Westinghouse Non-Proprietary Class 3

WCAP-15996-NP-A, Revision 0
CENPD-282-NP-A, Revision 1

APRIL 2004

TECHNICAL DESCRIPTION MANUAL

FOR THE

CENTS CODE

VOLUME 3

Westinghouse

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 1, 2003

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: FINAL SAFETY EVALUATION FOR TOPICAL REPORT WCAP-15996-P, "TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE" (TAC NO. MB6982)

Dear Mr. Bischoff:

On December 13, 2002, and February 19, 2003, the Westinghouse Owners Group (WOG) submitted Topical Report (TR) WCAP-15996-P, "Technical Description Manual for the CENTS Code" to the staff. On October 6, 2003, an NRC draft safety evaluation (SE) regarding our approval of WCAP-15996-P was provided for your review and comments. By letter dated October 31, 2003, the WOG commented on the draft SE. The staff's disposition of the WOG's comments on the draft SE are discussed in the attachment to the final SE enclosed with this letter. The red-line and strikeout version of the SE, along with numbering the lines of the SE, was very helpful in reviewing your comments. In the future, it would be helpful if you numbered the comments in the table in addition to providing the SE line numbers.

The staff has found that WCAP-15996-P is acceptable for referencing in licensing applications for Westinghouse and Combustion Engineering designed pressurized water reactors to the extent specified and under the limitations delineated in the report and in the enclosed SE. The SE defines the basis for acceptance of the report. The dose model portion of the CENTS code is being reviewed separately and will be the subject of a separate SE.

Our acceptance applies only to material provided in the subject report. We do not intend to repeat our review of the acceptable material described in the report. When the report appears as a reference in license applications, our review will ensure that the material presented applies to the specific plant involved. License amendment requests that deviate from this topical report will be subject to a plant-specific review in accordance with applicable review standards.

In accordance with the guidance provided on the NRC website, we request that the WOG publish an accepted version of this topical report within three months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed SE between the title page and the abstract. It must be well indexed such that information is readily located. Also, it must contain in appendices historical review information, such as questions and accepted responses, draft SE comments, and original report pages that were replaced. The accepted version shall include a "-A" (designating accepted) following the report identification symbol.

If the NRC's criteria or regulations change so that its conclusions in this letter, that the topical report is acceptable, is invalidated, the WOG and/or the licensees referencing the topical report will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the topical report without revision of the respective documentation.

Sincerely,

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Safety Evaluation

cc w/encl:
Mr. J. S. Galembush, Acting Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT WCAP-15996-P, "TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE"

WESTINGHOUSE OWNERS GROUP

PROJECT NO. 694

1.0 INTRODUCTION

By letters dated December 13, 2002, and February 19, 2003, the Combustion Engineering Owners Group (now part of the Westinghouse Owners Group [WOG]) submitted Topical Report (TR) WCAP-15996-P, "Technical Description Manual for the CENTS Code" (References 1 and 2), to the NRC staff for review and approval of the transient analysis methodology described therein for licensing applications with regard to both Combustion Engineering- (CE) and Westinghouse-designed pressurized water reactors (PWRs). By letter dated June 13, 2003, the WOG provided responses to the staff's request for additional information (RAI) (Reference 3). WCAP-15996-P is an update of CENPD-282-P-A (Reference 4); the latter was previously reviewed and approved by the staff for application to CE-designed PWRs (Reference 5), and subsequently the staff extended this approval to Westinghouse-designed PWRs (Reference 6). Central to the methodology described and discussed at length in both submittals is the CENTS computer code. This review focuses on, although is not limited to, the changes made to the CENTS code, between the approved version described in CENPD-282-P-A and the improved version described in WCAP-15996-P. The changes were made to more accurately model plant systems and transient behavior of the reactor system. To assist the staff in the review, the WOG prepared a "Roadmap" that identified the changes made to the original TR, CENPD-282-P-A, and the rationale for the changes. This review relies to a great extent, although not exclusively, on the submitted "Roadmap."

TR WCAP-15996-P will, on approval, supercede CENPD-282-P-A; the latter was previously found acceptable by the staff for referencing in licensing actions with respect to the calculation of transient behavior in PWRs. CENPD-282-P-A may continue to be utilized as it was originally approved by the NRC. In particular, the evaluation and approval of the models in the CENTS code, central to the CENPD-282-P-A methodology, are limited to non-loss-of-coolant accident (LOCA) licensing analyses. That is, CENTS is not approved for demonstrating compliance to 10 CFR 50.46 acceptance criteria. It is, however, acceptable when used to model small breaks in the primary system that can be classified as LOCAs for the purpose of demonstrating compliance to non-LOCA regulatory acceptance criteria. For example, CENTS is used to evaluate the dose consequences of steam generator tube rupture and letdown line break events. The qualification of the previous versions of the CENTS code was based on CENTS predictions of startup measurements, operating transients, and comparisons to calculations

made with the staff-approved design codes CESEC, CEFLASH-4AS, and RELAP 5/MOD 3. Since model upgrades to the CENTS code are under review, the staff evaluated differences in the predictions of the originally approved code version and those of the upgraded CENTS version described in WCAP-15996-P for the most limiting design basis events. The basis for the approval of WCAP-15996-P is that any variance from previous results due to the model changes precludes exceeding the safety-related limits on which the approved CENPD-282-P-A methodology was based.

2.0 REGULATORY EVALUATION

Section 50.34 of Title10 of the *Code of Federal Regulations* (10 CFR) contains requirements for the analysis of abnormal plant operating events by licensees. NUREG-0800, "Review of Safety Analysis Reports for Nuclear Power Plants," provides guidelines to licensees and the staff for evaluating these types of events. Section 50.71 requires licensees to update the final safety analysis report (FSAR) for a given plant periodically. Included in the FSAR are the descriptions of abnormal events and accidents for which a given plant is analyzed. These are typically referred to as Chapter 15 analyses, corresponding to Chapter 15 of NUREG-0800.

The CENTS code is intended to provide analysis capability in the areas of engineering, operations and training. It also is intended to provide evaluation capabilities for transient events, accidents, operator actions, design and scoping studies. Under this review, it is specifically being evaluated for non-LOCA Chapter 15 analyses for PWRs.

3.0 SUMMARY OF WCAP-15996-P

The WOG submittals identified the specific changes that have been incorporated into the CENTS code since its previous approval. These modifications can be grouped into two classes: those that do not have an impact on the computed results and those that do affect the computed results.

In the former class are the editorial changes to the descriptions in CENPD-282-P-A with regard to the models of the bubble rise velocity used in the heat transfer coefficient for bubble condensation and the annulus bubble release rate. Both changes bring the text in the TR into conformance with the correct and previously approved coding in the CENTS code. The staff approves these changes. Westinghouse also requested a clarification of the restriction on the use of the CENTS code for application to control element assembly (CEA) ejection licensing analyses. With regard to CEA ejection licensing analyses, the safety evaluation for CENPD-282-P-A states, "... CENTS is not approved for performing CEA ejection licensing analyses." The rationale for this restriction is stated as "Benchmarking for the CEA ejection transient has not been provided...." A sui generis application of the CENTS code to a CEA ejection event has been reviewed and approved by the staff (Reference 7). The staff will continue to entertain, on a case-by-case basis, such analyses for review.

The WOG has added a new dose assessment model to the CENTS computer code that has the capability to calculate offsite dose due to an accident condition. Westinghouse has indicated that this model is essentially the same as the currently employed hand-calculated assessments used to determine dose consequences. The WOG has indicated that the benefit offered by the

incorporation of the new dose model is the improved accuracy afforded by performing more exact iodine tracking and release calculations.

NRC review of this new dose assessment model is ongoing. Pending final approval, applicants may use the new model. Until such time as the new CENTS dose assessment model is approved by the NRC, the NRC will review each licensee's dose assessment on a case-by-case basis.

3.1 Model Changes

To technically justify those upgrades to the CENTS code that provide new modeling capabilities or provide more detail and accuracy for existing models, and, thereby have an impact on the computed results, the WOG performed benchmark testing. There are four such modifications to the CENTS code considered in this review; review of the fifth, a modification in the dose model, is ongoing as discussed in Section 3.0.

3.1.1 Core Channel Heat Transfer Model Upgrade

The original channel enthalpy model ignores the heat capacity of the fluid, and is based on the assumption that the change in the enthalpy over a computational section is negligible relative to the transport-time constant over the section. The new version of the CENTS code allows for a time-dependent change in the enthalpy in a computational section by taking into account the heat capacity of the liquid. The differential equation for the rate of change of enthalpy in a computational section is solved analytically. Thus, this new option not only takes into account the heat capacity of the fluid, but also precludes any numerical instability that might be introduced through a finite-difference solution for large time steps.

3.1.2 Steam Generator (SG) Tube Nodalization Model with Sectional Coolant Enthalpy

The updated SG model consists of an increase in the number of active-tube nodes per SG. Within each of the active-tube nodes of each SG tube, an internal calculation tracks a detailed temperature profile for the coolant and the tubes. For this purpose, each tube node is divided into multiple subsections; the number of sections in each tube node is specified via input. This more detailed nodalization of the primary side of the SG is provided as an option to support the enhanced tube heat transfer model described above.

3.1.3 Multiple Node Reactor Pressure Vessel (RPV) Downcomer Model

The updated CENTS code contains an option for a more detailed nodalization in the reactor vessel downcomer. This modification, by introducing both axial and azimuthal nodalization, improves the simulation of the asymmetric effects in the loops of the reactor coolant system (RCS).

3.1.4 Detailed Main Feedwater Model

For the previously approved simplified feedwater line model, the feedwater flowrate delivered by the pumps is specified directly by the control system for each SG. The model feeds the indicated flows to the SGs unless a feedwater line break has occurred. In the latter case, the

break flow from the feedwater lines is calculated by the homogeneous equilibrium model, or if the flow is choked, by the Henry-Fauske correlation.

The updated CENTS code allows discrete main feedwater (MFW) and auxiliary feedwater (AFW) models. This capability enables accurate, time-dependent transient simulation of the MFW and AFW systems. The models are predicated on the availability of a network of discrete MFW and AFW components and piping through user developed and specified input. Thus, the system network is adaptable to different plant designs.

4.0 EVALUATION

Benchmark testing consisted of code comparisons for six events:

1. Main Steamline Break
2. Feedwater Line Break
3. Control Element Assembly Withdrawal from Sub-critical Conditions
4. Control Element Assembly Withdrawal from Hot Zero Power Conditions
5. Reactor Coolant Pump Seized Rotor
6. SG Tube Rupture

These are viewed as the most limiting design basis events in this review.

To test that all the minor code modifications and error corrections made since 1994 have not had a significant net effect, the above six cases were run with the new version of the CENTS code with the upgrade models described above deactivated. No significant variances in the results were observed when compared to the results from the previously approved version. They are judged to preclude exceeding the safety-related limits on which the approval of the CENPD-282-A methodology is based. The staff accepts that the new version of the CENTS code (with the model upgrades described above deactivated) is comparable to the previously accepted version and that it continues to be acceptable to use CENTS in this manner.

The model upgrades in the new version of the code consist, as a whole, of a more realistic description of physical phenomena and a more detailed description of system components. As such, they will lead to more realistic and accurate results. These results may be noticeably different from those obtained with the previously approved version. To demonstrate that the new models lead to correct results, a second set of comparisons for the same general scenarios was made with all the CENTS upgrade models activated. To isolate the effect of the individual upgrades and evaluate their phenomenological behavior, the upgrades were also separately activated.

The new models in the CENTS code induce the following main changes in the results of the six benchmark cases.

4.1 Main Steamline Break

The new models cause a slightly more severe and rapid blowdown of the affected SG which results in a deeper drop in the core temperatures. This drop in core temperature has a

reactivity worth of +0.0023 Δρ compared to the upgraded version with model changes deactivated. This change in reactivity is far from sufficient to induce a return to power; it is conservative. The staff accepts that the CENTS code with the new models continues to give conservative results for this event.

4.2 Feedwater Line Break

The upgrade models, together and individually, result in greater system flow to the intact SG. This results in lower long-term RCS temperatures and pressures, and less swell into the pressurizer. The regulatory acceptance criterion for this event, with a limiting single failure, is that the peak RCS pressure must be less than 120 percent of the RCS design pressure. The staff accepts that the CENTS code with the new models continues to give conservative results with respect to this criterion for this event.

4.3 Control Element Assembly Withdrawal from Sub-critical Conditions

The only upgrade that has a significant effect on the results in this event is the channel heat transfer model. The improved modeling of the core fluid heat capacity reduces the positive moderator temperature reactivity feedback, and, thereby, lowers the peak power from ~119 percent to ~105 percent of nominal. The improved modeling reduces the code conservatism, however, it is physically based and is acceptable to the staff.

4.4 Control Element Assembly Withdrawal from Hot Zero Power Conditions

As in the previous event, the only upgrade that has a significant effect on the results is the channel heat transfer model. The improved modeling of the core fluid heat capacity reduces the positive moderator temperature reactivity feedback, and, thereby, lowers the peak power from ~106 percent to ~101 percent of nominal. It is acceptable to the staff as described above.

4.5 Reactor Coolant Pump Seized Rotor

The comparison of results between the upgraded CENTS code with models deactivated and activated shows good agreement, and, thereby, precludes exceeding safety-related limits on which the approved CENPD-282-P-A methodology was based. It is therefore acceptable to the staff.

4.6 SG Tube Rupture

The SG tube rupture event is a penetration of the barrier between the RCS and the main steam system due to the failure of a steam generator U-tube. The integrity of the barrier between the RCS and the main steam system is significant from the radiological release standpoint. The limiting event considered is a double-ended rupture of a SG tube with concurrent loss of alternating current (AC) power. Both phenomenologically and quantitatively, the comparison of thermal-hydraulic plant response parameters between the CENTS code with and without the upgraded model is excellent. The safety-related consequences for this event are mainly predicated on the dose model. The dose model portion of the CENTS code is presently under review by the staff as discussed in Section 3.0.

Although this review is based solely on the results of the above comparisons of benchmark calculations, the WOG has submitted results of a comparative analysis of a main steamline break event and a feedwater line break computed with CENTS with upgrades and RELAP5/MOD3 (Reference 8). The agreement is good, and, furthermore, gives some insight into the effectiveness of the model upgrades in the CENTS code.

5.0 CONCLUSIONS

The staff has reviewed TR WCAP-15996-P and the supporting documentation sent in response to the staff's request for additional information. On the basis of this review, the staff approves the transient methodology described in WCAP-15996-P for referencing in licensing actions with respect to the calculation of transient behavior in PWRs designed by CE and by Westinghouse, subject to the limitations stated below. These limitations were placed on the approval of the CENPD-282-P-A methodology and apply to WCAP-15996-P methodology, approved herein. This does not include approval of the CENTS code dose model. The dose model portion of the CENTS Code is under NRC review at this time. The CENTS code dose model will be evaluated separately.

1. CENTS departure from nucleate boiling ratio (DNBR) analysis: The CENTS DNBR calculation for determining overall trends in thermal margin should not be used for licensing analyses. The DNBR licensing analyses should be performed with the presently approved CE DNBR methods.

2. Limitation to CE and Westinghouse Type Plants: The application of CENTS is limited to PWRs of CE and Westinghouse design.

3. LOCA and Severe Accident Analysis: Adequate benchmarking of the CENTS LOCA and severe accident capabilities has not been provided. Consequently, CENTS should not be used for performing LOCA or severe accident licensing analyses. CENTS is not approved for demonstrating compliance to 10 CFR 50.46 criteria. It is; however, acceptable for use in modeling small breaks in the primary system that can be classified as LOCAs for the purpose of demonstrating compliance to non-LOCA regulatory acceptance criteria.

4. Three-Dimensional Core Neutronics: Benchmarking for the CENTS three-dimensional core neutronics capability has not been provided. Consequently, licensing applications of CENTS should be based on a point kinetics model.

5. CEA Ejection Analyses: This review does not give general approval for the application of CENTS simulations of a CEA ejection transient for licensing analyses. The staff will consider and review such requests on a case-by-case basis. This portion of the CENTS code remains under review at this time.

6.0 REFERENCES

1. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, and WCAP-15996-NP, entitled 'Technical Description Manual for the CENTS Code'," CEOG-02-256, December 13, 2002.

2. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, Volume 4 and WCAP-15996-NP, Volume 4 entitled 'Technical Description Manual for the CENTS Code'," WOG-03-76, February 19, 2003.

3. Letter, R. H. Bryan (WOG) to USNRC Document Control Desk, "Response to Request for Additional Information Related to the Westinghouse CENTS Topical Report (WCAP-15996-P)," WOG-03-305, June 13, 2003.

4. CENPD-282-A, Rev. 0, "Technical Description Manual for the CENTS Code."

5. Letter, M. J. Virgilio (NRC) to S. A. Toelle (ABB-CE), "Acceptance for Referencing of Licensing Topical Report CENPD-282-P, 'Technical Manual for the CENTS Code'," March 17, 1994.

6. Letter, R. C. Jones (NRC) to S. A. Toelle (ABB-CE), "Acceptance for Referencing of Licensing Topical Report CENPD-282-P, Vol. 4, 'Technical Manual for the CENTS Code'," February 24, 1995.

7. Letter, L. R. Wharton (NRC) to G. R. Overbeck (APS), "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 - Issuance of Amendments re: Various Administrative Controls (TAC Nos. ME1668, MB1669, and MB1670)," October 15, 2001.

8. RELAP5/MOD3 Code Manual, NUREG/CR5535, INEL-95/0174, Vol. 1.

Attachment: Disposition of Comments on Draft SE

Principal Contributor: Yuri Orechwa

Date: December 1, 2003

DISPOSITION OF COMMENTS RECEIVED FROM WOG ON
THE DRAFT SAFETY EVALUATION OF WCAP-15996

This table identifies and tracks the resolution of comments received from the WOG on October 31, 2003.

Comment Number	Comment Description A = comment accepted; PA = comment partially accepted; R = comment rejected
1	Suggest incorporating reference for submittal of CENTS Volume 4. A
2	Suggest incorporating reference for submittal of CENTS RAI responses. A
3	Update reference numbers due to previous incorporation of additional references. A
4	Request for clarification of the intent of the word "supercede" on Line #29. A
5	Suggest incorporating a more specific statement regarding CENTS usage with respect to analysis of LOCAs. A
6	Editorial R – staff prefers original wording.
7	Suggest incorporating a more complete statement regarding staff-approved design codes against which CENTS was originally benchmarked. Also, suggest deleting reference. A
8	Editorial A
9	Suggest incorporating a more specific statement regarding CENTS usage. PA
10	Suggest incorporating specific reference to the sui generis application the SE refers to and also update reference number. PA
11	Suggest incorporating a more specific constraint clarification regarding use of CENTS for a portion of a CEA ejection evaluation, as indicated. R – This comment involves an item that is still under review.
12	Suggest incorporating a more specific statement regarding the dose model assessment. A
13	Suggest incorporating a more specific section title. A
14	Suggest changing section title to eliminate proprietary information. A
15	Suggest deleting text to eliminate proprietary information. A
16	Change "channel" to "tube" to clarify that it is steam generator and not core heat transfer that is being discussed. A

Attachment

DISPOSITION OF COMMENTS RECEIVED FROM WOG ON
THE DRAFT SAFETY EVALUATION OF WCAP-15996

Comment Number	Comment Description A = comment accepted; PA = comment partially accepted; R = comment rejected
17	If SE statement is a limitation, it would seem to follow that it should be included in the Conclusion section where the NRC lists limitations. A
18	Suggest incorporating a more specific clarification regarding use of updated CENTS version in a manner which replicates the previously accepted version of the code. A
19	Editorial PA
20	Suggest incorporating a more specific statement regarding the dose model assessment. PA
21	Update reference number A
22	Suggest incorporating a more specific statement regarding the dose model assessment. PA
23	Suggest incorporating a more specific statement regarding CENTS usage with respect to analysis of LOCAs. A
24	Suggest incorporating a more specific constraint clarification regarding use of CENTS for a portion of a CEA ejection evaluation, as indicated. R – This item involves an issue still under review.
25	Correction of submittal reference. A
26	Incorporation of submittal reference for CENTS Volume 4. A
27	Incorporation of submittal reference for CENTS RAI responses. A
28	Update reference number. A
29	Update reference number. A
30	Update reference number and correct document number. A
31	Incorporate reference for CEA ejection event sui generis application. A
32	Incorporate reference for RELAP5/MOD3. A

DISPOSITION OF COMMENTS RECEIVED FROM WOG ON
THE DRAFT SAFETY EVALUATION OF WCAP-15996

Comment Number	Comment Description A = comment accepted; PA = comment partially accepted; R = comment rejected
33	Incorporate reference for CENPD-190-A, CEA ejection methodology. A
34	Delete incorrect reference to CEFLASH-4AS. A
35	RELAP5/MOD3 reference is now Reference 8. A

Westinghouse Non-Proprietary Class 3

WCAP-15996-NP-A, Revision 0
CENPD-282-NP-A, Revision 1

TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE

VOLUME 3

April 2004

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20 International Drive
Windsor, Connecticut 06095

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ABSTRACT

CENTS is an interactive computer code for simulation of the Nuclear Steam Supply System and related systems. It calculates the behavior of a PWR for normal and abnormal conditions including accidents. It is a flexible tool for PWR analysis which gives the user complete control over the simulation through convenient input and output options.

CENTS is an adaptation of design computer codes to provide PWR simulation capabilities. It is based on detailed first-principles models for single and two-phase fluids. Use of nonequilibrium, nonhomogeneous models allows a full range of fluid conditions to be represented, including forced circulation, natural circulation, extensive coolant voiding and lower mode operation. The code provides a comprehensive set of interactions between the analyst, the reactor control systems and the reactor. This allows simulation of multiple failures and the effects of correct and incorrect operator actions. Examples of simulation runs with CENTS are steady state, power change, pump trip, loss of load, loss of feedwater, steam line break, feedwater line break, steam generator tube rupture, anticipated transients without scram, rod ejection, loss of coolant accidents, anticipated operational transients, and malfunctions of components, control systems or portions of control systems.

The CENTS code models most of the nuclear steam supply system and related systems. Core power is computed using a point kinetics model. Boiling curves for forced convection and pool boiling are used in the multi-node core heat transfer model. Primary and secondary thermal-hydraulic behavior is calculated with detailed multi-node and flowpath models. Nonhomogeneous, nonequilibrium conditions are also modeled, as well as the transport of solutes and non-condensible gases. The main control systems for reactivity, level, pressure, and steam flow are simulated. A multi-node and flowpath representation of the feedwater system is provided. Related balance of plant systems for single-phase fluid are represented.

The code features a Generic Control System design that processes system parameters and produces signals to drive the various plant subsystems. The control system is modular in design. It is constructed by the system modeler to simulate a specific plant's control systems, and can be made as simple or as true to the actual controllers as desired. It has an inventory of predefined functional modules, including arithmetic, Boolean, integro-differential and specialized functions. Once the control system structure is established by the modeler, it functions automatically, and its details do not normally concern the CENTS user. However, the user can, at any time during a transient, interactively change setpoints, disable control systems or exercise manual control. The control system designer/analyst, on the other hand, may study the detailed functioning of control modules by tracing their dynamic behavior, experimenting with their parameters and algorithms, or interfering with the lines of communication among the control modules.

The CENTS database provides a complete description of the nuclear plant systems that are modeled. Multiple plant states can be maintained on disk simultaneously as independent "snapshot" files, each of which contains the database plus a complete set of transient information. To initiate a transient from any snapshot, the user effects appropriate changes or perturbations to the plant. A new plant state is obtained by running a simulation to maneuver the plant interactively from a given plant state, or by using the code's self-initialization feature. Any intermediate state during a transient simulation can be saved as a snapshot for later study or to initiate parametric variations on plant behavior.

Use of CENTS is supported by executive software that handles most of the simulation mechanics, and allows the user to interact with CENTS as the transient progresses. This software provides a sophisticated command language that supports basic simulation maneuvers, collection of transient data, as well as complex interactions and probes by the advanced user. The executive software supports changes desired in the course of the transient and facilitates evaluation of the plant behavior details. The user may freeze, resume or backtrack a transient simulation at any time, examine plant parameters, make changes, take manual actions and initiate malfunctions. The user may, at any time, instruct the code to

automatically make changes, display parameters or take any interactive action at pre-selected times, or when pre-selected dynamic conditions are satisfied, if desired, without interrupting the simulation.

