BuyCask1	CASK1	0	1	0
BuyCask1	CASK1	0	4	548
BuyCask1	CASK1	0	1	1643
BuyCask202	CASK202	0	8	0
BuyCask202	CASK202	0	5	2737
BuyCask202	CASK202	0	10	3832
BuyCask202	CASK202	0	6	10950
BuyCask214	CASK214	0	1	0
BuyCask217	CASK217	0	1	0
BuyCask226	CASK226	0	4	1645
BuyCask226	CASK226	0	2	7800
BuyCask226	CASK226	0	0	17600
BuyCask229	CASK229	0	3	7930
BuyCask238	CASK238	0	3	548
BuyCask244	CASK244	0	1	0
BuyCask247	CASK247	0	3	3834
BuyCask26	CASK26	0	8	0
BuyCask26	CASK26	0	5	2737
BuyCask26	CASK26	0	10	3832
BuyCask26	CASK26	0	3	6570
BuyCask29	CASK29	0	1	548
BuyCask29	CASK29	0	1	1950
BuyCask29	CASK29	0	3	2518
BuyCask44	CASK44	0	9	0
BuyCask44	CASK44	0	6	548
BuyCask50	CASK50	0	2	0
BuyCask50	CASK50	0	3	548
BuyCask51	CASK51	0	5	1095
BuyCask51	CASK51	0	5	10950
BuyCask52	CASK52	0	3	0
BuyCask52	CASK52	0	2	2190
BuyCask6	CASK6	0	5	0
BuyCask6	CASK6	0	1	1643
BuyCask6	CASK6	0	3	2738
BuyCask60	CASK60	0	3	7930
BuyCask62	CASK62	0	1	50
BuyCask63	CASK63	0	1	50
BuyCask65	CASK65	0	3	548
BuyCask66	CASK66	0	3	1600

Figure 12. Cask Work Orders in the IS File

Line items at the end of a typical IS file for cask WOs (shown in two columns for presentation)

4.1.3 DOE Wastes in the IS File

As discussed in detail in the TSMPP User Manual (BSC 2007b), the DOE wastes are generated as part of the IS file. For some studies, it may be desired to make some custom modifications to the DOE waste stream for better thermal matching with the CSNF or other logistics need. For example, in the Phase 1 TAD Study (BSC 2005) the DOE waste stream was modified to spread it over the CSNF WA period plus the time that was required to return all CSNF from aging. For these cases, the same DOE stream was used in each run by creating one special DOE stream as an IS EXCEL sheet. This data was then cut and pasted into the IS EXCEL sheet for CSNF created by the TSMPP. This ensured the DOE was consistent for all cases.

The nuclear waste that comes from DOE facilities appears in seven forms: HLW, HLW Long, DOE SNF, DOE SNF Long, Naval SNF, Naval SNF Long, and Multi-Canister Overpacks (MCO). The HLW and HLW Long are combined with the other wastes to form an ideal Codisposal WP. Within a given DOE waste stream, there may be more or less HLW and HLW Long than can be matched with the other wastes. If there is an excess of HLW or HLW Long within the DOE waste stream, a number of Codisposal WPs will be created with the central DOE SNF position left empty. Because the model has no way of determining if the HLW is "mismatched", the number of these packages to be created must be entered as a run-time parameter defined by the variable "HLW_Mismatch" in the TSMCC. The TSM will then complete all the DOE WPs and consume all the HLW and DOE SNF. For TSM Version 6.0, a similar algorithm for "DSNF_Mismatch" is implemented in the TSMCC to handle the complementary situation where there is excess DOE SNF.

The algorithm for HLW mismatch and DSNF mismatch is discussed in detail in the GROA Design and Bases (BSC 2007c), Section 2.6.2.2. This algorithm is implemented by the TSMCC (see Appendix B, Section B.2.4) based on an evaluation of the input IS file (Shipping Schedule). However, 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 MT case). This problem was discovered late in the development process and DSNF_Mismatch as currently implemented is not currently suitable for general use.

In order to work around this problem, additional "phantom" HLW is typically added to the DOE waste stream in the IS file to assure complete disposal of the DOE SNF. This is the so-called "teleporting" method. In this case DSNF_Mismatch is set to zero as it is assumed the analyst has properly matched the DOE SNF and HLW. The IS file entry for this HLW uses the HLW buffer in the GROA as the "Start Process". So, the HLW object enters the simulation at the GROA buffer and is immediately available for WP filling. This action skips all of the cask allocation and transportation actions used for a typical HLW cask load entering the simulation. IS files with teleporting wastes are usually set up and tested by the TSM Developers Group. For example, the IS in Section 2.3 for the test case used in Section 3.1 includes teleporting HLW indicated by colored text in the IS V6_CD1_101707.xls line item. Notice that when using teleporting, the TSMCC cannot recognize that all of the IS file shipments have arrived at the GROA, and therefore cannot detect that the run is completed and the shutdown action for

"Completion" will not work (see Appendix B, Figure B-16). In this case, the user must set a time step to shut down the simulation.

Another situation that arises that makes it difficult to make co-disposal WP is if the HLW and DOE SNF cask loads are not shipped such that they have timely co-arrival at the GROA. Some DOE waste streams require long waiting times for DOE wastes at the GROA to achieve the proper waste quantities to make the Codisposal WP. For TSM Version 6.0 a so-called "smoothing algorithm" was added to the TSMPP to adjust the shipment timings of the HLW and DOE SNF waste streams. This routine takes any DOE waste stream for input to TSM and "smoothes" it such that the arrivals of the DOE SNF and HLW wastes in the IS file are in the proper ratio to make co-disposal WPs. See Reference BSC 2007l for more information.

4.1.4 IS Analysis

After the IS file is prepared it can be checked and analyzed using EXCEL analysis tools. It is convenient that the IS file is in EXCEL and conventional EXCEL tools such as pivot tables can be used for evaluation. For example, using a pivot table can quickly assess the total number of shipments by cask and the MTU by cask as shown in Figure 13. Using the various IS file columns and the pivot tool, the IS file can be analyzed for shipments by the sites, waste types, cask load type, etc. It is a good practice to pivot all new IS files to check that the cask loads and totals are as expected.

The TSMCC also provides an analysis of the IS file (Shipping Schedule) as discussed in Appendix B, Section B.2.4.

Cask ID	Data	Total
CASK1	Sum of MTU	1,032
	Count of MTU	688
CASK102	Sum of MTU	336
	Count of MTU	33
CASK106	Sum of MTU	96
	Count of MTU	10
CASK109	Sum of MTU	15
	Count of MTU	1
CASK200	Sum of MTU	50
	Count of MTU	4
CASK206	Sum of MTU	5,717
	Count of MTU	1,388
CASK209	Sum of MTU	1,200
	Count of MTU	242
CASK212	Sum of MTU	127
	Count of MTU	15
CASK215	Sum of MTU	58
	Count of MTU	7
CASK218	Sum of MTU	359
	Count of MTU	33
CASK221	Sum of MTU	412
	Count of MTU	40
CASK224	Sum of MTU	1,010
	Count of MTU	96
CASK235	Sum of MTU	568
	Count of MTU	39
CASK239	Sum of MTU	552
	Count of MTU	61
CASK242	Sum of MTU	29
	Count of MTU	6
CASK245	Sum of MTU	46
	Count of MTU	4
CASK251	Sum of MTU	15,265
	Count of MTU	1,988
CASK254	Sum of MTU	32,655
	Count of MTU	3,579
CASK291	Sum of MTU	29
	Count of MTU	3
CASK44	Sum of MTU	6,072
	Count of MTU	2,429
CASK50	Sum of MTU	1
	Count of MTU	102
CASK51	Sum of MTU	4
	Count of MTU	263
CASK52	Sum of MTU	2
	Count of MTU	300
CASK6	Sum of MTU	3,450
	Count of MTU	2,008
Total Sum of MTU		69,085
Total Count of MTU		13,339

Figure 13. Pivot of IS File to Show the MTU

Total number of shipments and total MTU (MTHM) of each cask type is shown in this pivot table. This is a case with 69,085 MTHM of DOE and CSNF wastes in 13,339 shipments (pivot "count"). Results are shown in two columns for presentation purposes.

4.2 MAIN GUI AND LOGIC

Figure 14 shows the overall “canvas” for the TSM GUI. The GUI is generally laid out in sections that correspond to the main CRWMS mission elements of WA, Transportation, and Repository operations as shown in the figure. Additional screenshots of the various CRWMS activities are included in Figures 15-22 and are described in separate sections below. Additional detailed screen shots are included in the Transportation Design and Bases (BSC 2007d) and the GROA Design and Bases (BSC 2007c).

Note: The screenshots in this manual may have small differences from the current version of the TSM as they are not updated if the changes are minor. It is suggested that the current TSM be opened and used to see the current details.

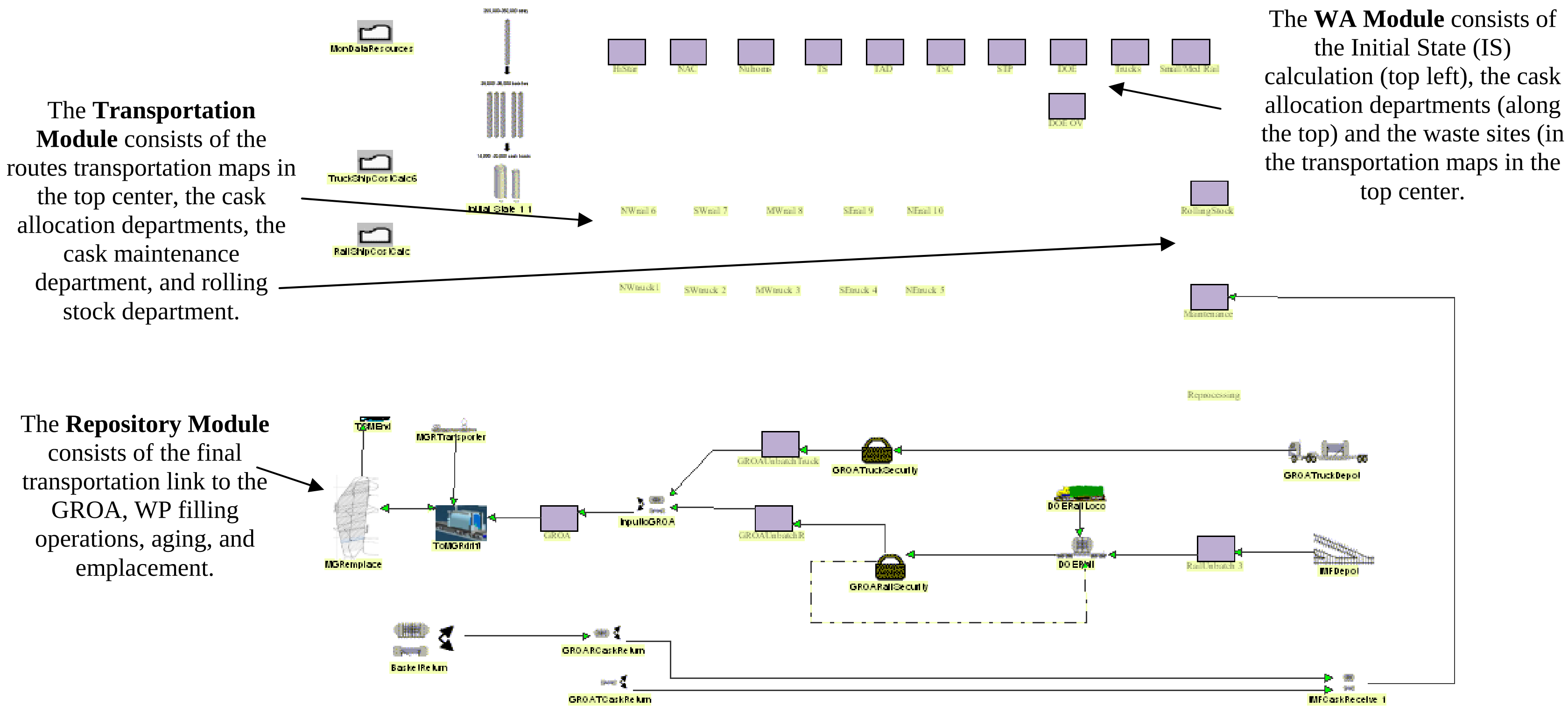

Figure 14. TSM GUI

This figure shows the entire TSM GUI or "canvas" that has the modules for the main three areas of the CRWMS mission. Details of each module are in later figures. When running the TSM, the user usually only has a small portion of the GUI visible. The flow of wastes and casks (the primary TSM objects) proceeds from the WA elements along the top of the GUI, through the transportation department maps, to the Repository at the bottom. Casks and rolling stock return at the bottom of the GUI through the maintenance departments in the center of the GUI to the cask allocation departments.

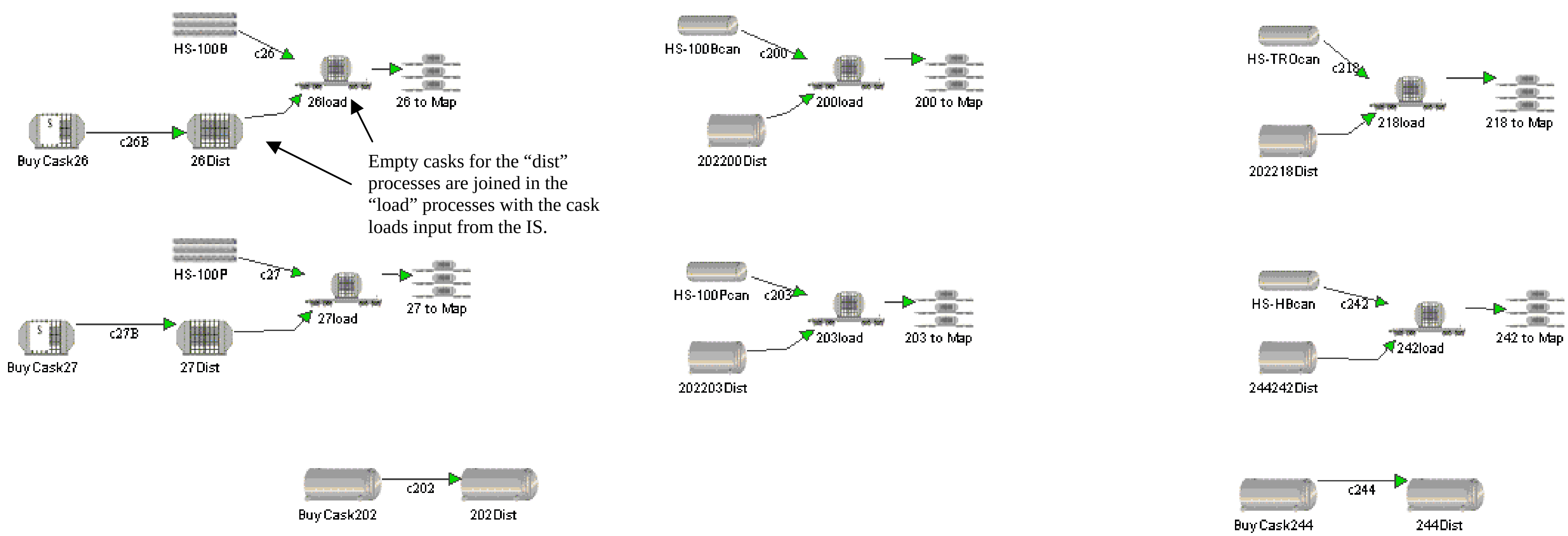

Figure 15. Cask Allocation

This figure shows the HiStar cask allocation department with 2 types of bare fuel baskets, 4 types of DPCs and 2 types of overpacks (shells). All baskets and cans except the HS-HBcan use shell 202. The SimCAD™ triggers (events and auto events) control the calls or "triggers" for the shells and the allocation. See the Transportation Design and Bases (BSC 2007d) for more explanation on the trigger actions.

The bare fuel load arrives at the upper processes in the left most column (such as HS-100B) and initiates the trigger sequence to call a basket (Cask 26 for the HS-100B) and an overpack (in this case Cask 202). If no basket or can is available, the call is deferred until the basket or can is available, else the overpack would be unnecessarily allocated for a shipment that is not ready to ship. Notice that bare fuel processes use a "basket" (such as cask 26 and 27) that is purchased by OCRWM.

For DPC cans (the two right columns), the DPC is joined with the shell to make the cask load. In the DPC cases, the utility has purchased the DPC and OCRWM has purchased the Cask 202 or 244 overpacks so no "buy" processes are needed for the DPC.

Other cask allocation departments have similar structure and actions.

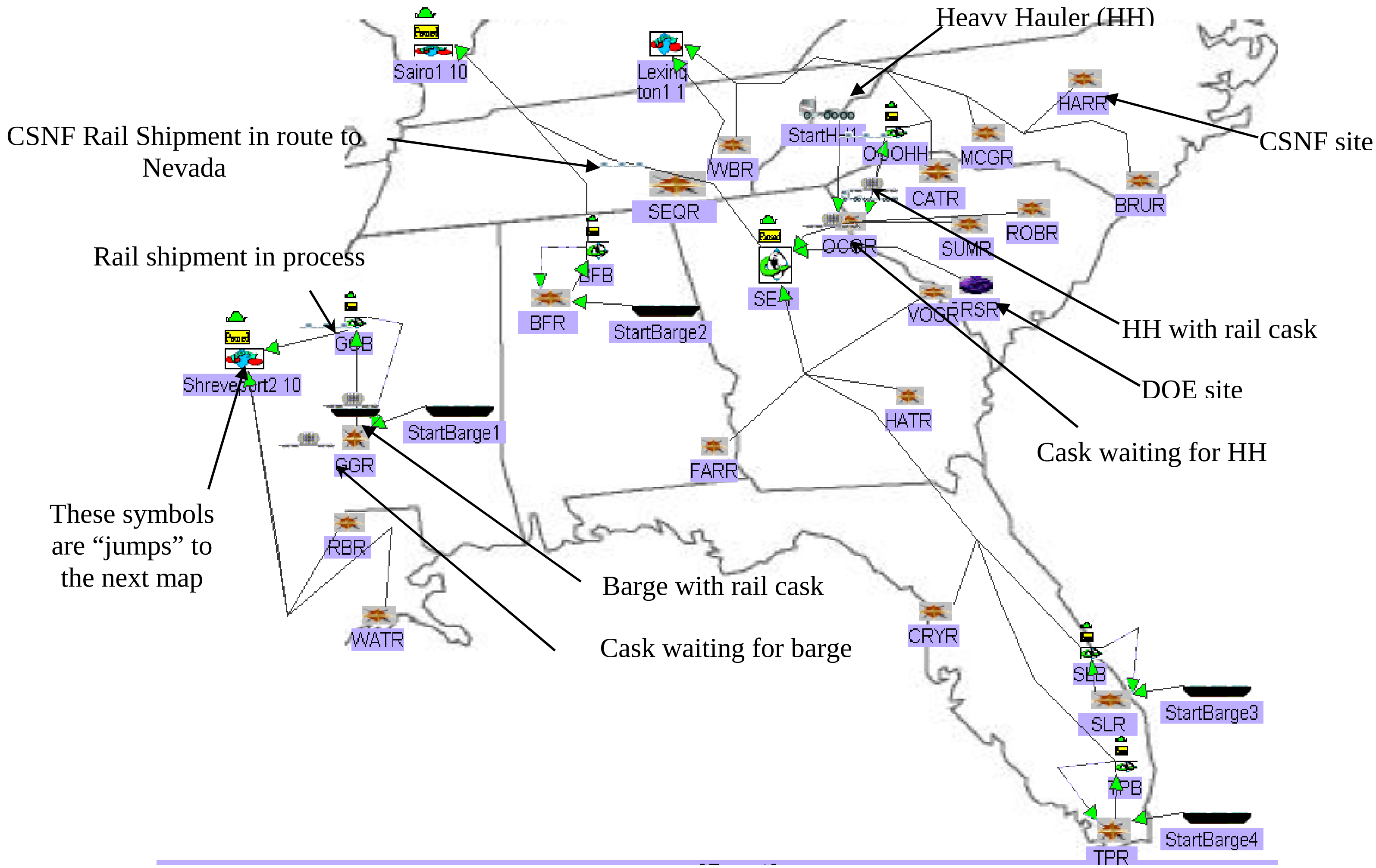

Figure 16. Transportation Map Department

This is a view of the SErail 9 transportation map showing the visual indicators that indicate the status of transportation resources and elements. The lines connecting the sites have information on the distances between the nodes. Other map departments have similar construction. See the Transportation Design and Bases (BSC 2007d) for all maps.

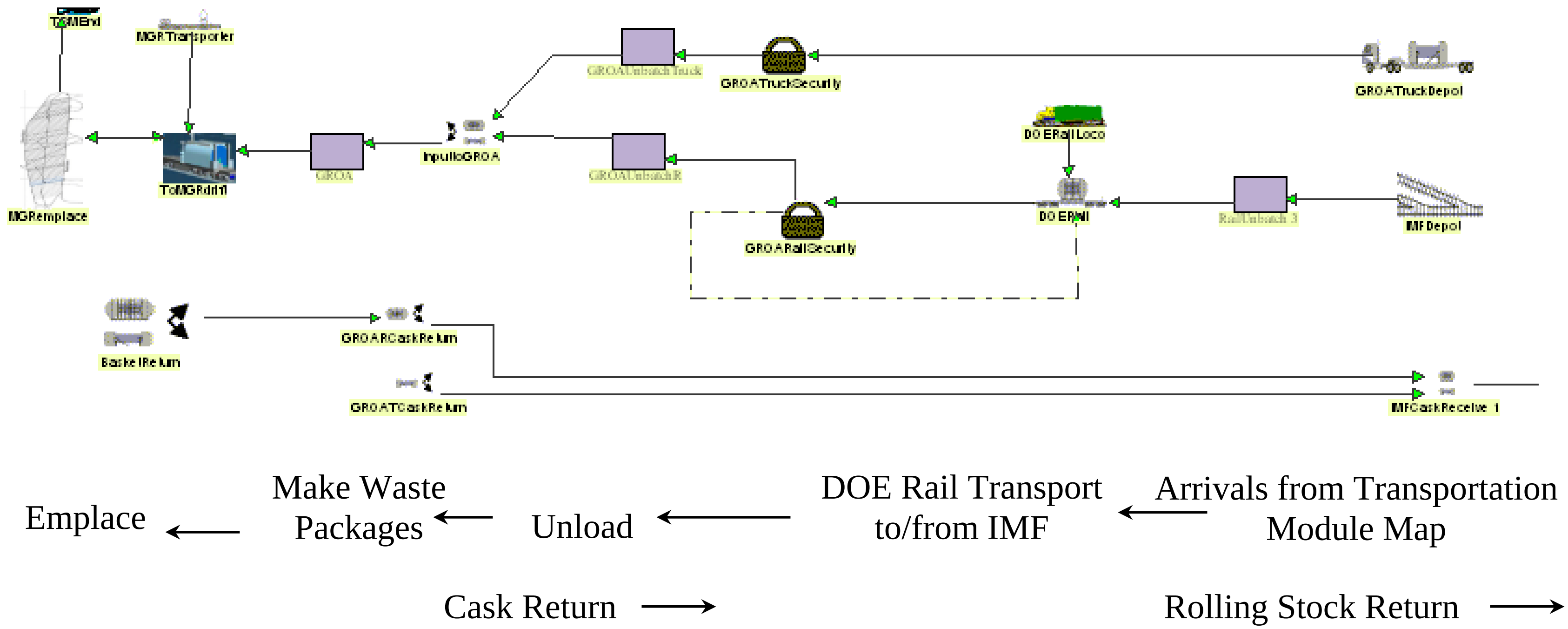

Figure 17. Repository Module

The repository module includes the final transportation to the GROA. On receipt of rail shipments at the Nevada IMFDepot, the shipments are placed on the DOE Rail for delivery to the GROA. Rolling stock is returned. For rail there are two departments that unbatch and route objects to the GROA. Truck shipments require only one department along this path. The TruckUnbatch and RailUnbatch departments have “Cask Hold” processes discussed in a later figure. The detailed GROA and logistics for unloading are shown in Figures 18- 20.

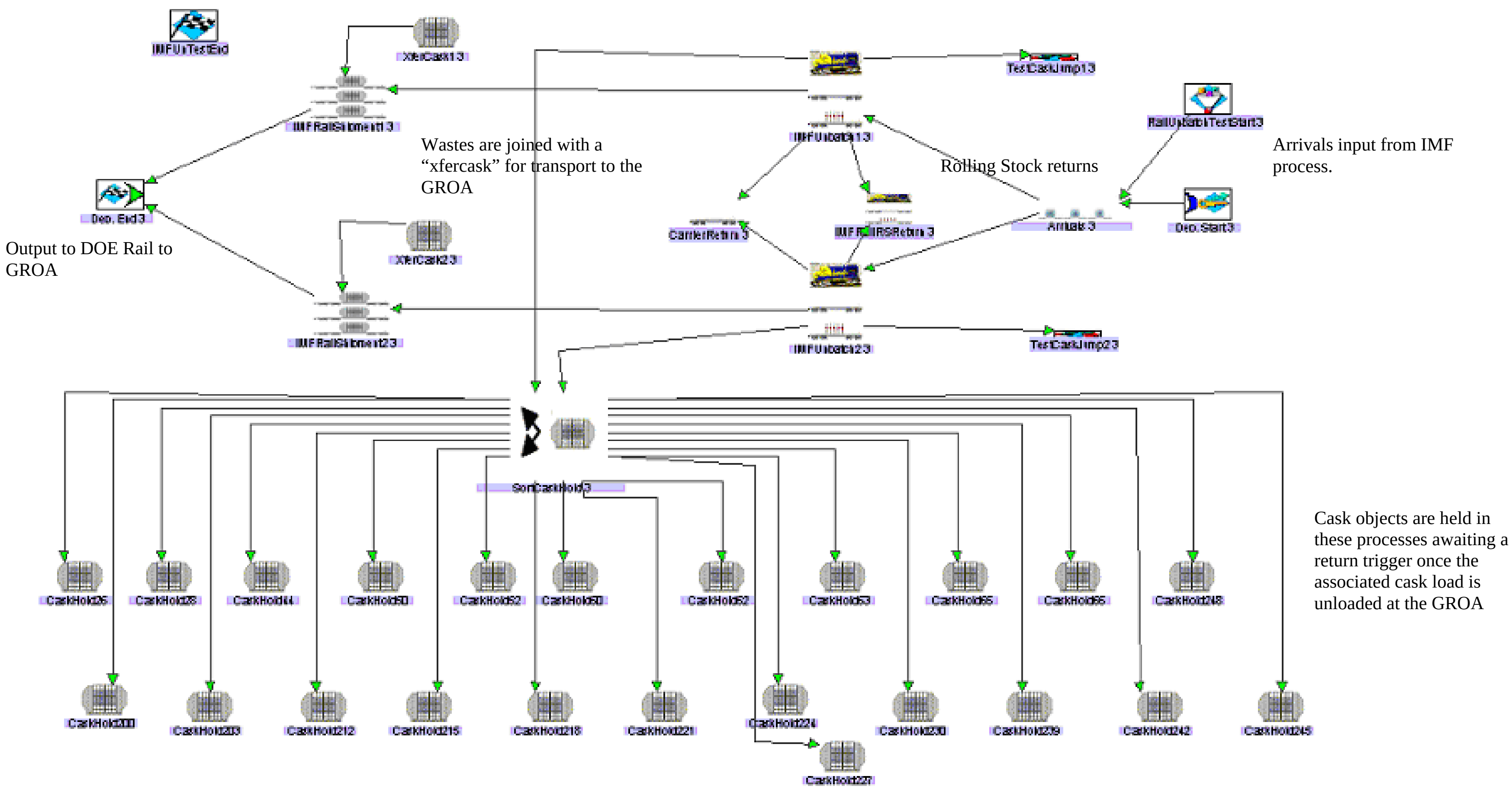

Figure 18. Repository Module: Rail Unbatch Department

On receipt of rail shipments at the Intermodal Facility (IMF), the shipments are completely unbatched and the constituent objects are routed to their next steps. Two unbatch routers are used to ensure adequate throughput. Rolling stock is returned via jumps; casks are placed in "caskhold" functions to await a trigger after the associated cask load is unloaded in the GROA; and the waste object is sent to a join process to be made into a "xfercaskload" for shipment on the DOE rail. Casks, when released from the cask hold, jump to the GROA cask return process to properly load the positioner.

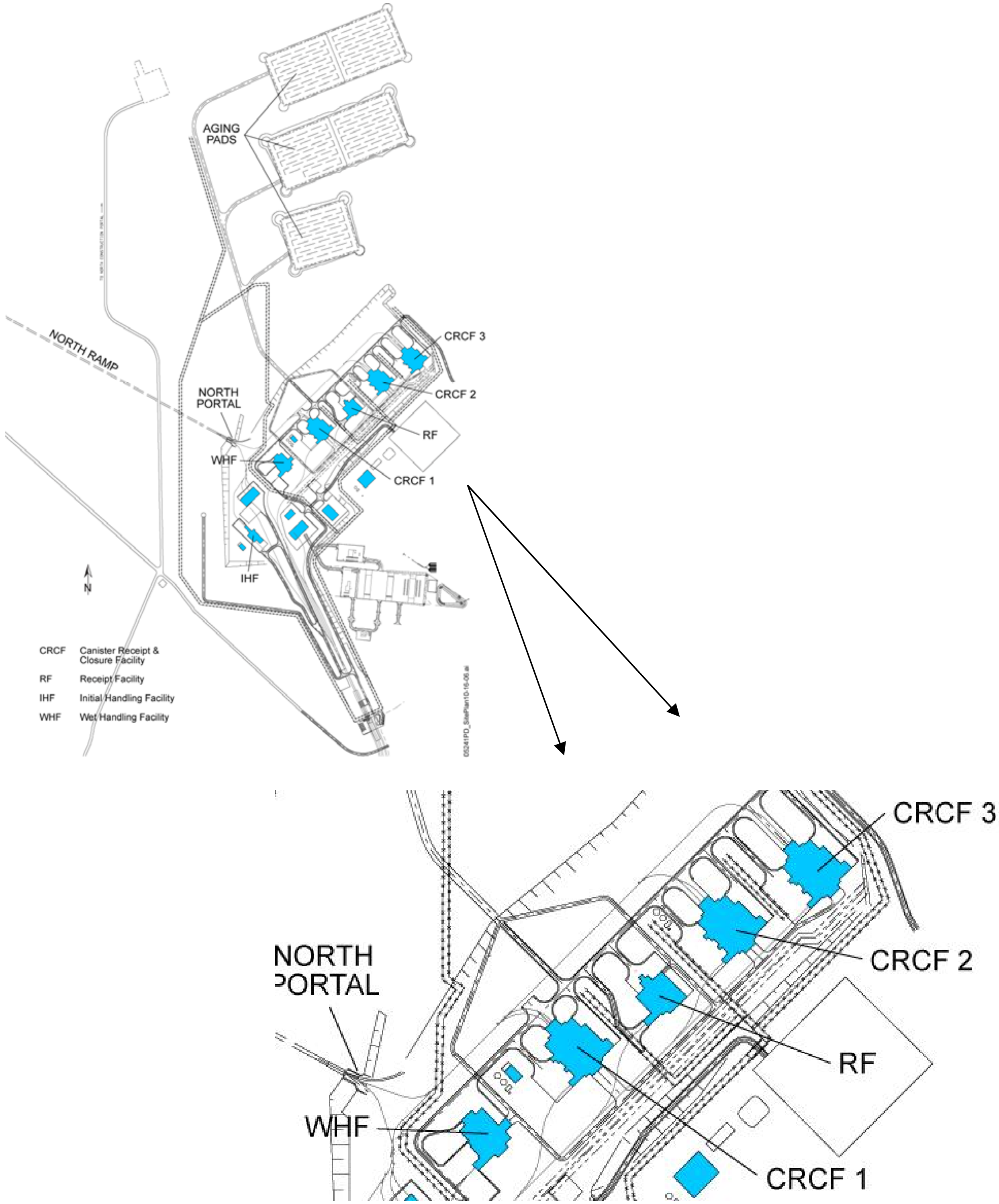

Figure 19. Repository GROA Configuration

The GROA design as of March 2007 was used for TSM Version 6.0.

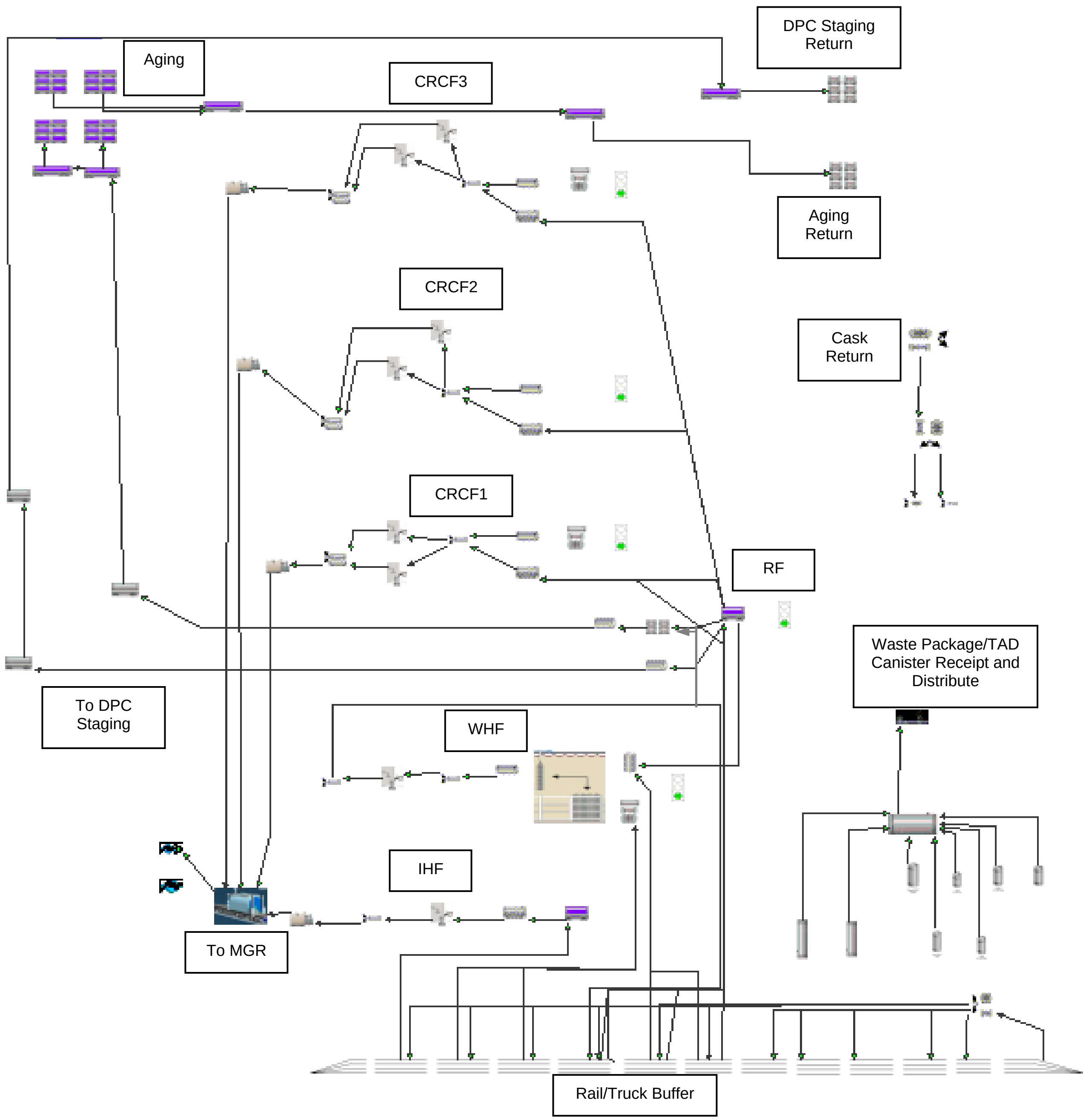

Figure 20. Repository GROA TSM Abstraction

The TSM GROA department layout mimics the physical configuration of the GROA shown in the previous figure.

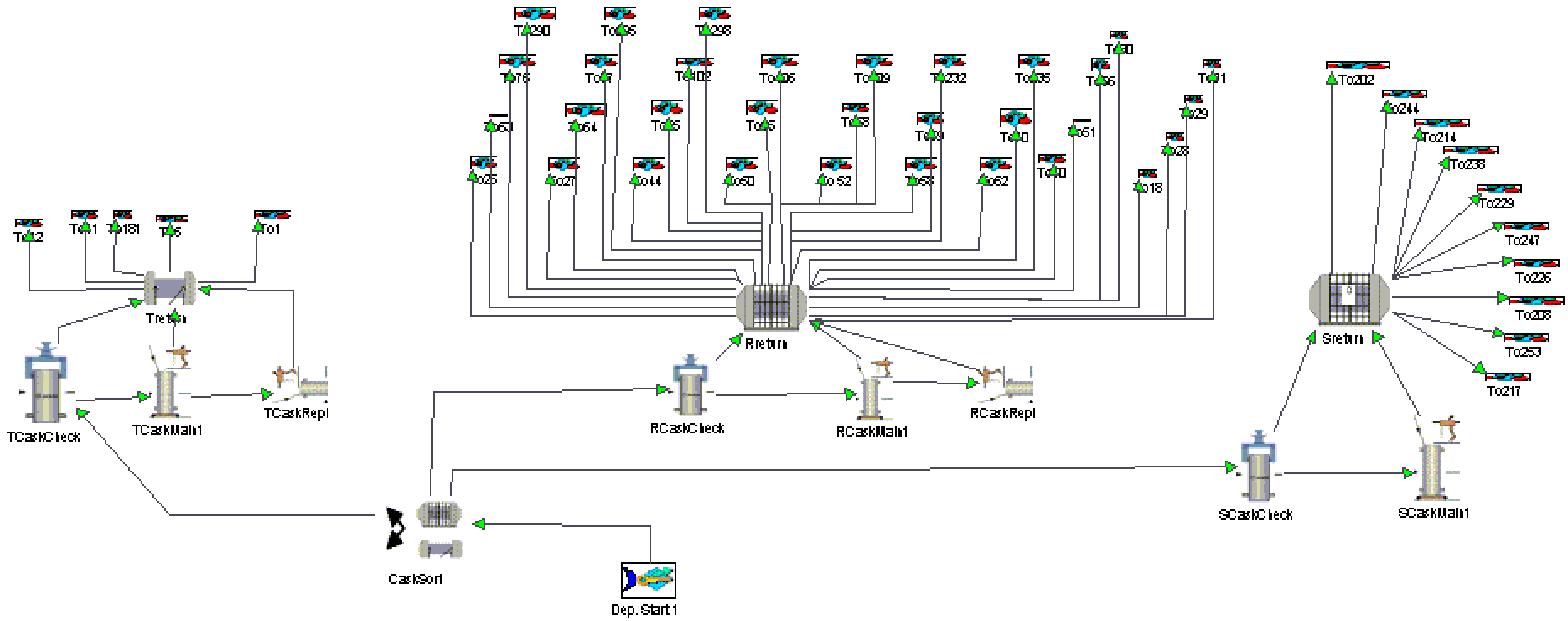

Figure 21. Cask Maintenance

Empty casks are returned from the GROA to the “Maintenance” department on the main GUI. Casks are sorted by truck (T), rail or basket (R) and shell/overpack (S). The need for cask maintenance (based on time or number of trips) is assessed in the “CaskCheck” processes. In the CaskMaint processes, T and R casks more than 25 years old are sent to a “CaskRepl” process for major overhaul. After maintenance, the casks are retuned to the “dist” processes in the cask allocation departments for reuse by the multiple jumps at the top of this department. A typical cask “dist” process is shown in Figure 15.

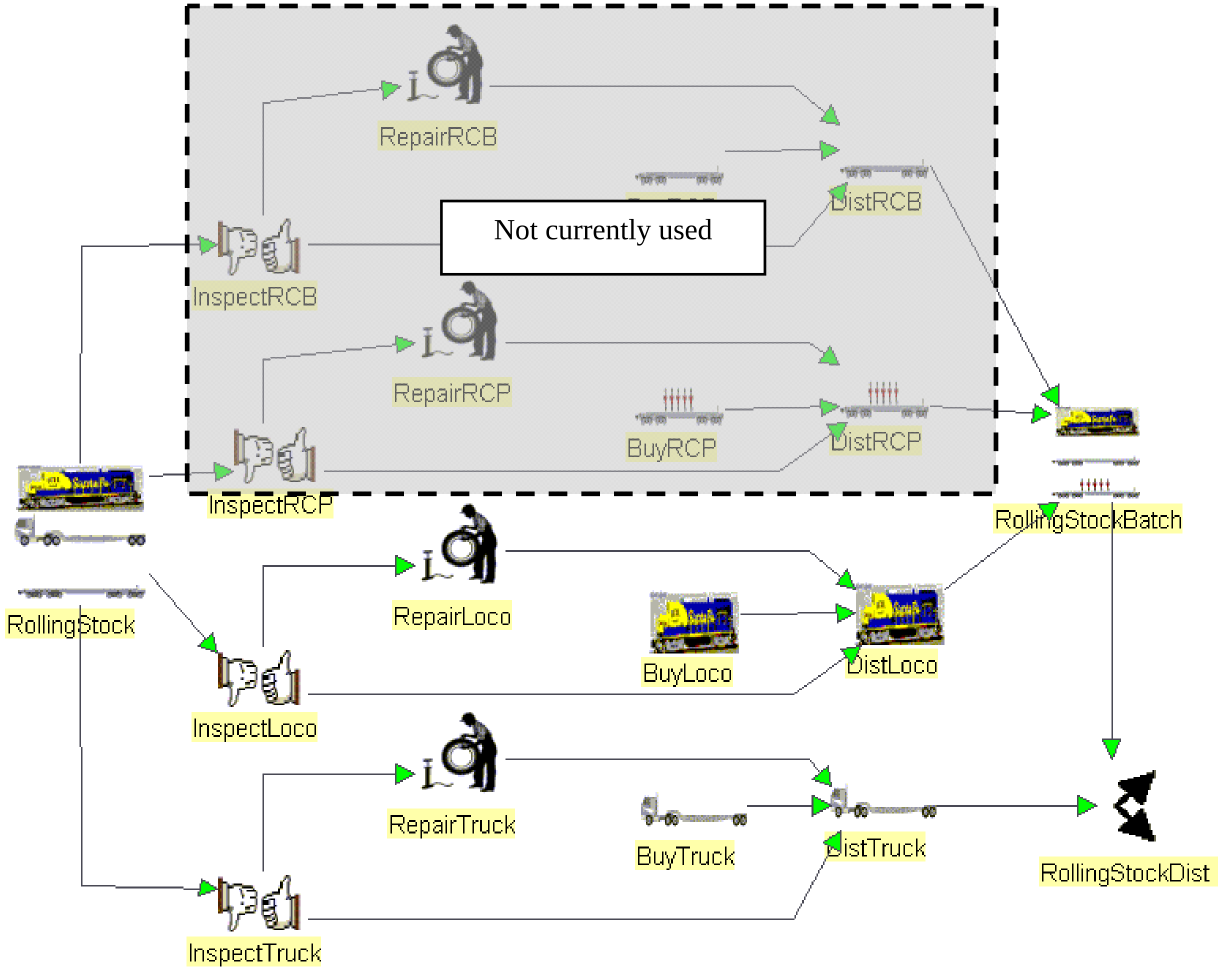

Figure 22. Rolling Stock Return and Maintenance

The transportation functions of rolling stock inspection, maintenance, purchase and distribute to the waste sites for shipments on demand is in this department. Rolling stock is returned from the "unbatch" departments shown in Figure 18. The DistTruck and RollingStockBatch send rolling stock to waste sites on demand. The need for maintenance or repair of the items is based on the number of trips as assessed in the "Inspect" processes.

4.2.1 Waste Acceptance Module

WA at a waste site is simulated at the site processes in the transportation map departments at the top center of the TSM GUI. For reference purposes, the TSM shows an inactive process at the upper left called “Initial State 1 1” that represents the separate action of the TSMPP to generate the IS file before the run. The WA actions to establish the cask loads and specify a WA date are set by the TSMPP. At the site, the cask loads that have been joined with transportation casks at the cask allocation departments arrive and are batched into a “railshipment” or “truck shipment” for transportation to the repository. So, WA includes parts of both the cask allocation departments and the transportation maps. Cask Allocation is discussed more with the discussion on the Transportation Module.

4.2.2 Transportation Module

The Transportation Module processes are shown in Figures 15, 16, 21, and 22. The main elements are the cask allocation, transportation routes, cask maintenance, and the rolling stock as discussed in separate sections below. See the TSM Transportation Design and Basis (BSC 2007d) for more details and all of the GUI views related to transportation.

4.2.2.1 Cask Allocation

Transportation casks are joined with the input cask loads at the cask allocation departments at the top of the GUI. When the cask load from the IS file is input to the “Process Connections” in Column 1 of the IS file it immediately generates a TSM “event” or “trigger” that requests that the correct transportation cask and overpack (if needed) be allocated and dispatched to the “load” process or “cask distribute” process. The load processes join the cask loads and transportation casks into new objects (“caskonrail” or “caskontruck”) that are then dispatched to the proper waste site on the transportation maps.

There are two modes for operating the cask allocation processes as discussed below. The user selects the mode by specifying the way that the casks are introduced into the simulation or “purchased” which controls the number of casks in use in the model as discussed below.

One mode is an “open” mode where there are no restrictions on the number of casks purchased. In this case the user sets the cask buy processes to buy a cask whenever the cask supply is empty. If a site requests a cask and none is available, the buy process initiates a "buy" to ensure that a cask is delivered for the waste pick up. This mode is used for scenarios where the object is to help ensure that cask loads are picked up as scheduled by the IS file. There may be other TSM elements or resources that may slow the pick up and transport, but the cask will always be available. This mode may include several thousand transportation casks in the fleet.

The second mode is to use a WOs in the IS file to buy a cask fleet as discussed in Section 4.1.2. A good example is using WOs to limit the cask buys and distribution so that the feed to processing in the GROA is Just in Time (JIT). The WO algorithm implemented in TSMPP automatically estimates a JIT cask fleet. However, it is recognized that the resulting JIT fleet may not be optimized. To optimize it, the TSM model is run to study when casks are requested and the status of the GROA at the time. If a particular type of cask has a long residence time in the GROA, it means there are too many of that type of cask arriving and the GROA is overloaded. By iteratively changing the WOs manually in the IS file and watching the impact on

GROA processing and casks residence times, the analyst can set up an optimized JIT scenario (this is recommended for advanced users only).

One result of using the two modes is that if the GROA does not have adequate throughput for the mission, wastes for processing will back up. In the open mode, the wastes backup and accumulate at the GROA. In the WO case, the cask load objects backup and accumulate at the start process in the cask allocation department effectively representing cask loads waiting pickup at the waste sites.

Another aspect of the "open" cask buy and distribution method is that the number of casks in the fleet as reported by SimCAD™ included 2 extra casks for each cask type. The triggers are setup so that there is always a "pipeline" of casks to use: one cask on the distribute process, one in the distribute process queue, and one in the buy process ready to be released. In open mode, users will observe that there are three of all cask types immediately after startup before the first cask is shipped. There are therefore 2 extra casks listed as "created" when the model is run in open mode and the number of casks in the fleet must be reduced by 2 for each cask type. For TAD canister overpacks and TSC Cask 66 and TSC Cask 76 the triggers are setup such that there are 3 "pipeline" casks.

The WO mode of operation does not depend on placing casks in a "pipeline", so when using the WO method the number of casks in the fleet does not need to be adjusted. So, using WOs is preferred over the "open" buy method. Exceptions may be for cases with TAD canisters where initial runs with open processes can assist in establishing the number of casks or overpacks that are needed. TAD canisters can be sent directly to aging at the GROA so the transportation cask can be immediately relinquished on arrival at the GROA whereas transportation casks for bare or DPC loads must be retained until the load is processed. However, the setting of the cask buy processes to depend on a WO is a CI, so any results from such a run cannot be used in published TSM analyses unless documented as an "interim" TSM version using AP-ENG-005.

For TSM Version 6.0, the WO processes have been established and tested to the point where the configured TSM is delivered with no "open" buy cask processes. WOs must be included for all the required casks and overpacks. Additionally, the RGs discussed in Appendix B have been modified to remove any adjustments for pipeline casks encountered when using "open" buy casks.

4.2.2.2 Cask Fleet

The transportation casks used in the TSM GUI are shown in Table 2. This table presents the casks that are objects in the TSM simulation. The cask fleet used in the TSMPP has more selections to include "derated" casks and other options but the TSMPP selection is always embodied as the objects in Table 2 in the simulation. An example of the casks that may be considered is in the Transportation Design and Bases (BSC 2007d). The cask fleet descriptions and the matching of cask type to the waste cask load are done in the TSMPP and the results are output to the IS file Cask ID column (see Figure 11). See the TSMPP User Manual (BSC 2007b) for more information on how casks and cask loads are distributed and allocated.

The cask list includes bare spent fuel baskets, DPCs, TAD canisters, transportation overpacks, and TSCs to support the various missions envisioned for CRWMS. The overpacks (shells), baskets, and DPC logic in the TSM is set up to implement a "basket and shell" approach whereby families of baskets and DPCs are used with a single compatible shell type. This allows one type of shell to handle both the basket and DPC. See Figure 15 for examples of basket and shells cask allocation implementation.

4.2.2.3 Transportation Routes

Figure 16 shows the processes for modeling the transportation of shipments from the waste sites to Nevada. The transportation routes are included in the ten transportation map departments: five for truck routes and five for the rail routes. The processes that represent the individual waste sites are shown in the transportation maps. The list of sites and the key parameters for each are in both the TSM Glossary (BSC 2007f) and the Transportation Design and Bases (BSC 2007d).

The waste site processes are the point where the loaded casks (caskonrail or caskontruck) are batched with the rolling stock to make “railshipment”, “truckshipment”, or “DOErailshipment” objects. For sites with Heavy Haul (HH) or barge needs, the batched objects are called “z-bargeshipment” or “z-HHshipment”. For CSNF sites and DOE sites, rail shipments consist of 3 casks or 5 casks, respectively, if the cask loads are available.

4.2.2.4 Cask Maintenance

When the empty transportation casks are returned from unloading at the GROA, the need for scheduled cask maintenance (based on time or number of trips) is assessed in the “CaskCheck” processes, see Figure 21. Casks that require maintenance are sent to “CaskMaint” processes. In the CaskMaint processes, casks more than 25 years old are sent to a “CaskRepl” process for major overhaul. After the check, maintenance, or major overhaul, the casks return to the “CaskDistribute” processes in the cask allocation departments to be reused for subsequent shipments on demand.

The current values and settings in the TSM for cask maintenance are assumptions because the final selection of the casks is not complete and detailed plans are not established. The process time for a check (every trip) is 24 hours, the time if scheduled maintenance is required is 72 hours, and the time for major refurbishment is 144 hours.

Currently, the parameters for assessing the number of trips that a cask has made and the time in use are being refined for each type of cask (the information is held in object variables Heat1 and Heat4, see Table 1). The current settings are that truck casks (GA-9 and GA-4) are maintained after every third trip and that rail casks are maintained every 5 years (based on the requirements for the HISTAR casks). These maintenance intervals are prescribed in the certification for the cask. For other casks the maintenance interval is conservatively assumed to be 12 months.

Table 2. Cask Types Used in the TSM Simulation

TSMPP Cask	Type[1]	No. Asy.	Cask Name	Process Connection to Start	TSM Dept.	Overpack	Nominal Hook Weight[2] (t)
CASK1	B	9	GA-9 LWT (legal weight truck)	GA-9	Trucks	None	25
CASK6	P	4	GA-4 LWT	GA-4	Trucks	None	25
CASK11	B	2	NAC LWT	NAC-LWTB	Trucks	None	25
CASK12	P	1	NAC LWT	NAC-LWTP	Trucks	None	26
CASK18	X	1	Truck Fort Saint Vrain	Truck-FSV	Trucks	None	27
CASK26	B	68	HI-STAR 100 bare fuel basket – BWR(boiling water reactor)	HS-100B	HiStar	202	N/A
CASK27	P	32	HI-STAR 100 bare fuel basket – PWR (pressurized water reactor)	HS-100P	HiStar	202	N/A
CASK28	B	42	Medium bare rail - BWR	MedRailB	Small/ Med Rail	None	100
CASK29	P	18	Medium bare rail - PWR	MedRailP	Small/ Med Rail	None	100
CASK30	B	20	Small bare rail - BWR	SmallRailB	Small/ Med Rail	None	60
CASK31	P	8	Small bare rail - PWR	SmallRailP	Small/ Med Rail	None	60
CASK44	H	5	HLW rail	DSNFHLW	DOE	None	125
CASK50	X	4	MCO rail	DSNFMCO	DOE	None	125
CASK51	X	9	DOE SNF rail	DSNF18	DOE	None	125
CASK52	X	1	Naval SNF rail	DSNFNAVY	DOE	None	125
CASK56	X	5	DOE SNF Rail	DSNF24	DOE	None	125
CASK58	X	12	Three Mile Island Canister	TMIcanonce	Nuhoms	None	100
CASK60	P	18	South Texas bare rail	STPBare	STP	229	N/A
CASK62	B	85	West Valley rail – BWR	TN-BRPwv	DOE	None	100
CASK63	P	40	West Valley rail – PWR	TN-REGwv	DOE	None	100
CASK64	P	26	NAC STC bare fuel basket – PWR	NAC-STC	NAC	214	N/A
CASK65	P	24	NAC UMS bare fuel basket – PWR	NAC-UMSP	NAC	238	N/A
CASK66	B	68	TN-68 TSC loaded from pool - BWR	TN-68TSC	TSC	None	125
CASK68	P	24	MP-187 bare fuel basket – PWR (24 assm)	MP-187-24	Nuhoms	226	N/A
CASK69	P	32	MP-187 bare fuel basket – PWR (32 assm)	MP-187-32	Nuhoms	226	N/A

TSMPP Cask	Type[1]	No. Asy.	Cask Name	Process Connection to Start	TSM Dept.	Overpack	Nominal Hook Weight[2] (t)
CASK70	B	61	MP-197 bare fuel basket – BWR	MP-197	Nuhoms	247	N/A
CASK76	P	32	TN-32 TSC loaded from pool – PWR	TN-32TSC	TSC	None	125
CASK77	B	56	NAC UMS bare fuel basket – BWR	NAC-UMSB	NAC	238	N/A
CASK102	P	24	VSC-24 canister – PWR	VSC-24can	TS	217	N/A
CASK106	P	21	Castor V21 – one time transport	CastorV21once	TSC	None	100
CASK109	P	33	Castor V33 - one time transport	CastorV33once	TSC	None	100
CASK200	B	68	HI-STAR 100 canister - BWR	HS-100Bcan	HiStar	202	N/A
CASK202[3]	B / P	N/A	HI-STAR 100 transportation overpack	HS-OV	HiStar	N/A	125
CASK203	P	32	HI-STAR 100 canister - PWR	HS-100Pcan	HiStar	202	N/A
CASK206	B	24	Small TAD - BWR	TADSmallB	TAD	208	N/A
CASK208[3]	B / P	N/A	Small TAD transportation overpack	TADSmallOV	TAD	N/A	70
CASK209	P	12	Small TAD - PWR	TADSmallP	TAD	208	N/A
CASK212	P	36	NAC STC bare fuel basket - Yankee Rowe	NAC-YRCAN	NAC	214	N/A
CASK214	P	N/A	NAC STC transportation overpack	NAC-STCOV	NAC	N/A	125
CASK215	B	64	TS-125 canister – Big Rock Pt	BRPcan	TS	217	N/A
CASK217[3]	B / P	N/A	TS-125 transportation overpack	TS-125OV	TS	N/A	125
CASK218	P	24	HI-STAR 100 canister - Trojan	HS-TROcan	HiStar	202	N/A
CASK221	P	26	NAC STC canister - PWR	NAC-STCcan	NAC	214	N/A
CASK224	P	24	MP-187 canister - PWR (24 assm)	MP-187-24can	Nuhoms	226	N/A
CASK226	P	N/A	MP-187 transportation overpack	MP-187OV	Nuhoms	N/A	125
CASK227	P	18	South Texas canister	STPcan	STP	229	N/A
CASK229	P	N/A	South Texas transportation overpack	STPOV	STP	N/A	125
CASK232	B	68	TN-68 from storage - one time transport	TN-68once	TSC	None	125
CASK235	P	32	TN-32 from storage - one time transport	TN-32once	TSC	None	125

TSMPP Cask	Type[1]	No. Asy.	Cask Name	Process Connection to Start	TSM Dept.	Overpack	Nominal Hook Weight[2] (t)
CASK236	B	56	NAC UMS canister - BWR	NAC-UMSBcan	NAC	238	N/A
CASK238[3]	B / P	N/A	NAC UMS transportation overpack	NAC-UMSOV	NAC	N/A	125
CASK239	P	24	NAC UMS canister - PWR	NAC-UMSPcan	NAC	238	N/A
CASK242	B	68	HI-STAR HB canister	HS-HBCAN	HiStar	244	N/A
CASK244	B	N/A	HI-STAR HB transportation overpack	HiStarHBOV	HiStar	N/A	125
CASK245	B	61	MP-197 canister - BWR	MP-197can	Nuhoms	247	N/A
CASK247	B	N/A	MP-197 transportation overpack	MP-197OV	Nuhoms	N/A	125
CASK248	P	32	MP-187 canister - PWR (32 assm)	MP-187-32can	Nuhoms	226	N/A
CASK251[4]	B	44 / 68[4]	Large TAD - BWR	TADLargeB	TAD	253	N/A
CASK253[3]	B / P	N/A	Large TAD transportation overpack	TADLargeOV	TAD	N/A	100 / 125[4]
CASK254[4]	P	21 / 32[4]	Large TAD - PWR	TADLargeP	TAD	253	N/A
CASK290	P	40	TN-40 - PWR -one time transport	TN-40once	TSC	None	125
CASK291	B	52	Nuhoms 52B canister (BWR)	NUHOM52Bcan	Nuhoms	247	N/A
CASK295	P	24	MC-10 - PWR - one time transport	MC-10once	TSC	None	100
CASK298	P	28	NAC-I28 - PWR - one time transport	NAC-I28once	TSC	None	100

Note 1: Waste types: P – PWR CSNF, B – BWR CSNF, H – HLW, and X – DOE SNF including Naval waste. Note: many transportation overpacks can carry either a BWR or a PWR canister.

Note 2: Hook weights for DPCs and baskets are listed as N/A and are included in the weight for the overpack listed.

Note 3: BWR and PWR versions of transportation overpacks (e.g., HI-STAR 100, NAC STC, NAC UMS) are treated as separate casks in the TSMPP, but are combined into one cask in the TSM IS for simulation.

Note 4: Large TAD capacity, weight, and assembly heat limit will change depending on scenario analyzed (see BSC 2005 for examples of TAD canister capacities used). For Version 6.0, it is anticipated that the large TAD canister and small TAD canister options will never be used but the functionality is retained.

4.2.2.5 Rolling Stock

The rolling stock processes are shown in Figure 22. Rolling stock refers to the trucks (object "x-truck") and rail stock (locomotive, 2 buffer cars, and crew car, identified as a single object "x-loco", note that individual locomotives or cars are not tracked as separate units) and these items are cycled through the overall process and are maintained and reused as needed. The need for maintenance or repair of the items is based on the number of trips assessed in the "Inspect" processes. No details are available on these operations so the current settings are 2% of the rolling stock go to repair that requires 1 extra day of time. Rolling stock is sent to a waste site on demand when a cask load arrives at the site.

Rolling stock can also be purchased or allocated using either "open" mode or WO mode similar to the transportation cask discussed previously. Open mode probably over estimates the rolling stock fleet by 20% or so. Rolling stock usually includes less than 10 trucks and less than 20 locomotives and neither is a major driver of system effects or costs. For TSM Version 6.0, the TSMPP has been modified to include WO for truck rolling stock as an option. However, the configured TSM as delivered has truck and rail rolling stock on "open buy".

4.2.3 Repository Module

The repository module elements are located along the bottom of the TSM GUI as shown in Figure 14. An overview of the repository module is shown in Figure 17. The repository includes processes from the point where the cask shipments arrive at the Intermodal Facility (IMF, process "IMFDepot") to the point where WPs are placed in the MGR and the point where casks are released after unloading.

The rail path in the TSM includes "unbatching" departments to properly handle the rail cask loads (see Figures 17 and 18). There is a similar unbatching department for truck shipments. The unbatching departments include "cask hold" processes where the transportation cask objects are held until the cask load they contained is unloaded in the GROA department. The total process time in the cask hold processes represents the cask turnaround time from the time that the cask arrives at the IMF until the cask is unloaded at the GROA. Cask turnaround times are a critical system aspect when evaluating CRWMS.

The repository module also contains a very large and elaborate department that represents the GROA processes, see Figures 19 and 20. The GROA abstraction is effectively a "model within a model" and includes a complex mixture of process interactions controlled by a large code referred to as the "VB for GROA Operations", see Section 4.3. See the GROA Design and Bases (BSC 2007c) for more details on the GROA model. As shown in Figures 19 and 20 the GROA model is based on the repository configuration as of September 2006.

The simulation for the aging pad is an important feature of the simulation because it is used to determine the net number of items or MTHM in aging at any time and can be used to assess the maximum in aging for a scenario. The net in aging evaluation is performed with the Valley Curve Generator (VCG) discussed in Appendix A. The aging algorithm includes decay up to 100 years and when the item has appropriate thermal properties for emplacement, the GROA VB code "returns" the item to the surface facilities for emplacement if process capacity exists. Newly arriving cask loads have priority over items returning from aging.

The repository module includes the simulation for emplacing the WPs in the drifts. In TSM, WPs are emplaced as they are created in the surface facilities. There is no attempt to stage WPs and emplace them in a particular order.

The settings to control the GROA simulation setup to represent various ways of processing the shipments and to set priorities are discussed in Section B.2.5. Most GROA action and priorities are set in the GROA VB programming discussed in the next section and the GROA Design and Bases (BSC 2007c). However, the options for managing bare cask loads and DPCs have more user flexibility because operation of the WHF is critical to good GROA throughput. For example, the GROA process "DPCAgePrep" allows the RF to remove the DPC from the transportation cask and return the transportation cask, place a storage overpack on the DPC, and send it to a "staging" area (in reality, an aging pad). This process is referred to as "DPC bypass" and models cases where DPCs cannot be immediately processed because the WHF is too busy or DPCs are arriving before the WHF is online. DPC bypass allows quick return of the DPC transportation cask for reuse and speeds waste acceptance. The key variables for setting up DPC processing are (see Section B.2.5):

- DPC Bypass: If DPCs will bypass to aging, this field is checked,
- DPC Queue Bypass: This value is the number of DPCs in the BWR or PWR buffer queues at which casks will bypass to aging-a long queue indicates the WHF is very busy, and
- DPC Return: The value specifies the time step number in the simulator to begin DPC processing in the WHF or allow DPCs to return from aging.

A case can be set up to maximize the DPCs sent to aging by setting the value for "DPC Return" time steps until after all shipments should have arrived (as in the test case in Section 3.1, where the value is 26,300 and the last IS shipment is at step 26,253). Notice that there can be cases with many DPCs where a value high DPC Return allows all the TADs in aging to be returned for processing before the DPCs are returned from aging. In these cases, if the "All" option is set for the simulation to pause (see Figure B-16) the simulation will stop before the DPCs are returned and the run will not be complete. In these cases, the user should use the option to pause the simulation at a time step as shown in Figure B-16.

Also notice that the DPCs in aging are not evaluated for radioactive decay, as are the TAD canisters on the aging pads; the DPCs are returned based on process availability, not heat. If the assemblies are too hot, this will be handled by the WHF that will place the hot assemblies in a TAD to go to aging for cooling and eventual return for emplacement. For most cases DPCs contain cold assemblies and ignoring decay is a negligible effect.

The user can also set up the logic to preferentially process truck casks rather than DPCs in the WHF, thus increasing ability to receive bare CSNF and increase GROA throughput. The "DPC/Truck Ratio" variable (see Section B.2.5) sets the number of truck cask loads processed before a DPC is processed. For example, 100 used in the test case in Section 3.1.1 means that 100 truck cask loads will be processed before a DPC can be processed. It is a way to provide low priority to DPC processing to allow trucks to be processed; DPCs go to aging instead of being processed so their transportation cask can be quickly returned.

Regardless of the settings of the DPC bypass, Truck /DPC Ratio, and other variable related to the DPC, the WHF processes a DPC if the WHF has availability to process it. WHF always tries to process the DPC before the TSM takes any other actions like bypass based on the DPC variables.

4.3 EXTENSIONS AND VB CODE

A major strength of the SimCAD™ platform is that it provides for flexible and complex programming outside of the operations provided by the drop-down menus and dialog boxes in the model and processes.

One programming capability is using "extensions" which is a SimCAD™-specific script code that can be used in any process or in the entire model. This program "extends" the inherent capability in SimCAD™ ergo the name "extensions". Extensions are primarily used in the TSM to trigger objects such as "calling" casks to sites that are ready to ship a cask load of waste and require a transportation cask and to calculate costs or other values of interest (see subsequent sections). Refer to the SimCAD Users' Manual (CaS 2006) for more detailed discussion.

There are several hundred lines of extension script throughout the processes in the TSM. To see the script code that is used, on the main TSM page, select the drop down menu, "Analysis", then "Model Information", then "Extensions/Events". This page shows all of the TSM extensions including the variables and the "events" (triggers). To use this report, it is best to copy the entire extension display into EXCEL to make it easier to print and to make it easy to follow the actions by searching on the variables and triggers of interest. See Reference BSC 2007e for typical extensions that are used for cost for an example.

SimCAD™ also allows the use of VB code and this is used in the TSM for the complex actions of the GROA WP filling and emplacement, also known as the "GROA Operations code". In the TSM, VB Code calls are reserved for actions related to the GROA. Other simulation actions in the TSM are performed and controlled using process extensions.

To see the VB code, select the drop down menu "View" and the "Open VB Script Window" option. It may be best to cut and paste the listing into MSWORD to make the VB code easier to print and to search for items and variables of interest. The actions of the VB code are described in the GROA Design and Bases (BSC 2007c).

4.4 CALCULATIONS

The TSM includes programming for various calculations for costs and other items. These calculations are placed in extensions in the overall model or with processes that are set up just to hold extensions. As mentioned above, the extensions can be viewed in the "Analysis" menu on the TSM toolbar.

The SimCAD™ extension programming options include a "Function Call" feature that is used to perform the same calculation for many different processes. For example, it is not necessary to provide an extension at all of the reactors to estimate the cost for shipping. A Function Call is used by all the site processes by exporting the shipping cost parameters for each shipment from the waste site to the Function via a Function Call.

4.4.1 Cost Calculations

The TSM calculates the WA, Storage, and Transportation (WAST) costs that are used in analyses like the Total System Life Cycle Cost (TSLCC) analyses. The cost analyses are in the overall model extensions under the “Properties” menu and in the “RailShipCostCalc” and “TruckShipCostCalc6” processes in the upper left of the TSM GUI, see Figure 14. Some cost calculations are also included in individual processes. The cost estimate limitations, assumptions, unit costs, methods and programming are documented in the Cost Estimating Design and Bases (BSC 2007e). NOTE: The TSM is not intended to be a comprehensive cost estimating model and the cost results that are directly output should only be used for relative cost comparison between various scenarios.

The basic principle is that cost variables that begin with “cost” are set up as model variables that can be accessed by all processes. These values are accumulated over the course of the run and all processes can add costs to the “cum” value of the variable. See the Cost Estimating Design and Bases (BSC 2007e) for a list of all the cost variables and how they are used to accumulate cost.