CENTS may also be driven by a graphical environment in which the user accesses an interactive menu system via mouse-driven controls. Its live system parameter plots and graphical depictions of the plant state are invaluable tools in helping the user gain an understanding of the system behavior. In addition, a combination of standard and user-defined numerical outputs allows the user to explore details of the plant subsystem behavior.

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APPENDIX A INPUT VARIABLES

This appendix lists input variables for the CENTS code. The variables are divided into two categories: base inputs and auxiliary inputs.

Table C.1 lists the "Base Input" variables needed to describe a plant and to initialize it at steady state conditions. These variables describe the primary and secondary side geometry and interconnection of the components (nodalization). They are grouped into categories based on related PWR components. The last group, "Universal", contains variables that are largely the same for most plants. However, some transients or plant designs may require application-specific data.

Table C-2 lists the "Auxiliary Input" variables, grouped by system or component. The table lists variables that provide additional detail of subsystems that play a role in balancing the NSSS, initiating transients or mitigating their effects, e.g., leaks and ECCS devices. The table also lists variables that are used to initiate accidents and component malfunctions. The systems necessary for a particular transient are determined by the control systems. A complete set of data for the systems present in a plant is necessary to run a broad range of transients.

It must be noted that this appendix does not list input variables that define the plant controllers, or which specify their auto/manual states, setpoints, delays, time constants, etc. Definition of controllers is explained in Appendix C. The controller setpoint inputs are presented in detail in Sections 6 and 7. Also, variables for any accident-specific variables are not discussed here.

Table A.1
Base Inputs

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** GENERAL *****				
TIME_SCALE	RE		Overall calculational time step size	Second
CTL_OUTPUT_INTERVAL	IN		Output frequency for line output – every N time steps	Counts
***** CORE *****				
POW_USER_POWZ	RE		Nominal steady-state power	Megawatts
CORE_HT_AREA	RE		Core heat transfer area, clad/coolant	Ft^2
AREA_CORE	RE		Active core flow area	Ft^2
CORE_HYD_DIA	RE		Core hydraulic diameter	Feet
CORE_RAD_OUT	RE	10	Outer radii of radial regions, CHT mesh	Feet
CORE_BOT	RE		Active core bottom elevation (relative to node bottom)	Feet
CORE_TOP	RE		Active core top elevation (relative to node bottom)	Feet
CHT_NUM_NODE	IN		Number of axial core nodes, max 20	Counts
CHT_NREGIONS_RAD	IN		Number of radial regions in heat transfer mesh	Counts
FUEL_DENSITY	RE		Density of uranium fuel	Lbm/ft^3
CHT_GAP_COND	RE	20	Fuel-clad gap thermal cond.	Btu/sec-ft-degF
MATTYP	IN	10	Radial fuel rod region material (1/2/3=Fuel/Clad/Gap).	Pointer
CHT_USE_NEW_ENTHALPY_OPTION	RE		1.0 => Use new (Sect. 3.3.5) CHT enthalpy calculation	Dimensionless
KSHAPIN	RE	50	Axial power shape input	Fraction
ZSHAPIN	RE	50	Fraction of core height for KSHAPIN	Fraction
AXPD_INPUT_OPT	IN		AXPD Input option: 0=node average, 1=node ends	Dimensionless
AXPD_NUM_POINTS	IN		Number of points in AXPD (AXPD_INPUT_OPT=1 only)	Dimensionless
***** REACTOR VESSEL *****				
N_SECTIONS	IN	50	Sections in node (node 1 max 22, rest 1)	Counts
N_AREA_SECT	RE	1,22	Cross sectional area of section (node,section)	Ft^2
N_HEIGHT_SECT	RE	1,22	Height of section (node,section)	Feet

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RCS_ANNUL_NSECT	IN		Number of sections in annulus lower plenum	Pointer
RCS_ANNUL_ASECT	RE	3	Annulus cross-sectional areas	Ft^2
RCS_ANNUL_HSECT	RE	3	Annulus section heights	Feet
N_TOP_UPLEN	RE		Top elevation of Upper Plenum part of inner vessel node	Feet
N_BOT_UPLEN	RE		Bottom elevation of Upper Plenum part of IV node	Feet
KLOSS_UPLEN_POS	RE		Upper Plenum geometric form loss coef, positive flow	Dimensionless
KLOSS_UPLEN_NEG	RE		Upper Plenum geometric form loss coef, negative flow	Dimensionless
RCS_CEAIN_KTERM	RE		CEA fully inserted - k factor multiplier	Dimensionless
HA_CEA_CORE	RE		CEA to IV wall heat transfer coefficient (hA)	Btu/sec-degF
HA_UHEAD_CORE	RE		Upper head to IV heat transfer coefficient (hA)	Btu/sec-degF
PATH_CEA_LOW	IN		Inlet path, Upper Plenum to CEA guide tubes	Pointer
PATH_CEA_UP	IN		Exit path, CEA to upper head	Pointer
CTL_CEA_MAX	RE		Maximum CEA withdrawal position	Steps
CTL_CEA_MIN	RE		Minimum CEA withdrawal position	Steps
CTL_CEA_STEP	RE		Step size of control rod motion	Inches
CEAS_DIST	RE		Traveling distance of CEAs	Feet
RTRV_BYPASS	RE		Fraction of vessel flow bypassing core	Fraction
RCS_KWEIGHT_HTILT	RE	4,4	Coefficient for cold leg to hot leg mixing	Fraction
RTRV_MIX_INLET	RE	2	Core-in mixg factor: (1) low flow, (2) high flow	Fraction
RTRV_MIX_OUTLET	RE	2	Core-out mixg factor: (1) low flow, (2) high flow	Fraction
***** NODES *****				
NUM_NODES	IN		Total number of nodes (50 max)	Counts
NUM_SG_NODES	IN		Number of SG nodes (2 or 4 per SG, 16 max)	Counts
NUM_HL_NODES	IN		Number of hot leg nodes	Counts
NUM_SL_NODES	IN		Number of suction leg nodes	Counts
NUM_CL_NODES	IN		Number of cold leg nodes	Counts
NODE_HL1	IN		Hot leg 1 node number	Pointer
NODE_HL2	IN		Hot leg 2 node number	Pointer
NODE_HL3	IN		Hot leg 3 node number	Pointer
NODE_HL4	IN		Hot leg 4 node number	Pointer
NODE_SG	IN	16	Steam Generator node numbers (in any order)	Pointer

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
NODE_CL1	IN		Cold leg node number, loop 1	Pointer
NODE_CL2	IN		Cold leg node number, loop 2	Pointer
NODE_CL3	IN		Cold leg node number, loop 3	Pointer
NODE_CL4	IN		Cold leg node number, loop 4	Pointer
NODE_SG1P	IN		SG outlet plenum and suction leg node loop 1	Pointer
NODE_SG2P	IN		SG outlet plenum and suction leg node loop 2	Pointer
NODE_SG3P	IN		SG outlet plenum and suction leg node loop 3	Pointer
NODE_SG4P	IN		SG outlet plenum and suction leg node loop 4	Pointer
NODE_CORE	IN		Core node number	Pointer
NODE_PRZR	IN		Pressurizer node number	Pointer
NODE_UHEAD	IN		Upper head node number	Pointer
NODE_ANNUL	IN		Annulus node number	Pointer
NODE_CEASH	IN		CEA shroud node number	Pointer
NODE_AREA	RE	50	Node cross sectional area	Ft^2
NODE_HEIGHT	RE	50	Node height	Feet
N_BOT	RE	50	Node bottom elevation	Feet
N_GEOM	IN	50	Node geometry indicator	Pointer
N_HEAT_XFER_LIQ	RE	50	Node wall-to-liquid overall heat transfer coefficients	Btu/sec-degF
N_HEAT_XFER_STM	RE	50	Node wall-to-steam overall heat transfer coefficients	Btu/sec-degF
N_HEAT_XFER_CONT	RE	50	Node wall-to-containment overall heat transfer coeffs	Btu/sec-degF
N_HEAT_XFER_BOT	RE	50	Node bottom wall-to-fluid heat transfer coefficients	Btu/secft^2degF
N_HEAT_CAP	RE	50	Node wall heat capacity	Btu/degF
NE_CANDIDATE	IN	50	Non-equilibrium state possible in node	Pointer
TEMP_CONT	RE	50	RCS Node containment temperatures.	Degree F
***** PATHS *****				
NUM_PATHS_MOM	IN		Number of momentum paths	Counts
NUM_PATHS_HL	IN		Number of hot leg flowpaths (4 max)	Counts
NUM_PATHS_CL	IN		Number of cold leg flowpaths (8 max)	Counts
RCS_NUMIN_CHGS	IN		Number of RCS-Charging connections (4 max)	Counts
RCS_NUMOUT_LDNS	IN		Number of RCS-Letdown connections (4 max)	Counts
RCS_NUMOUT_RCWDRAINS	IN		Number of RCS-RCW Drain connects (1 max)	Counts

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RCS_NUMOUT_SDC	IN		Number of RCS-Shutdown Cooling connections (2 max)	Counts
RCS_NUMIN_SIS	IN		Number of RCS-Safety Injection connections (8 max)	Counts
PATH_SURGE	IN		Surge line path number	Pointer
PATH_ANNUL_CORE	IN		Annulus-to-inner vessel path number	Pointer
PATH_CORE_UHEAD	IN		Upper head-to-inner vessel path number	Pointer
PATH_SPRAY	IN		Pressurizer spray path number	Pointer
PATH_LB_LOCA	IN		Large break LOCA path number	Pointer
PATH_PUMP	IN	4	RCP paths numbers	Pointer
PATH_HL	IN	8	Inner vessel to hot leg path numbers	Pointer
PATH_CL	IN	8	Cold leg to annulus path numbers	Pointer
PATH_SG	IN	4	Top of SG tube bundle path numbers	Pointer
PATH_UCEA	IN		CEA to upper head path number	Pointer
P_NODE_INLET	IN	150	Path inlet node number (all paths)	Pointer
P_NODE_EXIT	IN	100	Path exit node number (momentum paths)	Pointer
P_ELEV_INLET	RE	150	Path inlet elevation (at circle center)	Feet
P_ELEV_EXIT	RE	100	Path exit elevation (at circle center)	Feet
P_GEOM	IN	100	Path end geom 0,1,2,3=point,circle,upper/lower semicirc	Pointer
P_RADIUS	RE	100	Path radii at end (not related to P_AREA)	Feet
PATH_TLOA	RE	100	Combined inertia length/area (dMom/dt)	Composite
PATH_KLOSS_POS	RE	100	Geometric forward k-factor	Dimensionless
PATH_KLOSS_NEG	RE	100	Geometric reverse flow k-factor	Dimensionless
P_AREA	RE	100	Path flow area	Ft^2
PATH_LEN_DIAM	RE	100	Path length-to-diameter ratio	Dimensionless
P_DIAM_HYD	RE	100	Path hydraulic diameter	Feet
***** PRESSURIZER *****				
RCS_PRZR_NSECT	IN		Number of area sections in pressurizer	Pointer
RCS_PRZR_ASECT	RE	3	Pressurizer cross-sectional areas	Ft^2
RCS_PRZR_HSECT	RE	3	Pressurizer section heights	Feet
RCS_PRZR_HWALLF_MULT	RE		Multiplier for pressurizer wall condensation	Dimensionless

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** RCP *****				
NUM_PUMPS	IN		Number of main coolant pumps (4 max)	Counts
FRAC_TABL	RE	11	Independent variables for RCP homologous curves	Dimensionless
BAN	RE	11	RCP torque homologous curve (normal +f,+s)	Dimensionless
BVN	RE	11	RCP torque homologous curve (normal +f,+s)	Dimensionless
BAD	RE	11	RCP torque homologous curve (energy dissipation -f,+s)	Dimensionless
BVD	RE	11	RCP torque homologous curve (energy dissipation -f,+s)	Dimensionless
BAT	RE	11	RCP torque homologous curve (turbine -f,-s)	Dimensionless
BVT	RE	11	RCP torque homologous curve (turbine -f,-s)	Dimensionless
BAR	RE	11	RCP torque homologous curve (abnormal +f,-s)	Dimensionless
BVR	RE	11	RCP torque homologous curve (abnormal +f,-s)	Dimensionless
HAN	RE	11	RCP head homologous curve (normal +f,+s)	Dimensionless
HVN	RE	11	RCP head homologous curve (normal +f,+s)	Dimensionless
HAD	RE	11	RCP head homologous curve (energy dissipation -f,+s)	Dimensionless
HVD	RE	11	RCP head homologous curve (energy dissipation -f,+s)	Dimensionless
HAT	RE	11	RCP head homologous curve (turbine -f,-s)	Dimensionless
HVT	RE	11	RCP head homologous curve (turbine -f,-s)	Dimensionless
HAR	RE	11	RCP head homologous curve (abnormal +f,-s)	Dimensionless
HVR	RE	11	RCP head homologous curve (abnormal +f,-s)	Dimensionless
HANC	RE	11	RCP difference head homologous curve (normal +f,+s)	Dimensionless
HVNC	RE	11	RCP difference head homologous curve (normal +f,+s)	Dimensionless
HADC	RE	11	RCP difference head homol curve (energy dissip -f,+s)	Dimensionless
HVDC	RE	11	RCP difference head homol curve (energy dissip -f,+s)	Dimensionless
HATC	RE	11	RCP difference head homologous curve (turbine -f,-s)	Dimensionless
HVTC	RE	11	RCP difference head homologous curve (turbine -f,-s)	Dimensionless
HARC	RE	11	RCP difference head homologous curve (abnormal +f,-s)	Dimensionless
HVRC	RE	11	RCP difference head homologous curve (abnormal +f,-s)	Dimensionless
FRAC_HD_TABL	RE	11	RCP head degradation void frac (independent variables)	Dimensionless
HD_DEG_TABL	RE	11	RCP head degradation multiplier	Dimensionless
RATED_PUMP_SPEED	RE	4	Rated pump speed	Shaft RPM
RATED_VOL_FLOW	RE	4	Rated pump volumetric flow	Ft^3/sec
RATED_PUMP_DENS	RE	4	Rated pump density	Lbm/ft^3

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RATED_PUMP_HD	RE	4	Rated pump head	Feet
RATED_PUMP_TORQ	RE	4	Rated pump torque	Ft-lbf
RATED_PUMP_SYNCH	RE	4	Pump synchronous speed at rated frequency	Shaft RPM
NUM_POLES	IN		Number of poles per pump	Counts
WIND_TORQ_MULT	RE		Windage/friction torque constant	Ft-lbf
NPTS_TAB	IN		Number of points in Torque(slip) table	Counts
SLIP_TAB	RE	22	Electrical slip table (independent variable)	Dimensionless
TORQ_TAB	RE	22	Electrical torque multiplier table (dependent variable)	Dimensionless
RCP_VOLT_RATED	RE		RCP rated voltage	Volts
RCP_FREQ_RATED	RE		RCP rated frequency	Hertz
RCP_MOM_INERTIA	RE	4	Reactor coolant pump rotor/flywheel interia	Composite
RCP_HEAT_MULT	RE		Reactor coolant pump heat rate multiplier	Dimensionless
RCP_FR_SP_RUB_RATCH	RE		RCP fractional speed at which the pawls rub on ratchet	Fraction
RCP_TORQ_RUB_RATCH	RE		RCP torque when the pawls rub on ratchet	Ft-lbf
RCP_FRIC_COEFF	RE		RCP windage and friction coefficient	Composite
***** STEAMLINES *****				
NUM_SL	IN		Number of steamlines per steam generator	Counts
ASL_MAX	RE	2,2	Steamline flow area (design,line)	Ft^2
ASL_MIN	RE	2,2	Steamline restrictor min area upstream of MSIV or break	Ft^2
VOL_MSLH	RE		Header and steamline volume from MSIV to turbine stop	Ft^3
SLI_FLOW_COEFF	RE	8	Flow coefficient, steam nozzle to MSIV, at 100%	Composite
SLO_FLOW_COEFF	RE	8	Flow coefficient, MSIV to header, at 100%	Composite
SLI_DP100	RE	8	Pressure drop, steam nozzle to MSIV, at 100%	Psid
SLO_DP100	RE	8	Pressure drop, MSIV to header, at 100%	Psid
MSLH_MSIV_AMAX	RE	2,2	MSIV full-open flow area (design,line)	Ft^2
MSLH_MSIV_BYPASS_AMAX	RE	2,2	MSI Bypass Valve full-open flow area (design,line)	Ft^2
MSLH_VALVE_AMAX	RE	50	Steamline external valves full open flow areas	Ft^2
MSLH_VALVE_INLET	IN	50	Steamline external valves upstream regions	Pointer
MSLH_VALVE_EXIT	IN	50	Steamline external valves downstream regions	Pointer
MSLH_VALVE_NUM	IN		# of steamline external valves <50-NUM_SG*NUM_SL	Counts
SLI_CHECK_VALVE	LO	2,2	Steamline check valve (design,line)	True False

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
VEL100	RE	8	Steamline velocity at 100% flow	Ft/sec
HA_WALLI_MSLH	RE		Inside MSLH wall heat transfer coefficient hA	Btu/sec-degF
HA_WALLO_MSLH	RE		Outside MSLH wall heat transfer coefficient hA	Btu/sec-degF
MCP_WALL_MSLH	RE		Total heat capacity of MSLH pipe wall	Btu/degF
CTL_ATM_DUMP_NUM	IN		Number of steamline atmospheric dump valves	Counts
CTL_ATM_DUMP_PATH	IN	10	Path number for steamline atmospheric dump valve	Pointer
CTL_TAV_NUM	IN		Number of tubine admission valves	Counts
CTL_TAV_PATH	IN	5	Path number for turbine admission valve	Pointer
CTL_TURB_BYPASS_NUM	IN		Number of turbine bypass valves	Counts
CTL_TURB_BYPASS_PATH	IN	5	Path number for turbine bypass valve	Pointer
NUM_MSLH	IN		Number of Main Steamline Header nodes (1 or 2)	Counts
MSLH_AFRSL	RE	8	Steamline restrictor minimum flow area dnstrm	Ft^2
MSLH_ACROSS	RE		Steamline header cross tie flow area with TSV shut	Ft^2
MSLH_ACROSST	RE		Steamline header cross tie flow area with TSV open	Ft^2
MSLH_FKCROSS	RE		Steamline header cross tie flow resistance with TSV shut	Composite
MSLH_FKCROSST	RE		MSLH cross tie flow resistance with TSV open	Composite
MSLH_NO_MOISTURE_CARRY	RE		If 1 => No moisture carryover	Dimensionless
***** STEAM GENERATOR *****				
NUM_SG	IN		Number of steam generators	Counts
SG_DESIGN	IN	4	Type of steam generator design (1 or 2)	Pointer
SG_ECONOMIZER	LO		SG economizer: T=exist, F=none	True False
ASP_TBL	RE	15,2	Table: cross-sectional area of evaporator region	Ft^2
HSP_TBL	RE	15,2	Table: height in evaporator region	Feet
VST_TBL	RE	15,2	Table: volume in evaporator region	Ft^3
TBL2_NUM	IN	2	No. of entries in evaporator geometry table	Counts
HT3_TBL	RE	15,2	Table: height in SG downcomer	Feet
V3_TBL	RE	15,2	Table: volume in SG downcomer	Ft^3
TBL3_NUM	IN	2	No. of entries in downcomer geometry table	Counts
ASEP_SG	RE	4	Steam separation area at can deck, 100% steady state	Ft^2
EVAP_SS_ALPHA	RE	4	SG evaporator void fraction at 100% steady state	Fraction
PERIM	RE	2	Perimeter of tube shroud in lower SG	Feet

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
SG_V2_ACTIVE	RE	2	Volume in region 2 to cover tubes	Ft^3
VOLSGS	RE	2	SG volume to main steam isolation valve	Ft^3
W32_FLOW_COEFF	RE	4	Downcomer to tube bundle flow coefficient, 100% ss	Composite
TAURC1	RE		Time constant on recirculation flow W23	Seconds
SG_REF_NUM	IN	2	Number of level instrumentation reference legs	Counts
SG_REF_BOT	RE	2,3	Lower tap height above tubesheet (design, leg#)	Feet
SG_REF_TOP	RE	2,3	Upper tap height above tubesheet (design, leg#)	Feet
ELEV_TUBE_SHEET	RE	4	Tubesheet elevation above common reference	Feet
WALL_AREA	RE	2	SG surface area for heat loss to containment	Ft^2
WALL_MCP	RE	2	SG wall heat capacity	Btu/degF
SG_TUBE_AREA	RE	2	SG tube internal flow area, one tube	Ft^2
ATUBES_MAX_CS	RE	2	Primary flow area through tubes	Ft^2
ATUBES_MAX_HT	RE	2	SG tubes heat transfer area	Ft^2
QSG100	RE	4	Tube heat transfer to each SG at 100% power	Btu/sec
SGS_AREA_DOWNCOMER	RE	4	Area of downcomer for bubble rise calculation.	Ft^2
RTUBES	RE	2	Thermal resistance of SG tubes	Sec-ft^{2}degF/Btu
SGMTCP	RE	2	Total heat capacity of tubes	Btu/degF
SGT_HYD_DIAM	RE	2	Hydraulic diameter of SG tubes primary side	Feet
SGT_HTCRTC	RE	4	SG cold side heat transfer resistance tuning factor	Composite
SGT_HTCRTH	RE	4	SG hot side heat transfer resistance tuning factor	Composite
NUM_SG_SECT	IN	16	Number of sections in SG node (request)	Counts
RCS_SG_SECT_DH	RE		Tolerance for SG node saturation hysteresis	Btu/lbm
RCS_SG_SECT_DW	RE		Tolerance for SG node flow hysteresis	Lbm/sec
RCS_SG_SECT_TOPT	IN		Primary temp model for heat transfer: 0=T_{EXIT} , 1=T_{LMTD}	Pointer
***** UNIVERSAL *****				
RCS_CONT_HEAT_MULT	RE		Multiplier on containment heat transfer rates	Dimensionless
N_XFER_INJ	RE	50	Node liquid injection condensation multiplier	Dimensionless
XFER_SURF_POFF	RE	50	Node surface condensation coefficient (pump off)	Btu/secft^2degF
XFER_SURF_PON	RE	50	Node surface condensation coefficient (pump on)	Btu/secft^2degF
AREA_INJ_MULT	RE	50	Interfacial condensation area multiplier	Dimensionless
RCS_DROP_COND_MULT	RE	50	Multiplier on droplet condensation	Dimensionless

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RCS_COND_SURF_MULT	RE	50	Surface condensation multiplier	Dimensionless
RCS_KLOSS_MULT	RE	100	Geometric losses multipliers	Dimensionless
CONC_RATIO_STM_LIQ	RE	20	Ratio of concentrations in steam/liquid: Cs/(Cs+Cl)	Fraction
RCS_SUPERCRIT_FLOW_MULT	RE		Multiplier on critical flux at supercritical pressure	Dimensionless
RCS_SUBCRIT_FLOW_MULT	RE		Multiplier on critical flux at subcritical pressure	Dimensionless
RCS_PRZR_DH_SPRAY_EQ	RE		Pressurizer spray delta-enthalpy for equil.	Btu/lbm
RCS_PRZR_SPRAY_EQ	LO		Pressurizer spray delta-enthalpy equilibrium flag	True False
RCS_PRZR_DT_SUBH	RE		Pressurizer delta-temperature for boiling at the heaters	Degree F
RCS_PRZR_TAU_DTSUB	RE		Pressurizer time constant delta-temp subcooled	Seconds
RCS_PRZR_L_BOIL	RE	2	Boiling degradation parameters	Feet
RCS_CRIT_FLOW_CHECK	LO		Momentum paths critical flow check on	True False
RCS_PRZR_MSPRAY_TAU	RE		Main spray flow time constant	Seconds
RCS_PRZR_HAX_WALL	RE		Pressurizer walls axial overall heat transfer coefficient	Composite
RCS_PRZR_LVLDT_SUBC	RE	2	Pressurizer levels for boiling	Feet
CHT_GAP_HCAP	RE		Fuel-clad gap thermal heat capacity	Btu/ft^3-degF
CHT_PRESS_SUPERCRIT	RE		Pressure for supercritical DNB calculation	Psia
CHT_CHF_MULT	RE		Multiplier on calculated critical heat flux	Dimensionless
CHT_CONST_LEV	RE		Time constant for level calculation in the core.	Fraction
POW_KIN_TSS	RE		Maximum kinetics time step	Seconds
POW_DKHT_TIMDHT	RE	40	Time for ANS decay heat vs time table	Seconds
POW_DKHT_ANSDHC	RE	40	Decay heat fraction for decay heat vs time table	Fraction
POW_DKHT_NDHC	IN		No. of pairs in decay heat vs time table	Counts
POW_DKHT_DHCBEG	RE		Power fraction for switch to decay heat	Fraction
POW_DKHT_DHCFCT	RE		Multiplier on tabular decay heat	Dimensionless
POW_ZRH2O_NYZIR	LO		Option: calculate zirconium-water oxidation	True False
POW_ZRH2O_FZBJ	RE		Multiplier on Baker-Just generated heat	Dimensionless
RCS_NUM_MUKPR_P	IN		Number steps for mu-k-Pr calc.	Counts
RCS_NUM_FLOWLIM_P	IN		Number steps for critical flow checks	Counts
RCS_PRZR_CONT_HEAT_MULT	RE		Multiplier on pressurizer wall heat to containment	Dimensionless
RCS_UHEAD_CONT_HEAT_MULT	RE		Multiplier on upper head heat loss to containment	Dimensionless
RCS_SPRAY_EFF_MULT	RE		Spray efficiency multiplier	Dimensionless
RCS_L_EFF_SPR	RE	2	Levels for spray efficiency calculation	Feet
RCS_PRZR_TREF_TAU	RE	2	Pressurizer reference leg time constants	Seconds