Another method is to use local variables in the process context to send information to a Function Call for the estimate. For example, to estimate the truck shipping costs, sites that use a truck Cask 6 send information on the shipment to process “TruckShipCostCalc6” that contains the Function to estimate the shipping cost. There is also a similar Function Call for truck Cask 1 and all rail cask shipments.

In typical SimCAD™ use, resources are people or equipment needed to perform processes or move objects through connectors. Resources are defined in the Flow Properties dialog box and there are a limited number available during the simulation. Processes and connectors must compete for the resources needed to perform tasks, and if a required resource is not available, then the process and activity will pause until the resource is available. Resources are listed in the “Resources” tab of the Flow Properties dialog box and are also listed in the .simdata output tables.

In the TSM the resources can also be the basis for cost estimates. Costs are estimated by assessing the resources in use at a time step and using the associated unit cost per time step. These cost estimates are discussed in more detail in the Cost Estimating Design and Bases (BSC 2007e).

Resources that include people are indicated on the GUI by small man-like images. The state line crossing charge resources (ST) are indicated by a dot. See the Flow Properties tab “Resources” for the bmp images used for resources. The resources used in TSM as the basis for cost estimates are shown in Table 3. The columns in Table 3 provide information on:

Resource Name: The TSM resource name.

Where Used: Processes and locations in the TSM where the resources are required and used.

Description: The resources are abstractions of equipment and people that are needed to enable processing or material flow. The description states the items that are abstracted.

Costs Estimated: The cost item that is influenced or based on the resources use. Cost estimate details are in other TSM documentation.

The cost results from the TSM are usually provided to other external cost analyses such as those in the Phase 1 TAD Study (BSC 2005). The Cost Report Generator (CRG, see Section 5.3) is used to perform the post-run analysis and provide an interface to the external analyses.

Table 3. Resources Used in TSM

Resource Name	Where Used	Description	Costs Estimated
Bargeresource	Barge sites	Abstraction for the barge equipment and workers	Not used in TSM Version 6.0 for costs. The estimate is accomplished with variables only.
HHresource	HH sites	Abstraction for the HH equipment and workers	Not used in TSM Version 6.0 for costs. The estimate is accomplished with variables only.
Railresource	On rail routes as a shipment is made	Abstraction for the security crews and operators for a rail shipment	Rail security crew costs
Truckdemurrage	Truck sites	Abstraction for the resources to support truck waiting time at the WA sites	Not used in TSM Version 6.0 for costs. The estimate is accomplished with variables only.
Truckresource	On truck routes as a shipment is made	Abstraction for the security crews and operators for a truck shipment	Truck security crew costs
costStLineR	On rail routes as a shipment is made	Represents the number of state lines crossed in a route	Not used in TSM Version 6.0 for costs. The estimate is accomplished with variables only.
costStLineT	On truck routes as a shipment is made	Represents the number of state lines crossed in a route	Not used in TSM Version 6.0 for costs. The estimate is accomplished with variables only.

4.4.2 Material Flow and Mass Flow

Tracking the mass flow of the wastes through the TSM is a key element to assess if CRWMS objectives are achieved. For waste mass, the TSM uses the terminology MTU, although the mass flows are actually calculated in MTHM and include plutonium.

Recall from Section 4.1 that each CSNF waste object has an MTU defined in the IS file. To calculate the MTU for processes of interest, the processes have extensions to query the object that enters the processes and to add the MTU for that object to a cumulative variable of the MTU for all objects processed. See Table 4 for a list of variables used for mass calculations. These process extensions execute when the object arrives using the process "Object Activated" event handler. There are extensions for all of the surface facility unloading stations and for inputs to the GROA. Inputs to the GROA are an estimate of the WA rate in MTU and this, along with the real time for the time step can be used to estimate the MTU/year received.

The MTU data is used in post-run analyses using various RGs discussed in Section 5.3 and Appendix A. When a run is completed an overall system mass balance is performed using the VCG as discussed in Appendix A.

Post-run, the material flow in the GROA is evaluated based on the number of assemblies using the TSM GROA Report Generator (GRG). The GRG provides a mass balance between the number of assemblies entering the GROA and the number of assemblies placed in WPs. The data for this post-run analysis is recorded in the TSM.mdb file (see Section 5.2) by the GROA operations VB code. The results for MTU are also presented in the Results Report Generator (RRG). See Appendix A for more discussion on the GRG and RRG.

The mass balance of the sum of the CRCFs and the MTU into the GROA is not always precise because the MTU in the TAD canisters made in WHF are based on average MTU for the BWR and PWR assemblies that are unloaded from the bare transportation cask. The variable "mtucumintoGROA" uses the precise MTU that is assigned by the cask load object variable "MTU". As the cask load assemblies are unloaded for blending and TAD canister loading in the WHF, the MTU information in the cask load object is lost. The TAD canister MTU is estimated in the GROA VB code using average values for PWR and BWR assemblies. So, a TAD canister loaded in the WHF has an estimated MTU value that may be different than the MTU value used in mtucumintoGROA. The TAD canisters from the WHF will eventually be processed in the CRCFs so the MTU values for the CRCFs also reflect differences to the GROA input MTU. Differences of up to 4% have been observed and depend on the number of bare casks processed in WHF. The values for the average MTU per assembly for PWR and BWR is from the *Total System Model Version 6.0 Validation Report* (BSC 2007h).

Table 4. TSM Variables Used for Mass Calculations

Variable Name	Units	Processes/Depts. Where Used	Description
MTU	MTHM	Various to track weight processed or received	Object variable for the MTHM in a waste cask load
MTU_CRCF1	MTHM	GROA, CRCF1 Unload	Cumulative MTHM processed
MTU_CRCF2	MTHM	GROA, CRCF2 Unload	Cumulative MTHM processed
MTU_CRCF3	MTHM	GROA, CRCF3 Unload	Cumulative MTHM processed
MTU_WHF	MTHM	GROA, WHF Unload	Cumulative MTHM processed
MTU_GROA	MTHM	GROA, facilities	Cumulative MTU processed.
MTU_GROAprev	MTHM	GROA, facilities	Cumulative MTHM processed the previous 30 days
mtucumintoGROA	MTHM	InputtoGROA	Cumulative CSNF MTHM input to GROA
mtudoeintoGROA	MTHM	InputtoGROA	Cumulative DOE waste MTHM input to GROA

4.4.3 Radiation Dose Calculations

Doses are tracked in TSM to provide a basis to compare various scenarios. NOTE: The dose estimates in TSM are intended only for relative comparisons of results; they do not replace, complement, or validate doses calculated for licensing, regulatory, or risk assessment needs provided by the OCRWM organizations responsible for those calculations.

Dose variables in person-rem are set up for unit doses for various TSM process operations (for example, loading a bare rail cask at a reactor pool is 0.33 person-rem) and total doses in "cumulative" values. To calculate the dose at any process, process (or connector) extensions increment the value of the cumulative dose variables by the unit dose for the process activity. The extension typically executes when the object is completed using the process "Object Completed" event handler. The doses calculated by the TSM include those for the primary CRWMS activities: waste site operations, transportation, and GROA operations as described below:

Waste Site Dose: The waste site dose is calculated by the TSM at the point when a cask load is joined with its transportation cask before the joined object proceeds to the waste site process. The variables radSiteDPCLoad, radSiteRailLoad, radSiteTruckLoad, radSiteTADLoad, and radSiteTSCLoad are used for the dose in person-rem per cask values. RadSiteCum is used to hold the cumulative dose for all waste site activities. RadSiteCum is incremented in the connector before each cask joining process (see the join process connectors in Figure 15).

Transportation Dose: The variable radTransCum is used to hold the cumulative transportation dose. Notice that the dose for each shipment depends on the waste object type. The variables radSiteRailShip, radSiteTADShip, radSiteTSCShip, and radSiteTruckShip are used for the person-rem per cask values. These are on a per cask basis, so the extensions for these doses are also in the connector before the join processes like the waste site doses.

GROA Dose: The variable radGROACum is used to hold the cumulative dose for all operations at the GROA. Each of the facilities has its dose calculated separately by quarter to allow trending by facility. The variables with the "Cum" suffix are used to hold the total dose for the facility while the other variables are for the dose for only the current quarter.

The dose variable values in the .simdata results file are used in post-run analyses using the Dose Report Generator (DRG) discussed in Section 5.3 and Appendix A. An example of a dose analysis is in the Phase 1 TAD Study radiation dose calculation (BSC 2006c). Reference BSC 2007g provides the bases for the dose unit values, details of the process extensions, and the dose variable lists for TSM Version 6.0.

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5. DATA ANALYSIS

This section discusses how to use the dynamic displays to analyze results as the TSM is run and how to extract output data for reports and graphs.

Some of the most important results occur as the model is running and are ascertained by simple observations enabled by the GUI and the SimCAD™ dynamic data displays. Experienced simulation analysts can quickly identify "jams" or processes that are not operating effectively. Aided by the other quantitative information that the TSM provides, the analyst has a powerful tool to understand systematic effects.

However, performing analysis of run data, documenting results, and generating reports is an important element of systems analysis. This section discusses how TSM records data and the methods to analyze the data and generate graphs or other report inputs.

CaS, that developed SimCAD™, realized that the data presentation needs vary widely among users and did not include "standard" output reports in SimCAD™. CaS assumed that analysts will have considerable database and data analysis experience with programs like MS EXCEL and MS ACCESS, so data is provided in raw form. In TSM/SimCAD™ the output is in an MS ACCESS format post fixed as ".simdata" and in an ACCESS database, called the "TSM.mdb" file, for the GROA operations VB outputs. Users may print out large, detailed reports using the analysis results in the simdata using the "Analysis" menu in the TSM toolbar but these do not present data in a very useful form. Similarly, a printout of the TSM.mdb file is not very useful.

To resolve the issues of handling and analyzing the large amount of data, CaS developed the SimCAD Data Analyzer described in this section. Additionally, the TSM Developers Group developed some "standard" outputs based on EXCEL tools referred to as "RGs" that are also described in this section. Analysts can also use EXCEL to analyze results using cut and paste of data from the .simdata file and TSM.mdb file if desired.

As discussed in Appendix B, Sections B.2.2 and B.2.6, the TSMCC includes functions to analyze, organize, and archive data from runs.

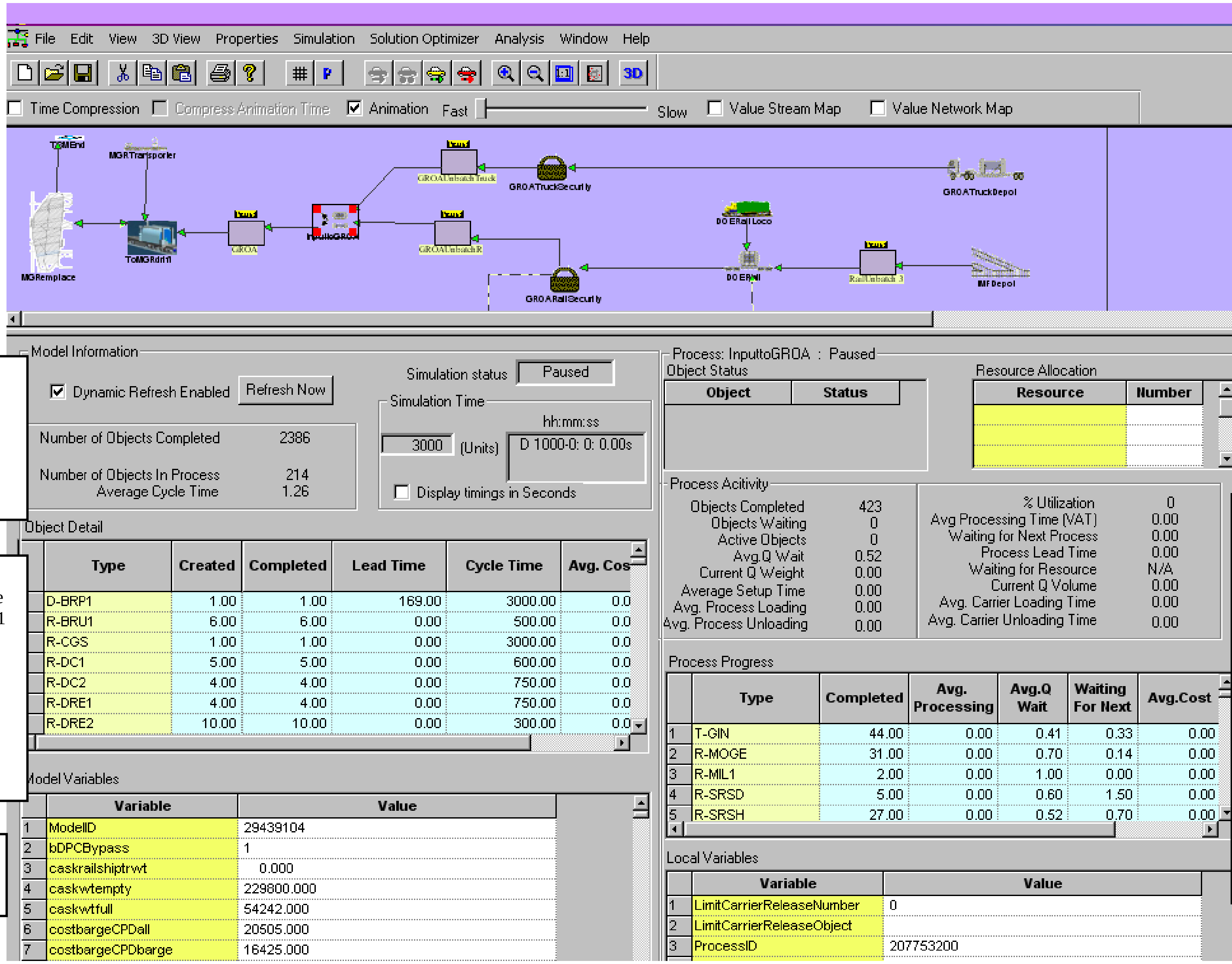
5.1 DYNAMIC DISPLAY OUTPUTS

As the TSM runs, data and results are dynamically displayed on the GUI as shown in Figure 23. The information provided in this display is shown in Table 5. In addition to the data shown in Table 5, the display also shows values for all the variables and "triggers" (0 or 1) used in the model. See the TSM Glossary (BSC 2007f) for a list and definition of the variables. See the SimCAD Users' Manual for more information on how the values are derived (CaS 2006).

Model Information: Model status such as current time step and overall model performance.

Object Detail. For example, the first line shows 1 rail shipment from Big Rock Point (R-BRP1) has been input from the IS.

Model variable values



Process/Connection Detail: Process Activity and local variables for the process selected on the GUI in this case InputtoGROA. In this case 423 objects have been completed with an average process time of 0.0 time steps and queue wait of 0.76 time steps. The objects include 44 truck shipments from Ginna (T-GIN).

Figure 23. TSM Dynamic Display

While running, the dynamic display shows data for the run, the overall process, variable, and processes. See Table 5 for a description of the data presented.

Table 5. Output Definitions on Dynamic Display and .simdata

Display Heading	Description / Formula
MODEL INFORMATION	
Number of Objects Completed	The total number of objects that passed through an end process since the start of the simulation. This is not very useful for TSM since there are so many different objects.
Number of Objects in Progress	Total number of objects in the overall model. This counter also includes all objects in the start processes that are created. This is not very useful in TSM because there are so many different objects.
Average Cycle time	The average cycle time based on all objects completed. (Total Simulation Time / Number of objects completed.) This is not very useful in TSM because there are so many different objects.
Simulation Time	Time in the simulation in 8-hour time steps with conversion to years-days-hours.
OBJECT DETAIL	
Type	The object type. Or just “object” such as a cask, a cask load, a locomotive, WP, etc.
Created	The total number of objects created to the current time step.
Completed	The total number of objects completed to the current step. In TSM many objects are never completed such as the transportation casks that constantly cycle.
Lead Time	The total time an object spends in the model from its creation time to its completion time. Batches or joined objects use the longest time of any of their components.
Cycle Time	The total time divided by the number of complete objects of a specific type. If a warm up period is used, and the total day time is less than a full day (as set in the flow properties – Simulation Control) the cycle time will then be based on the total operating time and not the total simulation time.
Avg Cost	The average cost of each object. (Not used in TSM)
PROCESS/CONNECTION DETAIL Applies to a process selected by clicking on the process image.	
Object Status	Displays the status of the object after it is received by the process. The status is tracked from the time the object enters the process queue until the object is passed to the next connection line.
Objects Completed	The total number of objects processed and passed on to the next connection line by the process.
Objects Waiting	The number of objects waiting in the process queue.
Active Objects	The number of objects actively being processed by the process. This number will never be greater than the process capacity.
Average Queue Wait	The average time objects spend in the queue before they enter a process to be processed.

Display Heading	Description / Formula
Current Queue Weight	The total weight of the queue computed based on the sum of the weights of all objects in it. Not used in TSM.
Average Setup Time	The average setup / change over time per object processed. Not used in TSM.
Average Process Loading	The average process loading time for all objects processed. Not used in TSM.
Average Process Unloading	The average process unloading time for all objects processed. Not used in TSM.
Percent Utilization	The total process utilization based on the number of time units counted (defined in the simulation control tab of the flow properties). By default, the utilization is based on the total simulation time. Percent utilization = Percent of (Process Lead time – Process queue wait time)/Total Time. Notice this is based on total model time so if a process is not active for the entire run time, these values can become very small. For example, the FHF processes finish their activity when the last truck cask is complete. This is usually much earlier than the time the model is stopped and during the time FHF is not active, the utilization will continually decrease. This value must be analyzed carefully and the value at the time when the last object is completed is the most meaningful and this value has limited value if the process is not routinely used.
Average Processing Time	The Value Added Time (VAT) of the process. This number is computed based on the value set in the detailed timing tab of the process setup menu.
Waiting for next process	The time required for an object to be transferred to the next connection. This number is affected by 2 main criteria: 1 – The next connection cannot accept the object due to delays down stream from it. 2 – The object cannot be released due to the “Enabled Controlled Object release” of the process (waiting for a trigger).
Process Lead Time	The total time an object spends in a process from the time it enters its queue until the time the next connection accepts the object. Also called Cycle Time in the .simdata file.
Waiting for Resource	The average time objects wait for a resource to be available. A high number indicates a resource contention within the model.
Current Queue Volume	The sum of volumes of all objects in the queue. Not used in TSM.
Average Carrier Loading time	The average time the process spends loading the carriers per object. Not used in TSM-the process times for processes with carriers includes the carrier loading time.
Average Carrier Unloading time	The average time the process spends unloading the carriers per object. Not used in TSM-the process times for processes with carriers includes the carrier unloading time.

5.2 OUTPUT DATA STRUCTURE

The SimCAD™ platform outputs data on virtually every aspect of the processes, resources, objects and variables as the simulation progresses. In the TSM this data is taken every 270 time steps (approximately 3 months), although other time intervals can be selected by modifying the "MOD" value in the model extension on the main GUI "Properties" menu, selection "Flow Properties", Tab "Extensions/Events", event handler "SimulationStepStarted" (changes must be in accordance with AP-ENG-006). As SimCAD™ runs, output data will be exported to a special MS ACCESS file (.simdata) that is automatically created and or initialized in the C:\SimCadPro directory. The .simdata output data tables are described in Table 6. Other tables not listed in Table 6 that are in the .simdata file are used to operate and control SimCAD™.

The parameter names/definitions displayed in SimCAD™ in Table 5 are sometimes different than the names in the column headings in the description of the .simdata file in Table 6. CaS often changes the display names to be consistent with the Lean Processing Institute (http://www.lean.org/) but neglects to change the names in the .simdata file. This can be confusing when using values from the Process and ModelObject tables in the .simdata file.

When provided, instantaneous or "Int" values are at the instant of data logging. Non-Int entries are running cumulative averages. The total run time is used for values averaged over time. As noted in Table 5 in "Percent Utilization" this method of averaging over total model time must be carefully analyzed.

When using the data in the .simdata file, it is listed by a run index that is correlated to the run time in the .simdata "RunDescriptionTbl." When cutting and pasting data from .simdata, the easiest way to include time is to set the first data point to 270 steps and increment subsequent points by 270 steps.

In addition to the .simdata file, the VB code for GROA operations writes data to an MS Access file called TSM.mdb. This file contains information on the WPs, and TAD canisters created in the WP filling processes. The data included in the TSM.mdb is described in Table 7. See the GROA Design and Bases for more details (BSC 2007c).

Table 6. Simdata Output Data Tables

Access Table	Description
ModelObjectTable	Overall object behavior for each object type: Objects completed, Cycle time (time from an object creation to completion), throughput (number of objects completed/model time), cost (not used), objects in process (at final data recording time).
ObjectTable	A list of all the objects and the processes it encounters during processing and the average processing parameters for all objects of this type.
ProcessTable	A list of all the processes and the average processing parameters shown in Table 5, Process/Connection detail. The .simdata lists "Lead Time" as "Cycle time".
ResourceRun	Resource usage. Fraction of the available resources in use. If there are 100 resources, 0.01 indicates 1 resource is in use.
Run Details	Records values for all custom variables.

Table 7. TSM.mdb Data Tables

Access Table	Description
LU_Heats	Lookup table containing decay heats used for long-term aging. Decay is calculated up to 100 years.
LU_Heats_Short	Lookup table containing decay heats used for short-term aging
Arrival	Contains a list of all shipments and when they arrive at the GROA. Data recorded includes the time of arrival and the MTU within the shipment.
MSC_Log **Note:** The name "MSC_log" was retained in TSM Version 6.0 even though the data is for TAD canisters, not MSCs.	Contains the list of all TAD canisters sent out to long-term aging. Data recorded includes the time that they arrived at aging, the time they were returned from aging, the number of assemblies in each of the 10 heat bins, the MTU of the SNF, and the Total Heat of the SNF. It also includes a "check" for items that have been returned that is used during the run to indicate that all items have been returned from aging and the run is complete.
Staging	Contains a listing of all CSNF unloaded in GROA facilities and the contents of surface facility lag storage at the end of a model run. Also contains detail of how items were selected for WP and TAD canister loading
WP_Recipe	Contains a list of all WPs and TAD canisters filled during a run.
TSM_Debug	Table used to archive any diagnostic messages during a run. This table does not contain any usable model results.

5.3 RESULTS REPORTING

This section discusses the various tools to generate results from the TSM output files.

5.3.1 SimCAD Data Analyzer

The SimCAD Data Analyzer that is provided with the SimCADPro™ software package is used to analyze data in the .simdata file. The SimCAD Data Analyzer GUI is shown in Figure 24, and allows users to graph information from .simdata as the run progresses or for post-run analysis. The SimCAD Data Analyzer allows plots of multiple curves simultaneously and also provides tabular data for cut and paste to EXCEL. Note that this tool cannot be used to access the TSM.mdb file; it is for the .simdata file only.

5.3.2 TSM Report Generators

Specialized post-processing tools, called "RGs", have been developed to retrieve data from the .simdata and the TSM.mdb files. These RGs, which use EXCEL workbooks with macros, are shown in Table 8. These tools have greatly reduced post-run analysis time and provide data reports (lists) and EXCEL charts for key TSM results. The detailed descriptions of the RGs are in Appendix A.

Post-run analyses using the complete suite of RGs provide a detailed and comprehensive basis to assess the validity and meaning of the run results. However, using and interpreting all of the results in a comprehensive analysis requires advanced experience in understanding CRWMS behavior and TSM operation.

RGs are designed to analyze only one run per EXCEL workbook. To compare results from multiple runs, the analysts must use standard EXCEL chart tools to combine results using cut and paste from the RG workbook results of interest.

Appendix A lists the RGs that are validated and are currently CIs as described in the TSM CMMP (BSC 2007p). The TSM Developers Group is continually developing additional RGs that may or may not become CIs depending on the extent of use.

As discussed in Section B.2, the TSMCC refers to the RGs as “TSM Tools” and allows users to invoke the RGs to perform post run analyses.

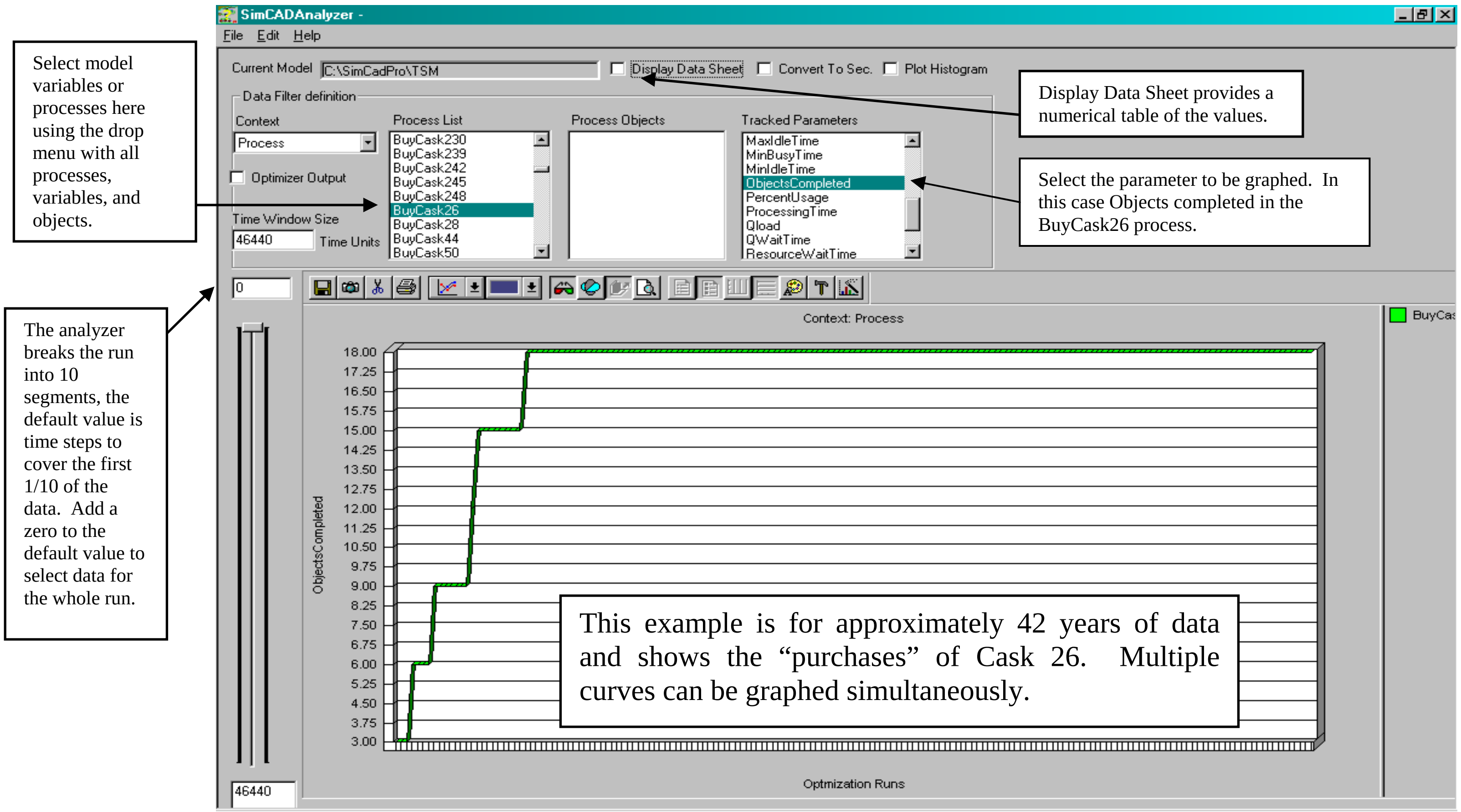


Figure 24. SimCAD Data Analysis Display

The SimCAD Data Analyzer has graphical displays of data from the .simdata file. This tool allows graphing of multiple variables and process values and the "Display Data Sheet" selection shows the data tables that can be transferred to EXCEL by cut and paste. This tool also allows the user to graph results for a run in process. The parameters that can be selected are the same as those in the dynamic display in Figure 23.

6. MISCELLANEOUS INFORMATION AND GUIDANCE

This section provides miscellaneous information and “pointers” for using the TSM program to perform systems analyses or run and analyze scenarios. Previous sections covered the mechanics of installing, executing, and understanding TSM. This section provides general guidance on using the TSM for systems analysis.

6.1 TSM OPERATIONS

Follow AP-ENG-005, *Total System Model (TSM) – Usage* to perform analyses using the TSM. Use Form AENG5-1, *Total System Model Analysis Request (TSMAR*) to document a request to perform a TSM analysis.

After a run is completed and TSM has paused, the following quick checks using the GUI can assess if the run is good. These should be done while the TSM is in “pause” (selection of “just pause” for the run) so the dynamic display is active (note that TSM cannot continue a run if it is stopped [red car], so always use the yellow “pause” button to stop for observations):

- Open the active TSM.mdb file under the SimCAD directory. All items have returned from aging as indicated by the check off of all line items in TSM.mdb MSC_Log table. If items remain, the simulation may not be complete because the decay is not complete. Note the TSMCC should not have “paused” the run unless all items are back if the TSMCC option “completed” is used in the simulation settings (see Figure B-14).

- Check that the number of cask loads in the IS file (count the cask load lines in the IS file for the number of cask loads, excluding any lines for cask WOs) have been received at the GROA (“objects complete” in process “InputtoGROA” in the main GUI, see Figures 14 and 17). Note the TSMCC should not have “paused” the run unless all items are back if the TSMCC option “completed” is used in the simulation settings (see Figure B-14). If cask load objects are missing, inspect the start processes in the cask allocation departments to find the cask loads and diagnose the problem. Alternately, use the SimCAD™ “Analysis” menu, option “Show Current State” to locate the missing cask loads.

- Check the number of WPs produced (“objects complete” in process “ToMGRDrift” in the main GUI). In many cases, the number of WPs will be within a few percent of the number of cask loads or the number can be compared to runs with similar waste streams.

Additional results using the RRG and the VCG should also be prepared; however, the interpretation of these results requires experience. Contact the TSM Users Group or Developers Group for help with the interpretation of the results.

If the results appear to indicate a problem with system plans or designs, first assume there is a problem with the TSM set up, inputs, or operation: always suspect the TSM has an error-especially for new analyses and TSM configurations. Possible causes related to IS file generation, TSM structural set up, VB bugs, or other issues must be carefully evaluated and eliminated as the cause of the observed behavior before concluding the results represent the expected behavior of the system.

Users should always question if results "make sense" based on their experience and knowledge of system actions. For example, if the waste stream is hotter (and the maximum WP heat has not increased), an experienced user would intuitively assume that more assemblies will be in aging and then check if this intuition is confirmed. If there are problems with the TSM software or errors occur, report them in accordance with the TSM CMMP (BSC 2007p).

In the TSM the model data writing must be coordinated with the extension that is holding maximum or minimum values that have occurred over the writing interval (usually 270 steps). To reset the timing in the TSM, go to Properties, Model Properties, Extensions and Event, Simulation Step Started. If this change is to be used as part of a published TSM analysis, it must be done in accordance with AP-ENG-006, or documented as an "interim" TSM version in accordance with AP-ENG-005. These files can get very large and the run time can be greatly slowed if data is recorded too often. A general rule is that taking data for 35 years at 270 time steps (140 recordings) creates a 100 Mb .simdata file. Only an experienced user should make this change.

Do not change the time per time step (currently set at 8 hours).

The .simdata file and TSM.mdb output files are re-initialized (overwritten) **each time** a TSM/SimCAD™ simulation is started. Therefore, the best practice is to use the TSMCC archive function after a run (see Appendix B, Section B.2.6) to prevent overwriting the files and losing the run data. Only the most experienced users should run more than one simulation at a time.

6.2 UNDERSTANDING TSM

As users begin to use the TSM, the first impression is that there are many unfamiliar variable names, process names, and other designators in the model. This manual assumes that the user has basic familiarity with the CRWMS mission and understands the basic mission activities that are in Figure 1 and the associated terminology. The terminology used in the TSM names is generally based on CRWMS conventions.

Users should apply a graded approach for their exposure to use of the documents in Figure 2. The biggest barrier to successful use of the TSM has been a lack of knowledge on CRWMS operations and lack of expertise performing systems analyses. Example studies like the so-called Phase 1 TAD Study (BSC 2005), CD-1 study (BSC 2006a), and phase 1 thermal envelope study (BSC 2007a) can be very helpful in learning how integrated systems analyses are performed using TSM. Proficiency in TSM is accomplished in small steps, beginning with simple changes to existing scenarios from analyses such as the Phase 1 TAD Study, proceeding to more complex changes, and finally to developing new scenarios from scratch.

Using this manual, users will be able to understand the basic architecture and functions of the TSM and how to make basic runs and view results and effects. To become proficient as a TSM and SimCAD™ user and analyst, the user should begin by performing the basic operations described in this manual and the SimCAD Users' Manual (CaS 2006). In addition, the user should attend formal training on SimCAD™ provided by the SimCAD™ vendor CaS. Experience shows that some use before the formal training is more effective than attending training with no previous use; however, both sequences have allowed users to progress to become efficient users and analysts.

There is no better way to learn and understand TSM than to execute runs, observe the system behavior in all departments, and perform post-run analyses. Reading and classroom instruction have very limited value without application experience.

6.3 PERFORMING SYSTEMS ANALYSES

Using the TSM simulation requires experience to understand the system effects and the ways that any problems or shortcomings may be corrected. After many runs, systems analysts get a "feel" for the system behavior and an understanding of key system interactions. Combining the simulation observations with post-run analysis of data provides a strong systems analysis capability that can assess impacts of CRWMS program changes and help ensure a successful mission.

As a minimum, any system study must follow procedure AP-ENG-005, and a TSMAR must be submitted prior to initiating the study.

If a study requires interim changes to the TSM (either the TSMPP or TSM GUI), these changes must be checked as part of the study documentation. If the changes are to be made permanent (i.e., part of a formally released TSM version), a TSM Change Request (TSMCR) must be submitted in accordance with AP-ENG-006.

When documenting studies, carefully plan the calculations that are needed. Always include all run files and other calculations as electronic attachments, to allow the run and analyses to be repeated. Run files can be large (>50 Mb) and a full set of data and electronic attachments for a large study may include several Gb of data even when compressed (zipped).

When developing new simulation concepts or enhancements, always begin with a small, stand-alone mock up or "game" of the new simulation vs. adding it in TSM. This is helpful to ensure the concept works as planned and is much easier to debug. The game can be tested under many situations and conditions to ensure it is resilient for the foreseeable run situations. Experience has shown that games can discover bugs in the SimCAD™ software and the game can be sent to CaS for resolution. This greatly reduces the time for CaS to repeat the problem, resolve the problem, and issue a patch.

For large integrated studies, planning and file management is critical. The TSMCC can be used to view archived results and organize files to support the planning process and understand the need for large studies. One suggested path for large systems studies or analyses is shown in Figure 25.

A study with multiple scenarios and CRWMS configurations requiring multiple runs should be pre-planned with run numbers that can be used in all file names entered in TSMCC to assist data management.

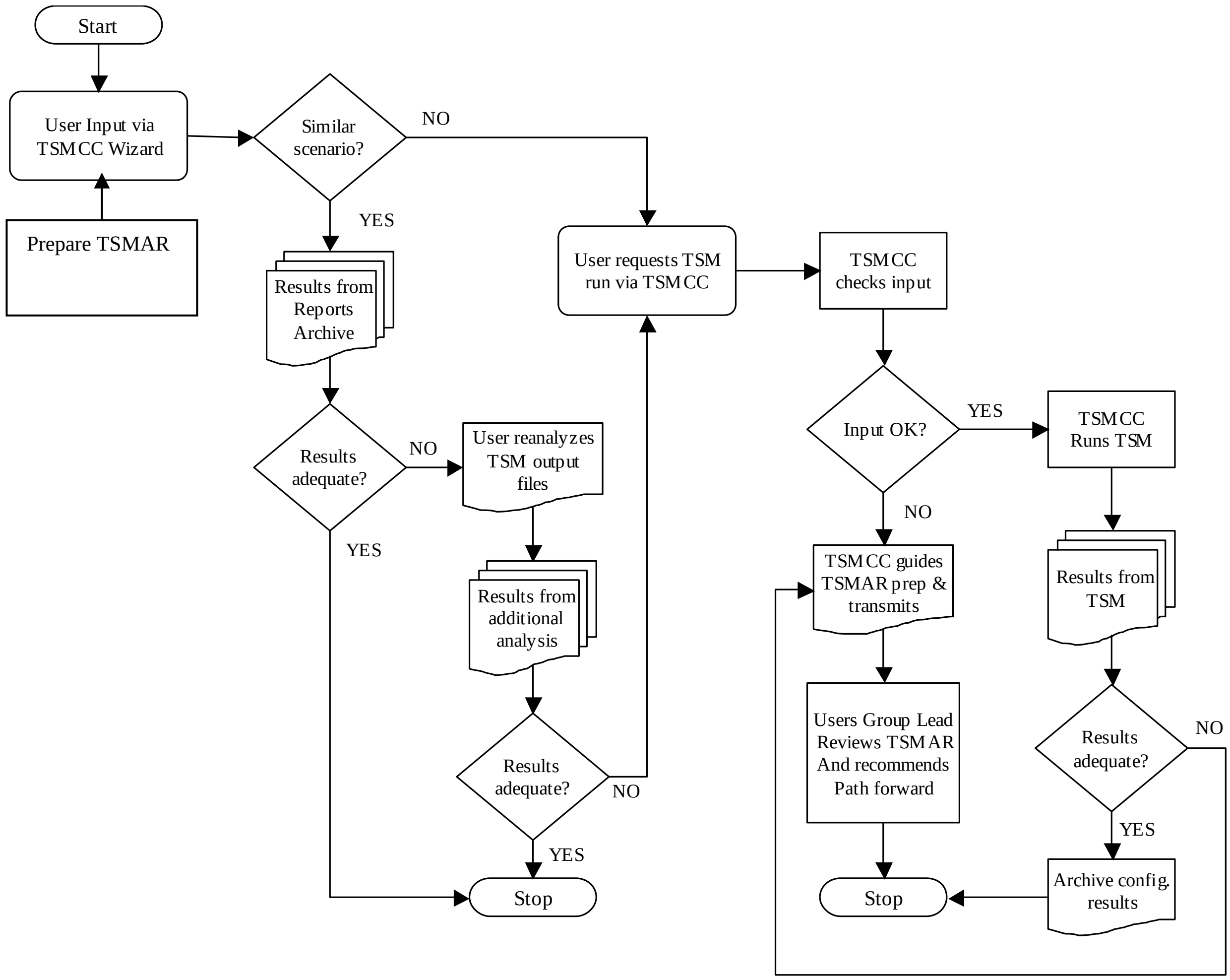


Figure 25. Analysis Method

The TSMCC interface guides the user to various levels of available data, analyses, and runs to achieve the desired results. There are already considerable amounts of run data and results that are archived by the Users Group and Developers Group. Users first explore the archived results and data to see if existing runs can support the analysis need. If not, then TSM runs are made. The TSMCC is helpful to prepare inputs for the TSMAR.

7. REFERENCES

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

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

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7.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

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AP-ENG-006 Revision 1 ICN 0, *Total System Model (TSM) - Changes to Configuration Items and Base Case*. Washington, D.C.: U.S. Department of Energy Office of Civilian Radioactive Waste Management. ACC: Submit to RPC.

APPENDIX A

TSM REPORT GENERATORS

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APPENDIX A. TSM REPORT GENERATORS

This Appendix describes the TSM RGs described in Section 2.2 and 5.3 of the main text. These are referred to as "data analysis tools" in the TSMCC. The RGs are provided with the package to install TSM in Section 2.2. The TSM RGs are CI under the control of AP-ENG-006. RGs are EXCEL workbooks with individual worksheets that are also referred to as "reports." The RGs have some actions and features that are common and these are discussed in the Section A.1. Subsequent sections cover the various RGs used with TSM Version 6.0 shown in the table below.

Report Generator	Results/Use	Section
Cask Information Report Generator (CIRG)	Reports and charts that extract and aggregate cask information from a run. A comparison of number of casks completed and cask turnaround time per year is performed for various types of casks.	A.7
Cost Report Generator (CRG)	Reports and charts that extract and aggregate the cost information from a run. Also provides counts of some objects like WPs. The results are usually input to other comprehensive cost analyses.	A.2
DOE Valley Curve Generator (DVCG)	Reports and charts for analyzing the difference between the DOE waste shipping schedule in the IS and the amount actually received at the GROA. Assists in identifying any DOE shipping delays.	A.10
Dose Report Generator (DRG)	Reports and charts that extract and aggregate dose estimates from a run.	A.3
Drift Length Report Generator (DLRG)	Reports and charts for the analysis of lineal heat for drifts for a run. It also offers the ability to make an examination of WP spacing on drifts and thermal effects. These results provide a general indication of thermal response; the thermal response prediction for OCRWM is done by other calculations.	A.8
GROA Report Generator (GRG)	Reports to assess if there is mass balance of the assemblies into and out of the GROA operations. The GRG also provides a chart that indicates the heat loading of each WP and the running average of all WPs that have been emplaced.	A.4
Results Report Generator (RRG)	Reports for the analysis of cask, cost, and GROA parameter data for the selected timeframe in the .simdata database. Used for post-run evaluation to confirm that the run appears good. RRG results from various runs can be compared to ensure the results are as expected.	A.5
TAD Throughput Report Generator (TTRG)	Reports and charts that extract and aggregate TAD canister information for a run including the throughputs for the various buildings. Also charts the WPs produced.	A.9
Transportation Cost Report Generator (TCRG)	Reports and charts that extract and aggregate the transportation cost information from a run: cask costs, truck and rail shipping costs, etc. Good for comparison to pre-2004 TSLCC reports.	A.11
Transportation Shipment Report Generator (TSRG)	Reports on MTU and shipments that traveled by rail and truck through the states and key cities. The TSRG also includes reference information for the locations traveled through by shipments from the TSM reactor sites to the repository.	A.12
Valley Curve Generator (VCG)	Reports and charts for analyzing the difference between the SNF shipping schedule and the amount actually received at the GROA. It also has charts for net in aging at the GROA. Valley curves provide a quick overview to show if the WA is met.	A.6

The RGs are validated in Reference BSC 2007j except the TSRG is validated in Reference BSC 2007m.

Some of the RGs in TSM Version 6.0 were simplified because the TSM is not as flexible as it once was. For example, previous TSM versions were used to study changes in the TAD canister sizes so the RGs accommodated the study of various canister sizes. The current plan is a single TAD canister size so the RG elements to handle multiple TAD canister sizes have been removed. In some cases, worksheets have been removed; however, the original workbook tab numbers have been retained for easier tracking of changes and comparison of results. For cases where new worksheets/tabs have been inserted a letter is added to the tab number to maintain numbering order and consistency.

Many of the RGs allow the systems analyst to revise input values in a "reference sheet" to do "what if" studies or to assess impacts of changes in unit values. In some cases, user input may be required for correct analysis of the TSM results (e.g., changing the default CSNF annual allocations in the VCG). The default values in these reference sheets match the values in the TSM Version 6.0 model and are CIs. If the TSM default values or default values in the RGs need to be permanently changed, the instructions in AP-ENG-006 must be used. Similar controls apply to other mechanisms where the RG allows user-defined settings such as the Chart Preferences. All of these are CIs while part of the controlled RG.

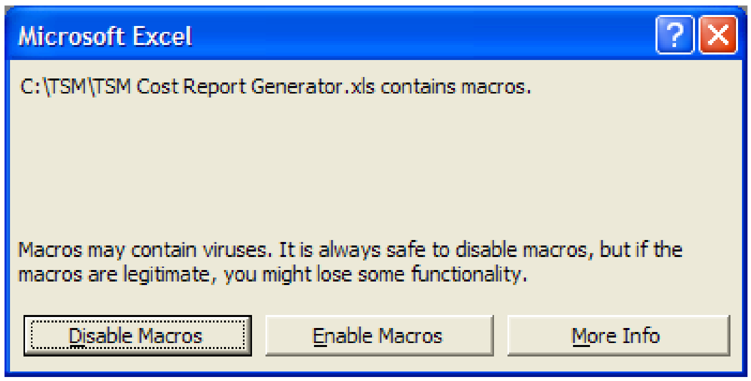
The controlled RG itself is governed by AP-ENG-006 but if an RG is used for an analysis and changes are made to reference values or other items that do not impact the programming that performs the analysis, the workbook can be modified to fit the analysis need. The workbook should be renamed and saved and it must be checked as part of the calculation or report preparation process. The workbook at that point is not the RG and is not a CI. The validity, accuracy, and control then depend on the checking and calculation process. This would also apply to changing or revising charts, combining results, etc. The RGs are considered like any analysis code; the code itself is configured but once the results are generated, the use of those results is no longer part of the code CM process.

A.1 COMMON FEATURES AND FUNCTIONS

There are several features and functions that have been implemented in all of the TSM Generators as described in this section.

Macro Security

When a TSM Generator Excel file is opened, a prompt regarding macro security will appear if the Excel security settings are set to Medium.

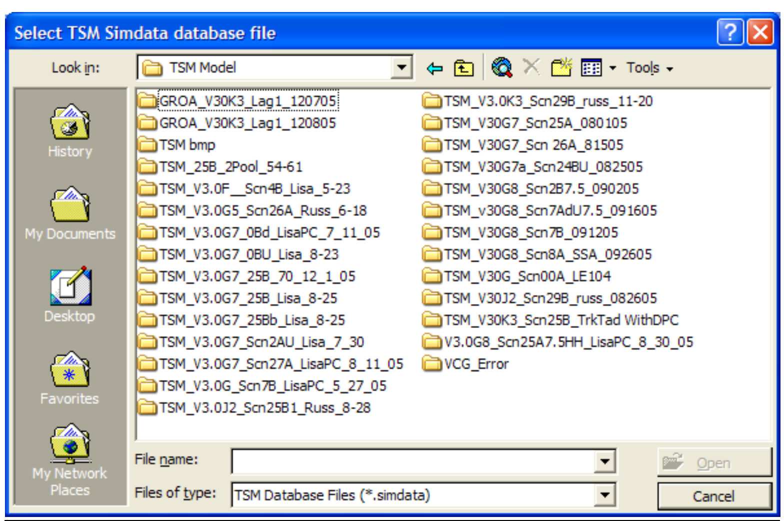


Macro Disabling Prompt

If the TSM toolbar in the Excel toolbar area is not visible or if there is difficulty running the application, the macro security setting should be checked. Security settings can be modified through menu items *Tools->Macro->Security…*. The available settings are High, Medium, or Low. The setting may be Medium or Low, but Medium is the preferred setting.

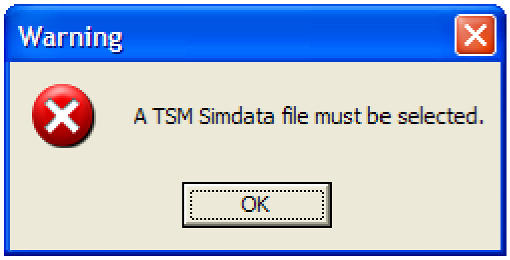
File Selection

During the generator opening process, a window for selecting the input file is displayed.



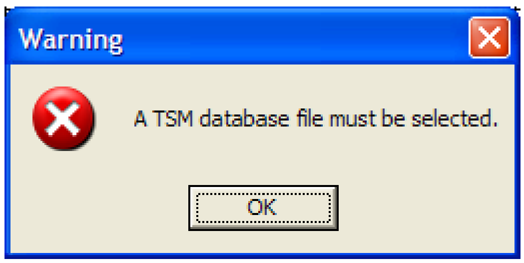
TSM Simdata File Browser Window

If the required .simdata input file has not been selected, a warning message will appear before generator execution commences.



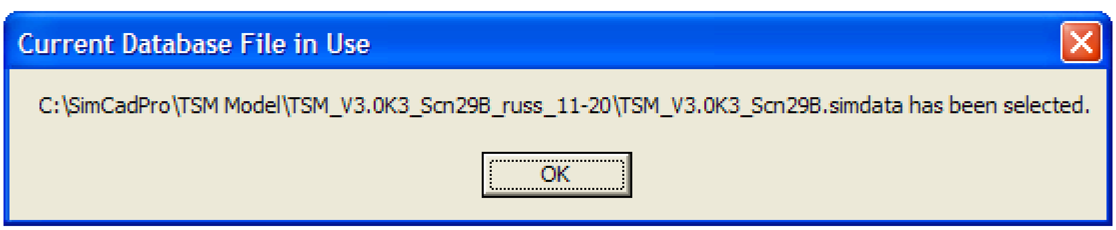
TSM Simdata File Warning

If the menu option to execute the generator is selected and a TSM.mdb input file has not been selected, a warning message is displayed.



TSM Database File Warning

Each generator has a menu option on the toolbar for selecting the input file. On the *File Selection* menu option are menu items for selecting the file and displaying the current menu in use. When the file selection menu item is selected, the file browser window is displayed. When the menu item to view the current input file is selected, a window appears with the full path name of the currently selected input file.



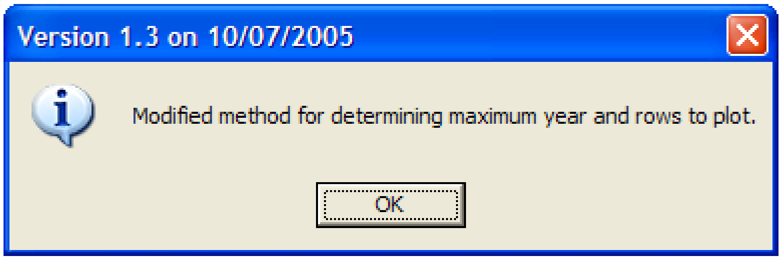
Current Input File in Use Window

Generate Reports

The *Generate Reports* menu option initiates the report and chart creation process. Any existing data is deleted before generation. When the report generation is finished, the resulting Excel file must be saved in order to save the newly generated reports. If a report cannot be generated because data is unavailable, a message alerts of the lack of available data.

Unable to Create Report Message

About Menu Option
Each generator contains an *About* menu option. Selection of the *About* menu option displays the version of the generator, the date of the version, and a brief description of the modifications to the macro or worksheet structure included in the version.



About Window

Chart Preferences
Many of the RGs have a *Chart Preferences* worksheet allows for specifying the format values of the X and Y axis of each chart. The values in this worksheet should be modified prior to report generation. Each worksheet that contains a chart is listed. If a value is defined in the Preferences section for the interval, minimum, or maximum settings, the value will be used during chart creation instead of the defined default value. If a value is not defined in the Preferences section, the default value will be used. Default values can also be updated if desired.

Chart Customization
The axis of a graph can be modified with a mouse right-click on the axis and selecting the *Format Axis* option. The Format Axis form appears with tabs for Patterns, Scale, Font, Number, and Alignment. Changes can be made by selecting the tab that corresponds to the feature of the axis requiring modification. For example, to change the scale interval, select the Scale tab and enter the desired interval value in the field for Major unit.

Printing
Worksheets are printed in landscape orientation with data delineated by grid lines. The page header of the sheet contains the name of the worksheet and the date with timestamp. The page footer includes the page number and the name of the Excel file.

A.2 COST REPORT GENERATOR

The TSM CRG generates a set of reports and charts that extract and aggregate the cost information from a run. It also provides counts of some objects like WPs. The results are usually input to other comprehensive cost analyses. Each report is represented on a separate worksheet with the name of the report appearing on the tab.

Generator File:	TSM Cost Report Generator.xls
Required Input File:	Simdata file, file with a .simdata extension
	TSM mdb file, file with .mdb extension

As discussed below, some cost unit values or parameters can be changed within the RG to allow comparison of the effect of changes without having to re-run the TSM SimCAD™ simulation.

For previous versions of TSM, the CRG had many options to study the costs for various sizes and types of casks and other options. Many of these options have been removed for the CRG for use with TSM Version 6.0 because OCRWM has made decisions on many of these options and alternatives and the calculation is no longer needed. See Reference BSC 2007e for the TSM default unit costs and other values.

INSTRUCTIONS

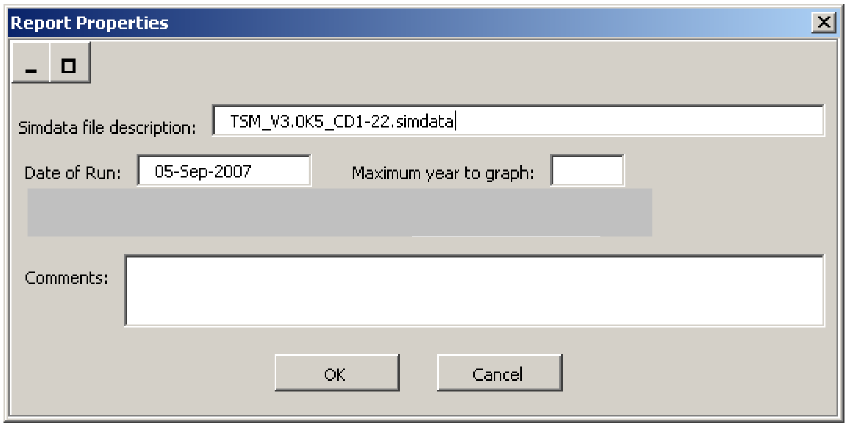
1. Execute the CRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the CRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, *Help*, and *About*. File selection can also be accomplished from the *Select TSM Simdata File* menu item on the *TSM File Selection* menu. The menu includes the *TSM Simdata Database File In Use* menu item, which displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected.



CRG Report Properties Window

The fields available are:

Simdata file description:

A read-only field that displays the name of the selected input file.

Date of Run:

An optional text field for the date of the run.

Maximum year to graph:

An optional text field for setting the maximum year to plot on the graphs. The default value for this is field blank meaning the maximum year for the retrieved data will be used.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.

WORKSHEET TABS

Introduction

The *Introduction* worksheet provides general information about the CRG and a history of its modifications.

Reference & End User Inputs

The *Reference & End User Inputs* worksheet contains values that are used in the report calculations. The values should be modified by modifying the values in the worksheet cells prior to report generation (i.e., open the CRG with the macros disabled, modify the inputs as necessary, save and close the file, then reopen with macros enabled, or, alternatively, run the CRG, then go back and adjust the user inputs, then rerun).

The calculation variables of various reports in CRG are identified below. When these values are modified, any affected variables are recomputed when the CRG is rerun in order to be used during report generation.

Many of the default values that are in TSM for "what if" cases or to assess changes in total costs based on changes in unit costs in post-run analysis. Only experienced cost analysts should make these changes to refine the cost estimate. However, any results used in published cost reports must be carefully checked by experienced analysts to ensure appropriate adjustments for unit costs and cask buy configuration are correct.

The options in the Reference sheet are correlated with each workbook below. Worksheets that are not listed do not require any reference inputs.

1. WAST Operations Cost
The escalation factor is used with the *Corrected values* column to calculate the *Escalated* column. The WAST unit costs are based on 2004 values. The cost analyst using TSM can escalate if desired.

2B. DOE Cask Costs
These cask unit costs may be modified. The values are used to populate columns for Cask 44, Cask 50, Cask 51, Cask 52, and Cask 56.

2C. DOE OV Cask Cost
Like TAD 2Bexcept this has the DOE cask and overpack costs (except for Navy) when the DOE "baskets and shells" option is selected in the TSMPP and the TSM "DOEOV" department is used for DOE cask allocation.

4. Cask Rail Car Costs
The value of *Rail Car Cost* can be modified, and will be reflected in the calculation of the *Cost per Year* column.

6. CSNF Waste Package Costs
The unit costs for the WPTAD can be revised.

6A. DOE Waste Package Costs
The values for these DOE WP costs can be modified. These values are listed in the report and are used to calculate the *Total* column.

7. WHF TAD Canisters
The unit cost for the TAD canisters filed in the WHF can be modified. The default value is the cost that utilities pay for TAD canisters (see Items 16 and 17). However, it is possible that the costs for WHF may be different. The cost values are listed in the report and are used to calculate the *Total Cost* column.

8. TAD Age Overpacks
The *Cost Each* value is used to calculate the *Cost per Year* column and can be modified.

9. DPC Age Overpacks
The *Cost Each* value is used to calculate the *Cost per Year* column and can be modified.

11. Rolling Stock
The cost values for *Buffer Cars* and *Security Cars* are used to calculate the *Rolling Stock Cost*. Each of these can be modified. The *Rolling Stock Cost* is used to calculate the *Cost per Year* column.

13. DPC Disposal
The values for *Can Diam,* and *Length* values are used for the calculation of *CF* (variable for cubic feet) and can be modified. The cost value for *Assume* can be modified and is used with *CF* to determine the *DPC Disposal Cost Each* value. The *DPC Disposal Cost* is used to calculate the *Cost per Year* column.

16. TADs Pool
The costs for casks TAD canisters 206, 209, 251, and 254 are used to calculate annual cost for TAD canisters that are filled from the waste site pool. NOTE: Although small TAD canisters (206 and 209) are no longer used in TAD scenarios, retaining them allows analysis of older runs that used small TAD canisters in the IS file using the TSM Version 6.0 CRG. However, the TAD canister costs are set the same for the nominal and small TAD canisters.

17. TADs Dry
The costs for casks TAD canisters 206, 209, 251, and 254 are used to calculate annual cost for TADs that are used for dry storage at the waste site. See NOTE in Item 16 above.

1. WAST Operations Cost

The *1.WAST Operations Cost* worksheet is a report of retrieved data from the RunDescriptionTbl and RunDetails tables of the selected Simdata database file. Charts for *WAST Operations Cost* and *Cost per Year* are included.

2. CSNF Trans Cask Costs-No TAD

The *2.CSNF Trans Cask Costs-No TAD* worksheet is a report of retrieved data from the RunDescriptionTbl and RunDetails tables of the selected Simdata database file. Charts for *CSNF Trans Cask Costs No TAD* and *Cost per Year* are included. The TAD transportation overpacks are in Sheet 3.

2A. TSC Use

The *2A.TSC Use* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. This sheet estimates the number of TSCs and when they are bought and is an input to the rail car costs in Sheet 4.

2B. DOE Cask Costs

The *2B.DOE Cask Costs* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *DOE Trans Cask Costs* and *Cost per Year* are included. This sheet always has the cost for the Navy Cask 52 (normally set to zero, since the Navy procures its own casks) since Navy is not included in the DOE 'basket and shell" approach (see TAB 2C). This sheet has the costs for the DOE casks in cases where the DOE "baskets and shells" is not implemented.

2C. DOE OV Cask Cost

Like TAD 2B except this has the DOE cask and overpack costs (except for Navy) when the DOE "baskets and shells" option is used in the TSMPP and the TSM "DOEOV" department is used for DOE cask allocation. Data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *DOE Trans OV Cask Costs* and *Cost per Year* are included

3. TAD Trans Overpack Costs

The *3.TAD Trans Overpack Costs* worksheet is a report of retrieved data from the RunDescriptionTbl and RunDetails tables of the selected Simdata database file. Charts for *TAD Trans Overpack Costs* and *Cost per Year* are included. This sheet complements Sheet 2 but is for TAD OV only.

4. Cask Rail Car Costs

The *4.Cask Rail Car Costs* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *Number of Cask Rail Cars* and *Cost per Year* are included. It is assumed there is a rail car for every transportation overpack (shell), TSC, or bare cask that is purchased.

5. TAD Costs

The *5. TAD Costs* worksheet is a report of retrieved data from the RunDescriptionTbl and RunDetails tables of the selected Simdata database file. Charts for *TAD Costs* and *Cost per Year* are included.

6. Waste Package Costs

The *6.Waste Package Costs* worksheet is a report of retrieved data from the RunDescriptionTbl, ModelObjectTable, and ProcessTable tables of the selected Simdata database file. Charts for *CSNF and DOE WP Costs* and *Cost per Year* are included.

6A. DOE Waste Package Costs

The *6A.DOE Waste Package Costs* worksheet is a report of retrieved data from the RunDescriptionTbl and ModelObjectTable tables of the selected Simdata database file. Charts for *DOE WP Costs* and *Cost per Year* are included.

7. WHF TAD Canisters

The *7.WHF TAD Canisters* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *SSC Canisters Cost* and *Cost per Year* are included.

8. TAD Age Overpacks

The *8. TAD Age Overpacks* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *TAD Overpack Cumulative Costs* and *Cost per Year* are included. The algorithm is programmed to re-use the overpacks.

9. DPC Age Overpacks

The *9.DPC Age Overpacks* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. Charts for *DPC Overpack Cumulative Costs* and *Cost per Year* are included. The algorithm is programmed to re-use the overpacks.

10. All Age Overpacks

The *10.All Age Overpacks* worksheets is a report using data from reports 8. SSC and TAD Age Overpacks and 9. DPC Age Overpacks. Charts for *All Overpack Cumulative Costs* and *Cost per Year* are included.

10A. No. in Aging

The *10A No in Aging* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcessTable tables of the selected Simdata database file. This sheet has no costs; it provides the total in aging (DPC and TAD) as a reference for the user.

11. Rolling Stock

The *11.Rolling Stock* worksheet is a report of retrieved data from the RunDescriptionTbl and ModelObjectTable tables of the selected Simdata database file. Charts for *Number of Rolling Stock* and *Cost per Year* are included.

12. Reserved

13. DPC Disposal

The *13.DPC Disposal* worksheet is a report of retrieved data from the RunDescriptionTbl and ProcesssTable tables of the selected Simdata database file. Charts for *Cumulative Costs* and *Number per Quarter* are included.

14. Reserved

15. All Costs

The *15.All Costs* worksheet is a summary report of cost totals from the other worksheets totaling these costs in the *Cost per Year* and *Cost Cumulative* columns. Charts for *Cumulative Costs* and *Cost per Year* are included.

16. TADs Pool

The *16. TADs Pool* worksheet is a report of count and cost of the TAD canisters loaded from the waste site pool.

17. TADs Dry

The *17. TADs Dry* worksheet is a report of count and cost of the TAD canisters loaded from the waste site dry storage.

18. Results Summary

The *Results Summary* worksheet is a summary report of cost totals and results from other sheets. It provides a quick overview for “sanity” checks by experienced cost analysts and TSM users.

19. Annual Costs

The *Annual Costs* worksheet is a summary report of cost totals from the other worksheets. It is setup to support direct input to TSLCC analyses and the total costs in this sheet will not be the same as the total costs in Sheet 18.

20. Annual Items

The *Annual Items* worksheet is a summary report of item counts of rolling stock, DPCs, WPs, and TAD canisters from the other worksheets. Note that the algorithm for annualizing the data in this sheet is slightly different than annualizing the data in the other sheets based on days. The cumulative counts should match, but the counts per year may not match exactly for all items.

A.3 DOSE REPORT GENERATOR

The DRG creates reports and charts that extract and aggregate dose (in person-rem) estimates from a run. The data is for TSM variables that are set up to track doses at various process locations and over quarterly periods and accumulated dose for the entire simulation. The dose variables and the basis for the unit doses that are used are in Reference BSC 2007g.

The charts of the cumulative doses vs. time should be fairly smooth, but could have abrupt changes as process lines are commissioned or if there are changes in production rates. Abrupt changes should therefore correlate with changes in other simulation processing results and can provide insight into overall OCRWM performance. Quarterly results will show the typical spikes that are caused by the extra shipments in the first quarter seen in most IS files. Doses in the GROA should generally follow the production in the GROA indicated by the TTRG.

Generator File: TSM Dose Report Generator.xls
Required Input File: Simdata file, file with .simdata extension

INSTRUCTIONS

1. Execute the DRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the DRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can also be accomplished from the *Select TSM Simdata File* menu item on the *TSM File Selection* menu. The menu includes the *TSM Simdata Database File In Use* menu item, which displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

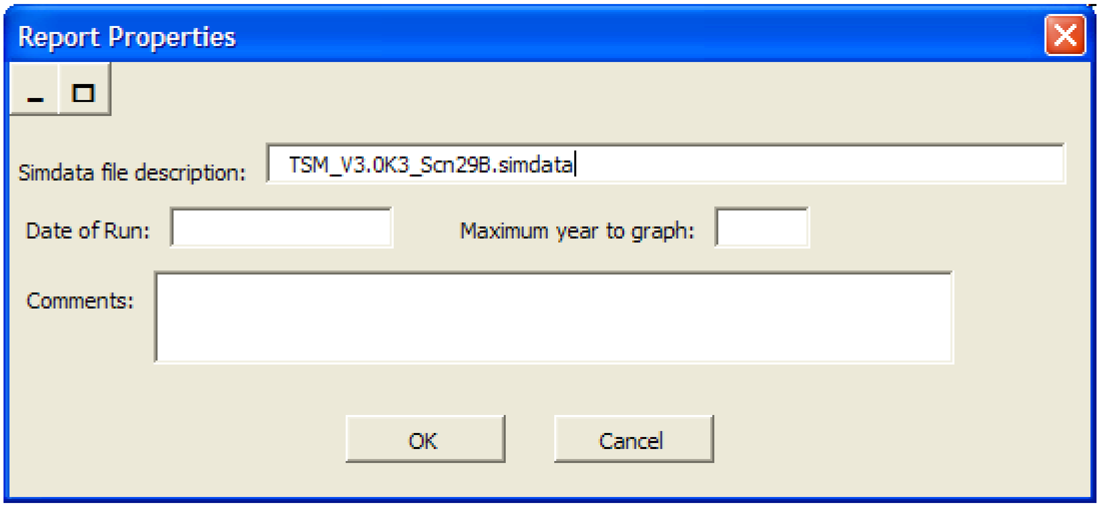
Simdata file description:
    A read-only field that displays the name of the selected input file.

Date of Run:
    An optional text field for the date of the run.

Maximum year to graph:
    An optional text field for setting the maximum year to plot on the graphs. Leaving this field blank means the maximum year for the retrieved data will be used.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



DRG Report Properties Window

During the workbook processing, status messages appear in the application status bar. When the report generation is finished, the *Processing complete* status message is displayed. The modified Excel file must be saved in order to save the newly generated worksheet.

If problems are encountered during the processing, errors are reported through error messages and processing is terminated.

WORKSHEET TABS

1. Dose Summary

The *1.Dose Summary* worksheet is a report of retrieved dose data from the RunDescriptionTbl and RunDetails tables of the Simdata database. Values are then summarized by quarter.

Charts generated from the computed data appear on the right side of the worksheet. Descriptions of these charts are as follows:

Cumulative GROA Dose

This chart plots the values in the RadGROAcum column in terms of Cum Person-REM by year.

Cumulative Site Dose

This chart plots the values in the RadSiteCum column in terms of Cum Person-REM by year.

Cumulative Trans Dose

This chart plots the values in the RadTransCum column in terms of Cum Person-REM by year.

Cumulative Total Dose

This chart plots the values in the Rad Total column, which is the sum of dose values in columns RadGROAcum, RadSiteCum, and RadTransCum, in terms of Cum Person-REM by year.

GROA Dose Per Quarter

This chart plots the values in the quarterly GROA dose column in terms of Person-REM per Quarter by year.

Site Dose Per Quarter

This chart plots the values in the quarterly Site dose column in terms of Person-REM per Quarter by year.

Trans Dose Per Quarter

This chart plots the values in the quarterly Trans dose column in terms of Person-REM per Quarter by year.

Total Dose Per Quarter

This chart plots the values in the quarterly Total dose column, which is the sum of dose values in columns for quarterly GROA, Site and Trans, in terms of Person-REM per Quarter by year.

Cumulative GROA, Site and Trans Dose

This chart is a scatter graph version that is a combination of the Cumulative GROA Dose, Cumulative Site Dose, and Cumulative Trans Dose charts.

GROA, Site, and Trans Dose

This chart is a pie chart version that is a combination of the Cumulative GROA Dose, Cumulative Site Dose, and Cumulative Trans Dose charts.