Table A.1

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
CONT_PRES	RE		Containment pressure	Psia
CONT_SG_TEMP	RE	4	Containment temperature at steam generators	Degree F
P_CONDENSER	RE		Condenser pressure	Psia
P_ATMOSPHERE	RE		Atmospheric pressure	Psia
SF_CONC_IO	RE		Stripping factor for SG iodine nuclides concentration	Dimensionless
SG_U12	RE		Heat transfer coefficient between SG regions 1 & 2	Btu/secft^2degF
SG_U23	RE		Heat transfer coefficient between SG regions 2 & 3	Btu/secft^2degF
TAU_REFLG_DN	RE	2	Time constant, level instrum ref leg during cooldown	Seconds
TAU_REFLG_UP	RE	2	Time constant, level instrum ref leg during heatup	Seconds
SG_HCONV	RE		Convective heat transfer coefficient outside SG wall	Btu/secft^2degF
SG_RWALL	RE	2	Thermal resistance of SG wall	Sec-ft^{2}degF/Btu
MSLH_TATM	RE		Atmospheric temperature at steamline header	Degree F
SGS_ASEP_TUNE	RE		SG steam separator area tuning factor	Dimensionless
SGS_FK3_TUNE	RE		SG downcomer flow coefficient tuning factor	Dimensionless
SGS_PCNVRG	RE		Pressure convergence criterion	Psia
SGS_RECIRC_DELVOL	RE		Delta volume for adjusting recirculation flow	Ft^3
SGS_RECIRC_MIN	RE		Minimum recirculation for crossflow	Dimensionless
SGS_TAURC1_TUNE	RE		SGS recirculation flow time constant tuning factor	Dimensionless
SGS_TAURC2_MAX	RE		SGS downcomer flow maximum time constant	Seconds
SGS_USTM_MIN	RE		Minimum steam separation velocity	Ft/sec
SGS_VCNVRG	RE		SG volume convergence criterion	Fraction
SGT_HTCSCW	RE		Tube reverse heat transfer coeff, if liquid or two-phase	Btu/secft^2degF
SGT_HTCSTM	RE		Tube heat transfer coefficient if tube is in steam	Btu/secft^2degF
SGT_Q_MULT	RE	4	Multiplier on SG tube heat transfer area	Dimensionless
SGS_VF_REF	RE		Liquid specific volume for level instrument calibration	Ft^3/lbm
SGS_VG_REF	RE		Steam specific volume for level instrument calibration	Ft^3/lbm
SGS_VLEG_REF	RE		Ref-leg specific volume for level instrument calibration	Ft^3/lbm
SGS_UADROP_PERIM	RE		Perimeter of the feedring	Feet
SGS_UADROP_WFDMIN	RE		Minimum feedflow below which condens efficiency = 1.	Lbm/sec
SGS_DELTV	RE	4	Multiplier on steam velocity. Normally set to 1.0	Dimensionless
SGS_VEL31_MULT	RE	4	Downcomer multiplier on Wilson velocity.	Dimensionless

Table A.2

Auxiliary Inputs

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** FEEDWATER *****				
FW_COEFF	RE	4	FW flow coefficient at 100%. Used for #pumps=0 only	Composite
FWS_FLOW100	RE	4	Feedwater flow at 100% power, each SG	Lbm/sec
HTNOZ	RE	2	Height of downcomer feedwater nozzle above tubesheet	Feet
HTNOZ_ECON	RE	2	Height of economizer feedwater nozzle above tubesheet	Feet
HTNOZ_EFW	RE	2	Height of auxiliary feedwater nozzle above tubesheet	Feet
NUM_FWS_PUMPS	IN		No. of MFW pumps (max 4). >0 turns on detailed model	Counts
FWS_HTABLE_ENTH	RE	20	Table: MFW norm. enthpy, (h-H1)/(H2-H1) (#pumps=0)	Dimensionless
FWS_HTABLE_LOAD	RE	20	Table: turbine normalized load, W/Wrated (#pumps=0)	Dimensionless
FWS_HTABLE_NUM	IN		Table: number of entries. Used for #pumps=0 only	Counts
CTL_FWS_H	RE	2	Steady state FW enthalpy: 1 at CST, 2 at SGS	Btu/lbm
CTL_FWS_H_MAX	RE		Maximum feedwater enthalpy. Used for #pumps=0 only	Btu/lbm
CTL_FWS_H_TC	RE		FW enthalpy time constant. Used for #pumps=0 only	Seconds
NUM_AFW_PUMPS	IN		Number of AFW pumps (max 4)	Counts
FWS_VOL	RE	4	FW line volume after downcomer valve.	Ft^3
FWS_ECON_VOL	RE	4	FW line volume after economizer valve.	Ft^3
FWS_DPEL	RE	50	FWS model: flowpath elevation gain, external path	Feet
FWS_CV	RE	50	FWS model: flowpath flow coefficient	Composite
FWS_NDIN	IN	50	FWS model: flowpath input node ID	Pointer
FWS_NDOUT	IN	50	FWS model: flowpath output node ID	Pointer
FWS_NDEXT	IN	50	FWS model: flowpath external node ID	Pointer
FWS_NCPUMP	IN	50	FWS model: flowpath pump ID	Pointer
FWS_ICK	IN	50	FWS model: flowpath check valve flag	Pointer
FWS_NFLO	IN		FWS model: network number of paths	Counts
FWS_PEXTN	RE	20	FWS model: external node pressure	Psia
FWS_HEXTN	RE	20	FWS model: external node enthalpy	Btu/lbm
FWS_AEXTF	RE	30	FWS model: node external leak flow area	Ft^2
FWS_NNOD	IN		FWS model: network number of nodes	Counts

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
FWS_NEXTN	IN		FWS model: network number of ext. nodes	Counts
FWS_NPSGMFW	IN	4	FWS model: SG main feedwater path ID	Pointer
FWS_NPSGECO	IN	4	FWS model: SG economizer feedwater path ID	Pointer
FWS_NPSGAFW	IN	4	FWS model: SG emergency/aux feedwater path ID	Pointer
FWS_NPFWLB	IN	4	FWS model: MFWLB path ID	Pointer
FWS_TOPN	RE	30	FWS model: valve stroke open time	Seconds
FWS_TCLOS	RE	30	FWS model: valve stroke close time	Seconds
FWS_TLAG	RE	30	FWS model: valve actuator lag	Seconds
FWS_CVP	RE	200	FWS model: valve CV vs Position	Composite
FWS_STP	RE	200	FWS model: valve position vs. CV	Fraction
FWS_NPATH	IN	30	FWS model: valve path location ID	Pointer
FWS_NTABLE	IN	30	FWS model: valve CV table ID	Pointer
FWS_NPTV	IN	10	FWS model: valve CV table number of points	Counts
FWS_NVMFV	IN	4	FWS model: Main Feed Valve ID	Pointer
FWS_NVBFV	IN	4	FWS model: Bypass Feed Valve ID	Pointer
FWS_NVAL	IN		FWS model: number of valves	Counts
FWS_NHDV	IN		FWS model: number of Heater Drain valves	Counts
FWS_NVHDV	IN	3	FWS model: heater drain valve ID	Pointer
FWS_NAFWVT	IN		FWS model: total number of AFW valves	Counts
FWS_NVAFW1	IN		FWS model: AFW valve 1 ID	Pointer
FWS_NTABFV	IN		FWS model: number of feedwater valve tables	Counts
FWS_TAUON	RE	20	FWS model: pump speed lag (increasing)	Seconds
FWS_TAUOFF	RE	20	FWS model: pump speed lag (decreasing)	Seconds
FWS_HT	RE	200	FWS model: pump head vs flow tables	Feet
FWS_WT	RE	200	FWS model: pump flow vs head tables	Gal/min
FWS_NPMPTH	IN	20	FWS model: pump path ID	Pointer
FWS_NTABP	IN	20	FWS model: pump performance table ID	Pointer
FWS_NPTP	IN	10	FWS model: pump table number of points	Counts
FWS_NPMPMFW	IN	4	FWS model: pump MFP ID	Pointer
FWS_NPMPEFW	IN	4	FWS model: pump AFW/EFW pump ID	Pointer
FWS_NPUM	IN		FWS model: number of pumps	Counts
FWS_NTABFP	IN		FWS model: number of feedwater pump tables	Counts
FWS_NMFWP	IN		FWS model: number of MFW pumps	Counts

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
FWS_NEFWP	IN		FWS model: number of EFW pumps	Counts
FWS_TQLAG	RE	9	FWS model: feedwater heater heat transfer tau	Seconds
FWS_HTRHOV	RE	9	FWS model: feedwater heater thermal mass	Lbm
FWS_PWRTBL	RE	90	FWS model: feedwater heater turbine power vs Q	Percent
FWS_QPTBL	RE	90	FWS model: feedwater heater Q vs turbine power	Btu/sec
FWS_HTRHMX	RE	90	FWS model: feedwater heater maximum enthalpy	Btu/lbm
FWS_TPOWR	RE	10	FWS model: feedwater heater drain turb pwr table	Percent
FWS_TWHDP	RE	10	FWS model: feedwater heater drain flow vs turb power	Lbm/sec
FWS_TENHDP	RE	10	FWS model: feedwater heater drain enth vs turb power	Btu/lbm
FWS_MAXTAU	RE	9	FWS model: feedwater heater maximum tau	Seconds
FWS_HFWBIAS	RE		FWS model: delta enthalpy bias to tune fw enthalpy	Btu/lbm
FWS_NPHEAT	IN	9	FWS model: feedwater heater path location ID	Pointer
FWS_NHTBL	IN	9	FWS model: feedwater heater table number of points	Counts
FWS_NHT	IN		FWS model: number of feedwater heaters	Counts
FWS_NHDPTBL	IN		FWS model: feedwater heater drain table no. of points	Counts
FWS_NRCIRC	IN		FWS model: number of recirculation flow control valves	Counts
FWS_FWRCPB	RE	20	FWS model: recirc pump control proportional band	Percent
FWS_FWRCRE	RE	20	FWS model: recirculation pump control reset	Seconds
FWS_FWRCSP	RE	20	FWS model: recirculation pump control setpoint	Gal/min
FWS_FWRCIR	RE	20	FWS model: recirculation pump control instrum range	Gallons
FWS_NPTHRC	IN	20	FWS model: recirculation pump control path ID	Pointer
FWS_NVALRC	IN	20	FWS model: recirculation pump control valve ID	Pointer
FWS_NPMPRC	IN	20	FWS model: recirculation pump control pump ID	Pointer
***** INITIALIZATION *****				
TGAPIN	RE		Initial core gap conductance	Btu/hr-ft2-degF
KFRAIN	RE		Initial core power fraction	Fraction
RPINIT	RE		Initial pressurizer pressure	Psia
RLINIT	RE		Initial pressurizer level	Feet
RWINIT	RE		Initial total loop flowrate	Lbm/sec
RTCLIN	RE		Initial cold leg temperature	Degree F
RBINIT	RE		Initial boron concentration	Parts/million

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
SGT_INIT_OPTION	RE		0 => Adjust area to get SPINIT. 1 => Calc. SG pressure	Dimensionless
SPINIT	RE		Initial SG pressure (input if option=0)	Psia
SLINIT	RE		Initial SG secondary side mixture level	Feet
RCS_DOSE_INIT_IOD	RE		Initial RCS Iodine Concentration	Microcurie/lbm
INIT_OFF_RCS	LO		Initialization of RCS: off flag	True False
INIT_OFF_CHT	LO		Initialization of CHT: off flag	True False
INIT_OFF_POW	LO		Initialization of POW: off flag	True False
INIT_OFF_SGS	LO		Initialization of SGS: off flag	True False
INIT_OFF_CON	LO		Initialization of CONT: off flag	True False
INIT_ITER	IN		Number of initialization passes	Counts
***** CORE POWER *****				
CHT_FRAC_HT_GEN	RE	11	Heat generated in fuel (1-8), gap, clad, coolant	Fraction
POW_USER_IFUPOW	LO		User option for using power table	True False
POW_USER_NPOWT	IN		No. of pairs in power vs time table	Counts
POW_USER_POWT	RE	20	Power values for power vs time table	Fraction
POW_USER_TPOWT	RE	20	Time values for power vs time table	Seconds
POW_KIN_ALPHA	RE	11	Fission products disintegration energies	Fraction
POW_KIN_DLAM	RE	11	Decay constants for fission products	1/seconds
POW_KIN_BETA	RE	6	Delayed neutron fractions	Fraction
POW_KIN_PLAM	RE	6	Decay constants for delayed neutrons	1/seconds
POW_KIN_STARL	RE		Prompt neutron lifetime	Seconds
POW_KIN_NDKCON	IN		No. of pairs, reactivity vs boric acid concentration table	Counts
POW_KIN_DKCON	RE	30	Table of boric acid reactivities, vs concentrations	Reactivity
POW_KIN_TDKCON	RE	30	Table of boric acid concentrations, vs reactivites	Parts/million
POW_KIN_NDKCTM	IN		Number of pairs, reactivity vs moderator temp table	Counts
POW_KIN_DKCTM	RE	30	Table of moderator temperature reactivities, vs temps	Reactivity
POW_KIN_TDKCTM	RE	30	Table of moderator temperatures, vs reactivites	Degree F
POW_KIN_NDKDEN	IN		Number of pairs, reactivity vs moderator density table	Counts
POW_KIN_DKDEN	RE	30	Table of moderator density reactivities, vs densities	Reactivity
POW_KIN_TDKDEN	RE	30	Table of moderator densities, vs reactivities	Lbm/ft^3
POW_KIN_NDKTMP	IN		Number of pairs, Doppler reactivity vs fuel temp table	Counts

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
POW_KIN_DKTMP	RE	30	Table of Doppler reactivities, vs fuel temperatures	Reactivity
POW_KIN_TDKTMP	RE	30	Table of fuel temperatures, vs Doppler reactivities	Degree F
POW_KIN_NQDK	IN		Number of pairs, reactivity vs time table	Counts
POW_KIN_QDK	RE	30	Table of reactivities, vs times	Reactivity
POW_KIN_TQDK	RE	30	Table of times, vs reactivities	Seconds
POW_KIN_NDKINS	IN		Number of pairs in worth vs position table	Counts
POW_KIN_DKINS	RE	100	Table of CEA reactivities, vs CEA positions	Reactivity
POW_KIN_TDKINS	RE	100	Table of CEA positions, va reactivities	Steps
POW_KIN_NCUTBACK	IN		No. of points in Reactor Power Cutback reactivity table	Counts
POW_KIN_CUTBACK	RE	10	Table of RPC reactivities, vs times	Reactivity
POW_KIN_TCUTBACK	RE	10	Table of times, vs RPC reactivities	Seconds
POW_KIN_SOURCE	RE		Kinetics source term	Neutron/sec
POW_KIN_SCRAM_ROD_OPTION	LO		Scram control rod reactivity option	Active Inactive
POW_KIN_REG_ROD_OPTION	LO		Regulating rod reactivity option	Active Inactive
POW_KIN_CUT_ROD_OPTION	LO		Reactor Power Cutback control rod reactivity option	Active Inactive
POW_KIN_DOPPLER_FB_OPTION	LO		Doppler reactivity option	Active Inactive
POW_KIN_BORON_FB_OPTION	LO		Moderator boric acid reactivity option	Active Inactive
POW_KIN_MOD_TEMP_FB_OPTION	LO		Moderator temperature reactivity option	Active Inactive
POW_KIN_MOD_DENSITY_FB_OPTION	LO		Moderator density reactivity option	Active Inactive
CORE_N16_MULT	RE		Production constant for N-16, µC/power-fraction	Composite
***** CESEC EMULATION *****				
POW_KIN_MOD_DENSITY_OPTION	LO		Flag for moderator react. by cold edge moderator density	True False
POW_KIN_HERM_CREDIT_OPTION	LO		Flag for Hermite 3-D reactivity feedback credit	Active Inactive
POW_KIN_HERM_TD	RE		Time delay after Scram for taking Hermite 3D credit	Seconds
POW_KIN_HERM_MULT	RE		Fraction of Hermite 3D credit taken	Fraction
POW_KIN_TEMP_TILT_MIN	RE		Temperature tilt (negative) below which it is set to zero	Degree F
POW_KIN_POWTOFLOW_MIN	RE		Minimum power to flow ratio (3D feedback)	Dimensionless
POW_KIN_FLOWFRAC_MIN	RE		Min flow fraction for which the Hermite tables are valid	Fraction
POW_KIN_TEMP_TILT_MAX	RE		Max temp tilt for which the Hermite tables are valid	Degree F
POW_KIN_POWTOFLOW_MAX	RE		Max power/flow ratio for which Hermite tables are valid	Dimensionless
POW_KIN_HERM_POW_REF	RE		Power for normalizing powers in the Hermite credit data	Megawatts

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
POW_KIN_HERM_FLOW_REF	RE		Flow for normalizing flows in the Hermite credit data	Lbm/sec
POW_KIN_HERM_N_FLOWFR	IN		No. of flow fracs in POW_KIN_CORE_W_FRACTAB	Counts
POW_KIN_CORE_W_FRACTAB	RE	8	Core flow fractions for the Hermite 3-D credit tables	Fraction
POW_KIN_HERM_CREDITTAB	RE	350	Hermite reactivity credit trivariant table (3D feedback)	Composite
POW_KIN_EDGE_WEIGHT	RE		Edge temperature geometric weight (3D feedback)	Fraction
POW_KIN_DH_FACTOR	RE		Core enthalpy rise adjustment fraction (3D feedback)	Fraction
SGS_TUBE_AREA_OPTION	LO		Option to degrade secondary tube area	True False
SGS_MASS_FULL_TUBE_AREA	RE		Minimum mass for full secondary-side tube area	Lbm
SGS_MASS_ZERO_TUBE_AREA	RE		Mass for zero secondary-side tube area	Lbm
***** UPPER HEAD *****				
RCS_ORING_PNODEIN	IN		RCS O-ring seal inlet node	Pointer
RCS_ORING_PELEVIN	RE		RCS O-ring seal inlet elevation	Feet
PRES_ATWS_MIN	RE		ATWS minimum head seal leakage pressure	Psia
P_AREA_ATWS_MIN	RE		ATWS minimum head seal leak area	Ft^2
PRES_ATWS_MAX	RE		ATWS maximum head seal leakage pressure	Psia
P_AREA_ATWS_MAX	RE		ATWS maximum head seal leak area	Ft^2
RCS_UHEAD_RING_SEAL_MULT	RE		Multiplier on upper head ring seal area	Dimensionless
RTRV_HEAD_SEAL_MULT	RE		Multiplier on head seal pressure	Dimensionless
RCS_P_ORING_FAIL	RE		Pressure for vessel O-ring failure	Psia
RCS_UHEAD_RELIEF_PNODEIN	IN		Upper head relief valves inlet node	Pointer
RCS_UHEAD_RELIEF_PELEVIN	RE		Upper head relief valves inlet elevation	Feet
RTRV_VENT_MULT	RE		Multiplier on head vent valve flows	Dimensionless
PLT_VLVAREA_UHEAD_CONT	RE		Area of vent valve from upper head to containment	Ft^2
PLT_VLVAREA_UHEAD_QT	RE	2	Area vents valves upper head to quench tank	Ft^2
MAL_VLV_UHEAD_CONT	RE		Upper head to containment valve position (malfunction)	Fraction
MAL_VLV_UHEAD_QT	RE	2	Upper head to quench tank valve position (malfunction)	Fraction
P_AREA_RODEJ	RE		CEA ejection leak area	Ft^2
RCS_Q_CEA_CORE_MULT	RE		Multiplier on heat transfer CEA to core	Dimensionless

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** PRESSURIZER *****				
NUM_PROP_HEATERS	IN		Number of proportional heaters (Prop + Backup ≤ 6)	Counts
NUM_BACK_HEATERS	IN		Number of backup heaters (Prop + Backup ≤ 6)	Counts
HCAP_HEATER	RE	6	Heater gross heat capacity	Btu/degF
XFER_HEATER	RE	6	Heater overall heat transfer coefficient	Btu/sec-degF
RESI_HEATER	RE	6	Heater electrical resistance	Ohms
TOP_HEATERS	RE		Top elevation of pressurizer heaters	Feet
PRZR_HEATER_MULT	RE		Multiplier on total pressurizer heat	Dimensionless
RCS_HEATER_VOLT_BUS	RE	6	Heater bus voltages	Volts
RCS_NUM_MSPRAYVLVS	IN		Number of pressurizer main spray valves	Counts
RCS_SPRAY_PNODEIN	IN		RCS pressurizer spray inlet node	Pointer
RCS_SPRAY_PELEVIN	RE		RCS pressurizer spray inlet elevation	Feet
RCS_SPRAYBLEED_PNODEIN	IN	2	RCS pressurizer spray bleed inlet node	Pointer
RCS_SPRAYBLEED_PELEVIN	RE	2	RCS pressurizer spray bleed inlet elevation	Feet
RCS_PRZR_RELIEF_PNODEIN	IN		Pressurizer relief valves inlet node	Pointer
RCS_PRZR_RELIEF_PELEVIN	RE		Pressurizer relief valves inlet elevation	Feet
PLT_VLVAREA_PRZR_MSPRAY	RE	2	Area main spray control valves	Ft^2
AREA_BLEED_MIN	RE		Pressurizer spray bleed line minimum area	Ft^2
PRZR_SPRAY_MULT	RE		Multiplier on main pressurizer spray	Dimensionless
MAL_VLV_PRZR_MSPRAY	RE	2	Main spray control valves positions (malfunction)	Fraction
RCS_NUM_PORVS	IN		Number of pressurizer PORVs	Counts
PLT_VLVAREA_PRZR_PORV	RE	4	Area pressurizer PORVs	Ft^2
PLT_VLVAREA_PRZR_MOV	RE	4	Area pressurizer MOVs (in series with PORVs)	Ft^2
PRZR_PORV_MULT	RE		Multiplier on PORV relief flowrates	Dimensionless
MAL_VLV_PRZR_PORV	RE	4	Pressurizer PORV positions (malfunction)	Fraction
MAL_VLV_PRZR_MOV	RE	4	Pressurizer MOV positions (malfunction)	Fraction
VLV_PRZR_KLOSS_UP	RE		Loss coefficient, pressurizer to pressurizer-relief-valves	Composite
VLV_PRZR_KLOSS_DOWN	RE		Loss coefficient, pressurizer-relief-valves to quench tank	Composite
RCS_NUM_SAFETYVLVS	IN		Number of pressurizer safety valves	Counts
PLT_VLVAREA_PRZR_SAFETY	RE	4	Areas of pressurizer safety valves	Ft^2
PRZR_SAFETY_MULT	RE		Multiplier on safety valve flowrates	Dimensionless
MAL_VLV_PRZR_SAFETY	RE	4	Pressurizer safety valves positions (malfunction)	Fraction

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
VLV_PRZR_QUAL_DF	RE		Upper quality limit for using VLV_PRZR_FLOW_OPTION	Fraction
VLV_PRZR_FLOW_OPTION	IN		PSV option: 1=choked, 2=Bernouli*cd(subc), 3=flux(P)	Pointer
VLV_PRZR_NPOINTS_TAB	IN		No. points in discharge table (..._FLOW_OPTION=2,3)	Counts
VLV_PRZR_FLOW_TABLE	RE	15	Discharge table: dependent var, 2=subcooling, 3=press	Undefined
VLV_PRZR_PROP_TABLE	RE	15	Discharge table: independent variable, 2=Cd, 3=flux	Undefined
PLT_VLVAREA_PRZR_CONT	RE		Area vent pressurizer to containment	Ft^2
PLT_VLVAREA_PRZR_QT	RE	2	Area vents pressurizer to quench tank (in series)	Ft^2
MAL_VLV_PRZR_CONT	RE		Vent valve pos, pressurizer to containment (malfunction)	Fraction
MAL_VLV_PRZR_QT	RE	2	Vent valve pos, pressurizer to quench tank (malfunction)	Fraction
PRZR_VENT_MULT	RE		Multiplier on pressurizer vent valve flows	Dimensionless
LEVL_REF_BOT	RE		Bottom level of pressurizer reference leg	Feet
LEVL_REF_TOP	RE		Top level of pressurizer reference leg	Feet
CTL_PRZR_LIQ_SPVOL_REF	RE		Pressurizer instrum. reference liquid specific-volume	Ft^3/lbm
CTL_PRZR_STM_SPVOL_REF	RE		Pressurizer instrum. reference steam specific-volume	Ft^3/lbm
LEVL_PRZR_RTD	RE		Level of pressurizer RTD	Feet
***** QUENCH TANK *****				
VOLU_QT	RE		Quench Tank total volume	Ft^3
HEIGHT_QT	RE		Quench Tank height assuming circular cross section	Feet
MASS_QT_MAX	RE		Quench Tank maximum mass of water	Lbm
QT_RUPTURE_SPOINT	RE		Quench Tank rupture disk setpoint pressure	Psia
QT_N2_MULT	RE		Multiplier on nitrogen supply flow	Dimensionless
QT_VENT_MULT	RE		Multiplier on Quench Tank vent flow	Dimensionless
PRES_N2	RE		Quench Tank nitrogen supply pressure	Psia
PLT_VLVAREA_QT_GWS	RE		Quench Tank to GWS vent valve area	Ft^2
PLT_VLVAREA_QT_CONT	RE		Quench Tank to containment vent valve area	Ft^2
PLT_VLVAREA_QT_NSUPPLY	RE		Valve area nitrogen supply to containment	Ft^2
MAL_VLV_QT_GWS	RE		Quench Tank to GWS vent valve position (malfunction)	Fraction
MAL_VLV_QT_CONT	RE		Quench Tank to containment vent valve position (malf)	Fraction
MAL_VLV_QT_NSUPPLY	RE		Nitrogen supply to Quench Tank valve position (malf)	Fraction

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** CVCS *****				
NUM_CHGS_PUMPS	IN		Number of charging pumps	Counts
RCS_CHGS_PNODEIN	IN	4	Charging inlet node	Pointer
RCS_CHGS_PELEVIN	RE	4	Charging inlet elevation	Feet
RCS_LDNS_PNODEIN	IN	4	RCS- letdown inlet node	Pointer
RCS_LDNS_PELEVIN	RE	4	RCS- letdown inlet elevation	Feet
CTL_CH_PUMP_W_RATED	RE	4	Charging pump rated flow	Lbm/sec
CTL_HA_REG_HEAT_X	RE		Regenerative heat exchanger overall heat transfer coeff	Btu/sec-degF
CTL_CH_H(1)	RE	2	Charging enthalpy at RHEX inlet	Btu/lbm
CTL_CH_T(1)	RE	2	Charging temperature at RHEX inlet	Degree F
CTL_CHV_RAREA	RE	5	Charging valve relative flow area	Dimensionless
CTL_CHV_FRAC	RE	5	Fractional opening of charging valves	Fraction
CHGS_RCS_BORON	RE		Charging system boron concentration (input to RCS)	Parts/million
CHGS_RCS_IOD	RE		Charging system iodine concentration (input to RCS)	Microcurie/lbm
***** STEAMLINE BREAK *****				
MSLB_AREA	RE		Area of main steamline breaks	Ft^2
MSLH_FKBRK	RE	8	Steamline K factor from SG to MSLB	Composite
MAL_MSLB_OUT	IN		Steamline break in MSLH: 0=>no 1=>yes	Flag
MAL_MSLB_IN	IN	8	SLB in stmln 0=No, 1-3=various locations	Flag
***** RCS LEAKS *****				
RCS_SBLOCA_PNODEIN	IN	4	RCS small break LOCA inlet node	Pointer
RCS_SBLOCA_PELEVIN	RE	4	RCS small break LOCA inlet elevation	Feet
MAL_SB_LOCA	RE	4	Small break LOCA areas	Ft^2
CONV_GPM_AREA(1)	RE	3	GPM-to-area conversion at RCP seals at nominal state	Ft^2/gpm
CORE_IOD_REL	RE		Core iodine release	Microcurie/sec
CORE_PART_REL	RE		Core particulate (cesium) release	Microcurie/sec
CORE_XEN_REL	RE		Core xenon release	Microcurie/sec
RCS_CRIT_MODEL	IN		Liquid/2-phase choked flow model: 0=HEM, 1=H/F	Pointer

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RCS_SGTR_PNODEIN	IN	8	RCS SG tube rupture inlet node	Pointer
RCS_SGTR_PELEVIN	RE	8	RCS SG tube rupture inlet elevation	Feet
MAL_SGTR	RE	8	SG tube rupture leaks (number of tubes)	Pointer
RCS_SGTR_FLOWMULT	RE		SG tube rupture flow area multiplier	Dimensionless
SGTR_TUBE_LENGTH	RE	8	SGTR tube length. 2 values/SG	Feet
SGTR_TUBE_ENTRANCE_K	RE	8	SGTR entrance K factor. Use 0.5 - 2 values/SG	Dimensionless
SGTR_BREAK_ELEV	RE	4	SGTR elevation above tube sheet - 1 value/SG	Feet
SGTR_SLOT_BREAK_OPT	LO	4	SGTR option for slot break flow calculation	True False
SGTR_SLOT_BREAK_AREA	RE	4	SGTR slot area per tube for slot break option	Ft^2
SB_PIPE_AREA	RE	4	SBLOCA pipe flow area	Ft^2
SB_PIPE_LOD	RE	4	SBLOCA pipe length/diameter	Dimensionless
SB_PIPE_KGEOM	RE	4	SB pipe geometric k-factor, excluding entrance loss	Dimensionless
SB_PIPE_KENT	RE	4	SBLOCA pipe entrance loss k-factor	Dimensionless
SB_DELTA_ELEV	RE	4	SB break elevation above RCS connection	Feet
LDN_PIPE_AREA	RE	2	Letdown line flow area (pre/post RHX)	Ft^2
LDN_PIPE_LOD	RE	2	Letdown line length/diameter (pre/post RHX)	Dimensionless
LDN_PIPE_KGEOM	RE	2	Letdown line geom k-factor, excl entrance loss (pre/post)	Dimensionless
LDN_PIPE_KENT	RE	2	Letdown line entrance loss k-factor (at RCS, at RHX)	Dimensionless
LDN_PIPE_DELTA_ELEV	RE	2	Letdown line elev above RCS connection (pre/post RHX)	Feet
MAL_LDN_BREAK	RE		Letdown line break area (<0: before RHX. >0: post RHX)	Ft^2
***** ECCS *****				
RCS_SIS_PNODEIN	IN	8	RCS safety injection inlet node	Pointer
RCS_SIS_PELEVIN	RE	8	RCS safety injection inlet elevation	Feet
CTL_HPSI_NPOINTS_TAB	IN		Number of pairs in HPSI flow vs pressure table	Counts
CTL_HPSI_FLOW_TABLE	RE	45	Flows for HPSI flow-vs-pressure table	Gal/min
CTL_HPSI_PRES_TABLE	RE	15	Back pressures for HPSI flow-vs-pressure table	Psia
CTL_HPSI_PUMP_NUM	IN		Number of operating HPSI pumps	Counts
CTL_HPSI_SPLIT	RE	8	HPSI flow split to injection points	Fraction
CTL_LPSI_NPOINTS_TAB	IN		Number of pairs in LPSI flow vs pressure table	Counts
CTL_LPSI_FLOW_TABLE	RE	45	Flows for LPSI flow-vs-pressure table	Gal/min
CTL_LPSI_PRES_TABLE	RE	15	Back pressures for LPSI flow-vs-pressure table	Psia

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
CTL_LPSI_PUMP_NUM	IN		Number of operating LPSI pumps	Counts
CTL_LPSI_SPLIT	RE	8	LPSI flow split to injection points	Fraction
CTL_SIS_HLPSI_BC	RE		HPSI/LPSI flow boron concentration	Parts/million
CTL_SIS_HLPSI_H	RE		HPSI/LPSI flow enthalpy	Btu/lbm
CTL_SIT_NUM	IN		Number of SI tanks	Dimensionless
CTL_SIT_ELEV_PRES	RE	4	SI tank elevation heads	Psid
CTL_SIT_FLOW_COEFF	RE	4	SI tank flow coefficients	Composite
CTL_SIT_GAS_CONST	RE		SI tank gas constant	Dimensionless
CTL_SIT_GAS_PRES	RE	4	SI tank gas pressures	Psia
CTL_SIT_GAS_VOLUME	RE	4	SI tank gas volumes	Ft^3
CTL_SIT_ISO_VALVE	LO	4	SI tank isolation valves	Open Closed
CTL_SIT_LIQ_SPVOL	RE	4	SI tank liquid specific volumes	Ft^3/lbm
CTL_SIT_LIQ_VOLUME	RE	4	SI tank liquid volumes	Ft^3
CTL_SIS_SIT_BC	RE		SI tank flow boron concentration	Parts/million
CTL_SIS_SIT_H	RE		SI tank flow enthalpy	Btu/lbm
CTL_SDC_DH	RE		Shutdown Cooling enthalpy drop	Btu/lbm
CTL_SDC_H_MIN	RE		Shutdown Cooling minimum return enthalpy	Btu/lbm
CTL_SDC_SPLIT	RE	4	SDC flow split to injection points	Fraction
SDC_RCS_FLOW	RE	2	Shutdown cooling out-flow (RCS connection).	Lbm/sec
***** FEEDWATER LINE BREAK *****				
FWLB_AREA	RE		Standard area for feedwater line breaks	Ft^2
MAL_FWLB_IN	RE	4	Feedline break inside check valve, downcomer line	Fraction
MAL_FWLB_ECON_IN	RE	4	Feedline break inside check valve, economizer line	Fraction
MAL_FWLB_OUT	RE	4	Feedline brk outside check valve, downcomer line	Fraction
MAL_FWLB_ECON_OUT	RE	4	Feedline brk outside check valve, economizer line	Fraction
FWLB_F	RE	4	Feedline break location, downcomer line	Fraction
FWLB_ECON_F	RE	4	Feedline break location, economizer line	Fraction
SGS_CRIT_MODEL	IN		Liquid/2-phase choked flow model: 0=HEM, 1=H/F	Pointer

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** RCP *****				
RCS_RCPLEAK_PNODEIN	IN	4	RCP leak inlet node	Pointer
RCS_RCPLEAK_PELEVIN	RE	4	RCP leak inlet elevation	Feet
RCP_SEALS_LEAK	RE	4	RCP seals leakage at rated conditions	Gal/min
RCPI_VOLT_FRAC	RE	4	RCP voltage (fraction)	Fraction
RCPI_FREQ_FRAC	RE	4	RCP electric motor frequency (fraction)	Fraction
RCP_MOM_INERTIA_SPLIT	RE		Frac. of inertia staying with motor when sheared shaft	Fraction
MAL_RCP_SHAFTBREAK	LO	4	RCP shaft break malfunction	True False
MAL_RCP_LOCKED	LO	4	RCP locked rotor malfunction	True False
***** SGBD *****				
SGBD_ACROSS	RE		Cross section area of SGBD tank	Ft^2
MCP_WALL_SGBD	RE		Total heat capacity of SGBD tank wall	Btu/degF
SGBD_VOL	RE		SGBD tank volume	Ft^3
SGBD_SURF_COEFF	RE	4	Flow coefficients, surface blowdown nozzles	Composite
SGBD_BOT_COEFF	RE	4	Flow coefficients, bottom blowdown nozzles	Composite
SGBD_SURF_HTNOZ	RE	2	Height of SG surface blowdown nozzle	Feet
SGBD_BOT_HTNOZ	RE	2	Height of SG bottom blowdown nozzle	Feet
SGBD_OUT_HTNOZ	RE	2	Heights above bottom, 2 BD tank outlet nozzles	Feet
SGBD_OUT_COEFF	RE	2	Flow coefficients, 2 BD tank outlet nozzles	Composite
SGBD_RELIEF_AMAX	RE		BD tank relief valve full-open flow area	Ft^2
HA_WALLI_SGBD	RE		Inside SGBD tank overall heat transfer hA	Btu/sec-degF
HA_WALLO_SGBD	RE		Outside SGBD tank overall heat transfer hA	Btu/sec-degF
***** ROD DROP/EJECTION *****				
RCS_RODEJ_PNODEIN	IN		RCS rod ejection small break inlet node	Pointer
RCS_RODEJ_PELEVIN	RE		RCS rod ejection small break inlet eleva	Feet
MAL_ROD_EJECT	RE		Rod ejection plus CEDM rupture (fraction)	Fraction

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
***** NON-CONDENSIBLES AND SOLUTES *****				
RCS_GAS_PNODEIN	IN	2	RCS gas injection inlet node	Pointer
RCS_GAS_PELEVIN	RE	2	RCS gas injection inlet elevation	Feet
NUM_SOLUTES	IN		No. dissolved solutes excl. nonc, $N_{SOLUTES} + N_{NONC} \leq 20$	Counts
NUM_NONC	IN		No. of noncondensible species, $N_{NONC} \leq 5$	Counts
HALF_LIFE_SOLUTES	RE	20	Decay half-lives of dissolved species	Seconds
CONC_MAX	RE	20	Maximum concentrations of species (lbm/lbm, PPM,...)	Composite
ID_TYPE_BORON	IN		Identifying pointer for boron	Pointer
ID_TYPE_N16	IN		Identifying pointer for N-16	Pointer
ID_TYPE_IODINE	IN		Identifying pointer for iodine	Pointer
ID_TYPE_XENON	IN		Identifying pointer for xenon	Pointer
ID_TYPE_PART	IN		Identifying pointer for particulates	Pointer
ID_TYPE_HYD	IN		Identifying pointer for hydrogen	Pointer
ID_TYPE_NIT	IN		Identifying pointer for nitrogen	Pointer
ID_TYPE_AIR	IN		Identifying pointer for air	Pointer
NONC_K_DISSOLVE	RE	5	Noncondensibles dissolution constant, lb/sec-ft2-Δconc	Composite
NONC_MW	RE	5	Molecular weights of noncondensibles	Composite
COND_NONC_FRAC	RE	2	Noncond fraction for (1) full condensation, (2) no cond	Fraction
COND_NONC_DEG_MULT	RE	50	Condensation degradation at initial inflow of nonconds	Dimensionless
RCS_PRZR_SPR_GAS_ENTR	RE		Constant for gas entrainment in sprays	Dimensionless
RCS_PRZR_Q_EFF	RE		Pressurizer condensation efficiency when n/c present	Fraction
SIS_RCS_NONC	RE	6,5	Noncondensibles inflow via SI lines	Lbm/sec
GS_VES_NONC	RE		Noncondensibles inflow to vessel via Gas System	Lbm/sec
GS_PRZR_NONC	RE		Noncondensibles inflow to pressurizer via Gas System	Lbm/sec
GS_SPECIES	IN		Species of Gas System gas (from ID_TYPE_...)	Pointer
CORE_RELE_SOLU	RE	20	Solute release rate in the core due to fuel failure	Composite
***** DOSE *****				
RCS_DOSE_INIT_IOD	RE		Initial RCS Iodine Concentration	Microcurie/lbm
RCS_DOSE_FLASH	RE		Dose model flashing factor flag	Dimensionless

Table A.2

VARIABLE NAME	TYPE	DIM	DEFINITION	UNITS
RCS_DOSE_BF	RE		Dose model breathing factor	Ft^3 /sec
RCS_DOSE_CF	RE		Dose model conversion factor	Rem/Curie
RCS_DOSE_XOQ2	RE		Dose model 2-hour site dispersion factor	sec/ft^3
RCS_DOSE_XOQ8	RE		Dose model 8-hour site dispersion factor	sec/ft^3
RCS_DOSE_CONT_LEAK	RE		Dose model containment leak rate	Frac./day
RCS_DOSE_COND_DF	RE		Turbine & condenser decontamination factor	Dimensionless
***** CETOP LINK *****				
CETOP_IN_FR_USER_MULT	RE		CETOP in: User input multiplier on the CETOP Fr	Fraction
CETOP_PRESS_OPT	LO		CETOP link: Constant pressure option	True False
CETOP_FR_DERIV	RE		CETOP link: Fr vs temperature derivative	1/Del-DegF
CETOP_FR_PATH1	IN		CETOP link: Path number for Temp1	Pointer
CETOP_FR_PATH2	IN		CETOP link: Path number for Temp2	Pointer
CETOP_FR_TEMP1	RE		CETOP link: Temp1 for DT calculation (if PATH1=0)	Degree F
CETOP_FR_TEMP2	RE		CETOP link: Temp2 for DT calculation (if PATH2=0)	Degree F

APPENDIX B CRITICAL FLOW TABLES

For choked flow of liquid or two-phase, CENTS provides a choice of one of two critical flow models. They are the homogeneous equilibrium (HEM) correlation and the Henry-Fauske (H-F) correlation. See Sections 4.7 and 5.2.6. CENTS finds the HEM critical flow from the data in Tables B.1 and B.2 using bi-variant interpolations on pressure and enthalpy. Similarly, it finds the H-F critical flow from Tables B.3 and B.4.

In the following tables, pressure and throat pressure are expressed in psia, enthalpy is in Btu/lbm, and the units of mass flux are lbm/sec-ft^2.

B.1 References

B.1 Moody, F.J., "Maximum Discharge Rate of Liquid-Vapor Mixtures from Vessels," ASME Winter Annual Meeting, November 1975.

B.2 R. E. Henry and H. K. Fauske, "The Two-Phase Critical Flow of One-Component Mixture in Nozzles, Orifices and Short Tubes," Journal of Heat Transfer, May 1971.

Table B.1

HEM Tables. Mass Flux as a Function of Pressure and Enthalpy

Pressure	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux
10.0	127.971	137.983	148.006	158.038	161.261	167.154	180.903	210.365
	1723.749	1501.987	1181.103	607.653	151.564	123.084	99.308	77.371
	220.186	259.470	357.678	455.887	554.096	652.305	848.722	1143.348
	72.932	60.844	46.069	38.620	33.919	30.605	26.134	22.040
50.0	208.502	218.633	228.787	238.966	249.174	250.212	255.755	268.690
	3702.818	3316.603	2812.067	2097.026	655.801	571.607	501.807	423.603
	305.645	342.600	434.988	527.376	619.765	712.153	896.929	1174.093
	325.329	276.601	213.904	181.015	159.842	144.728	124.116	105.033
100.0	208.608	239.066	269.775	280.078	290.420	298.539	303.870	316.311
	6410.551	5603.164	4188.359	3436.425	2333.636	989.455	897.414	776.931
	351.856	387.401	476.264	565.127	653.990	742.852	920.578	1187.166
	612.185	526.359	412.361	351.062	311.089	282.328	242.815	205.965
200.0	208.820	269.959	311.391	332.377	342.949	355.506	360.563	372.363
	9790.477	8408.488	6528.570	4911.988	3688.190	1685.384	1573.526	1402.104
	406.076	439.789	524.072	608.354	692.637	776.920	945.485	1198.334
	1140.016	994.153	792.037	679.714	605.195	550.991	475.771	404.896
400.0	209.243	280.617	322.169	375.266	407.962	424.168	428.850	439.776
	14329.500	13053.380	11708.310	8740.656	5252.215	2818.495	2694.821	2476.103
	470.993	502.210	580.252	658.295	736.337	814.379	970.464	1204.591
	2092.076	1858.251	1514.386	1314.225	1178.118	1077.547	935.914	800.417
600.0	209.667	298.977	332.970	386.291	430.322	471.697	476.089	486.336
	17741.710	16614.920	15146.710	12671.930	9252.980	3768.992	3644.763	3408.740
	515.615	544.893	618.089	691.285	764.481	837.677	984.069	1203.657
	2955.504	2660.682	2206.239	1931.696	1741.217	1598.627	1395.333	1198.326
800.0	210.092	312.367	354.379	419.311	464.479	509.812	513.949	523.603
	20594.720	18821.590	17497.950	14261.110	10498.470	4606.211	4485.508	4245.773
	551.186	578.769	647.727	716.684	785.642	854.599	992.514	1199.387
	3754.471	3417.408	2876.148	2538.149	2299.316	2118.374	1857.431	1601.483
1000.0	210.517	333.572	397.548	464.487	511.794	542.551	546.453	555.559
	23097.040	20846.150	18460.430	14298.540	9246.176	5360.902	5245.680	5009.688
	581.574	607.589	672.628	737.666	802.705	867.743	997.821	1192.936
	4501.098	4136.188	3528.065	3136.416	2854.799	2638.963	2324.198	2011.759
1200.0	221.027	344.373	408.632	476.035	523.846	571.853	575.531	584.112
	25242.270	22876.680	20471.970	16443.740	11929.060	6049.910	5941.258	5713.594
	608.631	633.149	694.445	755.741	817.037	878.333	1000.925	1184.813
	5202.613	4821.496	4164.141	3728.105	3409.157	3161.884	2797.197	2430.801

Table B.1 (continued)

HEM Tables. Mass Flux as a Function of Pressure and Enthalpy

Pressure	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux
1400.0	221.445	344.664	408.811	499.447	548.677	598.830	602.288	610.359
	27311.300	25003.610	22735.450	17359.110	12551.510	6683.371	6581.961	6365.664
	633.418	656.477	714.125	771.773	829.420	887.068	1002.364	1175.307
	5863.516	5475.953	4785.445	4314.086	3963.346	3688.239	3277.791	2860.220
1600.0	221.864	344.957	408.994	523.368	574.355	624.202	627.444	635.009
	29233.450	26962.530	24792.360	17972.270	12764.980	7267.660	7173.922	6971.113
	656.622	678.235	732.268	786.300	840.333	894.366	1002.431	1164.530
	6486.551	6100.922	5392.320	4894.734	4518.004	4218.938	3767.341	3301.789
1800.0	222.283	345.253	409.181	523.157	601.123	648.490	651.513	658.567
	31036.020	28787.660	26690.690	20329.760	12579.660	7806.832	7721.074	7533.320
	678.720	698.874	749.258	799.642	850.027	900.411	1001.179	1152.332
	7073.414	6697.105	5984.809	5470.367	5073.867	4755.141	4267.664	3757.933
2000.0	222.702	409.372	476.028	547.557	629.345	672.111	674.909	681.436
	32738.620	28462.120	25375.030	20586.680	11965.990	8303.238	8225.727	8054.324
	700.085	718.734	765.356	811.979	858.601	905.224	998.468	1138.336
	7625.125	7264.863	6563.016	6041.578	5632.180	5298.684	4781.527	4232.297
2200.0	223.122	409.567	499.111	572.671	659.615	695.462	698.022	703.996
	34356.400	30129.090	25858.070	20603.370	10853.930	8757.281	8688.324	8534.484
	721.064	738.132	780.802	823.471	866.141	908.811	994.150	1122.159
	8141.535	7803.730	7126.688	6608.961	6194.457	5851.926	5312.656	4729.914
2400.0	223.543	409.766	522.627	598.675	657.717	718.953	721.261	726.648
	35900.710	31708.020	26153.430	20376.650	14164.290	9077.238	9020.883	8893.668
	742.039	757.431	795.909	834.387	872.866	911.344	988.300	1103.735
	8559.883	8263.457	7645.703	7154.316	6750.324	6409.973	5863.156	5258.488
2600.0	223.964	409.968	546.656	625.813	690.036	744.475	746.500	751.226
	37380.620	33211.570	26262.830	19894.620	12766.030	9408.918	9361.852	9254.914
	764.729	778.232	811.988	845.745	879.502	913.259	980.772	1082.043
	8969.762	8711.047	8155.797	7699.270	7314.586	6984.250	6442.141	5827.277
2800.0	224.385	410.174	571.299	654.440	727.621	770.686	772.396	776.389
	38803.520	34649.520	26184.230	19137.050	11214.610	9700.238	9662.594	9576.551
	787.794	799.200	827.715	856.230	884.745	913.260	970.289	1055.834
	9343.570	9127.766	8650.637	8244.438	7892.750	7584.102	7064.777	6457.391
3000.0	225.000	421.150	583.644	668.593	745.797	801.845	803.155	806.213
	40000.000	35641.940	26886.760	19712.350	11705.470	9874.754	9848.203	9787.117
	814.950	823.687	845.529	867.371	889.213	911.055	954.740	1020.266
	9619.000	9459.719	9095.344	8771.859	8481.965	8220.082	7763.887	7206.020