2. Process Lines

This worksheet presents annual and quarterly charts for the process lines in the GROA and for the emplacement of the WPs. The data is from variables that are set up for track process line doses that include all the process lines, emplacement, and a total GROA value. Charts are presented as commutative dose over the run and also dose by quarter. Charts are included for all doses superimposed and break out charts for doses that assist to compare the process lines. The cumulative and quarterly charts include GROA Process Line Dose, GROA Dose, GROA RF and Emplace Process Line Dose, GROA IHF and WHF Process Line Dose, and GROA CRCF1, CRCF2 and CRCF3 Process Line Dose.

A.4 GROA REPORT GENERATOR

The GRG creates reports and charts to verify spent fuel assembly tracking and provide analysis of WP emplacement heat.

Generator File: TSM GROA Report Generator.xls
Required Input File: TSM mdb file, file with .mdb extension

The primary purpose of the GRG is to verify that all SNF assemblies are properly accounted for. There are two reports that are generated upon request:

The Facility Mass Balance report calculates the total number of assemblies of each SNF type that were unloaded within each facility, versus the number loaded into WPs or TAD canisters and the amount remaining within the facility at the end of the run. The report provides a separate calculation for each heat bin and marks in color the rows where load and unload totals do not match (different colors are used for each heat bin).

The System Mass Balance provides a similar calculation in that it compares the amount of SNF unloaded within facilities and compares that to the amount of SNF loaded into WPs and TAD canisters. This calculation provides a total for all facilities and gives a feel for how the heat distribution looks overall.

The GRG also provides a chart for BWR and PWR that indicates the heat loading of each WP and the running average of all WPs that have been emplaced.

INSTRUCTIONS

1. Execute the GRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input TSM.mdb file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the GRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can be accomplished from the *Select TSM Mdb Database File* menu item on the *TSM File Selection* menu. The menu includes the *TSM Mdb* menu item, which displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar.
The *Report/Chart Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

Date of Run:

An optional text field for the date of the run. The default value is the current date.

Model Version:

An optional text field for the user to record the TSM version number. This was added as feature in TSM Version 6.0 because the version of TSM in use is not recorded in the TSM.mdb used for input and is not retained with the results unless the user fills this field.

Time Started:

An optional text field for the beginning date and time of the simulation run. This time value is informational in nature and is not used for the calculations in the reports.

Time Completed:

An optional text field for the ending date and time of the simulation run. This time value is informational in nature and is not used for the calculations in the reports.

TSM database file description:

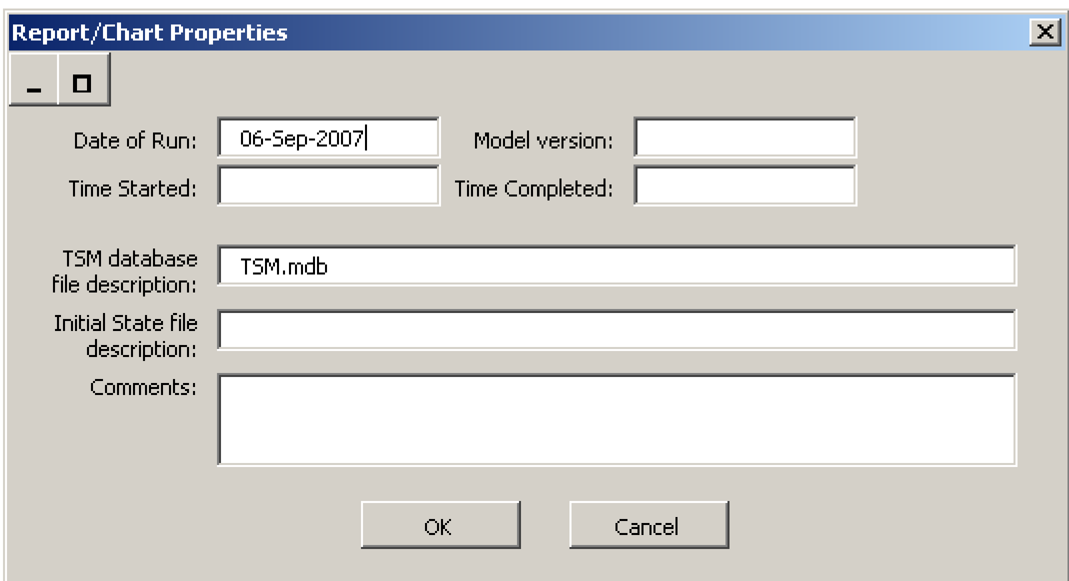
A read-only field that displays the name of the selected input file.

Initial file description:

An optional text field that can be used to indicate name of the IS.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



GRG Report/Chart Properties Window

WORKSHEET TABS

1. Load/Unload by Bldg

The *Load/Unload by Bldg* worksheet lists the cumulative load and unload values for assemblies by waste type for each building based on data from the Staging, WP_Recipe, and MSC_Log tables of the selected input file. (Note: the name of the TSM.mdb table MSC_Log was retained for Version 6.0 even though it records TAD canister data, not MSC data). The Staging table contains records on all casks that were unloaded by building. The WP_Recipe table contains heat, time, and building data for all WPs and TAD canisters that were created. The MSC_Log table contains data for TAD canisters that were sent to staging. In this table, the WP_Time field is the time the TAD canister went out, the RetTime field is when it was returned for processing, and the Returned field indicates if the TAD canister was actually returned.

Load values are retrieved from records with a WP type of WP, TAD, or FINAL (for the final WP that may be just a partial fill but empties all buffers). Unload values are from records with a WP type of Unload and are for the facility unload processes. When the sum of the load values does not equal the unload value of an assembly, the cells associated with that heat bin are highlighted to indicate there may be a mass balance issue.

All of the DOE waste types are assigned to heat bin 1 but this makes it difficult to compare the unload and WP values. So, for presentation purposes, the DOE wastes and WPs were assigned heat bins as follows:

Heat Bin	Waste Type
1	DOE SNF
2	HLW
3	DOE SNFL
4	HLWL
5	MCO

Each of the “WP” lines shows what was in each WP. For example, in the case of a WPMCO, this should be two HLW Long (Column for Heat4) and two MCO (Column for Heat5) for each WP.

2. Load/Unload System Balance

The Load/Unload System Balance worksheet is a report of the summary total of cumulative load and unload values for assemblies by SNF and waste type based on data from the Staging, WP_Recipe, and MSC_Log tables of the selected database file. Within each SNF type (also includes DOE canistered wastes), WP types are summed for the heat load totals. WP types are TAD, WPTAD, WP, and FINAL. Unload values are represented in rows with a WP type of Unload. Rows are highlighted where the sum of heat load values do not equal the sum of unload values. Heat bins for DOE waste and WPs were assigned heat bins as in worksheet 1 discussed above.

3. WP and TAD Created

This report is a summary of the total number of WPs and TAD canisters grouped by SNF type using data from the WP_Recipe table. The TAD counts are based on data from the MSC_Log table. Counts are reported for all WP, TAD WP, and TAD canisters to aging.

4. BWR Heat by Time

The *BWR Heat by Time* worksheet contains a scatter graph of BWR WP heat bins over time which represents values from the RG *Total Heat* column as small blue diamonds. The RG Total Heat values are directly from the TSM.mdb file, WP_Recipe table, “TotalHeat” data.

Superimposed on this scatter chart is a line graph, represented in red, of the average heat of all BWR WPs created to date using the *Cum Heat/WP Avg* column. The *Cum Heat* column is the row by row cumulative sum of *Total Heat* values. Each row of the *Cum Heat/WP Avg* column is calculated as the corresponding *Cum Heat* column divided by the number of WPs starting at 1.

5. PWR Heat by Time

The *PWR Heat by Time* worksheet contains a scatter graph of PWR WP heat bins over time. It is identical to the *BWR with Heat by Time* in its terms of design and implementation except that PWR “TotalHeat” data is used.

A.5 RESULTS REPORT GENERATOR

The RRG creates reports for the analysis of cask, cost, and GROA parameter data for the selected timeframe in the Simdata database file. The results are used for post-run evaluation for general results and to confirm that the run appears good. RRG from various runs can be compared to ensure the results are as expected. The RRG is typically used for a quick indication of results post-run and the results have not been included in any detailed studies or analyses.

Generator File: TSM Results Report Generator.xls
Required Input File: Simdata file, file with .simdata extension

INSTRUCTIONS

1. Execute the RRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the RRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can also be accomplished from the *Select TSM Simdata File* menu item on the *TSM File Selection* menu. The menu includes the *TSM Simdata File In Use* menu item, which displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. The *TSM Data Sheet* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

Date of Run:
An optional text field for the date of the run.
Time Started:
An optional text field for the beginning time of the Simdata file creation process.
Time Completed:
An optional text field for the ending time of the Simdata file creation process.
Time Step:
A required numeric field for the time step. The field defaults to the maximum time step retrieved from the selected Simdata file. If the user-entered time step is not available for the database, the value is rounded up to the next available time step.
Rolling Stock Restricted?
The *Rolling Stock Restricted?* check box is used for the calculation of RailRollingStock and X-Truck. If checked yes, the original value is used. If left unchecked, the value is adjusted by subtracting 2. The default setting is unchecked because as noted in Section

4.2.2.5 the configured TSM as delivered has truck and rail rolling stock on unrestricted "open buy". The value of 2 is used to account for objects in the buy process "pipeline". It is recognized that the settings in the rolling stock processes are CIs but there have been occasions where analysts do "one-off" studies to restrict rolling stock. However, if any results are reported from these runs, procedures AP-ENG-005 and/or AP-ENG-006 must be followed.

Simdata file description:

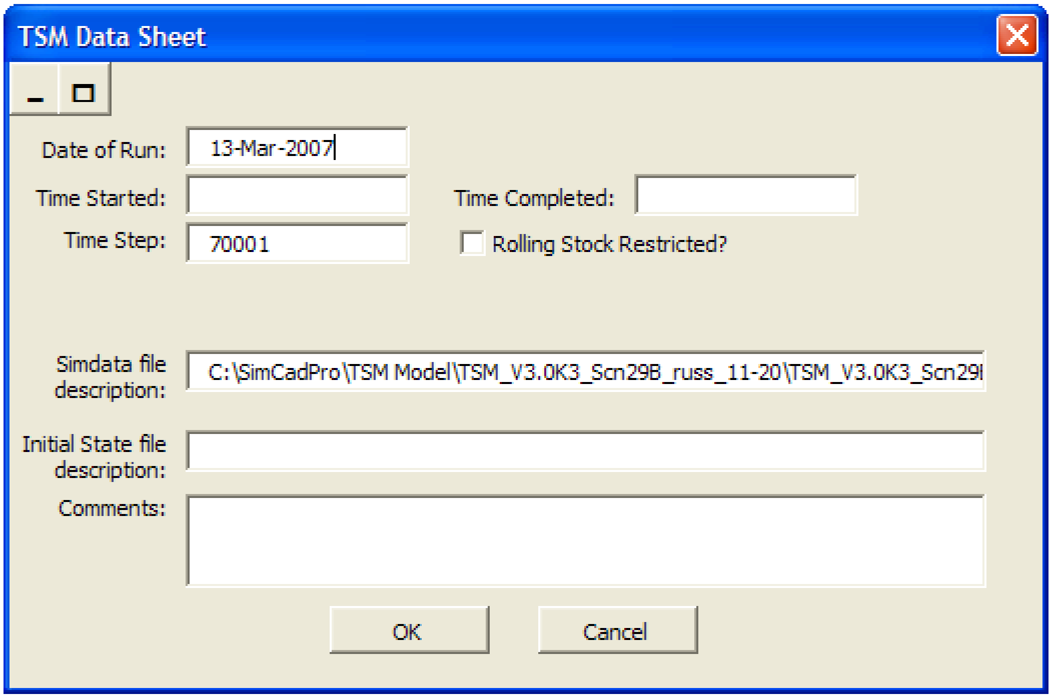
An optional text field that defaults to display the name of the selected input file.

IS description:

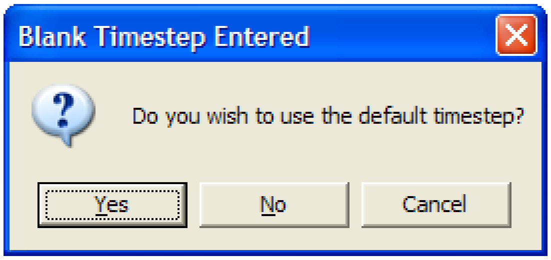
An optional text field for the name of the IS file.

Comments:

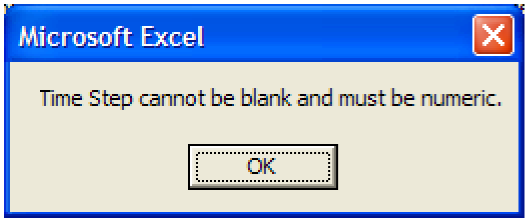
An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



RRG Data Sheet Properties Window



Default Time Step Prompt



Time Step Warning

WORKSHEET TABS

1. Object Data

The *1.Object Data* worksheet is a report of created and completed object totals from the ObjectTable and ProcessTable database tables.

2. Cost and Throughput

The *2.Cost and Throughput* worksheet is a report of cost values for model object variables of variable cost, throughputs, and rad factors. The data is retrieved from the RunDetails table.

3. GROA Parameters

The *3.GROA Parameters* worksheet is a report of completion counts, lead time, and usage for variables for the Fleet Management Facility (FMF) Maintenance, GROA Performance Inputs, GROA Performance Buffers, and Facility Performance. The data is retrieved from the ObjectTable and ProcessTable database tables.

4. Summary Results

The *Summary Results* worksheet is a summary report of Object Completed and Lead Time values for key objects and processes. The results are from other sheets and this sheet is intended to be a good "first check" comparison between two runs. Often, the two runs with the same settings are compared to note any differences from programming changes. If the two runs differ the analyst can use the more detailed results in other RRG sheets or other run other RGs to understand the differences.

A.6 VALLEY CURVE GENERATOR

The VCG creates reports and charts for analyzing the difference between the SNF shipping schedule and the amount actually received at the GROA. It also has charts for the net in aging at the GROA. Valley curves provide a quick overview to show if the WA is met. The net in aging shows if limits (if any) on the count or MTHM in aging are met and the time when the last item is returned from aging which indicates that emplacement is completed. Abrupt changes or discontinuities in the cumulative arrivals, valley curve, or net in aging could indicate a processing issue or problem and are a good barometer of OCRWM system performance and the VCG is usually the first RG run post-run to assess run results. Charts based on quarterly results will show the typical spikes that are caused by the extra shipments in the first quarter seen in most IS files. The spikes are especially prevalent in runs with small arrival deficits since the deficits are usually only in the quarter with the highest number of shipments and the GROA tends to "get behind".

Generator File: TSM Valley Curve Generator.xls
Required Input Files: TSM mdb file, file with .mdb extension
IS file, file with .xls extension

INSTRUCTIONS

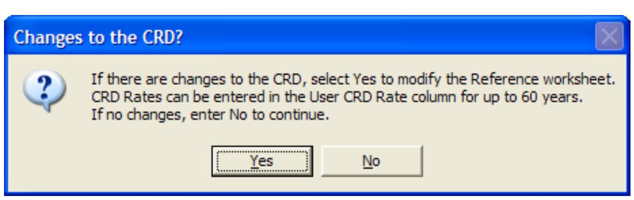
1. Execute the VCG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input TSM.mdb file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the VCG menu toolbar appears with menu options, *TSM File Selection*, *Generate Chart*, and *About*. File selections can also be accomplished from the *Select TSM Database File* menu item and *Select Initial State File* menu item on the *TSM File Selection* menu. The menu items to display the currently selected input files are *TSM Database File In Use* and *Initial State File In Use*.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. A message is displayed as a reminder that modifications to CRWMS Requirements Document (CRD) WA rates need to be made on the Reference worksheet before the report creation process is initiated. As noted later, when the run initiates, the VCG checks that the input reference data covers the time period for the arrivals.



CRD Rates Message

After this message, the *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

TSM database file:

A read-only field that displays the name of the selected TSM mdb input file.

Initial State file:

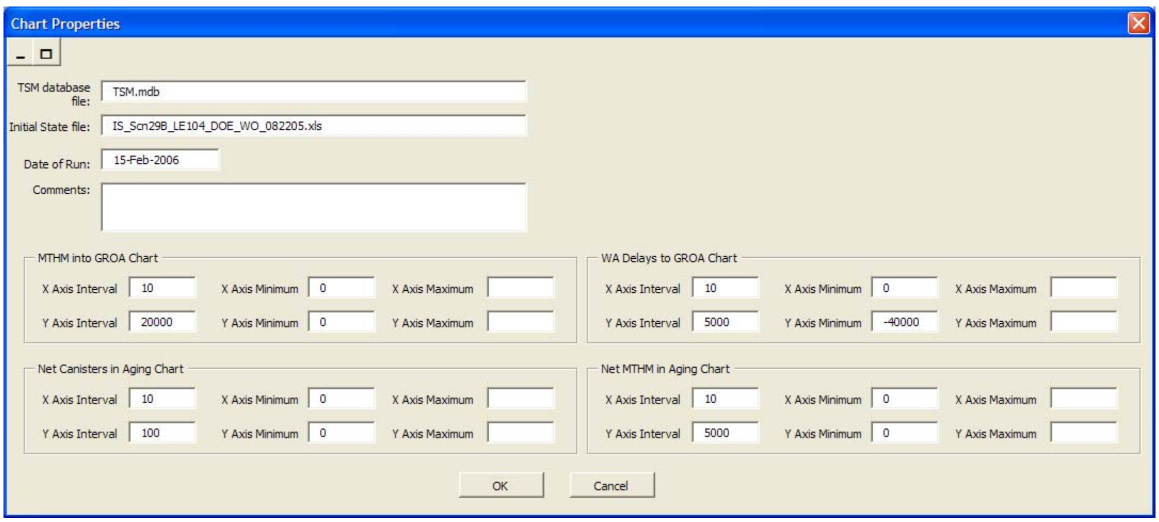
A read-only field that displays the name of the selected IS input file.

Date of Run:

An optional text field for the date of the run. The field value defaults to the current date.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



VCG Chart Properties Window

MTHM into GROA Chart

X Axis Interval:

A numeric field for defining the interval on the x axis of the graph. The default value is set to 10.

X Axis Minimum:

A numeric field for defining the minimum value to be plotted on the x axis of the graph. The default value is set to 0.

X Axis Maximum:

A numeric field for defining the maximum value to be plotted on the x axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

Y Axis Interval:

A numeric field for defining the interval on the y axis of the graph. The default value is set to 20,000.

Y Axis Minimum:

A numeric field for defining the minimum value to be plotted on the y axis of the graph. The default value is set to 0.

Y Axis Maximum

A numeric field for defining the maximum value to be plotted on the y axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

<u>WA Delays to GROA Chart</u>

X Axis Interval:

A numeric field for defining the interval on the x axis of the graph. The default value is set to 10.

X Axis Minimum:

A numeric field for defining the minimum value to be plotted on the x axis of the graph. The default value is set to 0.

X Axis Maximum:

A numeric field for defining the maximum value to be plotted on the x axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

Y Axis Interval:

A numeric field for defining the interval on the y axis of the graph. The default value is set to 5000.

Y Axis Minimum:

A numeric field for defining the minimum value to be plotted on the y axis of the graph. The default value is set to -40,000.

Y Axis Maximum

A numeric field for defining the maximum value to be plotted on the y axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

<u>Net Canisters in Aging Chart</u>

X Axis Interval:

A numeric field for defining the interval on the x axis of the graph. The default value is set to 10.

X Axis Minimum:

A numeric field for defining the minimum value to be plotted on the x axis of the graph. The default value is set to 0.

X Axis Maximum:

A numeric field for defining the maximum value to be plotted on the x axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

Y Axis Interval:

A numeric field for defining the interval on the y axis of the graph. The default value is set to 100.

Y Axis Minimum:

A numeric field for defining the minimum value to be plotted on the y axis of the graph. The default value is set to 0.

Y Axis Maximum

A numeric field for defining the maximum value to be plotted on the y axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

Net MTHM in Aging Chart

X Axis Interval:

A numeric field for defining the interval on the x axis of the graph. The default value is set to 10.

X Axis Minimum:

A numeric field for defining the minimum value to be plotted on the x axis of the graph. The default value is set to 0.

X Axis Maximum:

A numeric field for defining the maximum value to be plotted on the x axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

Y Axis Interval:

A numeric field for defining the interval on the y axis of the graph. The default value is set to 5000.

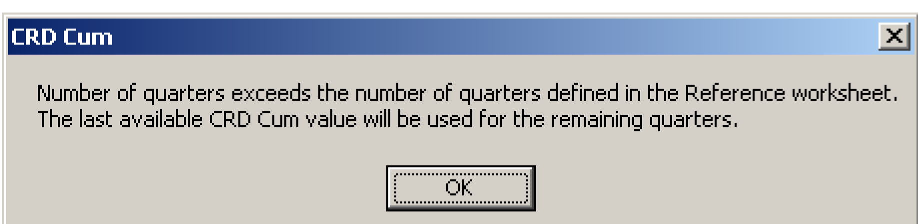
Y Axis Minimum:

A numeric field for defining the minimum value to be plotted on the y axis of the graph. The default value is set to 0.

Y Axis Maximum

A numeric field for defining the maximum value to be plotted on the y axis of the graph. The default value for the field is blank meaning the largest value for this axis will be plotted.

After the Report Properties are entered by the user, the VCG initiates the creation of the worksheets. The VCG first checks that the input data in the Reference worksheet covers the time period for the arrivals. This is often not the case because users typically input the expected CSNF arrivals up to the year that all shipments are completed in the IS file but leave the years after that blank. To properly display the VCG if there are delays in the arrivals (valley curves), the cumulative tons should be input for additional years to cover the time to receive all arrivals. If all of the arrival years are not included the information notice below is displayed: When the user selects OK, the VCG uses the last cumulative tons value for the additional quarters that are need to cover the arrival time.



For example, the user may input a CRD rate of 3,000 MT per year (or fraction of that) to provide a cumulative CSNF of 63,000 tons at 25 years (typical for a “70,000 ton” case). But if shipment delays cause the final arrival to delay until Year 30, the VCG will extend the cumulative value 63,000 to year 30.

WORKSHEET TABS

1. IS Shipments

The 1. *IS Shipments* worksheet is populated with data from the selected IS file. Data from columns *Process Connection*, *Object*, *Start Time*, and *MTU* are copied to this worksheet. The values in the *MTU Qtr Cum* column are the cumulative sum of *MTU Cum* values, which are calculated from the *MTU* column. (Qtr is an abbreviation for quarter of a year).

The *MTHM into GROA* chart contains the IS MTHM Cum series which plots the values in the *MTU Qtr Cum* column. The second series in the chart, Arrival MTHM Cum, plots the *MTU Qtr Cum* column in the *MTU Delays* worksheet.

Notice that the IS shipment results show the cask WO as the first items, the IS shipments begin after that. Also, notice that columns A-H contain the original IS data for each cask load and then Columns I-L analyzes the shipments by quarter.

2. MTU Delays

The *2. MTU Delays* worksheet contains MTU GROA data from the TSM mdb database file. The columns *Arrival Time*, *MTU*, and *Days* are retrieved from the Arrivals table. The imported data excludes object types INLD, INLH, INLN but not all INL and excludes object types HAND, HANH but not all HAN.

The *MTU Qtr* values are computed as the sum of values from the *MTU* column by quarter. The *MTU Qtr Cum* column is calculated as the cumulative total of *MTU Qtr* values. The *MTU Qtr Cum* column is used for the Arrival MTHM Cum series in the *MTHM into GROA* chart on the *1. IS Shipments* worksheet.

The *WA Delays to GROA* chart plots the WA deficit for each year represented in the *WA Deficit* column. The values in this column are calculated by subtracting the *MTU Qtr Cum* value of the *1. IS Shipments* worksheet from the *MTU Delays* worksheet *MTU Qtr Cum* value by year.

WA Delays to GROA based on CRD chart graphs the *CRD Deficit* column by year. The *CRD Cum* column is computed by comparing the last value in the *MTU Qtr Cum* column from *1. IS Shipments* worksheet to the corresponding quarterly *CRD Cum* value from the *Reference* worksheet.

If the *CRD Cum* value is not zero, the *CRD Deficit* value is calculated as the *MTU Qtr Cum* value minus the *CRD* Cum value. If the *CRD Cum* value is zero, the *CRD Deficit* value is set to 0.

3. Pad Staging

The *3. Pad Staging* worksheet contains aging data retrieved from the MSC_Log table of the TSM.mdb database file. The *Sent Count* column contains the number of items sent during the time period as determined by a count of MSC_Log records for the time specified in the WP_Time field. The *Return Count* value is a count of MSC_Log records indicated as returned by having a value of True for the Returned field and an acceptable return time represented in the RetTime field. The *Net Count* column is calculated as the net value of *Sent Count* less the value of the *Return Count* for the time interval.

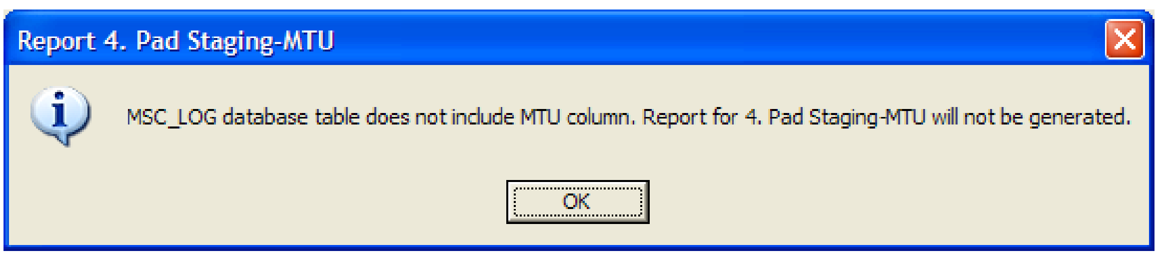
The *Net Canisters in Aging* chart plots the number of canisters in aging across the years using the *Net Count* column.

4. Pad Staging-MTU

The *4. Pad Staging-MTU* worksheet is a report of MTU information based on data in columns *WP_Time*, RetTime, and *MTU* that are retrieved from the MSC_Log table of the TSM.mdb database file. This report is only generated when the selected input TSM.mdb database has an MSC_Log table that contains the MTU column. If the report cannot be created, a message is displayed.

The *Tons In* column is the sum of *MTU* based on the *WP_Time Qtr* value. The *Tons In Cum* column is the cumulative quarterly total of the *Tons In* value. The *Tons Out* column is the sum of *MTU* based on the *RetTime Qtr* value. The *Tons Out Cum* column is the cumulative quarterly total of the *Tons Out* value. The *Net MTHM* column is the difference between the *Tons In Cum* and *Tons Out Cum* columns.

In this worksheet, the *Net MTHM in Aging* chart graphs the *Net MTHM* column, which contains the net metric tons of heavy metal by year.



Unable to Create Report for 4. Pad Staging-MTU Message

Reference

On the *Reference* sheet, values in the *User CRD Rate* column can be modified as needed. The values in columns *CRD Rate by Qtr* and *CRD Cum* are re-calculated using the updated values in the *User CRD Rate* column during the report processing. If there is a need to return to the default CRD rates, the rates can be copied from the columns with yellow shading on the right side of the *Reference* sheet.

A.7 CASK INFORMATION REPORT GENERATOR

The CIRG, like the RRG, provides reports for confirmation of run results. The generated reports are specifically for the analysis of cask information. Two reports, *1. Cask Data* and *1A. Cask Allocation*, were originally part of the RRG. For TSM Version 6.0, there are no "open buy" cask processes, so corrections previously used in the CIRG to correct for the "pipeline fill" have been removed (see Section 4.2.2.1 for a discussion of "open buy" processes).

Generator File: TSM Cask Information Report Generator.xls
Required Input File: Simdata file, file with .simdata extension

INSTRUCTIONS

1. Execute the CIRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

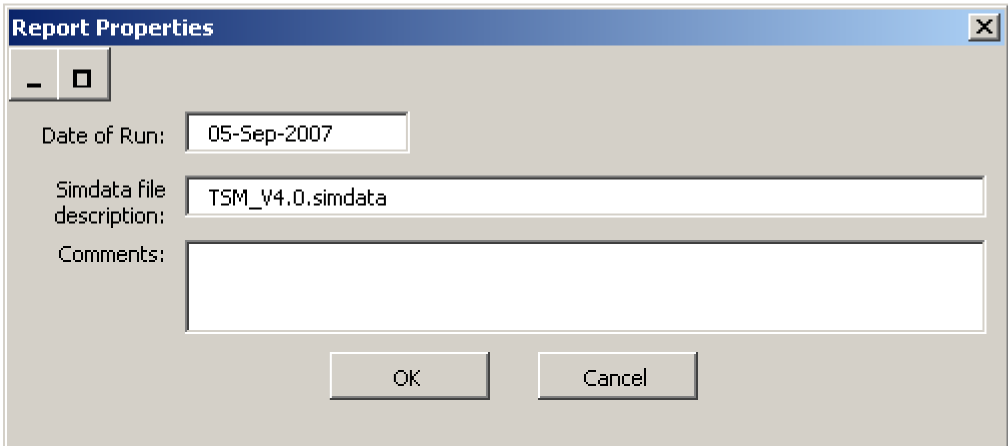
At the top of the Excel window, the CIRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can also be accomplished from the *Select TSM Simdata File* menu item on the *TSM File Selection* menu. The *TSM Simdata File In Use* menu item displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

Date of Run:
An optional text field for the date of the run.

Simdata file description:
An optional text field that defaults to display the name of the selected input file.

Comments:
An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



CIRG Report Properties Window

WORKSHEET TABS

1. Cask Data

The *1. Cask Data* worksheet is a report of counts for casks required and casks completed from the ProcessTable and ModelObjectTable database tables.

1A. Cask Allocation

The *1A. Cask Allocation* worksheet is a report that associates processes with casks and retrieves data from the ProcessTable database table. This sheet is for casks that “cycle” in the process such as the transportation overpacks and baskets. Canned objects such as DPCs or TAD canisters are not included.

2. Cask Residence Time

The *2. Cask Residence Time* worksheet is a listing of casks from the selected input file and the corresponding cask hold times. The values for the completed column are retrieved. This indicates the time from when a cask load arrives at the start of Nevada (DOE) rail until it is processed in the GROA facilities. Transportation overpacks are not included since (except in the case of the TAD canister overpacks) these objects are sent directly to the cask hold process after allocation and therefore include transportation time.

3. Cask 1 Residence Time Chart

The *Cask 1 Residence Time Chart* worksheet calculates the annual number of completed objects and the turnaround time for Cask 1 objects in a model run. The cask turnaround time in terms of days and the number of completed casks between years are then charted by year.

The process lead time on an annual basis is calculated using the SimCAD™ cumulative values. The number of completed objects and the cycle time for the Cask Hold process of the identified cask are retrieved from the ProcessTable of the selected Simdata file. Because the retrieved value for number of completed casks is cumulative, the annual number of completed cask is the difference between the current year’s number of completed casks and the previous year’s number of completed casks. Because the retrieved cycle times are in

terms of time steps, the turnaround time must be converted in terms of days using the number of ticks per day. The annual cask turnaround time is calculated as follows:
Turnaround Time = (((Cumulative Cycle Time * Cumulative Objects Completed) - (Previous Cycle Time * Previous Objects Completed)) / (Cumulative Objects Completed - Previous Objects Completed)) / Ticks per Day where Ticks per Day = 3.

4. Cask 6 Residence Time Chrt

The *Cask 6 Residence Time Chrt* worksheet calculates the annual number of completed objects and the turnaround time for Cask 6 objects in a model run. The cask turnaround time in terms of days and the number of completed casks between years are then charted by year.

5. Cask 26 Residence Time Chrt

The *5. Cask 26 Residence Time Chrt* worksheet is a report of turnaround time data for Cask 26. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work.

6. Cask 44 Residence Time Chrt

The *6. Cask 44 Residence Time Chrt* worksheet is a report of turnaround time data for Cask 44. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work.

6A. Cask 2XX Residence Time Chrt

The *6a. Cask 2xx Residence Time Chrt* worksheet is a report of turnaround time data for Cask 2XX. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work. Note this shows the aggregate cask turnarounds for all the DOE baskets (inserts) in the basket and shell scheme. The values are zero in non-basket and shell cases.

7. Cask 202 Residence Time Chrt

The *7. Cask 202 Residence Time Chrt* worksheet is a report of turnaround time data for Cask 202. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work.

8. Cask 208 Residence Time Chrt

The *8. Cask 208 Residence Time Chrt* worksheet is a report of turnaround time data for Cask 208. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work.

9. Cask 253 Residence Time Chrt

The *9. Cask 253 Residence Time Chrt* worksheet is a report of turnaround time data for Cask 253. Cask hold time and cask completed values for each time step are retrieved. After quarterly time and cask completed values are calculated, the values are summarized into annual values. The chart plots a comparison of annual values for lead time versus time for work.

10. Site Batching Time

The 10*. Site Batching* is a report of processing time retrieved from the ProcessTable database. As discussed in Section 4.2.2.3, objects are batched at the waste sites and the time to make these batches is a key element of the cask cycle time and is important cask information. Casks must be available in groups of three or five to support batching for rail shipments and if there is a cask shortage, the cycle times for the batching can be high. This sheet provides the cycle times at all batching sites broken out by barge sties, HH sites, rail sites, and truck sites for easy inspection of the batching times.

A.8 DRIFT LENGTH REPORT GENERATOR

The TSM DLRG creates a reports and charts for comparing the lineal drift heat from a run to the desired thermal profile and response. The results provide a general indication of the drift thermal response. These graphs and behavior do not define the OCRWM position on the drift thermal response for licensing or other reporting purposes; there are other calculations for the official OCRWM position. The DLRG results are sued as a general indication for impacts for "what if" studies including alternate shipment thermal schemes or drift management schemes. The results are for insight and guidance only.

Generator File: TSM Drift Length Report Generator.xls
Required Input Files: TSM.mdb file, file with .mdb extension

INSTRUCTIONS

1. Execute the DLRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input TSM.mdb file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the DLRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can also be accomplished from the *Select TSM Mdb File* menu item on the *TSM File Selection* menu. The *TSM Mdb File In Use* menu item displays the currently selected input file.