Table B.2

HEM Tables. Throat Pressure as a Function of Pressure and Enthalpy

Pressure	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr
10.0	68.023	127.971	158.038	161.261	171.082	259.470	1143.348
	0.949	4.743	9.340	9.650	8.154	6.496	5.790
50.0	128.067	208.502	249.174	250.212	259.451	342.600	1174.093
	4.793	24.957	49.198	46.405	41.407	33.248	28.844
100.0	162.486	249.271	290.420	298.539	307.425	387.401	1187.166
	10.000	49.151	89.624	90.503	82.876	67.329	57.647
200.0	198.716	300.970	353.581	355.506	363.934	439.789	1198.334
	20.714	102.834	180.702	175.406	164.681	136.489	115.377
400.0	239.663	353.844	419.039	424.168	431.972	502.210	1204.591
	41.575	194.794	361.388	337.392	323.863	276.702	231.530
600.0	260.457	397.165	464.481	471.697	479.017	544.893	1203.657
	56.940	306.477	528.647	492.631	478.077	417.923	348.679
800.0	281.339	430.431	499.841	509.812	516.707	578.769	1199.387
	76.538	418.138	698.838	643.036	628.302	559.344	466.866
1000.0	302.324	453.051	524.116	542.551	549.055	607.589	1192.936
	101.125	507.372	881.412	789.565	775.094	700.640	586.163
1200.0	313.025	476.035	549.106	571.853	577.983	633.149	1184.813
	115.303	610.293	1038.770	932.808	918.803	841.493	706.699
1400.0	323.746	499.447	574.999	598.830	604.594	656.477	1175.307
	130.969	728.206	1217.119	1072.961	1059.817	981.714	828.583
1600.0	344.957	511.259	602.067	624.202	629.605	678.235	1164.530
	167.859	790.525	1351.223	1210.452	1198.185	1121.109	951.904
1800.0	355.758	535.411	615.582	648.490	653.528	698.874	1152.332
	188.681	932.757	1521.275	1345.381	1334.041	1259.537	1076.741
2000.0	366.585	547.557	629.345	672.111	676.774	718.734	1138.336
	211.387	1006.848	1628.333	1477.914	1467.597	1396.955	1203.341
2200.0	366.854	559.812	659.615	695.462	699.729	738.132	1122.159
	210.436	1084.806	1839.125	1608.183	1599.026	1533.568	1332.213
2400.0	377.694	572.182	674.611	718.953	722.800	757.431	1103.735
	235.013	1166.653	2005.405	1720.205	1713.230	1659.926	1464.788
2600.0	388.561	584.678	690.036	744.475	747.850	778.232	1082.043
	261.657	1252.359	2134.147	1842.720	1837.008	1791.561	1601.543
2800.0	399.457	610.837	705.942	770.686	773.537	799.200	1055.834
	290.488	1448.209	2266.912	1962.770	1958.214	1921.627	1744.450
3000.0	410.353	636.996	721.848	801.845	804.029	823.687	1020.266
	319.319	1644.059	2399.677	2075.315	2072.253	2046.246	1896.673

Table B.3

H-F Tables. Mass Flux as a Function of Pressure and Enthalpy

Pressure	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux
10.0	161.261	164.207	167.154	170.100	190.724	210.365	259.470	357.678
	757.339	337.690	258.262	217.886	126.259	98.988	70.779	51.095
	455.887	554.096	652.305	750.513	848.722	946.931	1045.140	1143.348
	42.087	36.596	32.810	30.001	27.811	26.043	24.575	23.327
50.0	208.502	228.787	238.966	244.070	249.174	250.212	287.167	342.600
	3739.189	2975.727	2506.849	2271.742	2036.635	1993.246	502.699	328.075
	434.988	527.376	619.765	712.153	804.541	896.929	989.317	1174.093
	240.319	198.880	173.250	155.460	142.208	131.851	123.471	110.584
100.0	208.608	228.888	249.271	269.775	290.420	298.539	334.084	387.401
	6418.713	5941.358	5290.286	4415.844	3361.282	2971.010	954.246	630.974
	476.264	566.127	653.990	742.852	831.715	920.578	1009.440	1187.166
	467.517	388.274	338.711	304.129	278.292	258.063	241.674	216.452
200.0	208.820	249.465	269.959	290.594	332.377	355.506	372.363	439.789
	9796.246	9017.179	8444.994	7706.236	5627.812	4369.078	2323.364	1206.237
	524.072	608.354	692.637	776.920	861.203	945.485	1029.768	1198.334
	909.562	759.471	663.980	596.804	546.381	506.790	474.654	425.146
400.0	209.243	249.855	290.942	332.672	396.980	424.168	447.580	502.210
	14342.426	13741.844	12802.820	11360.451	7899.647	6312.357	3611.381	2283.790
	580.252	658.295	736.337	814.379	892.421	970.464	1048.506	1204.591
	1771.320	1491.964	1309.183	1178.818	1080.222	1002.457	939.167	841.526
600.0	209.667	250.245	291.291	354.111	397.165	471.697	500.976	544.893
	17765.658	17223.262	16409.572	14409.974	12321.509	7737.958	4581.633	3292.623
	618.089	691.285	764.481	837.677	910.873	984.069	1057.265	1203.657
	2618.017	2222.326	1956.854	1765.051	1618.957	1503.257	1408.878	1263.102
800.0	210.092	250.636	291.642	333.270	397.355	509.812	530.499	578.769
	20632.350	20115.563	19363.199	18279.240	15749.392	8873.789	6218.193	4245.921
	647.727	716.684	785.642	854.599	923.557	992.514	1061.472	1199.387
	3457.081	2956.541	2612.089	2360.042	2166.728	2013.043	1887.415	1693.191
1000.0	210.517	312.695	375.963	419.455	487.791	542.551	568.566	607.589
	23150.109	21464.008	19501.020	17554.799	13379.993	9810.510	6813.215	5176.532
	672.628	737.666	802.705	867.743	932.782	997.821	1062.859	1192.936
	4291.912	3696.905	3277.440	2966.484	2726.280	2534.563	2377.522	2134.516
1200.0	210.942	292.347	354.924	419.604	511.599	571.853	590.242	633.149
	25422.775	24226.150	22646.668	20123.576	14591.389	10593.408	8254.198	6084.725
	694.445	755.741	817.037	878.333	939.629	1000.925	1062.221	1184.813
	5126.006	4447.579	3956.356	3587.274	3300.133	3070.088	2881.309	2589.030

Table B.3 (continued)

H-F Tables. Mass Flux as a Function of Pressure and Enthalpy

Pressure	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux	Enthalpy Mass Flux
1400.0	211.368	313.356	376.443	441.928	511.421	598.830	621.889	656.477
	27511.141	25896.986	24123.764	21362.811	17199.482	11248.473	8621.405	6968.760
	714.125	771.773	829.420	887.068	944.716	1002.364	1060.011	1175.307
	5960.580	5209.245	4650.486	4224.657	3890.854	3622.370	3401.639	3059.737
1600.0	211.794	355.478	442.030	511.259	561.146	624.202	651.218	678.235
	29454.408	26796.936	23507.426	19562.717	16046.978	11791.727	8986.325	7832.780
	732.268	786.300	840.333	894.366	948.399	1002.431	1056.464	1164.530
	6798.636	5985.068	5362.414	4880.821	4500.405	4193.284	3940.360	3548.552
1800.0	212.221	355.758	442.139	511.113	587.214	648.490	673.682	698.874
	31279.619	28653.932	25483.775	21722.568	16361.599	12234.239	9679.584	8683.805
	749.258	799.642	850.027	900.411	950.795	1001.179	1051.564	1152.332
	7644.791	6779.140	6096.361	5559.987	5132.906	4786.762	4501.316	4059.358
2000.0	212.648	356.041	420.247	510.981	586.513	672.111	700.085	718.734
	33006.332	30401.457	28253.064	23717.533	18525.521	12584.719	9982.929	9533.384
	765.356	811.979	858.601	905.224	951.846	998.468	1045.091	1138.336
	8506.508	7597.539	6857.501	6266.759	5792.672	5407.093	5088.825	4596.680
2200.0	213.075	356.326	442.374	559.812	643.381	695.462	712.530	738.132
	34649.285	32057.303	29058.920	22439.350	16218.618	12844.819	11170.948	10410.529
	780.802	823.471	866.141	908.811	951.480	994.150	1036.820	1122.159
	9392.525	8446.301	7650.360	7004.818	6482.920	6057.265	5705.857	5163.890
2400.0	213.503	356.613	510.760	612.528	674.611	718.953	738.192	757.431
	36219.816	33634.914	27326.537	20464.371	15746.939	12996.687	11694.003	11316.755
	795.909	834.387	872.866	911.344	949.822	988.300	1026.779	1103.735
	10324.857	9327.321	8474.087	7771.945	7200.848	6734.362	6349.683	5759.240
2600.0	213.931	356.901	510.668	611.653	672.385	744.475	778.232	811.988
	37726.980	35144.758	28981.230	22343.668	17651.865	12971.041	12303.079	11320.592
	845.745	879.502	913.259	947.016	980.772	1014.529	1048.286	1082.043
	10260.879	9336.557	8571.472	7947.303	7437.981	7019.448	6672.513	6382.501
2800.0	214.360	357.192	510.589	639.301	753.572	770.686	799.200	827.715
	39178.105	36595.180	30555.600	21977.088	13661.039	13752.790	13427.841	12384.717
	856.230	884.745	913.260	941.774	970.289	998.804	1027.319	1055.834
	11228.914	10211.377	9369.284	8684.192	8128.177	7674.654	7302.198	6994.401

Table B.4

H-F Tables. Throat Pressure as a Function of Pressure and Enthalpy

Pressure	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr	Enthalpy Throat Pr
10.0	148.006	161.261	357.678	750.513	1143.348
	7.293	8.973	6.339	5.816	5.455
50.0	208.502	250.212	434.988	804.541	1174.093
	24.463	42.594	32.365	29.073	27.323
100.0	269.775	298.539	476.264	831.715	1187.166
	63.277	83.101	65.496	58.119	54.707
200.0	311.391	355.506	524.072	861.203	1198.334
	111.746	162.121	132.794	116.117	109.561
400.0	375.266	424.168	580.252	892.421	1204.591
	229.188	316.845	269.698	231.739	219.367
600.0	419.172	471.697	618.089	910.873	1203.657
	348.647	469.914	408.356	346.812	329.070
800.0	464.479	509.812	647.727	923.557	1199.387
	502.606	622.651	547.856	461.192	438.531
1000.0	487.791	542.551	672.628	932.782	1192.936
	606.647	775.737	687.590	574.635	547.429
1200.0	511.599	571.853	694.445	939.629	1184.813
	721.891	929.692	826.844	686.711	655.506
1400.0	536.004	598.830	714.125	944.716	1175.307
	849.921	1084.948	965.055	796.772	762.017
1600.0	587.967	624.202	732.268	948.399	1164.530
	1113.827	1241.877	1101.362	904.271	866.560
1800.0	560.670	648.490	749.258	950.795	1152.332
	1009.525	1400.740	1234.560	1007.961	968.059
2000.0	614.485	672.111	765.356	951.846	1138.336
	1321.506	1561.615	1362.659	1106.096	1064.784
2200.0	643.381	695.462	780.802	951.480	1122.159
	1511.262	1724.726	1482.440	1195.686	1153.867
2400.0	641.903	718.953	795.909	949.822	1103.735
	1538.618	1891.445	1585.643	1271.893	1230.471
2600.0	640.548	744.475	811.988	947.016	1082.043
	1553.431	2066.513	1661.749	1323.917	1283.685
2800.0	670.394	770.686	827.715	941.774	1055.834
	1770.429	2160.248	1690.066	1331.433	1291.599

APPENDIX C CENTS GENERIC CONTROL SYSTEMS

C.1 Introduction

CENTS features a Generic Control System design (Reference C.1) that defines the individual control systems (e.g., a pressurizer main spray controller) in a totally generic manner. Database input, supplied by the system modeler, defines the structure, operation and interdependence of control systems for the core, primary system, secondary system and selected balance-of-plant systems.

The design is flexible and modular. The overall system, consisting of all the individual control systems, is driven by a CENTS model, which provides interfaces for the process models, control models and the user. Each control model is assembled using generic modules as building blocks, in a manner determined by the database input. This input is constructed and supplied by the system modeler.

The system modeler has the flexibility to create control systems of any design, as simple or as sophisticated as needed. The flexible capability to model plant-specific characteristics of control systems is also available. For the system modeler, the control modules and the rules for assembling them constitute a kind of programming language, with decision making and branching capabilities.

The CENTS user, on the other hand, interacts with the control systems at a more superficial level. The control systems normally perform their functions and drive their associated physical systems automatically. However, as described in Chapter 6, the user may change setpoints, switch selected control systems to manual control mode, and exercise manual control via the interface variables. The setpoint variables eliminate the need for constants to be hard-coded into the control system definitions, giving the CENTS user easy access to the system setpoints and time-constants.

C.2 Control System Structure

The CENTS control system design uses a modular approach to model controllers and control systems, and to construct the detailed logic within the controllers.

C.2.1 Functional Elements

The basic building block available to the control system modeler is the functional element. It is a generic module, designed to perform the following three functions.

a. Input - The element may receive information from selected CENTS variables (pressure, flow, setpoints, etc.), from other functional elements, or from constant parameters built into the control system.

b. Processing - The element processes the input data according to its specific design. CENTS provides thirty functional element types, performing simple arithmetic and logical operations, differential and integral transfer functions, block branching, simulated valve characteristics, and specialized functions.

c. Output - The element generates a single numerical result, which is available as input to other elements, or as the final output of the control group.

C.2.2 Control Groups

A control group consists of up to 250 functional elements, grouped together to perform a desired operation. The control group is held together as a unit, and the relationship among its functional elements is defined, by the exchange of information between elements. Up to 1000 control groups may be defined.

The elements of a control group are executed sequentially, in the order specified by the system modeler. However, their logical order is defined by the lines of communication between them.

Figure C.1 demonstrates the structures of two control groups. Control Group I consists of six elements, while J contains 2 elements. Elements 4 and 5 must execute before element 6 in order to achieve a logical flow of information. Element outputs are available for input to other elements only during execution of their control group, and become undefined after the final element has been processed. Therefore, as seen in Figure C.1, the output of an element is readable only by elements of the same control group, or by the control group's output.

The output of a control group is defined as the output of the last element that executes within the control group and is not a Branch. In the example, the outputs of element 6 of Group I and element 2 of Group J are the control group outputs of I and J. The control group output is automatically stored in a Global Common array, GROUT(1:1000), immediately after the execution of the group's final element. Since GROUT is in Global Common, it is available at all times as input to elements of other control groups. Thus, in the example of Figure C.1, element 2 of control group J reads the output of group I, although it could not read the output of element 6 directly.

No restriction is made on the order of execution of groups I and J. That is, an element may read the output of any control group that precedes it in the execution sequence (backward reference) or that follows it in the sequence (forward reference), as well as its own control group's output (self-reference). In the latter two cases, the information would necessarily arrive lagged by one time step.

C.2.3 Control Systems

A control system is an association of one or more control groups, which produces a desired output to drive (control) a particular physical system or signal generator.

CENTS requires a control system for each of the physical systems listed in Table C.1. More specifically, it expects to find the driving quantities, with which to drive each physical system, in the output slots (GROUT) of the control groups. The association of a particular device driven by the control system to a specific control group is made via database input (Table C.1). For example, if the database contains

CTL_HEATER_CONTROLLERS(1) = 51

then control group 51 should be constructed to generate a fractional voltage signal for the pressurizer's proportional heaters, per Table C.1. CENTS obtains this signal from GROUT(51) and drives the proportional heaters with it.

In the above example, control group 51 may constitute the entire proportional heater control system. More likely, however, it is merely the final control group in a multi-group control system. In that case, CENTS uses GROUT(51) for its intended purpose, and ignores the outputs of the other groups in that control system. To illustrate, suppose that the two control groups in Figure C.1 constitute the proportional heater control system, with J=51. Control group 50 (I) generates a processed pressurizer pressure signal, while group 51 converts the pressure signal into a fractional voltage signal. Although the two control groups could have been defined as a single, eight-element group, they were split as shown in order to make the processed pressure signal, GROUT(50), available to other control systems – backup heaters, main pressurizer spray valves, PORV. Thus, the four control systems overlap, sharing control group 50 as the common initial group.

Tables C.1 and C.2 list the controllers required for driving particular signals or physical systems, the variables for the component model interfaces, and the number of controllers required for each. The controllers drive the variables listed under "Interface Variable." In addition, some control systems that drive valves have two interface variables associated with each – the valve modulating signal calculated by

the control system (under "Signal to Handler" in Table C.2), and the valve's position in response to the signal ("Interface Variable" in Table C.2).

C.2.4 Sequence of Control Group Execution

Control groups may be input and consequently numbered, in any convenient order. However, there may be a logical need for them to be executed in some other order. Therefore, CENTS drives the execution of control groups in the order indicated by a database input array, SEQNCE(1:1000).

C.2.5 Entry of Control System Information

The information that determines the structure, logic and data flow of the controllers and control systems is entered into the plant-specific database. The information is stored in several Control System arrays. Entering this information can be done in one of two methods:

1. Non-modular. Each of the Control System arrays is entered separately in its entirety, with each array addressing different aspects of all the control groups. Thus, all of ELEMS is entered (number of elements in each controller), followed by all of ELTYPE (Type ID of each element, Table C.3), then all of ELIN (inputs to the elements, Table C.3) with the CENTS variables referenced via numeric pointers, and all of SEQNCE (execution sequence).

2. Modular. The complete set of input describing each controller is entered together, followed by the complete set of input for the next controller, etc.. CENTS variables are referenced using their alphanumeric names [e.g. TEMP_LIQ(5)]. Element types are referenced by their Type Names (e.g., MULT; see Table C.3). This information is converted internally into numeric pointers similar to those entered directly in method 1, and is loaded into the control system arrays.

C.3 Description of Functional Elements

CENTS provides thirty functional element types, performing a variety of functions. Each element type has associated with it a required number of inputs and a required number of saved "last values". The last values, if required, are stored values of input, output or status variables that are saved from one time step to the next.

Table C.3 lists the functional elements and their functions, along with the number of inputs and last values required by each. The following nomenclature applies:

x, x_1, x_2	Input quantity	K, K_1, K_2	Constants
y	Output quantity	τ, τ_1, τ_2	Time constants (sec)
$()_i$	Quantity at the current time	s	Laplace differential operator
$()_{i-1}$	Quantity at previous time step	I	Integrated quantity
Δt	Current time step size (sec)		

C.4 References

C.1 CE-CES-59-P, Rev. 004, "Modeler's Manual for the CENTS Generic Control Systems," December 2002.

Table C.1: Controller Designations

	Required Controller Designation	Quantity	Magnitude	Units	Description
1.	CTL_CORE_TRIP_CONTROLLER	1	0 or 1	Trip signal [1]	Reactor scram
2.	CTL_RPS_CONTROLLERS	20	0 or 1	Trip signal [1]	Reactor protection system channels
3.	CTL_POWER_CUTBACK_CONTROLLER	1	0 or 1	Trip signal [1]	Reactor Power Cutback signal
4.	CTL_TURB_SETBACK_CONTROLLER	1	0 or 1	Trip signal [1]	Turbine Setback signal
5.	CTL_TURB_RUNBACK_CONTROLLER	1	0 or 1	Trip signal [1]	Turbine Runback signal
6.	CTL_CEA_CONTROLLER	1	[2]	Steps/minute	Control rod speed
7.	CTL_LETDOWN_CONTROLLERS	4	0.0 - 1.0	Fraction	Letdown valve position
8.	CTL_CHGS_CONTROLLERS	4	0.0 - 1.0	Fraction	Charging pump flows
9.	CTL_HEATER_CONTROLLERS	2	0.0 - 1.0	Fraction	Heater voltages
10.	CTL_SPRAY_CONTROLLERS	2	0.0 - 1.0	Fraction	Main spray valve positions
11.	CTL_PORV_CONTROLLERS	4	0.0 - 1.0	Fraction	Pressurizer PORV valve positions
12.	CTL_PSV_CONTROLLERS	4	0.0 - 1.0	Fraction	Pressurizer safety valve positions
13.	CTL_SIAS_TRIP_CONTROLLER	1	0 or 1	Trip signal [1]	SIAS: Safety Injection Actuation Signal
14.	CTL_TURB_TRIP_CONTROLLERS(1)	1	0 or 1	Trip signal [1]	Turbine trip signal
15.	CTL_TURB_TRIP_CONTROLLERS(2)	1	0.0 - 1.0	Fraction	Turb. admission valve position after trip
16.	CTL_MSIS_TRIP_CONTROLLER	1	0 or 1	Trip signal [1]	MSIS: Main Steamline Isolation Signal
17.	CTL_MSIV_CONTROLLERS	8	0.0 - 1.0	Fraction	MSIV valve positions
18.	CTL_MSLH_CONTROLLERS	50	0.0 - 1.0	Fraction	MSLH external valve positions
19.	CTL_PRZR_LVL_ERR_CONTROLLER	1	Defined by controller		Pressurizer level error
20.	CTL_PRZR_PROG_LVL_CONTROLLER	1	Defined by controller		Programmed pressurizer level
21.	CTL_T_AVG_CONTROLLER	1	[2]	°F	RCS average coolant temperature
22.	CTL_T_REF_CONTROLLER	1	[2]	°F	RCS reference coolant temperature
23.	CTL_FWS_TRIP_CONTROLLER	1	0 or 1	Trip signal [1]	Main feedwater (FW) trip signal
	➢ *NUM_FWS_PUMPS = 0:*				
24.	CTL_FWS_CONTROLLERS	4	[2]	Lbm/sec	Main FW to downcomer: flowrates
25.	CTL_FWS_ECON_CONTROLLERS [3]	4	[2]	Lbm/sec	Main FW to economizer: flowrates
	➢ *NUM_FWS_PUMPS > 0:*				
26.	CTL_FWS_CONTROLLERS	4	0.0 - 1.0	Fraction	Main FW to downcomer: valve signals
27.	CTL_FWS_ECON_CONTROLLERS [3]	4	0.0 - 1.0	Fraction	Main FW to economizer: valve signals
28.	CTL_FWS_BYPS_CONTROLLERS [4]	4	0.0 - 1.0	Fraction	FW System bypass valves demand signals
29.	CTL_FWS_PUMP_CONTROLLERS	4	0.0 - 1.0	Fraction	Main FW pumps speed signals
30.	CTL_FWS_ISOL_CONTROLLERS	4	0.0 - 1.0	Fraction	FW System isolation valves demand signals
	➢ *NUM_FWS_PUMPS = 0 or NUM_AFW_PUMPS = 0:*				
31.	CTL_AFWS_CONTROLLERS	4	[2]	Lbm/sec	Auxiliary feedwater flowrates
32.	➢ *NUM_FWS_PUMPS > 0 and NUM_AFW_PUMPS > 0:*				
32.	CTL_AFWS_CONTROLLERS	4	0.0 - 1.0	Fraction	Auxiliary feedwater pumps speed signals
33.	CTL_AFWS_VALVE_CONTROLLERS	14	0.0 - 1.0	Fraction	Auxiliary FW System valves demand signals

[1] 0.0 = False (no trip), 1.0 = True (trip). [2] Physically realistic. [3] If SG_ECONOMIZER = T . [4] If SG_ECONOMIZER = F