4. To initiate generator processing, select the *Generate Report* menu option from the toolbar.
The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

TSM database file description:
: An optional text field that defaults to display the name of the selected input TSM.mdb file.

Date of Run:
: An optional text field for the date of the run.

Drift Length (meters):
: A required field that is initialized to the default value of 600, a value defined by the program. The value can be modified, but if left blank, an error message is displayed and the field is reset to the default value.

Adjust Spacing:
: The *Adjust Spacing* checkbox is used to indicate if an adjustment length should be applied to lower the average heat. The default setting for the checkbox is checked. If the

Adjust Spacing option is disabled, adjustment calculations are not performed and the charts plot the original calculations for heat and length values. Also, the charts that plot the WP Spacing Differences between adjusted and original drifts are not generated.

Target Lineal Heat:

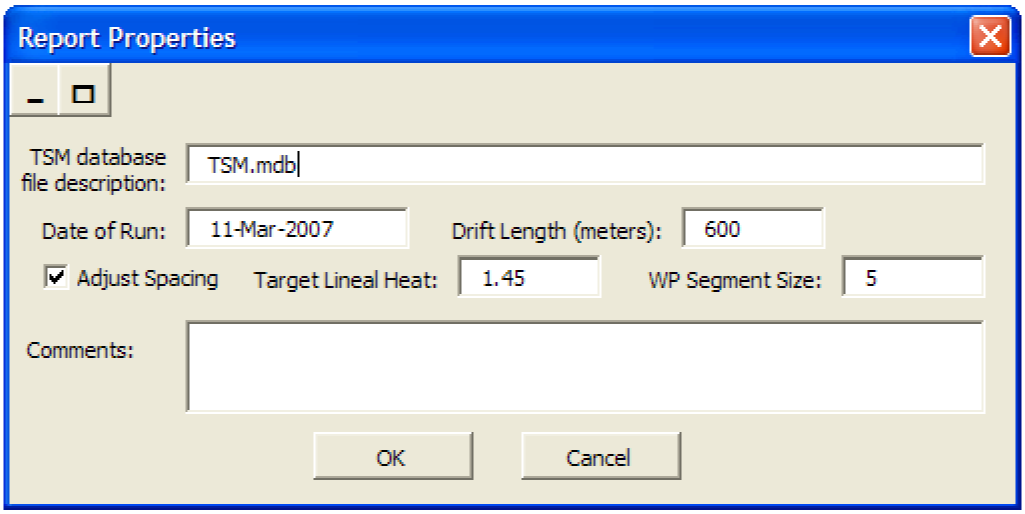
A required field that is initialized to the default value of 1.45, a value defined by the program. The value can be modified, but if left blank, an error message is displayed and the field is reset to the default value.

WP Segment Size:

A required field that is initialized to the default value of 5 for the number of WP included in the running heat average (a "segment"), a value defined by the program. The value can be modified, but if left blank, an error message is displayed and the field is reset to the default value.

Comments:

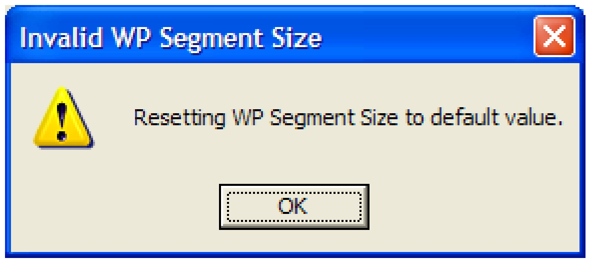
An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



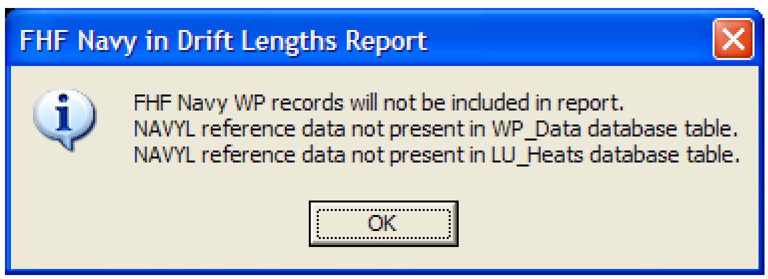
DLRG Report Properties Window

Invalid Drift Length Message

Invalid Target Lineal Heat Message



Invalid WP Segment Size Message



Presence of FHF Navy WP data Message

WORKSHEET TABS

WP Lengths

This worksheet has a reference table of WP length, which is retrieved from the WP_Data table of the selected TSM mdb database. BWR and PWR casks of WP type WPTAD are assumed to have the same length as the NavyLong WP and are assigned the cask length for NavyLong.

1. Drift Length

The *1. Drift Length* worksheet is based on data retrieved from the WP_Recipe, WP_Data, and LU_Heats tables of the TSM.mdb database. The generator provides an adjustment function that levels out the heat averages for the drifts by adding space to a drift if the average heat of a drift exceeds the defined lineal heat average. Adding length to the drift will lower the calculated average.

A new drift is identified whenever the drift length in the *Orig Total Length* column meets the desired drift length, which is set to a default of 600 meters. When a new drift is determined, the cumulative length total is reset to 0. The *Orig Avg Heat* column is calculated as Orig

Total Heat/Orig Total Length)/1000, in KW units. The *Orig Cum Length* column is the cumulative total of the original WP length retrieved from the database plus the 10 centimeters between each WP. The *Orig Smoothed* column contains values that were not adjusted for smoothing, but the column exists for comparison with the *Adjusted Smoothed* values.

To determine the impact on total length when trying to reduce the average drift by increasing space between WPs, calculations are made using the *Adjusted* columns. For every segment of WP, which is typically a default set size of 5 but can be modified, a comparison is made to see if the average heat is greater than the target lineal heat average, which is user-defined or the default value of 1.45 kW/meter. If the average heat of the set is greater than the target heat, spacing is adding to the original length for an adjustment length that will lower the average. The WP is then assigned a revised length if the length is greater than the original length. The additional spacing is distributed among the WPs of the set giving each WP a revised length if the length is greater than the original length. Revised length values are displayed in a blue font in the *Adj Length* column.

The algorithms applied to the adjusted totals columns are identical to those for calculating the original totals columns except revised values are used. The *Adj Total Heat* column contains the cumulative sum of *Heat* values with resetting. When the length of the current drift exceeds the defined drift length, the cumulative sum of heat is initialized with the heat of the first WP of the drift. Each row in the *Adj Total Length* column represents the cumulative sum of each WP's Adj Length value plus 10 centimeters. When the length of the current drift exceeds the defined drift length, the cumulative sum of length is reinitialized to 0. The values in the *Adj Avg Heat* column are calculated as (Adj Total Heat/Adj Total Length)/1000), in KW units. *Adj Cum Length (m)* column contains the cumulative total of the *Adj Length* values. Values for *Adj Smoothed* are the average of each set of 20 rows of *Adj Avg Heat*. The *Each km* column identifies the start of each drift with the *Adj Avg Heat* of the last WP of the previous drift.

Charts generated from the computed data appear on the right side of the worksheet. Descriptions of these charts are as follows:

Chart 1: Lineal Heat in Drifts

The first chart, *Lineal Heat in Drifts*, plots KW/meter to drift length in meters. The graph shows the drift with the lowest lineal heat at the end of the drift and the drift with the highest linear heat at the end of the drift.

Chart 2: Lineal Heat in Drifts

The second chart, *Lineal Heat in Drifts*, plots drift length in meters to KW/meter for all drifts.

Chart 3: Drift Length

The third chart, *Drift Length*, plots drift length in meters versus years. The graph includes lengths for all adjusted drift lengths and the original drift lengths. This chart indicates the rate of drift fill.

Chart 4: Lineal Heat in Drifts-Avg over 20 WP

The fourth chart, *Lineal Heat in Drifts-Avg over 20 WP*, plots the average heat for each set of 20 WPs graphing KW/meter to drift length in meters.

Chart 5: Lineal Heat in Drifts-Avg over 20 WP

The fifth chart, *Lineal Heat in Drifts-Avg over 20 WP*, plots the average heat for each set of 20 WPs graphing KW/meter to years.

Chart 6: Lineal Heat in Drifts-Avg each km

The sixth chart, *Lineal Heat in Drifts-Avg each km,* plots the average heat per km graphing KW/meter to drift length in meters.

Chart 7: Lineal Heat in Drifts-Avg each km

The seventh chart, *Lineal Heat in Drifts-Avg each km,* plots the average heat per km graphing KW/meter to years.

Chart 8 WP Spacing Difference

This set of charts plots the WP Spacing difference between the adjusted drift length and the original length. Each chart provides data for 5 drifts. The number of charts depends on the number of drifts needed for the analysis. In some cases, the extra spacing requires more drifts to be made to accommodate the extra length and this can increase the number of charts. If no changes in drift spacing are needed, these charts are zero over the drift lengths. If the *Adjust Spacing* is not checked on the Report Properties menu (see above) these charts are not generated.

A.9 TAD THROUGHPUT REPORT GENERATOR

The TSM TTRG creates reports and charts that show the throughput and processing in the GROA. It provides a good overview of overall processing in the GROA by the types of objects processed and the processing in each facility. For example, discontinuities in the chart curves are indications of potential processing problems or may reflect process line startups. The curves are also used to judge process line "balance" to see if some process lines are overworked. The results are presented as the cumulative objects during the run. The slope of the curves is the processing rate (number per year).

The results are from "objects completed" for various processes and are taken from the RunDescriptionTbl and ProcesssTable tables of the selected Simdata database file.

Generator File: TSM TAD Throughput Report Generator.xls
Required Input File: Simdata file, file with .simdata extension

INSTRUCTIONS

1. Execute the TTRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. Browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

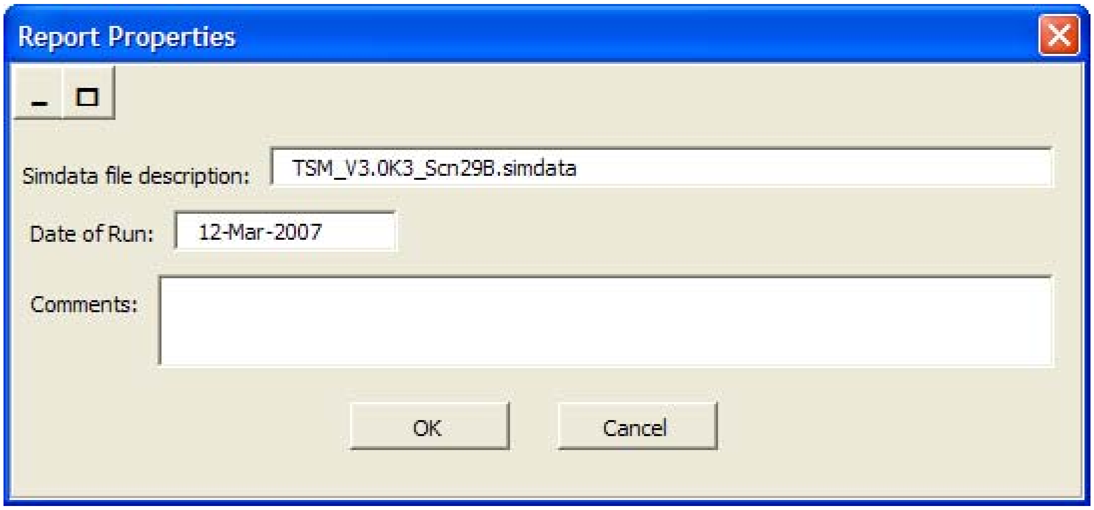
At the top of the Excel window, the TTRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Reports*, and *About*. File selection can also be accomplished from the *Select TSM Simdata File* menu item on the *TSM File Selection* menu. The menu includes the *TSM Simdata Database File In Use* menu item, which displays the currently selected input file.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

Simdata file description:
    A read-only field that displays the name of the selected input file.

Date of Run:
    An optional text field for the date of generator execution. The default value for this field is the current date.

Comments:
    An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



TTRG Report Properties Window

WORKSHEET TABS

1. CSNF Processed
This sheet shows the number of bare CSNF processed by the GROA broken out as BWR, PWR, and DPC for BWR and PWR. The data is based on buffer objects completed. These are principally the truck bare casks, DPCs and a few TSCs (usually less than 100).

2. TAD Processed
This sheet shows the number of TAD canisters processed by the GROA based on the TADBuffer objects completed. The TADReturn object completed to capture objects from aging is also presented. The difference between these values is the TAD canisters that arrive from the field. This is a good overview of overall TAD canister actions.

3. DOE Processed
This sheet shows the number of DOE wastes processed by the GROA broken out as DOE SNF, DOE SNFL, HLW, HLWL, and MCO. Data for objects processed by the IHF is also shown. The data is based on buffer objects completed. The IHF data is primarily the NAVY SNF.

4. WHF Unload
This sheet shows the number of cask loads processed by the WHF broken out as the bare casks processed (process line WHFUnload) and DPC's (process line DPCOpen).

5. CRCF1 Unload
This sheet shows the number of cask loads processed by the CRCF1 broken out as the TAD canisters processed (process TADxfertoWP1) and DOE wastes (process line CRCF1unload).

6. CRCF2 Unload
This sheet shows the number of cask loads processed by the CRCF2. In the TSM simulation, CRCF2 only processes TAD canisters in the TADxfertoWP3 process.

7. CRCF3 Unload

This sheet shows the number of cask loads processed by the CRCF3 broken out as the TAD canisters processed (process TADxfertoWP3) and DOE wastes (process line CRCF3unload).

8. To Aging

This sheet shows the number of objects sent to aging and includes TAD canisters that are above the thermal limit (objects complete in TADAgePrep) or have bypassed processing because the process lines are busy. It also includes DPCs that are bypassed to staging because WHF is busy (objects complete in DPCAgePrep). Net values for TAD canisters in aging are in the VCG.

9. IHF WP

This sheet shows the IHF WP output (objects complete in IHFDispatch) and the IHF unload (objects complete in IHFReceipt). These values should be almost identical unless there are process problems.

10. WHF TAD

This sheet shows the WHF WP output from objects complete in WHFDispatch1.

11. CRCF WP

This sheet shows the WP output for the CRCF1, CRCF2, and CRCF3 process lines from objects complete in line “dispatch” processes. The processing for CRCF1 and CRCF3 should be balanced for most runs. The CRCF2 will typically have higher throughput than CRCF1 or CRCF3 because it processes only TAD canisters.

12. WP Emplaced

This sheet shows the WP emplaced (the WP output from all process lines) from objects complete in MGREmplace. The curve should be smooth and steady.

A.10 DOE VALLEY CURVE GENERATOR

The DVCG provides reports and charts for analyzing the difference between the DOE waste shipping schedule in the IS and the amount actually received at the GROA. It can also calculate delays to a program defined shipment rate. It can be used to identify any DOE shipping delays and the possible causes.

The approach and algorithm are very similar to the VCG discussed in Section A.6. However, the DOE wastes do not have a prescribed CRD tons per year rate as a shipping target. So, the DVCG is set up to assess shipping delays as cask load items, not tons.

Like the VCG, the DVCG has reference sheets that are used to prescribe a desired DOE shipping rate (similar to the reference sheet in the VCG with the CRD). It is possible for this rate to be different than that in the IS file output from the TSMPP. Valley curves comparing the GROA arrivals relative to the IS file and the reference file are provided.

Generator File:	TSM DOE Valley Curve Generator.xls
Required Input Files:	TSM.mdb file, file with .mdb extension
	Simdata file, file with .simdata extension
	IS file, file with .xls extension

INSTRUCTIONS

1. Execute the DVCG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

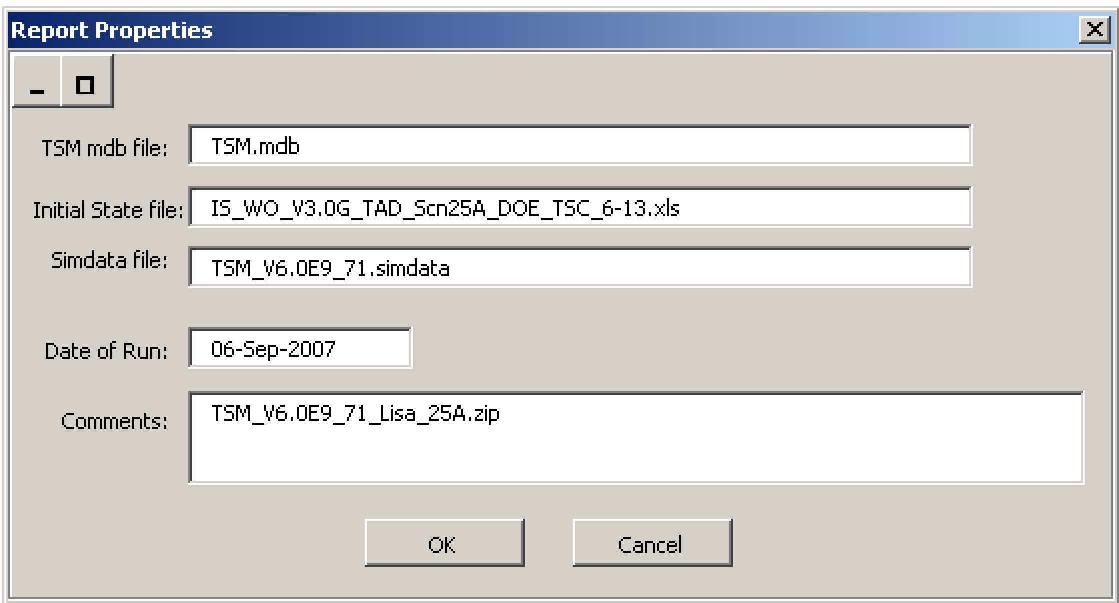
3. When prompted, browse to the desired directory and select the input TSM.mdb file, Simdata file and IS file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the VCG menu toolbar appears with menu options, *TSM File Selection*, *Generate Chart*, and *About*. File selections can also be accomplished from the *Select TSM Database File* menu items and that include *Select TSM File Select Simdata File*, and *Select Initial State File*. The menu items to display the currently selected input files are *TSM Database File In Use*, *Simdata File in Use*, and *Initial State File In Use*.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar. A message is displayed as a reminder that modifications to CRD WA rates need to be made on the Reference worksheet before the report creation process is initiated.

5. The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

TSM database file:
  A read-only field that displays the name of the selected TSM.mdb input file.
Initial State file:
  A read-only field that displays the name of the selected IS input file.
Date of Run:
  An optional text field for the date of the run. The field value defaults to the current date.
Comments:
  An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



DVCG Report Properties

When the RG initiates run files that use TSM.mdb files without a Waste_Type column (most current IS files) display the message shown below. This is not an error; it is just for information that was implemented when the TSM.mdb was revised for TSM Version 4.0. Acknowledge "ok" to continue the RG.

WORKSHEET TABS

The DVCG has many sheets with the same structure and function but applied to the various types of wastes. The descriptions for similar worksheet tabs are grouped and generically described below.

Reference Worksheets (DSNF Reference, HLW Reference, MCO Reference, and Navy Reference).
This sheet is user inputs for the cumulative number of cask loads by quarter for some desired waste shipment rate. In most cases, no such stream is desired and the valley curve charts in the Waste Valley Curve sheets (see below) associated with the reference sheet are meaningless. The default values in the reference sheet is documented in RG validation report (BSC 2007j)

Cask Load Worksheets (1. DSNF IS Cask Loads, 3. HLW IS Cask Loads, 5. MCO IS Cask Loads, 7. NAVY IS Cask Loads)
These worksheets provide a chart of the cumulative reference cask load shipments and the cumulative cask load arrivals for the waste types. The arrivals are from the TSM.mdb "Arrivals" table. If there are no shipping delays, the two curves are virtually identical. If the arrival curves lags, this indicates a shipping delay.

Waste Valley Curves (2. DSNF Cask Load Delays, 4. HLW Cask Load Delays, 6. MCO Cask Load Delays, 8. NAVY Cask Load Delays)
These sheets are the typical Valley Curve and have the charts showing the differences between the IS shipments and the arrivals in Cask Load Worksheets (above) for the four types of waste. There is also a chart for the differences in the arrivals and the reference shipments but as mentioned above, these may not be relevant.

Site Valley Curves (9. Cask Load Delays SRS-HLW, 10. Cask Load Delays SRS-DSNF, 11. Cask Load Delays HAN-HLW, 12. Cask Load Delays HAN-DSNF, 13. Cask Load Delays INL-HLW, 14. Cask Load Delays INL-DSNF, 15. Cask Load Delays INL-NAVY)
These sheets show the shipment delays (valley curve) for each of the DOE waste sites for the various types of wastes excluding MCOs. These sheets determine the scheduled shipments for each site from the IS then compare that to arrivals based on the objects completed by object type at the InputtoGROA process.

A.11 TRANSPORTATION COST REPORT GENERATOR

The TCRG extracts and presents the transportation cost information from a run such as cask costs, truck and rail shipping costs, etc. Annual costs and total costs are provided. The format and content is setup to match input needs for TSLCC analyses. The format is also good for comparisons to pre-2004 TSLCC reports. The TCRG provides more detailed cost analysis of the transportation elements than the CRG; most users will find the results in the CRG adequate.

The TCRG is also designed to allow the analysts to change some of the unit costs to assess cost impacts. A reference sheet is sets default values for unit costs that match those in the TSM Version 6.0 model. Changes do not always impact all sheets; see the notes in the Reference worksheet for items that are impacted by changes.

The TCRG offers an alternate calculation to the cumulative cost calculations performed as TSM runs. The TCRG typically uses the object counts and the unit costs to estimate costs. These results should match the cumulative cost results for the simulation. For example, the cumulative costs for truck casks from TSM should match the total number of trucks times the unit costs for the trucks. So, the TCRG can be used as a cross check.

See Reference BSC 2007e for more details on the cost descriptions and bases.

Generator File:	TSM Transportation Cost Report Generator.xls
Required Input File:	Simdata file, file with a .simdata extension

INSTRUCTIONS

1. Execute the TCRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. When prompted, browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the TSRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Report*, and *About*. File selections can also be accomplished from the *Select TSM Database File* menu item *Select Simdata File.* The menu items to display the currently selected input files are *Simdata File In Use*.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar.

The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

Simdata file description:

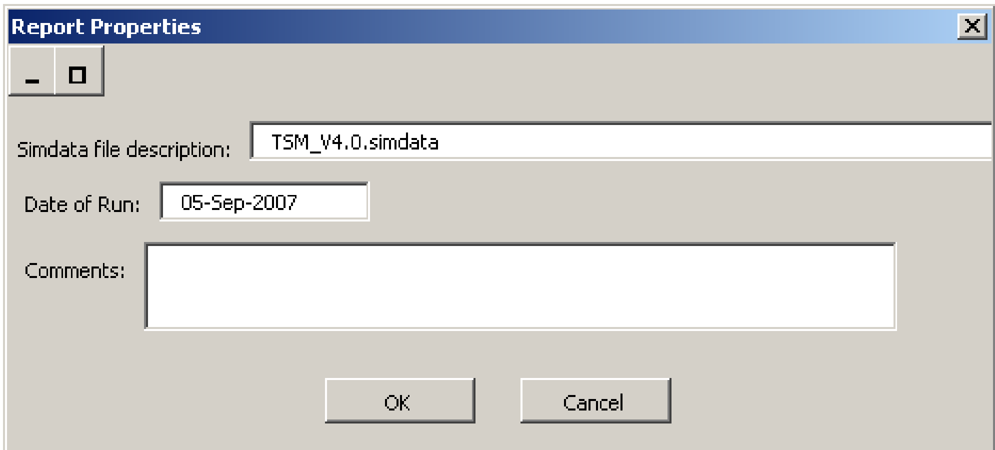
A read-only field that displays the name of the selected Simdata input file.

Date of Run:

An optional text field for the date of the run. The field value defaults to the current date.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



TCRG Report Properties Window

WORKSHEET TABS

Reference sheet

The reference sheet sets default values for unit costs that match those in the TSM Version 6.0 model. This sheet can be used by the analyst to revise unit costs to refine or revise the estimate or to do "one-off" or "what if" analyses. Changes do not always impact all sheets; see the notes in the Reference worksheet for items that are impacted by changes.

The reference sheet also includes a line item "corrections" for many of the cost worksheets. This is a remnant from earlier versions where corrections were required.

1. Rail Costs

This sheet shows costs for Barge, Rail Shipping, State Line Fee, State Lines, HH, Rail Security, Rail Satellite, and a sum for Rail Total. The format of this table mimics that of TSLCC studies prior to 2004. These costs are from TSM variables that track these costs. The number of state lines is "back calculated" from the total State Line cost divided by the unit cost.

2. Truck Costs

This sheet shows costs for State Line Fee, State Lines, Truck Shipping, 2nd Driver, Demurrage, Truck Security and a sum for Truck Total. The format of this table mimics that of TSLCC studies prior to 2004. These costs are from TSM variables that track these costs. The number of state lines is "back calculated" from the total State Line cost divided by the unit cost

3. All Cask Costs

This sheet shows costs for Rail Casks, Rail Cask Baskets, Trans Overpacks, Rail Cask Repl, Truck Cask , Tk Cask Repl. This sheet calculates the costs for the bare CSNF overpacks using the unit cost from the reference sheet and cask counts from the simulation. Overpack costs are added to the costs from sheets 4, 6, 8, 9, and 10 to capture all the rail cask costs. Replacement costs (RepL) are from TSM variables that track these costs.

4. TSC Costs

This sheet calculates the costs for the TSCs using the unit cost from the reference sheet and cask counts from the simulation. TSCs include Cask 106, Cask 109, Cask 232, Cask 235, Cask 290, Cask 295, Cask 298, Cask 66, and Cask 76.

5. Truck Cask Costs

This sheet calculates the costs for the truck casks using the unit cost from the reference sheet and cask counts from the simulation. Truck casks include Cask 1 and Cask 6. Currently values for truck casks 11, 12, and 18 are not implemented (TSM includes these casks for future use).

6. Rail Baskets Costs

This sheet calculates the costs for the bare CSNF baskets using the unit cost from the reference sheet and cask counts from the simulation. Bare baskets include Cask 26, Cask 27, Cask 58, Cask 60, Cask 64, Cask 65, Cask 68, Cask 69, Cask 70, and Cask 77.

7. Rail Overpacks

This sheet calculates the costs for the rail overpacks using the unit cost from the reference sheet and cask counts from the simulation. Overpacks for CSNF baskets include Cask 202, Cask 214, Cask 217, Cask 226, Cask 229, Cask 238, Cask 244, and Cask 247.

8. Medium Rail Cask

This sheet calculates the costs for the bare medium rail casks using the unit cost from the reference sheet and cask counts from the simulation. Medium rail casks include Cask 28 and Cask 29. There is no “basket and shell” for medium casks.

9. Small Rail Cask

This sheet calculates the costs for bare small rail casks using the unit cost from the reference sheet and cask counts from the simulation. Small rail casks include Cask 30 and Cask 31. There is no “basket and shell” for small casks.

10. DOE Cask Costs

This sheet calculates the costs for DOE rail casks using the unit cost from the reference sheet and cask counts from the simulation. DOE casks include DSNFHLW (Cask 44), DSNFMCO (Cask 50), DSNF18 (Cask 51), DSNF24 (Cask 56). Costs for Navy casks are always $0. Currently, the TCRG does not include costs for DOE casks using the DOEOV department and the DOE basket and shell approach.

A.12 TRANSPORTATION SHIPMENT REPORT GENERATOR

The TSRG provides information on MTU that traveled by rail and truck through each of the USA states, MTU that traveled by rail and truck through designated US cities, shipments that traveled by rail and truck through each of the USA states, and shipments that traveled by rail and truck through the designated US cities. The TSRG also includes reference information for the locations traveled through by shipments from the TSM reactor sites to the repository. The information is an effective way to respond to requests from states and localities on the estimated shipments and tonnage. The TSRG provides only project totals; it does not provide the information by year.

Generator File:	TSM Transportation Shipment Report Generator.xls
Required Input File:	Simdata file, file with a .simdata extension
	TSM mdb file, file with .mdb extension

INSTRUCTIONS

1. Execute the TSRG by double-clicking on the Excel file or clicking with the right mouse button on the file to display a menu and choosing the *Open* option.

2. When the Macro warning message box appears, select the *Enable Macros* button.

3. When prompted, browse to the desired directory and select the input TSM.mdb file. Then browse to the desired directory and select the input Simdata file. If the file selection operation is cancelled, a warning message is displayed.

At the top of the Excel window, the TSRG menu toolbar appears with menu options, *TSM File Selection*, *Generate Report*, *Generate References*, and *About*. File selections can also be accomplished from the *Select TSM Database File* menu item and *Select Simdata File* menu item on the *TSM File Selection* menu. The menu items to display the currently selected input files are *TSM Database File In Use* and *Initial State File In Use*.

NOTE ON GENERATE REFERENCES MENU: As discussed below, there are worksheet tabs for reference data that is used for the TSRG calculation. These reference worksheets are updated using files specified in the Generate References menu. These menu options are for use by the TSM developers only. The reference files are for the FEIS data used for the transportation routes as discussed References BSC 2007d and BSC 2007m. The TSRG validation in Reference BSC 2007m confirmed that the data in the reference sheets is correct.

4. To initiate generator processing, select the *Generate Reports* menu option from the toolbar.

The *Report Properties* window appears for entering user preferences. The values from this window are included in the header of each report. Generator execution begins when the *OK* button is selected. The fields available are:

TSM database file:

A read-only field that displays the name of the selected TSM mdb input file.

Simdata file:

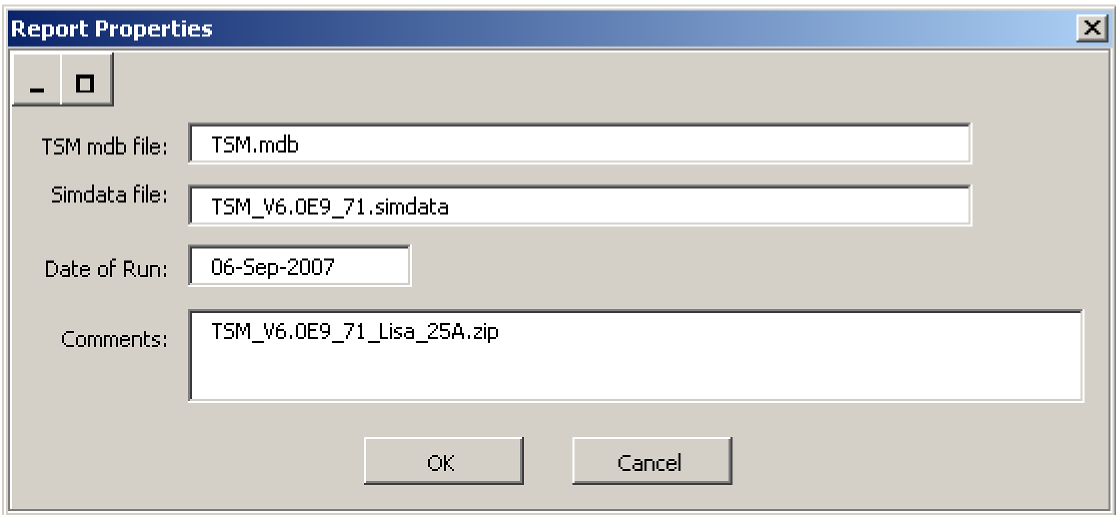
A read-only field that displays the name of the selected Simdata input file.

Date of Run:

An optional text field for the date of the run. The field value defaults to the current date.

Comments:

An optional text field for entering information about the generator. It is recommended to include in the comments field the name of the zip file for the run being analyzed.



TSRG Properties Menu

WORKSHEET TABS

1. MTU State-Rail

The *1. MTU State-Rail* worksheet contains data on the MTU quantities shipped through any state. This sheet uses the information from the *Ref Rail State* sheet and the data from the MTU completed at each waste site to calculate the total tons shipped through each state.

2. MTU State-Truck

The *2. MTU State-Truck* worksheet contains data on the MTU quantities shipped through any state. This sheet uses the information from the *Ref Truck State* sheet and the data from the MTU completed at each waste site to calculate the total tons shipped through each state.

3. MTU City-Rail

The *3. MTU City-Rail* worksheet contains data on the MTU quantities shipped through any city. This sheet uses the information from the *Ref Rail City* sheet and the data from the MTU completed at each waste site to calculate the total tons shipped through each city.

4. MTU City-Truck

The *4. MTU City-Truck* worksheet contains data on the MTU quantities shipped through any city. This sheet uses the information from the *Ref Truck City* sheet and the data from the MTU completed at each waste site to calculate the total tons shipped through each city.

5. Shipment State-Rail

The *5. Shipment State-Rail*-worksheet contains data on the number of rail shipments through any state. This sheet uses the information from *Ref Rail State* and the shipments completed at each waste site to calculate the total shipments through each state.

6. Shipment State-Truck

The *6. Shipment State-Truck*-worksheet contains data on the number of truck shipments through any state. This sheet uses the information from *Ref Truck State* and the shipments completed at each waste site to calculate the total shipments through each state.

7. Shipment City-Rail

The *7. Shipment City-Rail*-worksheet contains data on the number of rail shipments through any city. This sheet uses the information from *Ref Rail City* and the shipments completed at each waste site to calculate the total shipments through each city.

8. Shipment City-Truck

The *8. Shipment City-Truck*-worksheet contains data on the number of truck shipments through any city. This sheet uses the information from *Ref Truck City* and the shipments completed at each waste site to calculate the total shipments through each city.

Ref Rail State

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

The *Ref Rail State*-worksheet contains the state reference matrices that are used to tally the MTU or shipments by node, state or city. The information in this worksheet is derived from the files identified in the *Ref Route Files* worksheet.

Note: On all “reference” sheets the waste sites are listed in rows with the city and states listed in the columns. A “1” in the workbook indicates that the route from the waste site to Yucca Mountain includes the city or state.

Ref Rail City

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

The *Ref Rail City*- worksheet contains the city reference matrices that are used to tally the MTU or shipments by node, state or city. The information in this worksheet is derived from the files identified in the *Ref Route Files* worksheet.

Ref Truck City

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

The *Ref Truck City*- worksheet contains the city reference matrices that are used to tally the MTU or shipments by node, state or city. The information in this worksheet is derived from the files identified in the *Ref Route Files* worksheet.

Ref Truck State

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

The *Ref Truck State*-worksheet contains the state reference matrices that are used to tally the MTU or shipments by node, state or city. The information in this worksheet is derived from the files identified in the *Ref Route Files* worksheet.

Ref Route Files

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

The *Ref Route Files*-worksheet identifies the files to be used in creating the Reference worksheets *Ref Rail State, Ref Rail City, Ref Truck City, and Ref Truck State*. It is a list with shipper utility unit in the first column, corresponding shipper abbreviations in the second and third columns, name of the utility's EXCEL file containing routing information for rail in the fourth column, and name of the utility's EXCEL file containing routing information for trucks in the fifth column. The file associated with a utility shipper can be modified by the developers as needed for updates. The route EXCEL files identified in this worksheet were created from the FEIS data in files that are provided in the files with the TSRG so they are CI. This sheet is not intended for use with typical TSM users and is not user friendly or documented for typical users.

Ref City

DO NOT MODIFY-FOR DEVELOPERS USE ONLY

Ref City-this reference worksheet contains the city reference matrices that are used to tally the MTU or shipments. The cities defined in this worksheet are then reflected in *Ref Truck City* and *Ref Rail City*.

APPENDIX B

TSMCC DESCRIPTION AND USE

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APPENDIX B. TSMCC DESCRIPTION AND USE

B.1 INTRODUCTION

This appendix describes the TSMCC functions and how to use the TSMCC. It complements Section 2.2 and Section 3 of the main text but is set up to be used as a standalone quick reference for the TSMCC. For this purpose, references to the “main text” refer to this TSM User Manual.

The TSMCC provides a user-friendly GUI to control the key TSM elements and is designed to standardize the way TSM runs are created, performed, archived, and analyzed. As discussed in Figure 4 of the main text, the TSMCC is part of the TSM suite of programs and tools that is designed to make the TSM easier to use. It provides an organized set of workflow screens to automate and guide the user through the processes of setting up and archiving a SimCAD™ TSM run. In addition, it provides a simplified means of analyzing a run using the various TSM Tools (also known as “RGs”, see Appendix A). The term “TSM Tools” is used in TSMCC dialog for user friendliness.

The discussion in Section 3.0 of the main text provides the means to test the TSM/TSMCC setup to run simulations and archive data. Functionality of other TSM features and capabilities can be tested using the descriptions in this appendix. Users should check the proper function by opening the TSMCC and executing the actions described in this appendix.

The appendix is organized to follow the sequence of activities performed by the TSMCC: analyze existing run data, create the IS file for the shipment schedule, analyze the IS file, run SimCAD™, and archive files. The organization follows the sequence of action buttons on the TSMCC main screen. The final section covers other features in the TSMCC such as editing scenario information organized into studies, modifying the local set up of TSMCC, and help.

B.1.1 TSMCC Capabilities

The TSMCC provides integration between the TSM, the TSMPP, the TSM Tools, and the user. As discussed in Sections 1.2 and 2.3, the TSM includes various programs, databases, and output files that collectively form the systems analysis capability. The key component is the SimCAD™ COTS and the other elements are designed with SimCAD™ as the central focus. CRWMS functional plans and the scenario inputs and parameters provide constraints and inputs for the TSMPP and the TSM as shown in Figure 4 of the main text.

Although the TSMCC allows a user to operate the TSM and perform post-run analysis without any knowledge of SimCAD™, it is actually designed to serve as an aid for the experienced user. The TSMCC automates many of the tedious infrastructure tasks that make up a study and assists the user in organizing, archiving, and annotating files.

NOTE: VARIABLES ASSIGNED BY THE TSMCC CAN ONLY BE VIEWED IN THE “MODEL VARIABLES” LIST IN THE MAIN GUI (see Figure 23). TSMCC VARIABLE VALUES ARE NOT DISPLAYED IN THE PROPERTIES DROPDOWN, VARIABLES MENU.

B.2 OPERATION OF TSM CONTROL CENTER

This section provides a general overview for running TSMCC. The TSMCC software uses a database, maintained with Microsoft Access, to save and retrieve input parameters specific to each analysis.

B.2.1 Initiation

When TSMCC is started by double clicking on the TSMCC.exe file in **C:\SimCadPro\TSMCC**, the *Main* screen is displayed (Figure B-1). The *Main* screen provides a unified view of the features available to the user.

The left panel will display a dynamic summary of the progress of a TSM Model that is currently being run (press the *Refresh* button to display). The *Details* button will display additional parameters beyond that of the simple time step provided by default. The number of items still in aging, the number of WPs created, and the number of items that have arrived at the GROA all provide the analyst for a feel of how much longer the run is likely to require.

The right panel provides one-click access to the most common features that a user will require: *Analyze Runs with TSM Tools*, *Create Initial State file with TSMPP*, *Analyze Initial State file*, *Run SimCAD*, and *Archive Files*. Each of these is covered separately below.

The Standard Windows Menu provides access to less commonly used features which are discussed in Section B.3, “Other Features”, and also provides an alternate means to execute TSMCC actions rather than via the navigation screens. Actions from the Standard Windows Menu are in **bold** in this appendix.

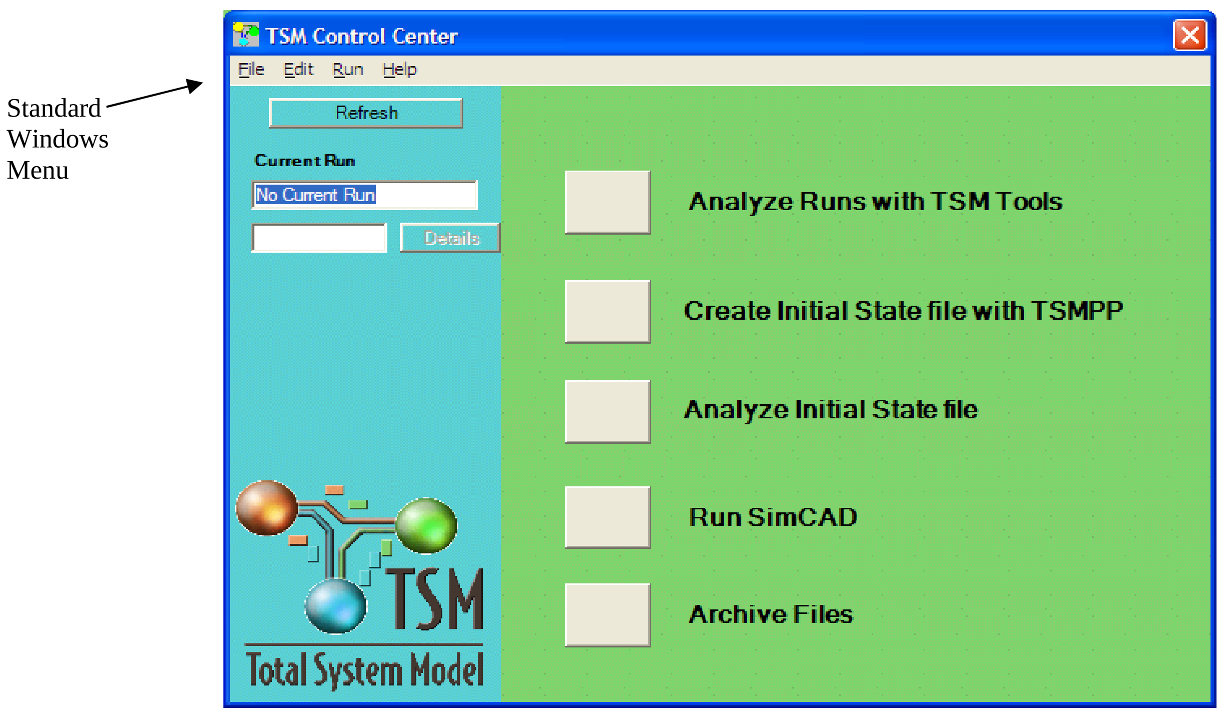

Figure B-1. Main Screen

B.2.2 Analyze Runs with TSM Tools

This feature is used to analyze data from completed runs that are stored on your PC using the TSM report generator tools. Results are analyzed more often than runs are made so this is the first option. There is also a broader audience for analysis versus running.

Due to their extreme size, all TSM set up and run data files are stored in compressed format using WinZip. The TSMCC automates the process of extracting files out of the ZIP format, copying them to an Analysis directory, and pointing the TSM Tools to the appropriate files. The first step is to locate the run of interest which may be done in one of three ways as indicated in Figure B-2.

On the *Search for Run to Analyze* screen (Figure B-2), the user is prompted to specify whether the run will be found by browsing through a list of Scenarios and runs, selecting from a list of all runs on their PC, or by simply browsing the hard drive or the network for the file.

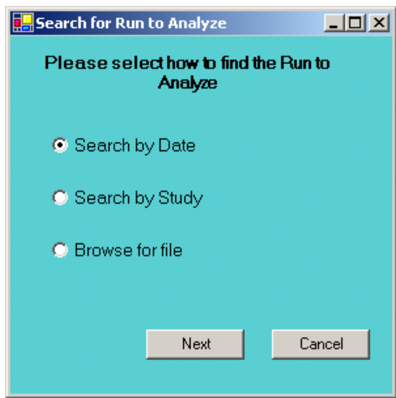

Figure B-2. Search for Run to Analyze

The *Search by Date* option (see Figure B-3) requires the user to have previously entered information about the run as described in Section B.3.1. All entered runs are displayed in descending date order for selection.

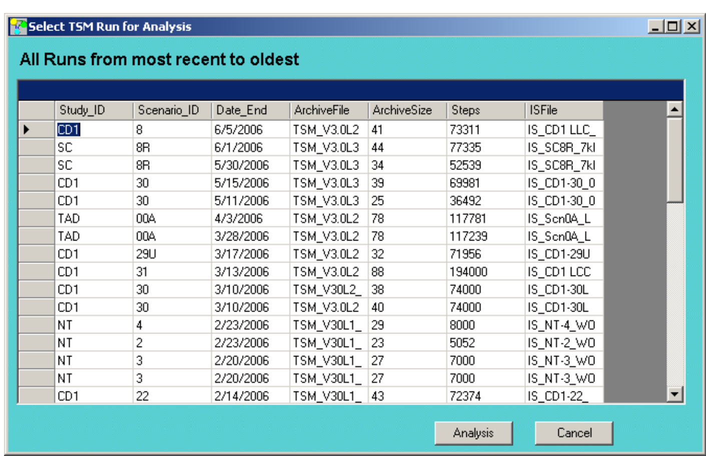

Figure B-3. Search for Run by Date

The *Search by Study* option (see Figure B-4.) similarly requires the user to have entered run information per Section B.3.1. It will display a list of all scenarios under each study. Once a scenario is selected, a list of all runs for that scenario is then displayed for selection.

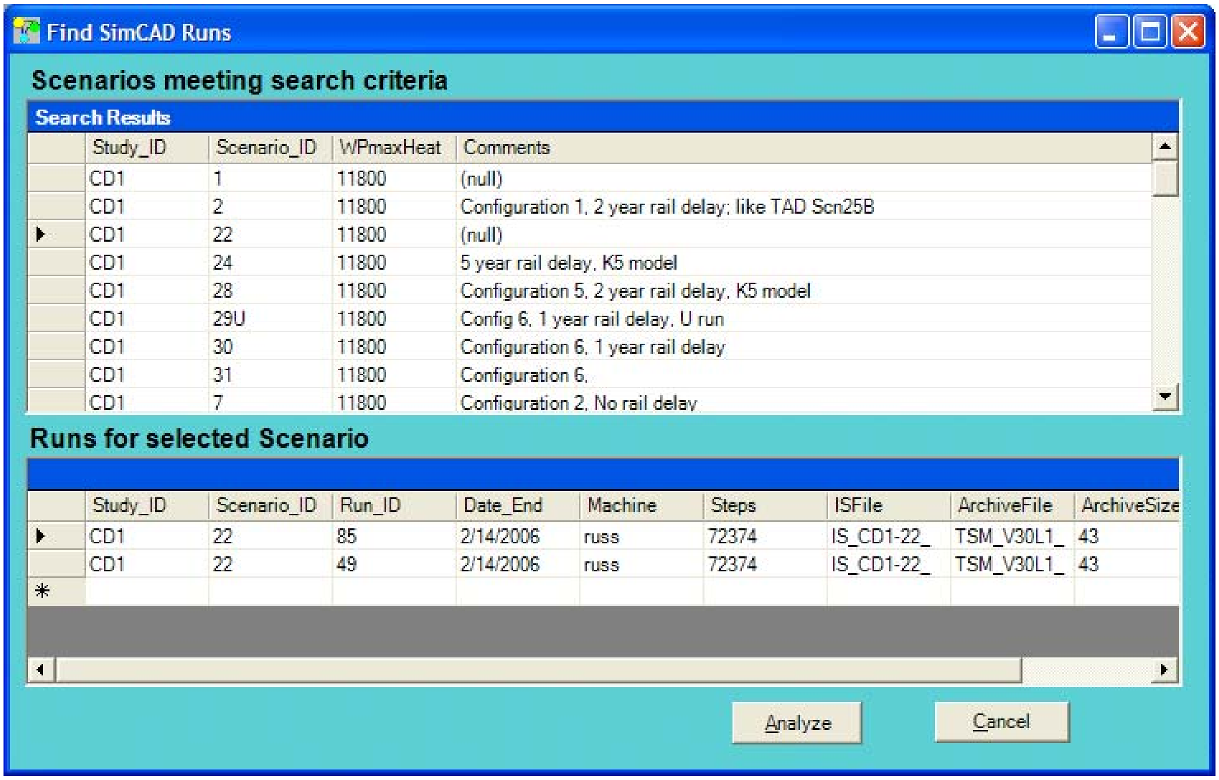

Figure B-4. Search for Run by Study

The most common method of locating a run is to simply browse to the archive (see Figure B-5).

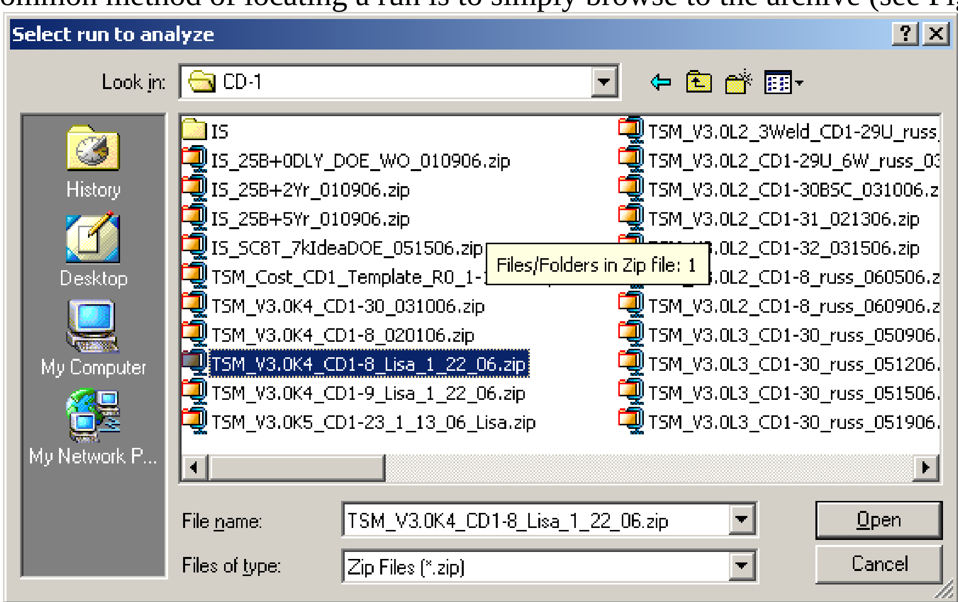

Figure B-5. Search for Run by Browse for file

Once the desired archive is located and selected, the *Run Analysis* screen (see Figure B-6) will be displayed, showing the archive path and any comments that were entered. A listing of all the available tools is provided for selection. This screen is also available from the ***Run->TSM Tools*** menu option in the Standard Windows Menu.

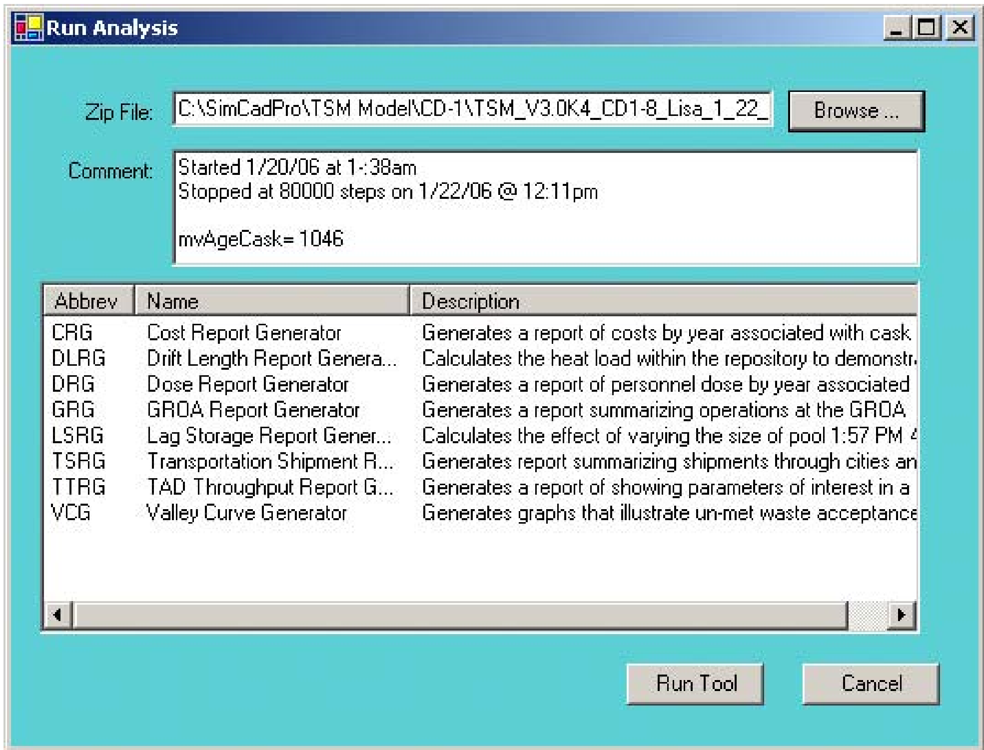

Figure B-6.   Analyze Runs Screen

The most time consuming aspect of performing model runs is the post-run analysis to determine just what was learned from the run. To assist in this process, the TSM Tools (RGs) discussed in Appendix A were developed to automatically extract relevant information from the data files. These tools require some combination of the IS file, .simdata file, and TSM.mdb file.

Once a tool is selected, and the *Run Tool* button is pressed, the contents of the archive will be extracted to the Analysis directory and the desired tool will be invoked and the appropriate files will be imported for analysis. Run the TSM Tool per the instructions in Appendix A.

As runs are analyzed, the Analysis directory will accumulate a number of large files that may eventually impact the available hard drive space. It is recommended that the user periodically examine this directory and remove extraneous files. Although this process could have been automated, it was decided that such a feature could cause problems for some users.

B.2.3 Create Initial State file

The task of creating an IS file with a shipment schedule is performed by the TSM Preprocessor (TSMPP). The *Create Initial State file* button will invoke the TSMPP as shown in Figure B-7. Please consult the TSMPP User Manual (BSC 2007b) for information on its operation.

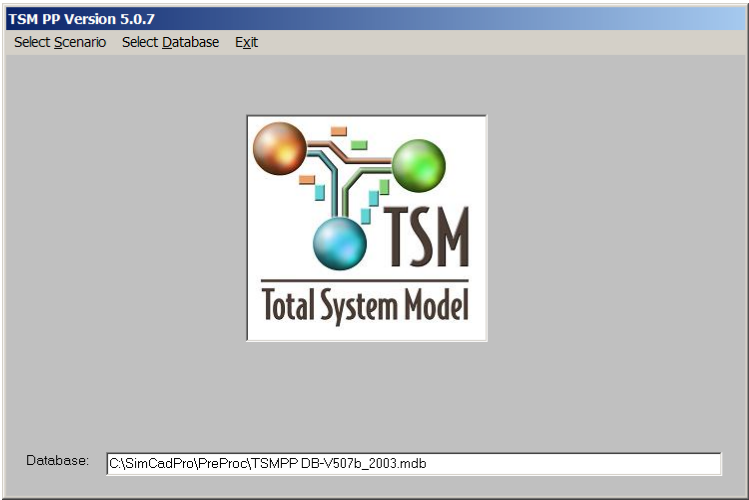

Figure B-7. TSM Preprocessor Initial Screen

B.2.4 Analyze Initial State file

The *Analyze Initial State file* button on the main TSMCC menu will invoke the *Schedule Analysis* screen as shown in Figure B-8. This form provides tools to summarize information found within the shipment schedule of the selected IS file.

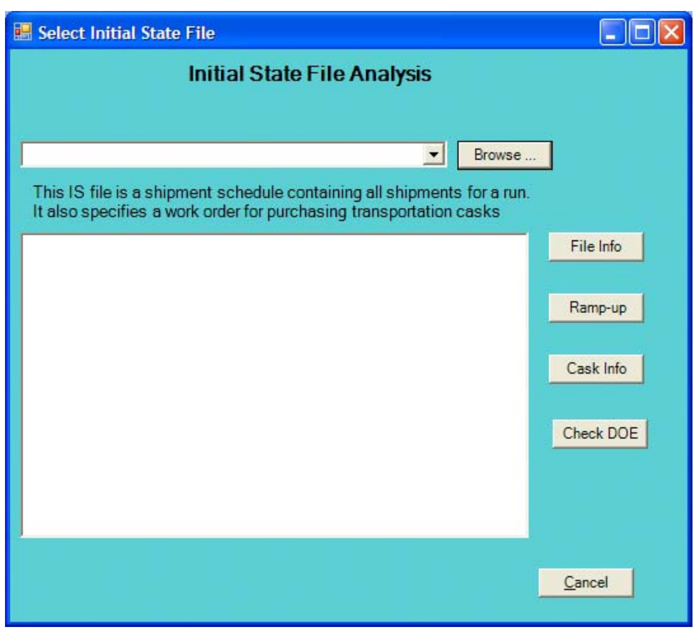

Figure B-8. Initial State File Analysis Screen

The *File Info* button provides the number of shipments, the spreadsheet rows to be entered into SimCAD™, and the date of the last shipment in time steps. IS files prior to Version 6.0 may provide a warning that there is an "offset field" in the IS as shown in this case; this can be ignored.

Sample Output:

Last shipment date: 47257
Rows: 11779
Shipments: 11703
WARNING: Offset field present within IS File!!!!

The *Ramp-up* button provides a total of the CSNF shipments during the first several years. It also shows total CSNF and DOE SNF in the IS file:

Sample Output:

MTHM Year1:	427.75
MTHM Year2:	649.02
MTHM Year3:	1192.81
MTHM Year4:	1982.30
MTHM Year5:	2994.11
MTHM Year6:	3001.76

MTU CSNF total:	62999.94
MTU DOE SNF total:	6078.49

The *Cask Info* button provides a listing of all the casks found within the IS file and allows the user to review the casks being purchased. Casks with non-zero shipments should not have a 0 in the *Purchases* column, otherwise shipments will be stranded and the run will not automatically stop.

Sample Output:

CASK ID	Shipments	Cask to Buy	Purchases
CASK1	696	CASK1	20
CASK102	30	CASK217	3
CASK200	5	CASK202	3
CASK212	15	CASK214	3
CASK215	7	CASK217	3
CASK218	33	CASK202	3
CASK221	40	CASK214	3
CASK224	79	CASK226	3
CASK239	61	TAD	0
CASK242	6	CASK244	1
CASK245	1	CASK247	3
CASK248	2	CASK226	3
CASK251	2748	TAD	0
CASK254	3813	TAD	0
CASK291	3	CASK247	3
CASK44	2430	CASK44	15
CASK50	102	CASK50	5
CASK51	263	CASK51	5
CASK52	300	CASK52	5
CASK6	1980	CASK6	20

The *Check DOE* button provides a summary of the DOE SNF and HLW present within the IS file. It lists the total number of canisters for each type of DOE SNF and calculates the amount of HLW Mismatch or DSNF Mismatch that should be entered on the *General* tab of the *SimCAD™ Parameters* screen (see next section). If the HLW Mismatch or DSNF_Mismatch displayed as calculated by TSMCC is different from what was desired by the user using the *General* tab, return to the previous screen and enter the proper HLW Mismatch or DSNF_Mismatch amount. See Section 4.1.3 of the main text for more discussion of DOE wastes.

Teleporting:	0
HLW Canisters:	6830
HLWL Canisters:	5313
DOE SNF Canisters:	1384
DOE SNFL Canisters:	963
MCO Canisters:	408
Navy Canisters:	144
NavyL Canisters:	156
HLW Mismatch:	0
DSNF Mismatch	0

B.2.5 Run SimCAD

The *Run Simcad* button will invoke the "TSM Run Wizard" which guides the user through the process of starting a TSM run. The various screens are navigated by a next or back command and will assist the user in selecting model parameters, selecting the IS file and Model file to be used, and writing this information to the tsm_v6.xml file. It will also provide the option to start a run directly from the TSMCC.

The wizard consists of four main screens for gathering information followed by a summary page. The user is free to navigate backwards or forwards through these screens as all entered information is preserved.

The first input screen, *SimCAD Parameters*, consists of three tabs that are used to organize the types of information to be added. This screen is also available from the ***Run->SimCAD*** Windows Standard Menu option. The first tab, *Study*, is shown in Figure B-9. This allows the user to define the study of which this run will be a part. This information is used later by the *Archive Files* feature to name the archive file, determine where the archive will be placed on the hard drive, and which directory will be used on the FTP if the archive is uploaded (see Section B.2.6).

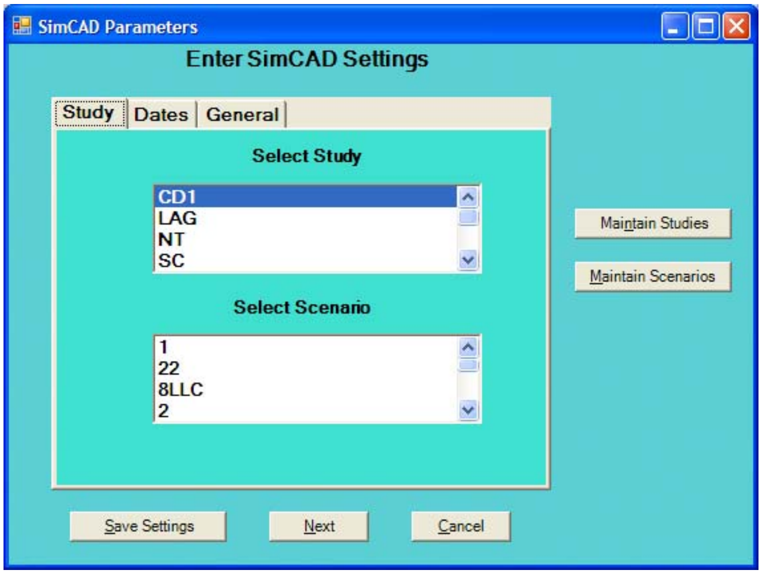

Figure B-9. SimCAD Parameters Screen, Study Tab

The second tab on the *SimCAD Parameters* screen is the *Dates* tab, shown in Figure B-10. This allows the user to specify when each building will begin operation. The dates are given as the number of SimCAD™ time steps (8-hour increments) from the start of the model run (Step 0). The actual scenario/run start date is determined by the *Create Initial State file* function (see Section B.2.3).

The fields in the *Dates* tab are defined as follows:

CRCF1: The value specifies the time step number in the simulator to begin processing in the Canister Receipt and Closure Facility One.

CRCF2: The value specifies the time step number in the simulator to begin processing in the Canister Receipt and Closure Facility Two.

CRCF3: The value specifies the time step number in the simulator to begin processing in the Canister Receipt and Closure Facility Three.

RF: The value specifies the time step number in the simulator to begin processing in the Receipt Facility.

WHF: The value specifies the time step number in the simulator to begin processing in the Wet Handling Facility.

DPC Return: The value specifies the time step number in the simulator to begin DPC returns (see Section 4.2.3).

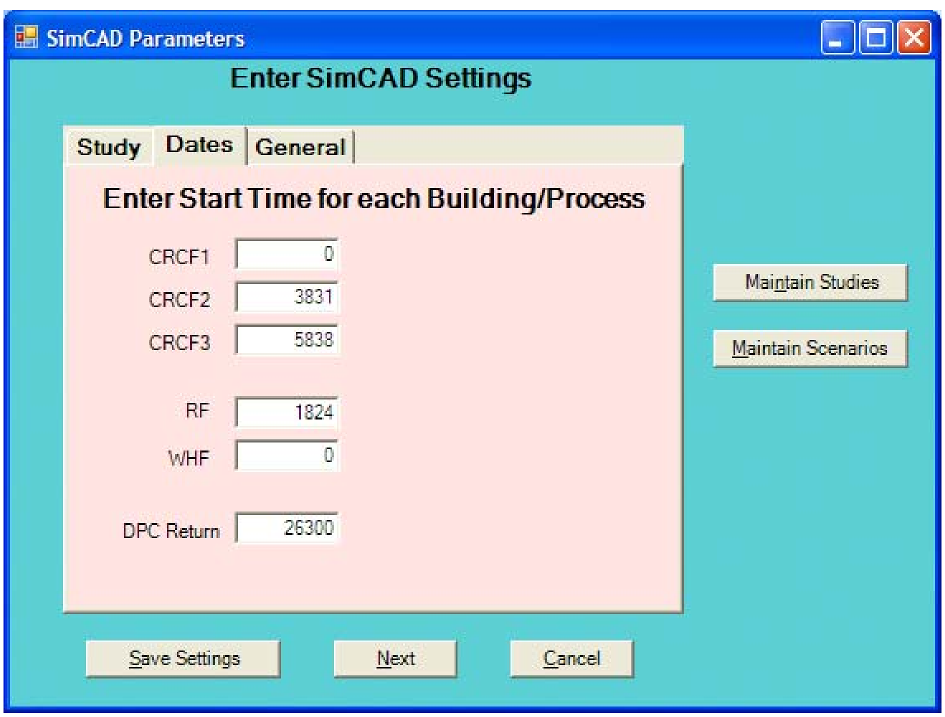

Figure B-10. SimCAD Parameters Screen, Dates Tab

The third tab of the *SimCAD Parameters* screen, *General,* (see Figure B-11) provides access to the rest of the control parameters.

DPC Bypass: If DPCs will bypass to aging, this field is checked (see Section 4.2.3).

TAD Queue Bypass: This value is the number of TAD canisters in the TAD buffer at which casks will bypass to aging-indicates the CRCFs are very busy.

DPC Queue Bypass: This value is the number of DPCs in the BWR or PWR buffer queues at which casks will bypass to aging-indicates the WHF is very busy.

HLW Mismatch: This field indicates the number of DOE CoDisposal WPs that will be created without a matching DOE SNF element. This is usually set to 0 for a 70,000 MTU case. Setting this improperly will likely strand some DOE waste. See Section 4.1.3 of the main text on how this HLW Mismatch is determined.

DSNF Mismatch: This field indicates the number of DOE CoDisposal WPs that will be created without matching HLW elements. This is usually set to 0 for a “full inventory” case (i.e., the entire DOE waste inventory is shipped). Setting this improperly will likely strand some DOE waste. See Section 4.1.3 of the main text on how this DSNF Mismatch is determined.

DPC/Truck Ratio: This field contains the number of truck cask loads processed before a DPC is processed. For example, 20 means that 20 truck cask loads will be processed before a DPC can be processed. It is a way to provide low priority to DPC processing to allow trucks to be processed; DPCs go to aging instead of being processed.

Maximum Heat in WP (Watts): This value is the maximum heat target for a TAD canister being loaded by WHF and the maximum heat in a WP that can be emplaced.

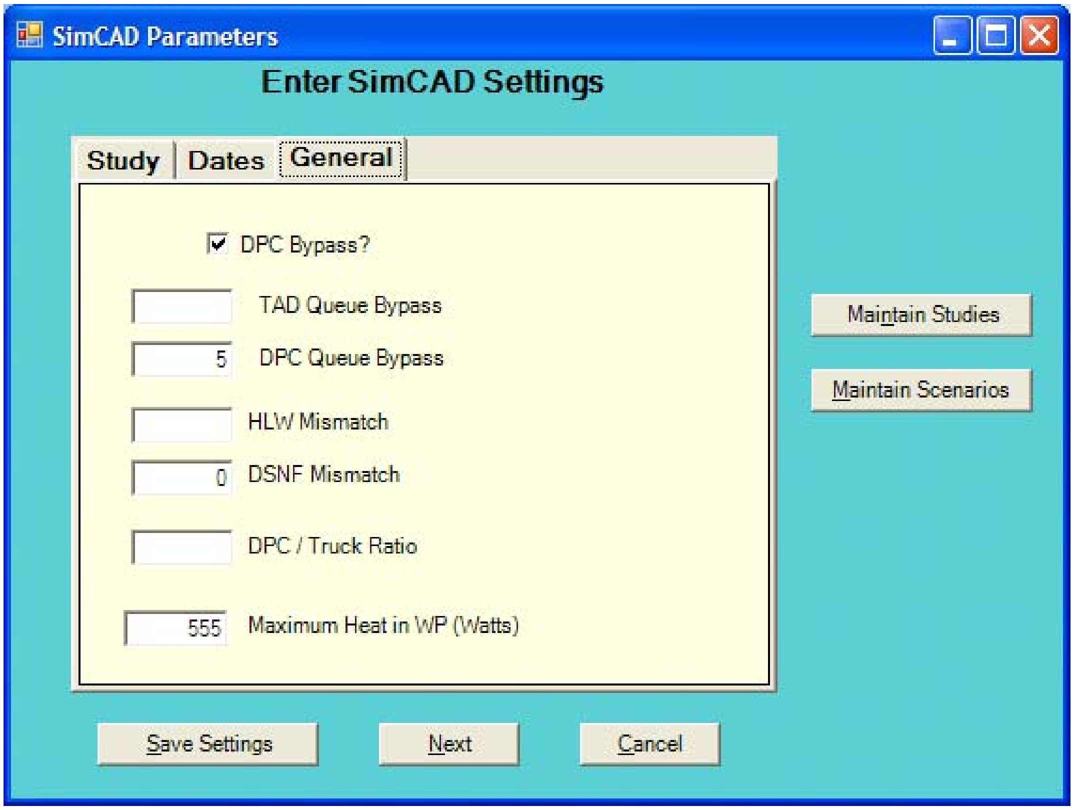

Figure B-11. SimCAD Parameters Screen, General Tab

The user can create new studies and scenarios and edit existing ones from the *SimCAD Parameters* screen. The buttons on the *SimCAD Parameters* screen provide the following functions:

- **Cancel**

Selection of the *Cancel* button exits the *Run SimCAD* function and returns to the Main screen of TSMCC.