Table C.2: Controller Interface Variables

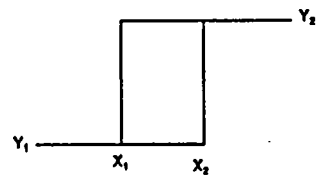
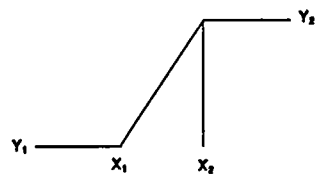
	Description	Interface Variables	Required Number	Signal to Handler
1.	Reactor scram	CTL_CORE_TRIP	1	
2.	Reactor protection system channels	CTL_CORE_TRIP_SIG( )	CTL_NUM_RPS	
3.	Reactor Power Cutback signal	CTL_RPCS_TRIP	1	
4.	Turbine Setback signal	CTL_TURB_SETBACK_TRIP	1	
5.	Turbine Runback signal	CTL_TURB_RUNBACK	1	
6.	Control rod speed	CTL_CEA_SPEED	1	
7.	Letdown valve position	CTL_LETDOWN_FRAC( )	RCS_NUMOUT_LDNS	
8.	Charging pump flows	CTL_CH_PUMP_FRAC( )	NUM_CHGS_PUMPS	
9.	Heater voltages	PRSI_HEATER_VOLT_FRAC( )	2 (Proportional & Backup)	
10.	Main spray valve positions	VLV_PRZR_MSPRAY( )	RCS_NUM_MSPRAYVLVS	VLV_PRZR_MSPRAY_SIG( )
11.	Pressurizer PORV valve positions	VLV_PRZR_PORV( )	RCS_NUM_PORVS	VLV_PRZR_PORV_SIG( )
12.	Pressurizer safety valve positions	VLV_PRZR_SAFETY( )	RCS_NUM_SAFETYVLVS	
13.	SIAS: Safety Injection Actuation Signal	CTL_SIAS_TRIP	1	
14.	Turbine trip signal	CTL_TURB_TRIP	1	
15.	Turb. admission valve position after trip	MSLH_VALVE_POS( )	1	MSLH_VALVE_SIG( )
16.	MSIS: Main Steamline Isolation Signal	CTL_MSIS_TRIP	1	
17.	MSIV valve positions	MSLH_MSIV_POS( )	NUM_SG * NUM_SL	MSLH_MSIV_SIG( )
18.	MSLH external valve positions	MSLH_VALVE_POS( )	MSLH_VALVE_NUM	MSLH_VALVE_SIG( )
19.	Pressurizer level error	CTL_PRZR_LEVEL_ERROR	Optional	
20.	Programmed pressurizer level	CTL_PRZR_PROG_LEVEL	Optional	
21.	RCS average coolant temperature	CTL_T_AVG	Optional	
22.	RCS reference coolant temperature	CTL_T_REF	Optional	
23.	Main feedwater (FW) trip signal	CTL_FWS_TRIP	1	
	➢ *NUM_FWS_PUMPS = 0:*			
24.	Main FW to downcomer: flowrates	FWS_FLOW( )	NUM_SG	
25.	Main FW to economizer: flowrates	FWS_ECON_FLOW( )	NUM_SG (1)	
	➢ *NUM_FWS_PUMPS > 0:*			
26.	Main FW to downcomer: valve signals	CTL_FWS_SIG( )	NUM_SG	
27.	Main FW to economizer: valve signals	CTL_FWS_ECON_SIG( )	NUM_SG (1)	
28.	FWS bypass valves demand signals	CTL_FWS_BYP_SIG( )	NUM_SG (2)	
29.	Main FW pumps speed signals	CTL_FWS_SPEED_SIG( )	NUM_FWS_PUMPS	
30.	FW System isolation valves demand signals	CTL_FWS_ISO_POS( )	NUM_SG	
	➢ *NUM_FWS_PUMPS = 0 or NUM_AFW_PUMPS = 0:*			
31.	Auxiliary feedwater flowrates	AFWS_FLOW( )	NUM_SG	
32.	➢ *NUM_FWS_PUMPS > 0 and NUM_AFW_PUMPS > 0:*			
32.	Auxiliary feedwater pumps speed signals	CTL_AFWS_SPEED_SIG( )	NUM_AFW_PUMPS	
33.	Auxiliary FW System valves demand signals	FWS_STROKE( )	FWS_NAFWVT	

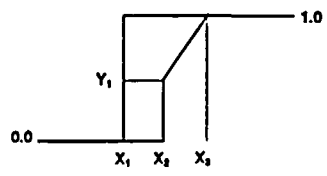
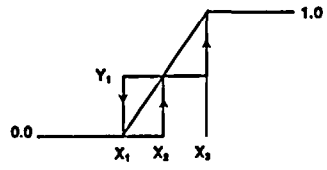
(1) If SG_ECONOMIZER = T (2) If SG_ECONOMIZER = F

Table C.3

FUNCTIONAL ELEMENT DESCRIPTIONS

Type ID	Type Name	Description	Definition	Inputs No.	Inputs Values	Last Values No.	Last Values Values
1	PASS	Pass Value	$y = x$	1	x	0	---
2	ADD	Add	$y = x_1 + x_2$	2	x_1, x_2	0	---
3	WSUM	Weighted Add	$y = K_1x_1 + K_2x_2$	4	x_1, x_2, K_1, K_2	0	---
4	MULT	Multiply	$y = x_1 * x_2$	2	x_1, x_2	0	---
5	DIV	Divide	$y = x_1 / x_2$	2	x_1, x_2	0	---
6	COMP	Compare	$y = 1.0$, if $x_1 > x_2$ $y = 0.0$, if $x_1 \leq x_2$	2	x_1, x_2	0	---
7	MIN	Minimum	$y =$ Minimum (x_1, x_2)	2	x_1, x_2	0	---
8	MAX	Maximum	$y =$ Maximum (x_1, x_2)	2	x_1, x_2	0	---
9	LIM	Limit	$y = x_1$, Subject to $x_2 \leq y \leq x_3$	3	x_1, x_2, x_3	0	---
10	SUB	Subtract	$y = x_1 - x_2$	2	x_1, x_2	0	---
11	PI	Proportional–Integral (PI)	$\frac{y}{x} = K + \frac{1}{\tau s}$	5	$x_i, K, \tau,$ K_{min}, K_{max}	2	x_{i-1} I_{i-1}
12	PID	Proportional–Integral–Differential (PID)	$\frac{y}{x} = K + \tau_1 s + \frac{1}{\tau_2 s}$	6	$x_i K, \tau_1,$ τ_2, K_{min}, K_{max}	2	x_{i-1} I_{i-1}

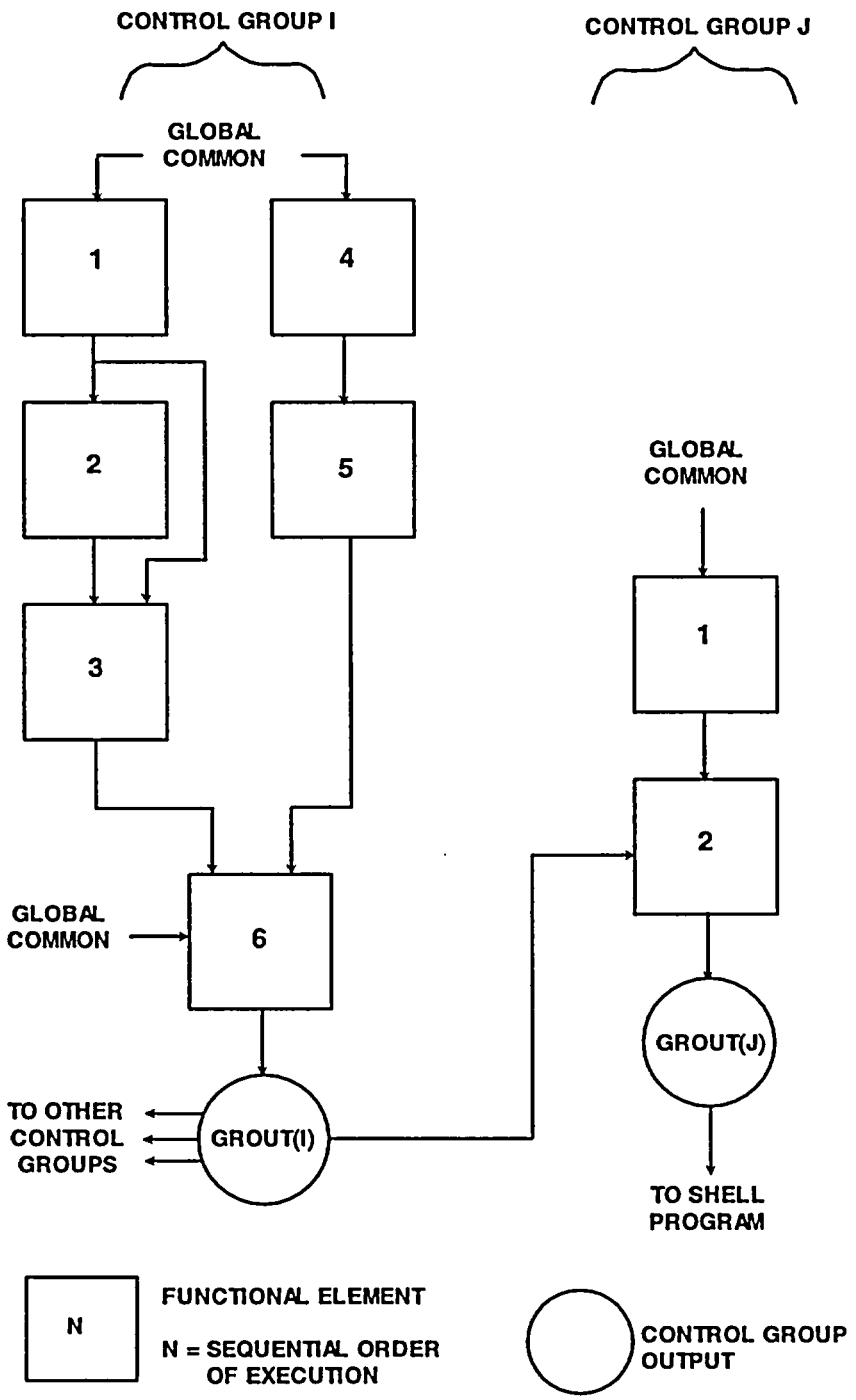
Type ID	Type Name	Description	Definition	Inputs No.	Inputs Values	Last Values No.	Last Values Values
13	DERIV	Filtered Derivative (Impulse)	$\frac{y}{x} = \frac{\tau_1 s}{1+\tau_2 s}$	3	x_i, τ_1, τ_2	2	x_{i-1}, y_{i-1}
14	LAG	Lag (Filter)	$\frac{y}{x} = \frac{1}{1+\tau s}$	2	x_i, τ	2	x_{i-1}, y_{i-1}
15	LLAG	Lead-Lag	$\frac{y}{x} = \frac{1+\tau_1 s}{1+\tau_2 s}$	3	x_i, τ_1, τ_2	2	x_{i-1}, y_{i-1}
16	STEP	Step with Hysteresis (or Bistable)		5	x, X_1, X_2, Y_1, Y_2	1	Z_{i-1}
17	RAMP (or CHOICE)	Ramp (or Bistable)		5	x, X_1, X_2, Y_1, Y_2	0	---
18	FUNC	User Defined Function	y = F(x) where F(x) is defined by Table No. M, and y is found by interpolation	2	x, M	0	---
19	DELAY	Signal Delay	Delay an input On/Off signal by a given length of time	6	x, ΔT_{IN1}, ΔT_{IN0}, ΔT_{OUT1}, ΔT_{OUT0}, Opt	3	$T_{X,i-1}$, $T_{Z,i-1}$, y_{i-1}

Type ID	Type Name	Description	Definition	Inputs No.	Inputs Values	Last Values No.	Last Values Values
20	BRANCH	Branch (Block If)	$x_1 > x_2$ Execute 1st block $x_1 \leq x_2$ Execute 2nd block	4	x_1, x_2, K_1, K_2	0	---
21	AND	Boolean AND	$y = x_1$ .AND. x_2	2	x_1, x_2	0	---
22	OR	Boolean OR	$y = x_1$ .OR. x_2	2	x_1, x_2	0	---
23	XOR	Boolean XOR	$y = x_1$ .XOR. x_2	2	x_1, x_2	0	---
24	NOT	Boolean NOT	y = .NOT. x	1	x	0	---
25	VDIR	Valve Handler: Constant Rate, Direction Signal	Modulate valve at rate K x = -1, close x = 0, no action x = 1, open	2	x, K	1	y_{i-1}
26	VPOS	Valve Handler: Rate Limited, Position Signal	Modulate toward x rate = K_1, opening rate = K_2, closing	3	x, K_1, K_2	1	y_{i-1}
27	SV1	Valve Handler Accumulation and Blowdown		5	x, X_1, X_2, X_3, Y_1	1	z_{i-1}
28	SV2	Valve Handler Step Open, Ramp Closed		5	x, X_1, X_2, X_3, Y_1	1	z_{i-1}

Type ID	Type Name	Description	Definition	Inputs No.	Inputs Values	Last Values No.	Last Values Values
29	VLAG	Valve Handler: Lag Compensation	Valve position (y) approaches x exponentially with time constant τ. $y_i = x_i$, if $\lvert y_i - x_I \rvert < Y_1$	3	x_I, τ, Y_1	2	x_{i-1}, y_{i-1}
30	SVGEN	Valve Handler: Generic Safety Valve	Valve opening and closing curves are described by up to 4 points each.	14	x, X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, Y_2, Y_3, Y_6, Y_7, ΔP_{TOL}	4	x_{i-1}, y_{i-1}, z_{i-1}, p_{i-1}

* Boolean inut is 0.0 (false) or 1.0 (true).

Figure C.1
SCHEMATIC STRUCTURE OF CONTROL GROUPS



APPENDIX D CENTS INITIALIZATION

This appendix describes a procedure of initializing CENTS. This initialization procedue brings CENTS to a steady state whose parameters are defined by a set of user-specified inputs.

D.1 Initialization Routines

This section describes the CENTS initialization routines, with emphasis on the assumptions and limitations. One has to pay attention to these limitations in order to utilize this procedure.

D.1.1 INITIAL

This program is the initialization driver, called in response to the INITIAL command. It calls the other initialization programs that are described below, followed by the transient process models, and repeats this cycle INIT_ITER times (typically 30-80 cycles) without updating the transient time.

When done, this program resets the transient time to TIME = 0, and displays an Initialization Summary Report on the initial mass and energy balances in the primary and secondary systems. The following is an example of the Initialization Summary Report:

```
NSSS initializing with the following parameters:
   Total core power (Kfrain)            1.0000      Fraction
   Pressurizer pressure (Rpinit)        2250.0      PSIA
   Pressurizer level (Rlinit)           17.400      Feet
   Total vessel flow (Rwinit)           41111.      Lbm/sec
   Cold leg temperature (Rtclin)        553.00      Deg F
   Boron concentration (Rbinit)         0.0000      PPM
   SG pressure option (Sgt_init_option)   1.0  =>  Do not adjust area
   =>  SG pressure (Spinit)             Calculated based SG area
   Steam generator level (Slinit)       36.550      Feet
   Fuel Gap conductance (Tgapin)        6527.0      Btu/hr-ft2-degF
   Fission Source Term (Pow_kin_source) 1.00000E-09
   Feedwater enthalpy (Fhinit)          425.80      Btu/lbm
   =>  Calculated as (1.0-Kfrain)*Ctl_fws_h(1) + Kfrain*Ctl_fws_h(2)
Initializing:   RCS  CHT  POW  SGS  CTL
Exercise models and iterate to a steady state. Init_iter =  30

   RCS loop energy balance        -61.88                Btu/sec
   RCS loop mass balance            0.36                Lbm/sec
   Przr energy balance             -8.01                Btu/sec
   SG mass balance                  0.00        0.00    Lbm/sec
   SG energy balance             -117.63     -289.53    Btu/sec
   SG global balance (Q/dh-W)       0.27        0.27    Lbm/sec
   SG pressure                    907.59      907.59    PSIA
```

The first portion of the Initialization Summary Report consists of:

a. Confirmation of the initialization parameters, which are discussed below in Section D.1.2 - D.1.6.

b. Confirmation of the models being initialized. Normally, all five models indicated in the above example are initialized. Flags to activate/deactivate the initialization of specific models are listed in Appendix C, Table C.2, under "Initialization".

c. Confirmation of the number of initialization cycles.

The second section of the Initialization Summary Report consists of relevant mass and energy balances, and the calculated initial steam generator (secondary) pressure. The displayed information is described below.

d. RCS loop energy balance:

e. RCS loop mass balance:

f. Pressurizer energy balance:

g. SG mass balance, separately for each steam generator:

h. SG energy balance.

i. SG global balance.

[ ]

j. Steam generator pressure.

[ ]

D.1.2 RCSINI

This program is called by INITIAL to initialize RCS conditions. The user inputs for this program are

RPINIT : initial pressurizer pressure (psia)

RLINIT : initial pressurizer level (feet)

RWINIT : initial total loop flowrate (lbm/sec)

RTCLIN : initial cold leg temperature (°F)

RBINIT : initial boron concentration (ppm)

RCS_DOSE_INIT_IOD : Initial iodine concentrations (μCi/lbm)

The overall assumptions used for this procedure are

1. The loop conditions are symmetric.
2. Single-phase water flows in the loops. Only the pressurizer has a steam phase.
3. The RCP's are running at speed RATED_PUMP_SPEED (RPM).

The loop flows are initialized using RWINIT with the assumption that all flowrate ratios to the total loop flowrate in the system stay the same. The flowrate in the pressurizer surge line is set to the pressurizer spray flow. No assumptions are made for the flow direction from the upper plenum to CEA and upper head.

The loop enthalpies are calculated first, with the temperatures in the pump discharge cold legs set to RTCLIN. The pump heat and heat transfer rates in the steam generators are considered in the enthalpy balances. The pressurizer liquid enthalpy is set to saturation at the RPINIT conditions.

The node pressure calculation starts at the pressurizer, whose pressure is RPINIT. Pressure drops by both friction and head losses are accounted for following both directions from the hot leg. The main coolant pump head rise is calculated using the homologous curve. The ratio between the calculated pressure drop across the pump and the pump head rise is defined as an RCP efficiency factor (RKPUMP). This factor multiplies the RCP head in subsequent transient calculation.

The liquid and steam masses are calculated by dividing the node volume by appropriate specific volumes, and the steam masses are set to zero except in the pressurizer. The liquid and steam masses in the pressurizer are calculated using RLINIT, state and geometric information. Iodine concentrations, if input, are set to RCS_DOSE_INIT_IOD.

The wall temperatures are the steady state temperatures that result from setting the right hand side to zero in Equation (4.10.1). For the pressurizer, the lower and upper wall temperatures are set to the steady state temperatures that result from setting the right hand sides to zero in Equations (4.10.2). The pressurizer heater temperatures are set to the steady state temperatures that result from setting the right hand side to zero in Equation (4.13.1). The boron concentration is set to RBINIT.

D.1.3 CHTINI

This program is called by INITIAL to initialize the core heat transfer rate. This routine uses the following user inputs:

KFRAIN :	initial core power fraction (fraction)
TGAPIN :	initial core gap conductance (Btu/hr-ft^2-°F)
KSHAPIN(1:50) :	power shape (fraction; see Section 7.1.1.)

The axial power shape and distribution are calculated using the reference power POW_USER_POWZ and the inputs of KSHAPIN and KFRAIN. The gap conductivity is also calculated with the gap width and TGAPIN. The conductivity is assumed to be a constant along the fuel rod.

The core fluid conditions are obtained by mass and energy balances. The fuel rod temperatures are calculated by enforcing a steady state heat transfer balance. It is assumed that the core heat transfer is in a forced convection mode.

D.1.4 POWINI

This program is called by INITIAL to initialize the power generation rate. The user inputs for this program are:

KFRAIN :	initial core power fraction (fraction)
RBINIT :	initial boron concentration (ppm)
POW_KIN_SOURCE :	fission source term (fraction)

The core power fraction and RCS boron concentrations are set to KFRAIN and RBINIT, respectively. The average fuel temperature, core coolant temperature and specific volume are calculated in CHTINI. These values are used to calculate reference boron, Doppler, moderator temperature and density feedbacks. The reference control rod reactivity feedback is calculated at the input initial rod position. No reactivity feedbacks from cutback and scram are included in this initialization.

The decay heat, prompt power and temporary prompt power fractions are calculated by assuming that they are proportional to the power level. The normalized concentrations of the fission products and delayed neutrons are also calculated in the same way. The fission source term is included, although it is only significant for initially subcritical conditions.

D.1.5 SGSINI

This program is called by INITIAL to initialize the steam generators (SGs). The user specified variables for this program are:

SGT_INIT_OPTION :	Option flag for SG pressure calculation (see below)
SPINIT :	if option=0, initial steam generator pressure (psia)
SLINIT :	initial SG downcomer water level (feet)
CTL_FWS_H(1:2) :	limits for initial feedwater enthalpy (Btu/lbm)

The tube heat transfer rate is initialized by employing a steady state energy balance on the primary system. The tube heat rate is the sum of heat input from the core and RCPs, heat losses to containment (excluding the pressurizer), and energy flows due to charging, letdown and RCP seals leakage.

The steam generator dome pressure is determined based on the input option flag:

- If SGT_INIT_OPTION = 0.0, then CENTS sets the pressure to the input SPINIT, and adjusts the effective tube heat transfer area to achieve the primary-to-secondary heat balance necessary to attain the desired pressure.

- If SGT_INIT_OPTION = 1.0, then CENTS calculates SPINIT as the steam generator dome pressure that provides the best steady-state heat balance for the given initial conditions. The SG tube heat transfer areas remain at their input value.

The coolant temperature in the evaporator is the saturation temperature for the pressure SPINIT. Heat transfer coefficients are calculated on the primary and secondary sides of the tubes, as described in Sections 5.3.4 and 5.3.5. The tube metal temperatures on the cold and hot sides of the bundle are then determined from a steady state heat balance that results from setting the right hand side to zero in Equation (5.25).

The initial feedwater enthalpy (FHINIT) is determined as a function of the initial core power fraction KFRAIN (Sections D.1.3-4), based on the input CTL_FWS_H(1:2). This array of two elements represents the feedwater enthalpy at zero power and full power, respectively, with linear interpolation for intermediate initial power levels.

The required feedwater flowrate is found from a steady state energy balance on the steam generator, with steam flow set equal to the feedwater flowrate.

Downcomer water level is set to the input SLINIT. The evaporator level is set equal to the can deck height. The average void fraction in the evaporator is found as the void fraction for which the Wilson correlation (Section 5.2.2) will produce the required steam flow.

The circulation and recirculation flows are determined based on the calculated downcomer-to-evaporator driving head. The average downcomer enthalpy (subcooled) is the result of imposing a steady state energy balance on the downcomer.

With all levels, pressures, void fractions and temperatures (or enthalpies) known, the procedure calculates the masses and total energies, utilizing the liquid and steam property routines.

D.1.6 CONINI

This program is called by INITIAL to initialize the control systems. ELLAST and GROUT arrays are set to proper initial conditions. The setpoints are not changed. Valve states and error signals after this initialization are based on the setpoints and the initial conditions. Therefore, the user may need to change setpoints to bring the valve states and error signals to those expected for specific applications.

D.2 Initialization Procedure

The guidelines for this initialization procedure are as follows:

1. Input initial conditions. The variables for the initial conditions are discussed in Section D.1, and are summarized below.

RPINIT :	Initial pressurizer pressure (psia)
RLINIT :	Initial pressurizer level (feet)
RWINIT :	Initial total loop flowrate (lbm/sec)
RTCLIN :	Initial pump-discharge cold leg temperature (°F)
KFRAIN :	Initial core power fraction (fraction)
TGAPIN :	Initial core gap conductance (Btu/hr-ft^2-°F)
KSHAPIN(1:50) :	Power shape (fraction)
RBINIT :	Initial boron concentration (ppm)
SLINIT :	Initial steam generator downcomer water level (feet)
SGT_INIT_OPTION :	Option flag for SG pressure calculation (Section D.1.5)
SPINIT :	If option=0, initial steam generator pressure (psia)
CTL_FWS_H(1:2) :	Limits for initial feedwater enthalpy (Btu/lbm; Sect. D.1.5)
RCS_DOSE_INIT_IOD :	Initial iodine concentrations (μCi/lbm, Section 5.8.2)

2. Issue the command INITIAL.
3. Examine the Initialization Summary Report, Section D.1.1. Confirm that:
   - The echoed initialization parameters are as input.
   - If SGT_INIT_OPTION = 1.0, the steam generator pressure is as expected.
   - The mass and energy balances (items d. through i. in Section D.1.1) are acceptably small. If not, the number of initialization cycles, INIT_ITER, may be increased. Alternatively, system parameters, boundary conditions or control setpoints may have to be changed.
4. Check the values of RKPUMP(1:4) (RCP head efficiency factors, Section D.1.2), which normally should be near 1.0. If SGT_INIT_OPTION = 0.0, then check the value of SGT_Q_MULT(1:4), which normally should be near 1.0. If these values are much different from 1.0, the resultant initial condition is still valid, but the user should understand the reasons – e.g., boundary conditions are not realistic.
5. Proceed with the transient simulation, or use the SNAP command to save the new initial conditions for later use.

APPENDIX E CESEC EMULATION

CENTS incorporates some of the features of CESEC (Reference E.1), to support licensing applications with the conservatism of CESEC for certain accident scenarios. These features are:

1. Temperature Tilt in the Core
2. Cold-Edge Moderator Density Reactivity Feedback
3. Hermite Reactivity Credit
4. Steam Generator Heat Transfer Degradation

The following sections discuss these features and their implementation within CENTS.

E.1 Temperature Tilt in the Core

In reality, there are three dimensional temperature distributions in the core. CESEC uses the coldest temperature in the core in calculating the moderator density. The implementation of the CESEC temperature tilt feature within CENTS is based on the following guidelines:

1. The implementation uses the CENTS calculated cold leg temperatures, core flowrates and reactivities.
2. The implementation provides flexibility for users in calculating and adjusting the mixing in the lower plenum.
3. The implementation follows the CESEC input arrangements as much as possible.

These guidelines mean that the implementation of the CESEC feature within CENTS retains the essential feature of CESEC, but does not emulate the CESEC calculation exactly.

CENTS employs a reactor vessel mixing model to calculate core mixing and the core-exit/hot-legs enthalpy tilt that results from non-symmetric operation of the steam generators. Section 7.2.5 provides details for this model.

CENTS calculates the temperature tilt in the core, as part of the CESEC model emulation, in order to support the Cold-Edge Moderator Density Reactivity Feedback model emulation (Section E.2) and/or the Hermite Reactivity Credit model emulation (Section E.3). That is, the core temperature tilt is calculated if either of these flags is True:

POW_KIN_MOD_DENSITY_OPTION

POW_KIN_HERM_CREDIT_OPTION

The cold-edge enthalpy (h_{ec}) and hot-edge enthalpy (h_{eh}) are calculated as:

$$h_{ec} = K_e \Delta h_c + h_{path\,1} + F_{DH} \Delta h_{core}$$

$$h_{eh} = K_e \Delta h_h + h_{path\,1} + F_{DH} \Delta h_{core}$$

where

$h_{path\,1}$ = specific enthalpy of the flow in the core inlet flowpath

F_{DH} = input core enthalpy rise adjustment factor, POW_KIN_DH_FACTOR

Δh_{core} = core enthalpy rise

K_e = input weight factor for edge enthalpies, POW_KIN_EDGE_WEIGHT

Δh_c = cold side enthalpy defect, $h_{min} - h_{ave}$, passed through a lag with time constant = (annulus mass) / (total cold legs flowrate into annulus)

Δh_h = hot side enthalpy excess, $h_{max} - h_{ave}$, lagged as above

h_{min} = minimum cold leg path enthalpy

h_{max} = maximum cold leg path enthalpy

h_{ave} = flow-averaged cold leg enthalpy = $\Sigma(W \cdot h) / \Sigma(W)$

The edge temperatures (T_{ec} and T_{eh}) are calculated by a CENTS property function, evaluated at the core pressure, and h_{ec} and h_{eh}. That is,

$$T_{ec} = T_{sub}(P_{core}, h_{ec})$$

$$T_{eh} = T_{sub}(P_{core}, h_{eh})$$

The input variables for this option are listed in table E.1. The temperature tilt is defined as

$$\Delta T_{TILT} = T_{eh} - T_{ec}$$

E.2 Moderator Density Calculation

The moderator density and the corresponding moderator reactivity feedback is computed by the CENTS when the flag POW_KIN_MOD_DENSITY_FB_OPTION is True. CENTS calculates the moderator density for use in the reactivity versus density tables, as described in Section 7.1 and in Tables 7.4 and 7.5. Normally, this is the bulk density in the core.

However, if the flag POW_KIN_MOD_DENSITY_OPTION is True, then CENTS uses the CESEC emulation model to calculate the moderator density from a property function, evaluated at the core pressure and the cold-edge enthalpy (Section E.1):

$$\rho_{mod} = \text{POW_KIN_DENCOR} = 1 / v_{sub}(P_{core}, h_{ec})$$

The input variables for this option are listed in table E.1.

E.3 Hermite Reactivity Credit

CENTS and CESEC employ a point kinetics model to calculate power in the core. However, the CESEC method of calculating the reactivity based on the coldest temperature (Section E.2) is overly conservative. Therefore, the Hermite credit, which accounts for the effect of three dimensional power distribution, is available in CENTS. The Hermite credit is calculated if the flag POW_KIN_HERM_CREDIT_OPTION is True, and then only after POW_KIN_HERM_TD seconds (input) past the Scram.

The implementation of the Hermite credit follows very closely the method in CESEC. The temperature tilt (ΔT_{TILT}) and the moderator density (ρ_{mod}) are calculated as outlined in Sections E.1 and E.2. The flow fraction is

$$F_W = W_{CORE} / W_{REF}$$

where W_{CORE} is the CENTS calculated core flow, and W_{REF} is the input reference flow POW_KIN_HERM_FLOW_REF. The fission power fraction is

$$F_{MW} = \Pi_{CORE} / \Pi_{REF}$$

where Π_{CORE} is the CENTS calculated fission power, and Π_{REF} is the input reference power POW_KIN_HERM_POW_REF. The power-to-flow ratio is

$$R_{PF} = F_{MW} / F_W \geq \text{POW_KIN_POWTOFLOW_MIN (input minimum).}$$

The 3-D Hermite reactivity credit (POW_KIN_DKHERMC) is calculated at each time step, based on the current temperature tilt (ΔT_{TILT}) and power-to-flow ratio (R_{PF}), and using the input tables POW_KIN_HERM_CREDITTAB(1:350) and POW_KIN_CORE_W_FRACTAB(1:8). Table E.1 describes these inputs.

The final resulting 3-D Hermite reactivity credit, POW_KIN_DKHERMC, is multiplied by the input fraction of Hermite credit to be taken, POW_KIN_HERM_MULT, and the result is added to the total reactivity.

E.4 Inputs for CESEC Reactivity Model Emulation

The input variables are listed in Table E.1. The CESEC input vector numbers, where applicable, are shown for comparison. It must be noted the CESEC vectors A(5550)-A(5553) are a subset of the CENTS array POW_KIN_HERM_CREDITTAB. All the relevant CESEC vectors are represented in CENTS.

E.5 Steam Generator Heat Transfer Degradation

Normally, CENTS calculates the degradation of heat transfer as a function of the void fraction in the steam generator evaporator region. However, CENTS also provides for optional emulation of the CESEC model, in which the steam generator heat transfer is degraded as the secondary mass inventory decreases.

The CESEC emulation is activated via the flag SGS_TUBE_AREA_OPTION. If this flag is True, then the alternate, CESEC emulation model computes the degradation as a function of the total liquid mass in the steam generator. For steam generator i:

- When the total mass < SGS_MASS_ZERO_TUBE_AREA(i), then the heat transfer is completely degraded to zero.

- When the total mass > SGS_MASS_FULL_TUBE_AREA(i), there is no degradation.

- When the total mass is between these two masses, the degradation is linearly interpolated.

This model should not be used in realistic calculations, but only when it is required to match the CESEC methodology.

E.6 References

E.1 LD-82-001-P, Enclosure 1-P, "CESEC, Digital Simulation of a Combustion Engineering Nuclear Steam Supply System," January 6, 1982.

TABLE E.1
INPUTS FOR CESEC EMULATION

Variable Names (dimension) Short	Long	CESEC Vector	Definition
***** MODERATOR DENSITY CALCULATION *****			
KFLDEN	POW_KIN_MOD_DENSITY_OPTION		Flag for moderator reactivity by cold edge moderator density
KFDH	POW_KIN_DH_FACTOR		Core enthalpy rise adjustment factor
KWEDGE	POW_KIN_EDGE_WEIGHT		Weight factor for edge temperatures and enthalpies
***** HERMITE CREDIT CALCULATION *****			
KOPHER	POW_KIN_HERM_CREDIT_OPTION		Flag for Hermite 3-D reactivity feedback credit
KTDHER	POW_KIN_HERM_TD	A(5500)	Time delay after Scram for taking Hermite credit
KMLHER	POW_KIN_HERM_MULT	A(5501)	Fraction of Hermite credit taken
KTLTMN	POW_KIN_TEMP_TILT_MIN	A(5502)	Temperature tilt (negative) below which ΔT_{TILT} is set to zero
KPTWMN	POW_KIN_POWTOFLOW_MIN	A(5503)	Minimum power to flow ratio
KWFRMN	POW_KIN_FLOWFRAC_MIN	A(5504)	Minimum flow fraction for which the Hermite credit tables are valid
KTLTMX	POW_KIN_TEMP_TILT_MAX	A(5505)	Maximum temperature tilt for which the Hermite credit tables are valid
KPTWMX	POW_KIN_POWTOFLOW_MAX	A(5506)	Maximum power to flow ratio for which Hermite credit tables are valid
KPHER	POW_KIN_HERM_POW_REF	A(5508)	Power to which powers are normalized in the Hermite credit data
KWHER	POW_KIN_HERM_FLOW_REF	A(5509)	Flow to which flows are normalized in the Hermite credit data
KNWFR	POW_KIN_HERM_N_FLOWFR	A(5510)	Number of flow fractions in the POW_KIN_CORE_W_FRACTAB array
KWFHET	POW_KIN_CORE_W_FRACTAB (1:8)	A(5511-8)	Core flow fractions for the Hermite 3-D reactivity credit tables
KRHER	POW_KIN_HERM_CREDITTAB (1:350)		Hermite 3-D reactivity credit tables. *See description on next page.*

Structure of the array POW_KIN_HERM_CREDITTAB(1:350)

The array POW_KIN_HERM_CREDITTAB has several different variables as its elements which follow exactly the CESEC structures. The elements are:

- ***Begin repeat block for first flow fraction***

Element (1) : Table number (=1) of reactivity vs. temperature tilt and vs. power to flow ratio, for the first flow, POW_KIN_CORE_W_FRACTAB(1).

Element (2) : Degree of Lagrangian interpolation.

Element (3) : Number of table entries for temperature tilt (NX).

Element (4) : Number of table entries for power to flow ratio (NY).

Elements (5),...,(4+NX) : Temperature tilt entries.

Elements (5+NX),...,(4+NX+NY) : Power to flow ratio entries.

Elements (5+NX+NY),...,(4+NX+NY+NY) : Reactivity feedback entries for the first flow fraction, POW_KIN_CORE_W_FRACTAB(1), and the first temperature tilt, POW_KIN_HERM_CREDITTAB(5), for all NY power to flow ratios.

Elements (5+NX+NY+NY),...,(4+NX+NY+2*NY) : Reactivity feedback entries for the first flow fraction, POW_KIN_CORE_W_FRACTAB(1), and the second temperature tilt, POW_KIN_HERM_CREDITTAB(6), for all NY power to flow ratios.

•
•
•

Elements (5+NX+NY+(NX-1)*NY),...,(4+NX+NY+NX*NY) : Reactivity feedback entries for the first flow fraction, POW_KIN_CORE_W_FRACTAB(1), and the NX'th temperature tilt, POW_KIN_HERM_CREDITTAB(4+NX), for all NY power to flow ratios.

- ***End repeat block for first flow fraction***

- ***Begin repeat block for second flow fraction***

Element (5+NX+NY+NX*NY) : Table number (=2) of reactivity vs. temperature tilt and vs. power to flow ratio, for the second flow, POW_KIN_CORE_W_FRACTAB(2).

•
•
•

The pattern of the first table repeats for each of the POW_KIN_HERM_N_FLOWFR entries in POW_KIN_CORE_W_FRACTAB().

APPENDIX F CETOP LINK

CETOP is a quick-running program to compute DNBR (Reference F.1). It has been approved for use on C-E designed plants.

CENTS provides a link to the CETOP program to calculate DNBR based on the RCS system response calculated by CENTS. The link is done directly through the computer memory, and affects neither the CENTS nor the CETOP calculation. This link eliminates the need for utility codes to manipulate the CENTS output into CETOP input format. When this link is activated:

- CETOP is called periodically from within CENTS;
- CETOP receives its thermal-hydraulic input from the CENTS calculation;
- CETOP sends its output to CENTS for processing by the user.

The CENTS/CETOP link is controlled by the "CETOP" command, which is described below. The data passed between CENTS and CETOP is contained in the data partition CETOP_LINK. The variables within that partition are described in detail below.

The CETOP base deck is a separate file that is not a part of the CENTS data base and is not saved as part of the SNAPshot. The CETOP command must be used to read the CETOP base deck for every CENTS run.

F.1 The CETOP Command

Syntax: CETOP {INPUT = (*in-filespec*) }
{OUTPUT = (*out-filespec* {,REPLACE})}
{TAPE8 = (*tape8-filespec* {,REPLACE})}
{DT = *interval*}
{On | Off}
CETOP CLEAR
CETOP

Description:

- INPUT = (*in-filespec*)
  - Open the CETOP base deck file for reading only.
  - Call CETOP to execute this file.
  - Basedeck values from this file are used for subsequent CETOP execution, except for the parameters which are over-written by CENTS calculated values, as described below.
  - If INPUT includes stacked cases, all of the cases are executed. The calculation will use the last set of basedeck values.
- OUTPUT = (*out-filespec*)
  - Open an output file with the given name for the standard (long) CETOP output. If *out-filespec* does not include an extension, the extension ".out" is appended.
  - If "OUTPUT = (*out-filespec*)" is not provided, CENTS will select a file name *cetpnnn.out*.

- TAPE8 = (*tape8-filespec*)
  - Open an output file with the given name for the standard (short) CETOP output. If *tape8-filespec* does not include an extension, the extension ".tp8" is appended.
  - If "TAPE8 = (*tape8-filespec*)" is not provided, CENTS will select a file name *cetpnnn.tp8*.
- DT = *interval*
  - Set the time interval (seconds) for executing CETOP.
- ON / OFF
  - Activate / suspend the execution of CETOP.
  - "ON" causes the execution to proceed normally.
  - "OFF" causes the CENTS-CETOP link to be inactive. CETOP is not called, and the data exchange between CENTS and CETOP does not take place. However, file definitions, CETOP basedeck values, time step size, etc, remain defined.
- CLEAR
  - CETOP files are closed. No further CETOP calculations are performed. File definitions, CETOP basedeck values, time step size, etc, become undefined.
- (NO FUNCTION GIVEN)
  - Display a summary of the current CETOP control setup. The summary lists the names of the current input and output files, the time interval for executing CETOP, and the settings of the two flags which define the way the Fr and pressure to CETOP is determined.

F.2 Associated CENTS Variables

The CENTS partition CETOP_LINK contains the data that passes back and forth between CETOP and CENTS. It has three sub-partitions, for the outputs from CETOP, the inputs passed by CENTS to CETOP, and the parameters used by CENTS to calculate certain inputs to CETOP.

Outputs from CETOP

Output values are passed from CETOP to CENTS. These are the standard CETOP summary information. The CETOP output are stored in the subpartition CETOP_OUT which consists of the following variables:

CETOP_OUT_CASE	CETOP out: Case number	Fraction
CETOP_OUT_QDBL	CETOP out: Heat flux	MegBtu/hr-ft^2
CETOP_OUT_POLR	CETOP out: Power operating limit	Fraction
CETOP_OUT_TIN	CETOP out: Inlet temperature	Degree F
CETOP_OUT_PIN	CETOP out: Pressure	Psia
CETOP_OUT_GAVG	CETOP out: Core average mass velocity	10^6 lbm/hr-ft^2
CETOP_OUT_ASI	CETOP out: Axial shape index	Ratio
CETOP_OUT_NRAD	CETOP out: Peripheral axial shape index	Fraction
CETOP_OUT_P1MAX	CETOP out: Max radial avg peaking factor	Fraction
CETOP_OUT_DNB-N	CETOP out: Min DNBR at final iteration	Fraction
CETOP_OUT_X-N	CETOP out: Quality at final iteration	Fraction
CETOP_OUT_DNB-1	CETOP out: Min DNBR at first iteration	Fraction
CETOP_OUT_X-1	CETOP out: Quality at first iteration	Fraction
CETOP_OUT_QUIX	CETOP out: QUIX file case number	Fraction
CETOP_OUT_ITER	CETOP out: Number of iterations	Fraction
CETOP_OUT_IEND	CETOP out: Iter code: 1 => DNBR conv'd	Fraction
CETOP_OUT_ATR	CETOP out: Avg enthalpy transport coeff	Composite Units
CETOP_OUT_HCH	CETOP out: Min DNBR hot channel number	Pointer
CETOP_OUT_MNOD	CETOP out: Min DNBR node location	Pointer

Inputs to CETOP

The data that is passed from CENTS to CETOP is stored in the subpartition CETOP_IN which consists of the following variables:

CETOP_IN_TIME	CENTS simulation time. Equals CENTS variable TIME. Replaces CETOP vector #93.	Seconds
CETOP_IN_FLOW_FRAC	Core inlet flow normalized by the initial core inlet flow. Equals CENTS variable CTL_CORE_FLOW_FRAC. The CETOP mass flow specified by CETOP vector #1 is multiplied by this factor.	Fraction
CETOP_IN_INLET_TEMP	Core inlet temperature. Equals CENTS variable CHT_TEMP_COOL(1). Replaces CETOP vector #3.	Degree F
CETOP_IN_CORE_PRESSURE	Core pressure. Replaces CETOP vector #4. If CETOP_PRESS_OPT=F: Equals CENTS variable PRESS(NODE_CORE). If CETOP_PRESS_OPT=T: A constant *input* pressure.	Psia
CETOP_IN_HEAT_FLUX_FRAC	Core average heat flux normalized by the heat flux at full power. Equals CENTS variable CTL_HEAT_FLUX_FRAC. The CETOP heat flux specified in CETOP vectors 2 and 102 are multiplied by this factor	Fraction
CETOP_IN_FR_USER_MULT	User specified multiplier (first of two multipliers) on the CETOP radial peak Fr given by CETOP input vector #58. The user sets (or RAMPs) this multiplier to account for radial effects such as the increase in Fr due to a dropped CEA. This variable should normally be set to 1.0.	Fraction
CETOP_IN_FR_TEMP_MULT	Temperature driven multiplier (second of two multipliers) on the CETOP radial peak Fr given by CETOP input vector #58. This factor accounts for the increase in core peaking due to changes in core inlet temperature. It is calculated by CENTS based on current path temperatures (see Case Control variables, below): = 1.0 + CETOP_FR_DERIV * | CETOP_FR_DEL_TEMP |	Fraction

Case Control

A few CENTS variables control the way CENTS transient data is processed before being passed to CETOP:

CETOP_PRESS_OPT	User input option flag to use constant pressure in the DNBR calculation. The default is False, so that CETOP receives the current value of core pressure. When True, the user must assign the constant pressure value to the variable CETOP_IN_CORE_PRESSURE.	True/False
CETOP_FR_DERIV	User input derivative of Fr with respect to temperature. See CETOP_IN_FR_TEMP_MULT, above. A typical value is 0.005 /degF. To disable the Fr temperature correction, set CETOP_FR_DERIV to 0.0 so that CETOP_IN_FR_TEMP_MULT will always be 1.0.	1 / DegF
CETOP_FR_PATH1	Path number for CETOP_FR_TEMP1.	Pointer
CETOP_FR_PATH2	Path number for CETOP_FR_TEMP2.	Pointer
CETOP_FR_TEMP1	If CETOP_FR_PATH1 > 0: Temperature in that path, set be CENTS. If CETOP_FR_PATH1 ≤ 0: Constant temperature, assigned by user. This enables the user to calculate the temperature correction based on the difference of a path temperature and a reference value. See CETOP_FR_DEL_TEMP and CETOP_IN_FR_TEMP_MULT.	Degree F
CETOP_FR_TEMP2	If CETOP_FR_PATH2 > 0: Temperature in that path, set be CENTS. If CETOP_FR_PATH2 ≤ 0: Constant temperature, assigned by user. This enables the user to calculate the temperature correction based on the difference of a path temperature and a reference value. See CETOP_FR_DEL_TEMP and CETOP_IN_FR_TEMP_MULT.	Degree F
CETOP_FR_DEL_TEMP	Temp difference for the Fr correction = CETOP_FR_TEMP2 - CETOP_FR_TEMP1	Degree F

Example

```
rest (snapshot_file)

CETOP Input  = (plant1_cetop_basedeck.inp) \
      Output = (case1_cetop_output.out)    \
      Tape8  = (case1_cetop_summary.out)   \
      DT = 0.5
!
! New variables must be set
!
CETOP_PRESS_OPT       = F        ! CETOP uses calculated core pressure
CETOP_FR_DERIV        = 0.005    ! Fr increases 0.5% per degree F
CETOP_FR_PATH1        = 1        ! CETOP_FR_TEMP1 based on core inlet path
CETOP_FR_PATH2        = 0        ! Don't update CETOP_FR_TEMP2 = user
specified
CETOP_FR_TEMP2        = (RTCLIN) ! DT is Current temp - Initial temp
CETOP_IN_FR_USER_MULT = 1.0
!
go
```

F.3 Reference

F.1 "CETOP: Thermal Margin Model Development," CE-NPSD-150-P, Rev 03, May, 2002.

APPENDIX G CENTS VARIABLE DICTIONARY

This appendix lists the elements (variables, arrays and partitions) of the CENTS data dictionary, along with a detailed description of each one and a general description of the structure of the data dictionary. For simplicity, the following discussion refers to variables, arrays and partitions as "variable".

Each variable in the CENTS data dictionary is identified by either of two names, which are completely synonymous. The Short Name is conveniently short, with a length of six characters or less. The Long Name is more descriptive, and may be up to 32 characters long. Both names are displayed in this appendix. All references in the body of this report, outside of this appendix, are to the variables' Long Names.

The variables of the CENTS variables dictionary are listed in five tables. Table G.1 lists the variables that are used by CENTS, with Long Names and full definitions. Table G.2 displays the entire dictionary (used and unused variables) in tree-structure format, with both Long and Short Names, and abbreviated definitions. Table G.3 is an alphabetized index of the variables' Long Names with corresponding index numbers, to facilitate access to Tables G.1 and G.2. Likewise, Table G.4 is an alphabetized index of the variables' Short Names with corresponding index numbers.

G.1 Variables Dictionary With Full Definitions

Table G.1 lists the variables of the CENTS variables dictionary, with full definitions.

This table lists only variables that are actually used by CENTS, and their container partitions (see "Partition" below). Unused variables are omitted from this table. Hence, the Index No. column displays gaps in the number sequence.

The information in Table G.1 is organized in eleven columns, as described below.

1. Index No.....The index numbers uniquely identify each of the variables.
2. Long Variable Name..Descriptive variable name, up to 32 characters long. Each variable also has a Short Name, which is synonymous and is up to 6 characters long. The Short Names are not shown in this table, due to space limitations. The short names are listed in Sections G.3 and G.5.
3. Input / Output.....Indicates the Input/Output status of each variable:

   Input.....The variable is used by CENTS, but is not calculated. Therefore, an input value is expected.

   Output .....The variable is calculated by CENTS. The variable may also be used by CENTS, or it may be strictly for output. Since the variable is calculated, input is generally not accepted.

   I/O .....The variable may serve as input or output, depending on status. Typically, the status is determined by an input controlling flag. The variable is calculated (output) by CENTS when the flag is in one state, but is not calculated (input or constant) when the flag is in the opposite state. Example 1: For some valve control signals, the I/O status is determined by a Auto/Manual control flag (e.g., see Section 6.4.1). Example 2: The initialization parameter SPINIT is either the input steam generator pressure or the calculated pressure, depending on the input value of the flag SGT_INIT_OPTION (Section D.1.5).

   Input / Init .....The variable is calculated by CENTS during INITIALization. Thereafter, it remains constant, unless changed by the user during a transient.

   Output / Init.....The variable is an input for system initialization. Thereafter, it is calculated as an output.

Partition.....Arrays that contain other variables. Partitions are normally organized by subject matter. E.g., CTL_FWS_CONTROL is a partition that contains feedwater setpoints, control flags, and other FW related partitions.

Segment.....The top-level partitions, representing the major plant systems. E.g., RCS_COMMON for the primary system dynamics, SGS_COMMON for the secondary system dynamics.