- **Maintain Studies**

Selection of the *Maintain Studies* button displays the *Study Maintenance* screen (Figure B-12). A study is a group of runs designed to show the system effects based on changing a set of parameters. This screen offers functions for creating a new study, editing an existing study, or deleting a study. If a study has been selected from the study list on the Study tab of the *SimCAD Parameters screen*, the Maintenance screen will be displayed with the current values associated with the selected study. The buttons on the Study Maintenance screen are:

Delete: Deletes the selected study and clears the fields

Clear Field: Blanks out the fields in the window but does not alter any database records.

OK: Updates the study record with the values entered in the window's fields or adds a new study if a record does not exist for the Study ID. Returns to the SimCAD Settings window.

Cancel: Returns to the SimCAD Settings window.

The fields in the *Study Maintenance* window are defined as follows:

Study ID: Each study must be assigned a unique identifier. This is a required field.

Start Date: A popup calendar is displayed when the downward arrow at the end of the field is selected. The calendar is used for selecting the start date for the study, in format mm/dd/yyyy. The default date is the current date.

Name: This is a required field, which defines the name of the study.

Directory on FTP server: This directory is the destination folder for the archived zip file of the study. The directory defined in this field is a folder based off the path of the root directory. If the folder does not exist during the Ftp upload process, the zip file will be placed in the top folder of the Ftp account. This folder needs to be created manually on the Ftp server. This is a required field.

Prefix: The prefix consists of a few characters that are added to the file names of the study to augment identification. The prefix is typically composed of two to three characters and is an optional field.

Comments: Comments can be used to include a description of the study.

Directory for archiving: This directory is the location for the archived files of the study. The directory defined in this field is in relation to the base Archive directory set in the TSMCC Settings window accessed from the Edit menu. If this field is left blank, the base Archive directory will be used as the folder for archiving.

Directory of IS file: This directory is the location of the IS file. The directory defined in this field is in relation to the base Archive directory set in the TSMCC Settings window accessed from the Edit menu. If this field is left blank, the base Archive directory will be used as the folder for archiving.

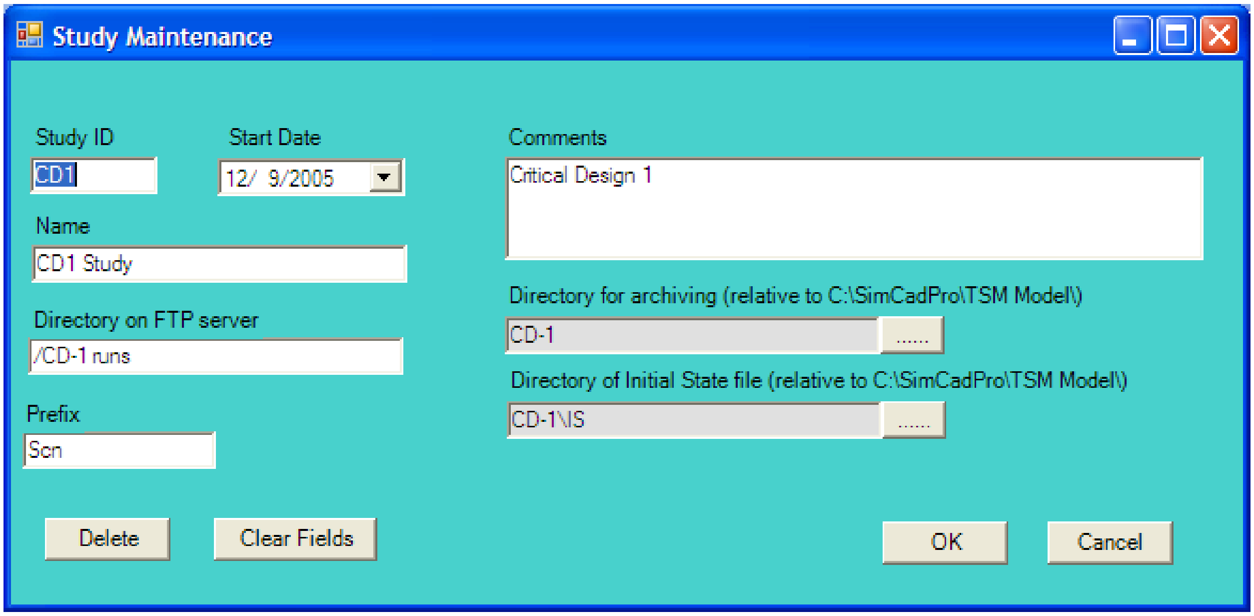

Figure B-12. Study Maintenance screen

- **Maintain Scenario**

Selection of the *Maintain Scenario* button displays the *Scenario Maintenance* screen (Figure B-13). This screen offers functions for creating a new scenario, editing an existing scenario, or deleting a scenario. A scenario is a single set of parameters coupled with an IS file. There are typically several scenarios associated with a study. If a scenario has been selected from the scenario list on the *Study* tab of the *SimCAD Parameters screen*, the Maintenance screen will be displayed with the current values associated with the selected scenario. The buttons on the *Scenario Maintenance* screen are:

Delete: Deletes the selected scenario and clears the fields

Clear Field: Blanks out the fields in the window but does not alter any database records.

OK: Updates the scenario record with the values entered in the window's fields or adds a new scenario if a record does not exist for the Scenario ID. Returns to the SimCAD Settings window.

Cancel: Returns to the SimCAD Settings window.

The fields in the Scenario Maintenance window are defined as follows:

<u>Scenario ID</u>: Each scenario in a study must be assigned a unique identifier. This is a required field.

<u>Name</u>: This field assigns the name of the scenario.

Comments: Comments can be used to include a description of the scenario.

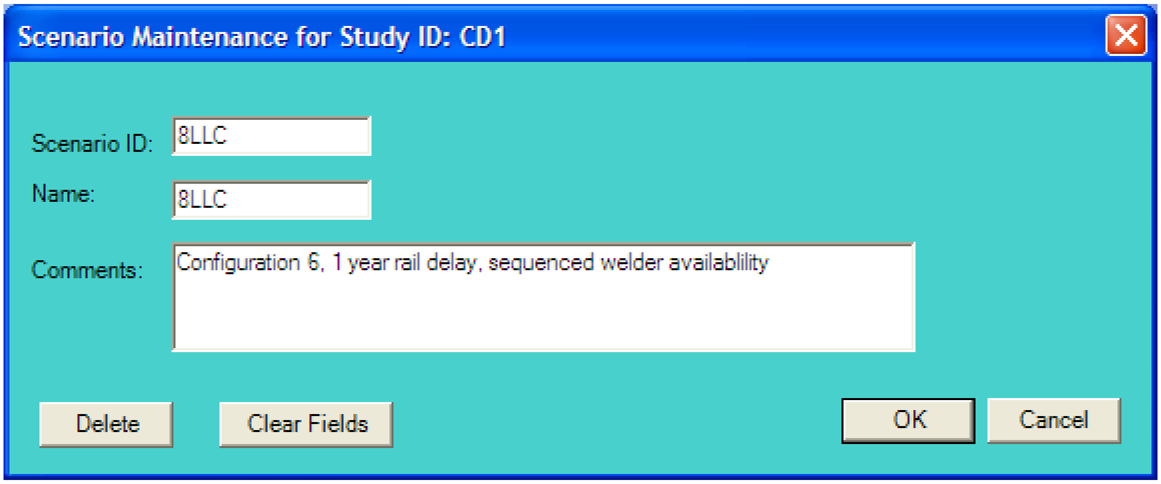

Figure B-13. Scenario Maintenance screen

- **Save Settings**

The *Save Settings* button saves the entered SimCAD™ settings for a scenario to a database record. When a scenario is selected from the scenario list on the *Study* tab, the SimCAD™ parameter fields of the *Dates* and *General* tab are populated with the values stored in the scenario's database record.

- **Next**

After selecting the *Next* button, the second input screen of the TSM Run Wizard, *Select Initial State File* (see Figure B-14) is displayed. This screen allows the user to select an IS file. Once the file is selected via the Browse button, the four buttons on the right provide summary information about the schedule (see Section B.2.4 *Analyze Initial State file* for more detail).

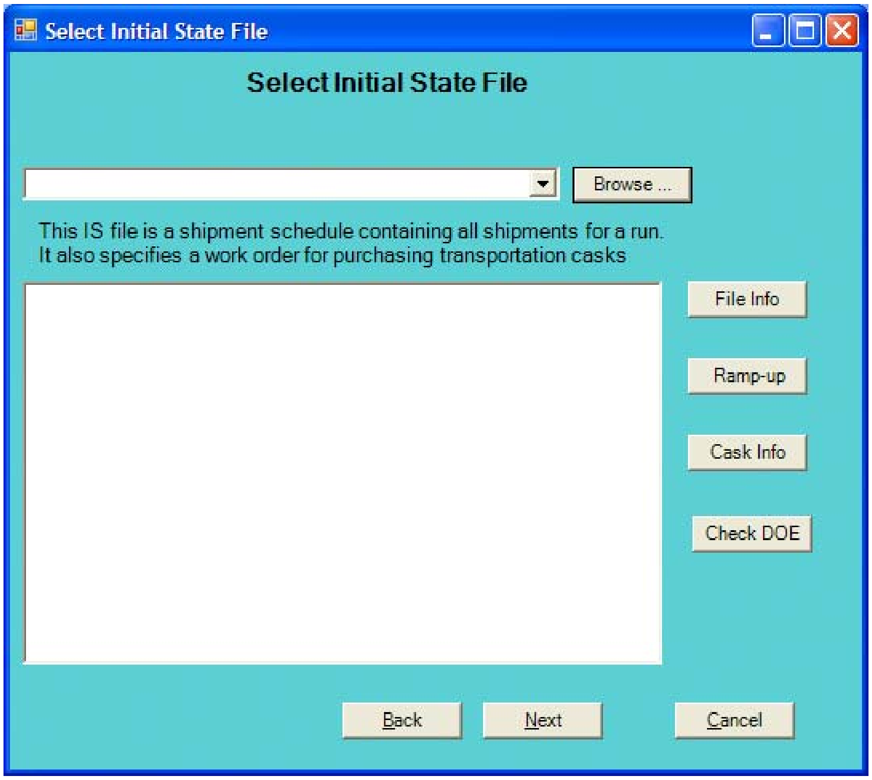

Figure B-14. Select Initial State File screen

The third input screen of the TSM Run Wizard, *Select SimCAD Model File* (see Figure B-15) allows the user to specify the SimCAD™ file that will be run. If TSMCC is used to start a run, this is the file that will be loaded into the TSM simulation and run. It is also the file that will be saved in the run archive by the *Archive Run* process.

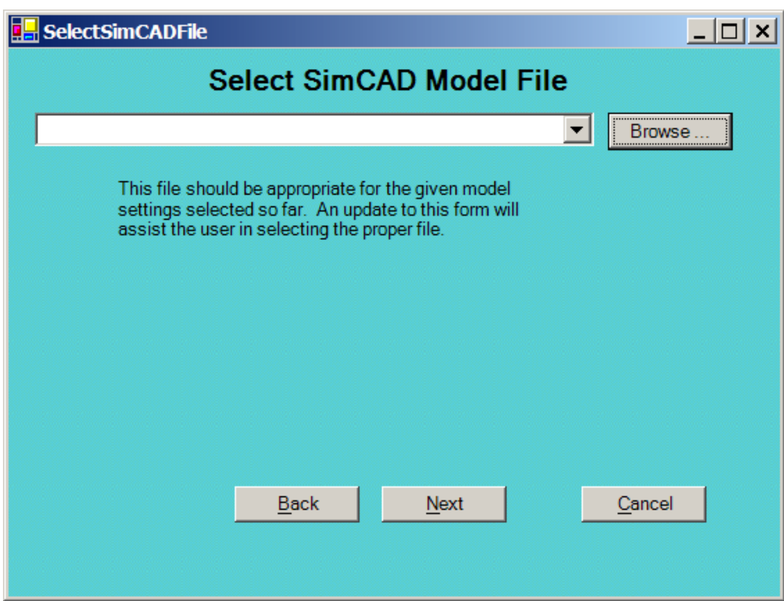

Figure B-15. Select SimCAD Model File

The fourth and last input screen is the *SimCAD Simulation Settings* (see Figure B-16) that allows the user to specify how the TSMCC will detect that a run is complete. The default selections are *Completion* and *Just Pause*. The *Just Pause* option pauses a run after all shipments have arrived at the GROA and all items have returned from aging. When a time step is specified for the run options, the simulator may run several time steps beyond this point before exiting. This issue will be addressed in the next release.

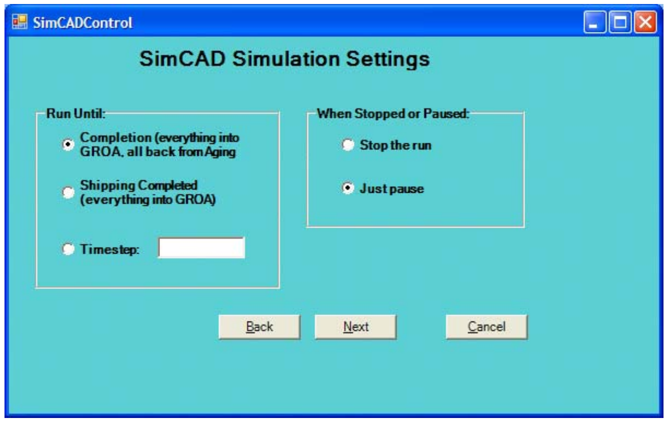

Figure B-16. SimCAD Simulation Settings Screen

The *SimCAD Summary* screen automatically appears after the input screens are complete and presents the input information for review by the user (see Figure B-17). If anything is not correct, the *Back* button allows navigation to the appropriate screen for modification. The *Run SimCAD* button will write this information to the tsm_v6.xml file, start SimCAD™, load the .sim model file, and start the run. If the *Only write XML file* option is checked, only the XML file is written; SimCAD™ will not be loaded and run. This is useful for transferring the setup if the run will take place on another machine.

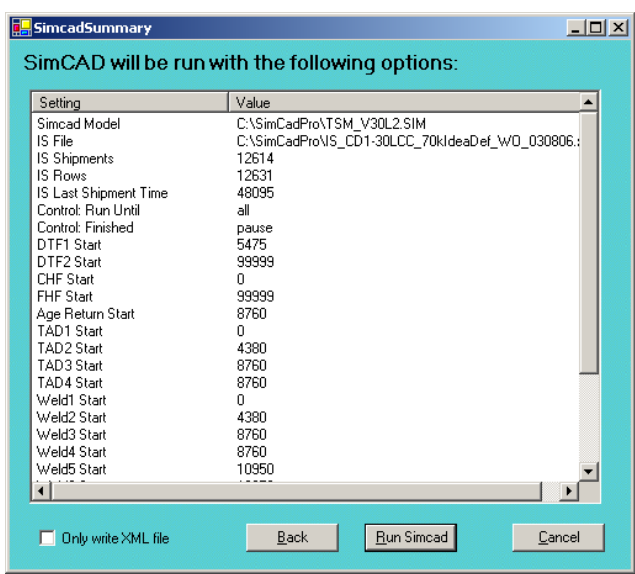

Figure B-17. SimCAD Summary

B.2.6 Archive Files

The *Archive Files* button on the TSMCC Main Menu is used to package a completed run for later analysis. It assures that all required information is gathered together into a coherent package. The *Archive Files* process uses the tsm_v6.xml and TSM.mdb files found in the SimCadPro directory to locate the .simdata and the .sim files along with the IS file. It also extracts some information from these files to provide a basic template for comments. This information is then displayed in the *Archive Files* screen (see Figure B-18). The user is free to add additional files to the archive using the *Add* button and is strongly encouraged to expand upon the basic comments provided by default. The *Archive* button will then create a zip file containing these files which will then be placed in the archive directory specified for the Study (see Section B.3.2).

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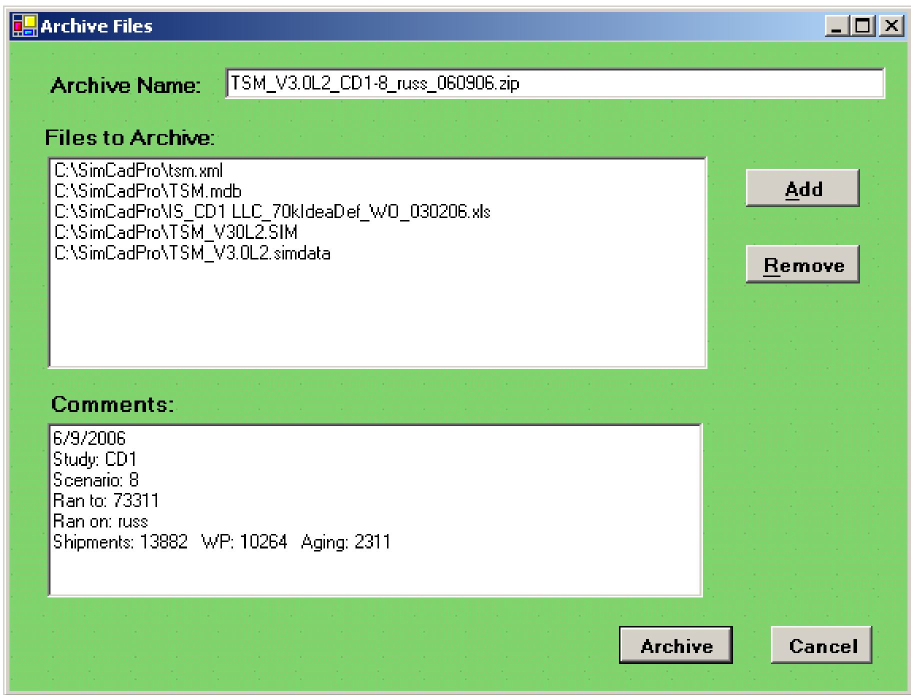

Figure B-18. Archive Files

Once the archive is created, the user is prompted to upload the archive file to the TSM FTP site (Figure B-19). Answer “No” unless permission to access the FTP site has been granted by the TSM Developers Group (requires a user name and password).

Figure B-19. Prompt to Upload to FTP

Following the successful archiving of a run, the user is then prompted to enter information about the run to make it easier to find the run in the future. Much of the information on the Edit Run Information screen seen in Figure B-20 is entered automatically from the data files. The *Run OK* option is the user's best judgment that the run does not appear to have any problems or curious behavior. Refer to Section 3.1.1 for observations to make while running. Refer to Section 6.1 of the main text for ideas on items to review when the run has completed and is paused. As the user gains experience, the judgment "Run OK?" will become more clear and sophisticated. If there is uncertainty, use the "Comments and Observations" window to record them. The *Did Run Display Error at End?* option lets the user record any error messages that were encountered for analysis by the Developers Group.

The *Edit Run Information* screen is also available from the ***Edit->Runs*** Windows Standard Menu option in the TSMCC screen, see Figure B-1.

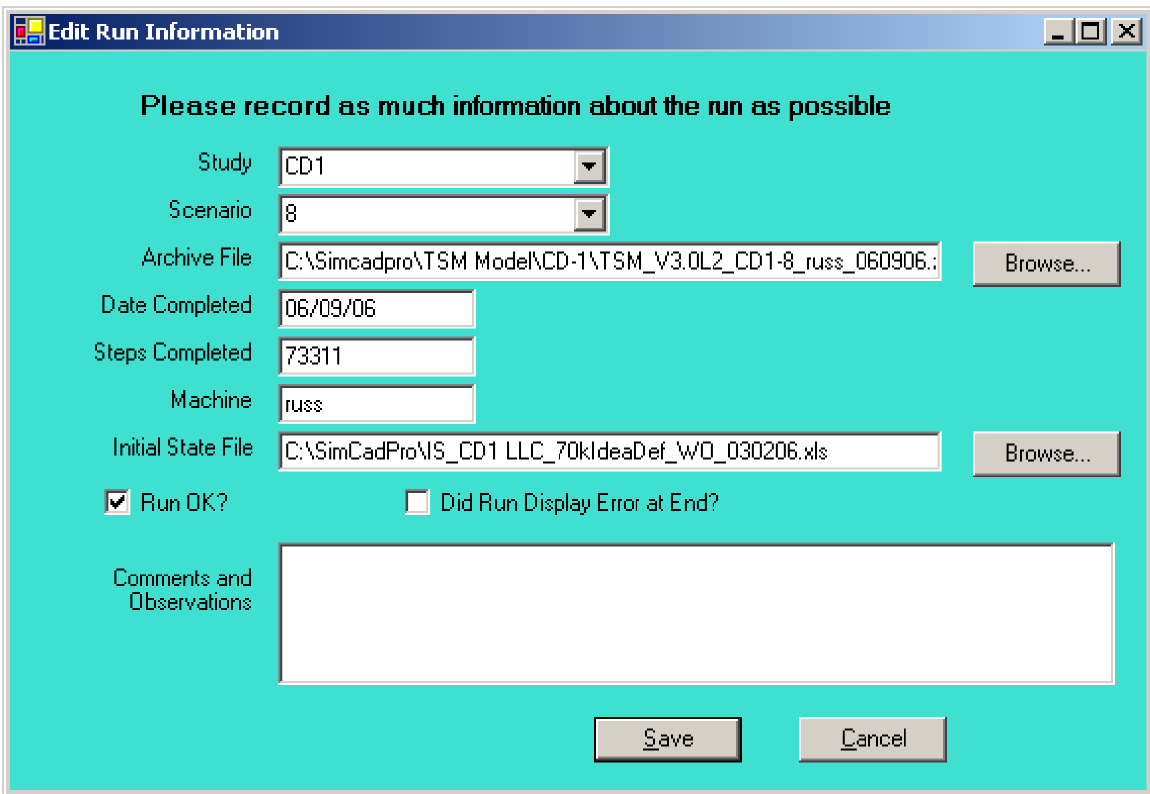

Figure B-20. Edit Run Information

B.3 OTHER FEATURES

The collection of functions grouped into the "Other Features" category is available from the Windows Standard Menu bar at the top of the TSMCC Main Menu (see Figure B-1). Each of these will be covered in the sections below.

B.3.1 Edit TSMCC Settings

Most of the important setup information is available from the **Edit->TSMCC Settings** menu option in Figure B-21. This allows the user to specify where the various files are located on their machine. The machine name is used in the archival process to identify where a run was made and to help differentiate between similar runs made on the same day.

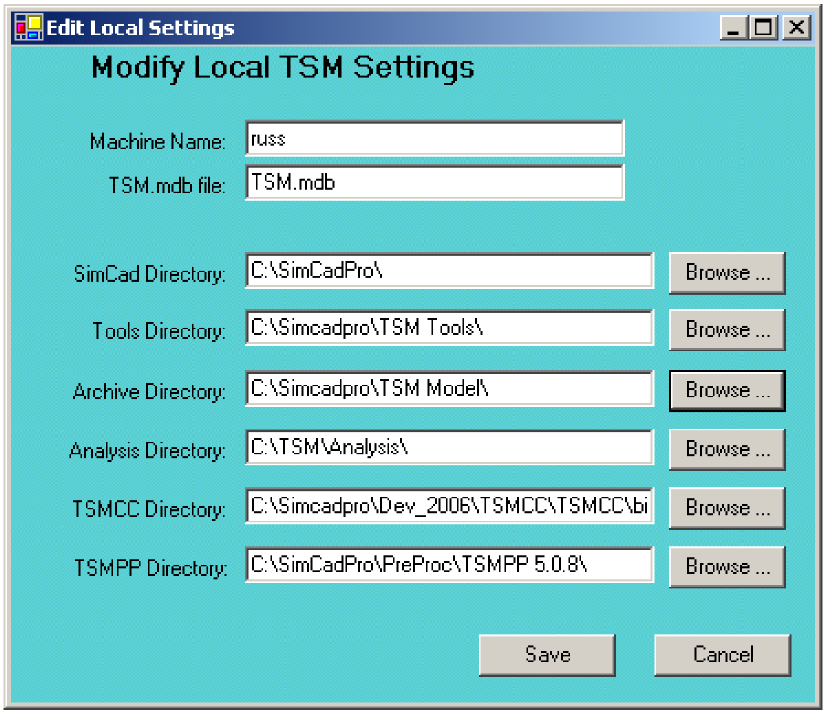

Figure B-21. Modify Local Settings

B.3.2 TSMCC Help

Help documents are available by pressing F1 when TSMCC is running or selecting **Help** from the TSMCC Menu. The help menu shown in Figure B-22 will be displayed if help is invoked from the Main Screen. On the Main screen, selecting F1 will display TSMCC Help option. On other screens, selecting F1 will display the page in Appendix B from this report that describes the function currently displayed.

TSMCC Help – displays a PDF of Appendix B of the UM
TSM Help – displays a PDF of the TSM UM
TSM Tools Help – displays a PDF of the Appendix A of the UM

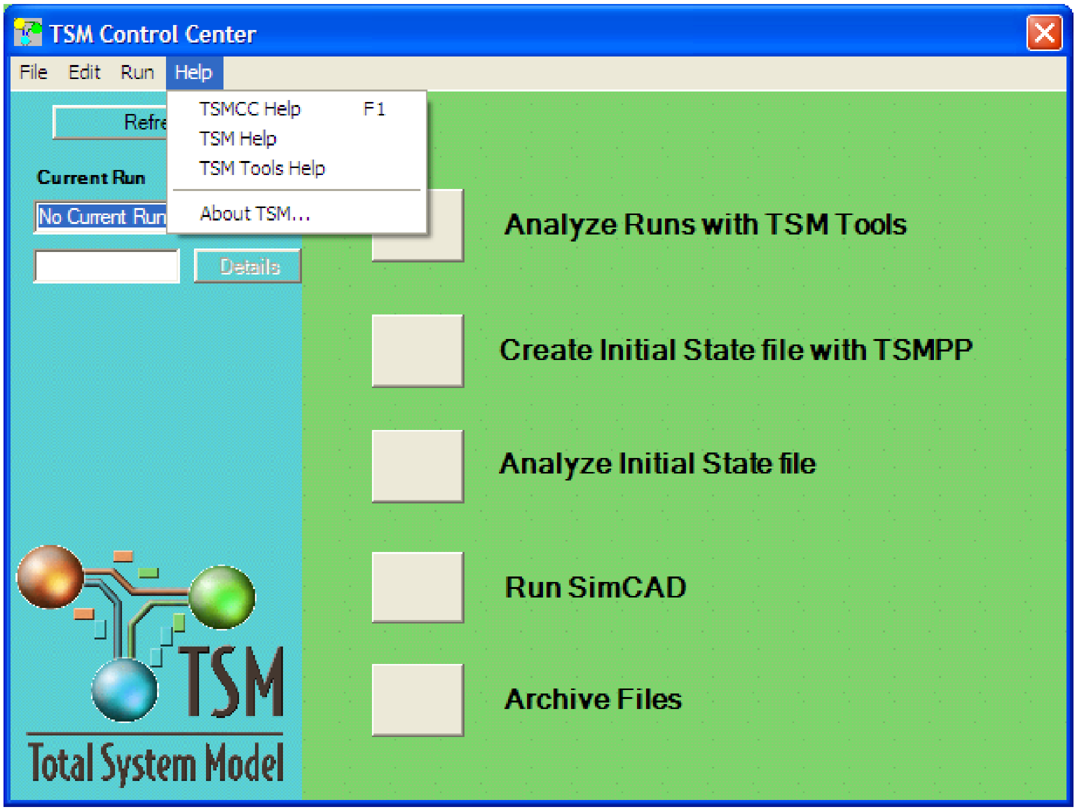

Figure B-22. Main Help Screen

B.4 TSM RUN SHEETS

A style sheet, SimcadXML1.xslt, was created to transform the tsm_v6.xml file into a printed document to be used to record run details. Double-clicking the tsm_v6.xml file will display the sheet shown in Figure B-23 in a browser window, which may then be printed. The style sheet is installed in the c:\\SimCadPro\TSMCC directory when TSMCC is installed.

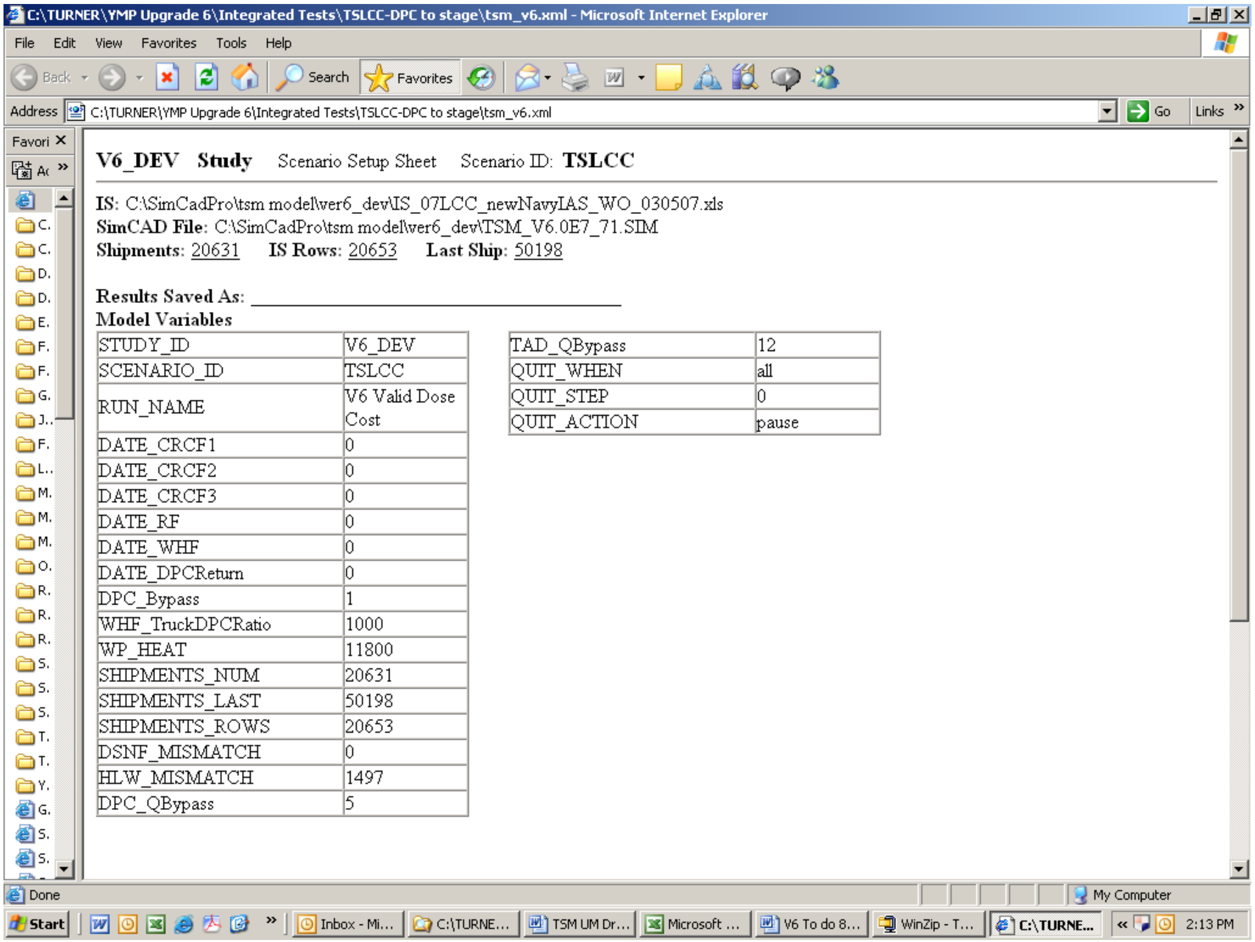

Figure B-23. TSM Run Sheet

B.5 MISCELLANEOUS POINTERS

This section provides various pointers related to the use of the TSMCC program. They are as follows:

1. For each study to be conducted, the user should create a directory to store the archived files both locally and (if possible) on the FTP Server. This information along with a list of all Scenarios to be conducted under the study should then be entered via the *Study Maintenance and Scenario Maintenance* screens.

2. Running the most similar scenarios as a group will minimize the number of changes that need to be entered into the TSM Run Wizard screens. This will reduce the chance for data entry errors.

3. Always create a run sheet and note any inconsistencies on it. Enter any inconsistencies into the comments when prompted. This makes later analysis much easier.

4. Experienced users often perform runs or make similar runs without using the TSMCC by manually modifying the tsm_v6.xml file shown in the previous section. For example, a user wants to repeat a run and only change the parameter WP_Heat. One quick way to do this is to open the tsm_v6.xml file in a text format (navigate to the tsm_v6.xml file under the .simdata folder on the C: drive where it is installed, then right click on the tsm_v6.xml file and select “open with” and select Notepad or Wordpad that will open tsm_v6.xml in a text format). When opened, move the cursor to the WP_Heat value and revise it as desired. Close and save TSM.mxl. Reopen the TSM model and click the green start car. The TSM model will be able to find and access the revised tsm_v6.xml file and the IS file and run this case.