Input Partition .....A partition containing input variables, which may be accessed either by reference to the variables, or by reference to an element of the partition which is treated as an array. E.g., RCS_SGTR_PNODEIN(1) is also accessible as RCS_P_NODE_INLET_NONM(26) or as P_NODE_INLET(126).

Output Partition....A partition containing output variables, which may be accessed either by reference to the variables, or by reference to an element of the partition which is treated as an array. E.g., RCS_SGTR_FLOW(1) is also accessible as RCS_P_FLOW_NONM(26) or as P_FLOW(126).

Constant .....Input parameters that are treated as hard constants, e.g., 1.0, 2.0.

4. System.....Major system to which the variable belongs. E.g., RCS.
5. System Alt. 1.....Second system to which the variable belongs. E.g., pressurizer.
6. System Alt. 2.....Third system to which the variable belongs. E.g., spray.
7. Variable's Function....Categorizes the nature of the variable. E.g., plant design (number of charging pumps), model design (number of RCS nodes), flag (control system Auto/Manual).
8. Type .....Real (RE), integer (IN), logical (LO) or character (CH).

9. Dimensions .....Length of an array. For two-dimensional arrays, both dimensions appear. For single variables, the entry is blank.

10. Definition .....An explanation of the variable's function, use, method of calculations, limits, references, and more as necessary. These definitions are more detailed than the dictionary definitions listed in Table G.2 and which CENTS displays in response to interactive queries.

11. Units.....Dimensional units. E.g., ft, ft^2, lbm/sec.

G.2 Variables Dictionary in Tree Structure

Table G.2 displays the entire CENTS variables dictionary (used and unused variables) in tree-structure format, with both Long and Short Names, and abbreviated definitions.

The variables are listed in tree format, showing a multi-level equivalencing scheme. In this scheme, a variable can be designated as an element of one or more arrays that are hierarchically equivalenced to each other.

There are ten arrays in the first level of equivalencing (Section 7.6.2), labeled "Segment" in the Units column. These are subdivided into multiple levels of lower-level arrays, which are labeled "Partition". Since the partitions are organized by subject matter at their various levels, the partitioning scheme provides a convenient means of accessing groups of variables. Thus, a query of the value of a variable or of a lowest-level array yields the value(s) of that variable or array only, whereas a query for a partition yields the values of all variables and arrays (and other partition) within that partition.

Each variable in the CENTS data dictionary is identified by either of two names, which are completely synonymous. The Short Name is conveniently short, with a length of six characters or less. The Long Name is more descriptive, and may be up to 32 characters long. Both names

are displayed in Table G.2. All references in the body of this report, outside of this appendix, are to the variables' Long Names.

The information in Table G.2 is organized in eight columns, as described below.

1. Index No.....The index numbers uniquely identify each of the variables.
2. Tree-structure hierarchy.....(No title) The level of each variable in the tree structure is indicated by indentation filled with periods.
3. Variable Name: Short .....Short variable name, up to 6 characters long. The Short Names are indexed in Section G.5.
4. Variable Name: Long.....Descriptive variable name, up to 32 characters long. The Long Names are indexed in Section G.4.
5. Type .....Real (RE), integer (IN), logical (LO) or character (CH).
6. Dimensions .....Length of an array. For two-dimensional arrays, both dimensions appear. For single variables, the entry is blank.
7. Definition .....An abbreviated explanation of the variable's function. These definitions are identical to the one-line definitions that CENTS displays in response to interactive queries. They are more concise than the detailed definitions given in Table G.1.
8. Units.....Dimensional units. E.g., ft, ft^2, lbm/sec.

G.3 Alphabetized Index of Long Variable Names

Table G.3 provides a complete listing of all variables, arrays and partitions in the CENTS data dictionary. The variables appear alphabetized by their Long Names, along with their index numbers for easy reference to any of the other tables in this appendix.

G.4 Alphabetized Index of Short Variable Names

Table G.4 provides a complete listing of all variables, arrays and partitions in the CENTS data dictionary. The variables appear alphabetized by their Short Names, along with their index numbers for easy reference to any of the other tables in this appendix.

G.5 References

The following documents are referenced in the Definition column of Table G.1. For convenience, the referencing there is done without the prefix G; e.g., "Reference 1" or "Ref. 2".

G.1 This document.

G.2 CE-CES-59-P, Rev. 004, "Modeler's Manual for the CENTS Generic Control Systems," December 2002.

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1	CHR_COMMON	Segment	CEER				CH		Character string data. All character string information is collected in this segment.	Segment
2	PLANT_DATA_LABEL	Partition	CEER				CH		ID information for the static plant data snapshot file (*._st).	Partition
3	PLANT_DATA_FILE_NAME	Output	CEER			Snap Info	CH		File name of the static plant data snapshot (70 characters). Set by CEER based on the SNAP command's "STATIC (filename)" parameter. Displayed during processing of REST command.	Character
4	PLANT_DATA_TITLE	Input	CEER			Snap Info	CH		Descriptive title of the static plant data snapshot (70 characters). Set by User before SNAP: PLANT_DATA_TITLE = "title text". Displayed during processing of REST command.	Character
5	PLANT_DATA_TIME	Output	CEER			Snap Info	CH		Creation time stamp of the static plant data snapshot (10 characters). Set by CEER during processing of SNAP command. Displayed during processing of REST command.	Character
6	PLANT_DATA_DATE	Output	CEER			Snap Info	CH		Creation date stamp of the static plant data snapshot (10 characters). Set by CEER during processing of SNAP command. Displayed during processing of REST command.	Character
7	SNAPSHOT_LABEL	Partition	CEER				CH		ID information for the dynamic data snapshot file (*._dy).	Partition
8	SNAPSHOT_FILE_NAME	Output	CEER			Snap Info	CH		File name of the dynamic data snapshot (70 characters). Set by CEER based on the SNAP command's "SNAP (filename)" parameter. Displayed during processing of REST command.	Character
9	SNAPSHOT_TITLE	Input	CEER			Snap Info	CH		Descriptive title of the dynamic data snapshot (70 characters). Set by User before SNAP: SNAPSHOT_TITLE = "title text". Displayed during processing of REST command.	Character
10	SNAPSHOT_TIME	Output	CEER			Snap Info	CH		Creation time stamp of the dynamic data snapshot (10 characters). Set by CEER during processing of SNAP command. Displayed during processing of REST command.	Character
11	SNAPSHOT_DATE	Output	CEER			Snap Info	CH		Creation date stamp of the dynamic data snapshot (10 characters). Set by CEER during processing of SNAP command. Displayed during processing of REST command.	Character
12	CTL_TITLE	Output	Control			Title Info	CH	1000	Titles of the Control Groups (60 characters). Set by the Control System Input Processor (CSIP) based on titles in the control system input. Displayed by the CSIP when processing the PRINT(F) directive. Reference 2.	Character
13	PLT_DATA	Segment					RE	25000	Static plant data	Segment
18	PLT_RCS	Partition					RE	2350	Static RCS plant data	Partition
19	PLT_RCS_DESIGN	Partition					IN	10	RCS design features	Partition
20	NUM_SG	Input	RCS	SGS		Plant Design	IN		Number of steam generators, up to 4. Plant design dependent. CENTS uses this parameter to determine the nodal structure required by the model. Reference 1, Section 7.2.1.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
22	NUM_PROP_HEATERS	Input	PZR	Heaters	PPCS	Plant Design	IN		Number of proportional heater banks in the pressurizer. Plant design dependent. This parameter can be set to the number of banks, or for simplicity, all the proportional banks may be lumped into one. The advantage to multiple banks is the ability to model failures of individual groups of heaters. The total number of proportional & backup heater groups is limited: NUM_PROP_HEATERS + NUM_BACK_HEATERS ≤ 6.	Counts
23	NUM_BACK_HEATERS	Input	PZR	Heaters	PPCS	Plant Design	IN		Number of backup heater banks in the pressurizer. Plant design dependent. This parameter can be set to the number of banks, or for simplicity, all the backup banks may be lumped into one. The advantage to multiple banks is the ability to model failures of individual groups of heaters. The total number of proportional & backup heater groups is limited: NUM_PROP_HEATERS + NUM_BACK_HEATERS ≤ 6.	Counts
24	NUM_CHGS_PUMPS	Input	CVCS	PLCS	PZR	Plant Design	IN		Number of charging pumps, up to 4. Plant design dependent. This parameter indicates the expected number of entries for other arrays of charging pump related variables and controls.	Counts
25	RCS_NUM_MSPRAYVLVS	Input	PZR	PPCS	Spray	Plant Design	IN		Number of pressurizer main spray valves, up to 2. Plant design dependent. This parameter indicates the expected number of entries for other arrays of spray valve related variables and controls.	Counts
26	RCS_NUM_PORVS	Input	PZR	PPCS	PORV	Plant Design	IN		Number of pressurizer PORVs, up to 4. Plant design dependent. This parameter indicates the expected number of entries for other arrays of PORV related variables and controls.	Counts
27	RCS_NUM_SAFETYVLVS	Input	PZR	PSV	Valves	Plant Design	IN		Number of pressurizer safety valves, up to 4. Plant design dependent. This parameter indicates the expected number of entries for other pressurizer safety valve related arrays.	Counts
28	MOD_INIT	System				Flag	LO		Cue for to force initialization and error checking of the Control System. Automatically set by the code to FALSE, except TRUE during the first cycle of INITIAL, immediately after REST, after a variable assignment (from command file, keyboard or triggered WHEN), or upon a CONTROL command.	True False
29	MOD_INITV	System				Flag	LO		Cue for to force initialization and error checking of the process models' internal arrays. Automatically set by the code to FALSE, except TRUE during the first cycle of INITIAL, immediately after REST, after a variable assignment (from command file, keyboard or triggered WHEN), or during an active RAMP.	True False
30	PLT_RCS_NODE	Partition					RE	900	Static RCS nodes data	Partition
31	PLT_RCS_NODALIZATION	Partition					IN	50	RCS nodalization data	Partition
32	RCS_NODE_TOTALS	Partition					IN	6	RCS total number of nodes per group	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
33	NUM_NODES	Input	RCS	Nodes		Plant Design Model Design	IN		Total number of nodes, up to 30. For CE design plants with 2 SGs, this parameter is typically set to 17 (if 2 nodes/SG) or 21 (if 4 nodes/SG). For Westinghouse design plants, it is typically set to 20 with 3 SGs, and 25 with 4 SGs. This parameter determines the expected number of entries for other RCS node related arrays. Reference 1, Section 7.2.1.	Counts
34	NUM_NODES_SEC	Input	RCS	Nodes		Model Design	IN		Number of nodes that are sectionalized for heat transfer calculations. Must equal 1. The core node is the only node that is sectionalized for heat transfer. Reference 1, Sect. 4.8.1.	Counts
35	NUM_SG_NODES	Input	RCS	Nodes	SG	Plant Design Model Design	IN		Number of SG nodes (16 max). Each SG's tubes are divided into 2 or 4 nodes. The hot side from the top of the tube sheet to the top of the bundle, and the cold side from the top of the bundle to the top of the tube sheet, are each represented by 1 or 2 nodes. If using 4 nodes per SG, then the two lower nodes also includes the plena. NUM_SG_NODES / NUM_SG must equal exactly 2 or 4. Reference 1, Section 7.2.1.	Counts
36	NUM_HL_NODES	Input	RCS	Nodes		Plant Design	IN		Number of hot leg nodes, up to 4. Dependent on plant design.	Counts
37	NUM_SL_NODES	Input	RCS	Nodes		Plant Design	IN		Number of suction cold leg nodes, up to 4. Dependent on plant design. Note the two suction legs exiting from each CE design SG are lumped together as one node. Reference 1, Section 7.2.1.	Counts
38	NUM_CL_NODES	Input	RCS	Nodes		Plant Design	IN		Number of discharge cold leg nodes, up to 4. Dependent on plant design. Reference 1, Section 7.2.1.	Counts
39	RCS_NODE_NUMBERS	Partition					IN	30	RCS node numbers	Partition
40	RCS_NODE_HL	Partition					IN	4	Array of hot leg node numbers. NUM_HL_NODES entries are expected.	Partition
41	NODE_HL1	Input	RCS	Nodes		Model Design	IN		Hot leg 1 node number. Reference 1, Section 7.2.1.	Pointer
42	NODE_HL2	Input	RCS	Nodes		Model Design	IN		Hot leg 2 node number. Reference 1, Section 7.2.1.	Pointer
43	NODE_HL3	Input	RCS	Nodes		Model Design	IN		Hot leg 3 node number. Reference 1, Section 7.2.1.	Pointer
44	NODE_HL4	Input	RCS	Nodes		Model Design	IN		Hot leg 4 node number. Reference 1, Section 7.2.1.	Pointer
45	NODE_SG	Input Partition	RCS	Nodes		Plant Design Model Design	IN	16	Array of primary-side SG node numbers, in any order. NUM_SG_NODES entries are expected. Reference 1, Section 7.2.1.	Pointer
46	NODE_SG1H	Input	RCS	Nodes	SG	Model Design	IN		First element of NODE_SG.	Pointer
47	NODE_SG1C	Input	RCS	Nodes	SG	Model Design	IN		Second element of NODE_SG.	Pointer
48	NODE_SG2H	Input	RCS	Nodes	SG	Model Design	IN		Third element of NODE_SG.	Pointer
49	NODE_SG2C	Input	RCS	Nodes	SG	Model Design	IN		Fourth element of NODE_SG.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
50	NODE_SG3H	Input	RCS	Nodes	SG	Model Design	IN		Fifth element of NODE_SG.	Pointer
51	NODE_SG3C	Input	RCS	Nodes	SG	Model Design	IN		Sixth element of NODE_SG.	Pointer
52	NODE_SG4H	Input	RCS	Nodes	SG	Model Design	IN		Seventh element of NODE_SG.	Pointer
53	NODE_SG4C	Input	RCS	Nodes	SG	Model Design	IN		Eighth element of NODE_SG.	Pointer
54	NODE_CL	Partition					IN	4	Array of discharge cold leg node numbers. NUM_CL_NODES entries are expected.	Pointer
55	NODE_CL1	Input	RCS	Nodes		Model Design	IN		Discharge cold leg node number, loop 1. Reference 1, Section 7.2.1.	Pointer
56	NODE_CL2	Input	RCS	Nodes		Model Design	IN		Discharge cold leg node number, loop 2. Reference 1, Section 7.2.1.	Pointer
57	NODE_CL3	Input	RCS	Nodes		Model Design	IN		Discharge cold leg node number, loop 3. Reference 1, Section 7.2.1.	Pointer
58	NODE_CL4	Input	RCS	Nodes		Model Design	IN		Discharge cold leg node number, loop 4. Reference 1, Section 7.2.1.	Pointer
59	RCS_NODE_SL	Partition					IN	4	Array of suction cold leg node numbers. NUM_SL_NODES entries are expected.	Partition
60	NODE_SG1P	Input	RCS	Nodes		Model Design	IN		Suction cold leg node number, loop 1. Includes SG outlet plenum, suction cold leg and loop seal. Reference 1, Section 7.2.1.	Pointer
61	NODE_SG2P	Input	RCS	Nodes		Model Design	IN		Suction cold leg node number, loop 2. Includes SG outlet plenum, suction cold leg and loop seal. Reference 1, Section 7.2.1.	Pointer
62	NODE_SG3P	Input	RCS	Nodes		Model Design	IN		Suction cold leg node number, loop 3. Includes SG outlet plenum, suction cold leg and loop seal. Reference 1, Section 7.2.1.	Pointer
63	NODE_SG4P	Input	RCS	Nodes		Model Design	IN		Suction cold leg node number, loop 4. Includes SG outlet plenum, suction cold leg and loop seal. Reference 1, Section 7.2.1.	Pointer
64	RCS_NODE_OTHERS	Partition					IN	10	Array of remaining node numbers	Partition
65	NODE_CORE	Input	RCS	Nodes	Core	Model Design	IN		Core node number. Reference 1, Section 7.2.1.	Pointer
66	NODE_PRZR	Input	RCS	Nodes	PZR	Model Design	IN		Pressurizer node number. Reference 1, Section 7.2.1.	Pointer
67	NODE_UHEAD	Input	RCS	Nodes	RV	Model Design	IN		RV upper head node number. Reference 1, Section 7.2.1.	Pointer
68	NODE_ANNUL	Input	RCS	Nodes	RV	Model Design	IN		RV annulus node number. Reference 1, Section 7.2.1.	Pointer
69	NODE_CEASH	Input	RCS	Nodes	RV	Model Design	IN		CEA shroud node number. Reference 1, Section 7.2.1.	Pointer
70	RCS_NODE_GEOMETRY	Partition					RE	250	RCS node geometry variables	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
71	NODE_AREA	Input	RCS	Nodes		Dimension	RE	50	Node average cross sectional areas. Plant dependent. This area must be defined as the ratio of node fluid volume to node height (volume/height), where the volume is derived from plant drawings and data documents, and the height is NODE_HEIGHT. NUM_NODES entries are expected. Reference: Individual plant basedeck calculations.	Ft^2
72	NODE_HEIGHT	Input	RCS	Nodes		Dimension	RE	50	Node heights. Plant dependent. Defined as the difference between the top and bottom elevations of the node, which are normally dependent upon some logical physical boundary, and are obtained from plant drawings and data documents. NUM_NODES entries are expected. Reference: Individual plant basedeck calculations.	Feet
73	N_BOT	Input	RCS	Nodes		Dimension	RE	50	Node bottom elevations, relative to a reference datum (zero elevation). The bottom elevations are plant dependent, and are derived from plant drawings and data documents. NUM_NODES entries are expected. The reference datum is arbitrary, but must be consistent for all base deck elevations, except where specifically defined differently. The reference datum is typically defined either at the lowest elevation in the RCS (usually at the bottom of the reactor vessel) or at the hot leg centerline. Reference: Individual plant basedeck calculations.	Feet
74	N_GEOM	Input	RCS	Nodes		Model Design	IN	50	Node geometry indicators (Reference 1, Section 7.2.1): 0 = Vertical node. The cross-sectional area of horizontal slices is vertically uniform. 1 = Horizontal-pipe node. The cross-section of vertical slices is circular and horizontally uniform. NUM_NODES entries are expected.	Pointer
75	N_SECTIONS	Input	RCS	Nodes	Core	Model Design	IN	50	Number of axial sections in each node for segmented heat transfer calculations (node 1: max 22; rest: max 1). Node 1 (the core node) is modeled with 1 section below the active fuel, CHT_NUM_NODE (typically 12) sections within the active fuel, and 1 section above the active fuel; therefore N_SECTIONS(1) must equal CHT_NUM_NODE+2. All other nodes can only have one section. (However, the pressurizer and RV annulus are geometrically "segmented" to allow proper determination of water level vs. height.) NUM_NODES entries are expected. Reference 1, Sect. 4.8.1	Counts
76	RCS_NODE_TH_VARS	Partition					RE	500	RCS node thermal-hydraulic constants	Partition
77	N_HEAT_XFER_LIQ	Input	RCS	Nodes		T/H Dimension	RE	50	Node wall-to-liquid overall heat transfer coefficients (h*A). Plant dependent. NUM_NODES entries are expected. When calculating this parameter, it is common to assume an infinite surface heat transfer coefficient; therefore, the overall heat transfer coefficient is conductivity limited, and depends on the thickness and conductivity of the metal. This parameter is based on the total surface area in contact with RCS fluid. Reference: Individual plant basedeck calculations.	Btu/sec-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
78	N_HEAT_XFER_STM	Input	RCS	Nodes		T/H Dimension	RE	50	Node wall-to-steam overall heat transfer coefficients (h*A). Plant dependent. NUM_NODES entries are expected. Calculated as surface heat transfer coefficient (usually assumed at 10 Btu/hr-F-ft^2) x the total metal surface area in contact with RCS fluid. Reference: Individual plant basedeck calculations.	Btu/sec-degF
79	N_HEAT_XFER_CONT	Input	RCS	Nodes		T/H Dimension	RE	50	Node wall-to-containment overall heat transfer coefficients (h*A). Plant dependent. NUM_NODES entries are expected. Surface heat transfer coefficient is dependent upon the quality and tightness of the insulation surrounding the outside of the RCS components. Often calculated based on an approximate heat loss flux at hot conditions (typical value is 65 Btu/hr-ft^2). This is multiplied by the metal surface area or insulation area in contact with the containment atmosphere, and is divided by the coolant-containment temperature difference. Reference: Individual plant basedeck calculations.	Btu/sec-degF
80	N_HEAT_XFER_BOT	Input	RCS	Nodes		T/H Dimension	RE	50	Node bottom wall-to-liquid heat transfer coefficients. Not used if a node contains only steam or gas. This variable is usually set to zero for all nodes except the pressurizer and the RV upper head. NUM_NODES entries are expected. Reference: Individual plant basedeck calculations.	Btu/sec-ft^2-degF
81	N_HEAT_CAP	Input	RCS	Nodes		T/H Dimension	RE	50	Node wall heat capacities. Plant dependent. NUM_NODES entries are expected. This variable is the sum of the products of mass x specific heat capacity of all of the metal components in each of the nodes. Reference: Individual plant basedeck calculations.	Btu/degF
82	N_XFER_BOIL	Input	RCS	Nodes		T/H Dimension	RE	50	Node boiling heat transfer coefficients. Determines the rate of vaporization at the liquid-steam interface of any node that contains both liquid and superheated steam simultaneously. This is a very minor effect, and this parameter is usually set to zero for all nodes. NUM_NODES entries are expected.	Btu/sec-degF
83	N_XFER_INJ	Input	RCS	Nodes		T/H Multplier	RE	50	Node liquid injection condensation rate multipliers. Multiplies the condensation of steam on cold liquid that enters a node in that node's steam space (except for the pressurizer spray) if the node is in thermal nonequilibrium. This multiplier is independent of plant design. It is used only for tuning or testing, and should always be set to 1.0 in actual transients for all nodes. NUM_NODES entries are expected.	Dimensionless
84	XFER_SURF_POFF	Input	RCS	Nodes		T/H Dimension	RE	50	Node surface condensation coefficients (pump off). Used when a node is in thermal nonequilibrium. This array and XFER_SURF_PON are heat transfer coefficients for condensation at each node's liquid-steam interface. XFER_SURF_PON applies when the RCPs are running, and XFER_SURF_POFF applies when the RCPs are idle. These coefficients are independent of plant design. The values that are used for the quiescent and turbulent conditions are typical physical coefficients for such conditions. NUM_NODES entries are expected.	Btu/sec-ft^2-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
85	XFER_SURF_PON	Input	RCS	Nodes		T/H Dimension	RE	50	Node surface condensation coefficients (pump on). Used when a node is in thermal nonequilibrium. This array and XFER_SURF_POFF are heat transfer coefficients for condensation at each node's liquid-steam interface. XFER_SURF_PON applies when the RCPs are running, and XFER_SURF_POFF applies when the RCPs are idle. These coefficients are independent of plant design. The values that are used for the quiescent and turbulent conditions are typical physical coefficients for such conditions. NUM_NODES entries are expected.	Btu/sec-ft^2-degF
86	AREA_INJ_MULT	Input	RCS	Nodes		T/H Multplier	RE	50	Interfacial condensation area multipliers. This is completely redundant to N_XFER_INJ, and should always be set to 1.0 for all nodes. NUM_NODES entries are expected.	Dimensionless
87	RCS_NODE_SECTIONALIZED	Partition					RE	100	RCS sectionalized nodes variables	Partition
88	RCS_PRZR_NSECT	Input	PZR	RCS		Model Design	IN		Number of segments in the pressurizer (max. of 3). Normally set at 3, for the lower head, cylindrical section and upper head. The segmenting of the pressurizer supports accurate determination of mixture level as a function of mixture volume within the node. Reference: Individual plant basedeck calculations.	Counts
89	RCS_PRZR_ASECT	Input	PZR	RCS		Dimension	RE	3	Cross-sectional areas of the segmented pressurizer's sections. Each section's area is calculated by dividing the section volume by its height. The bottom head volume also includes that of the surge line. Reference: Individual plant basedeck calculations. Plant dependent.	Ft^2
90	RCS_PRZR_HSECT	Input	PZR	RCS		Dimension	RE	3	Heights of the segmented pressurizer's sections. The sum of the heights must equal NODE_HEIGHT() of the pressurizer node (NODE_PRZR). Reference: Individual plant basedeck calculations. Plant dependent.	Feet
91	RCS_ANNUL_NSECT	Input	RCS	Annulus		Model Design	IN		Number of segments in the node representing the RV annulus / lower plenum (max. of 3). Normally set at 3, for the lower vessel head, the flow skirt region and the annulus section. The segmenting of the RV annulus supports accurate determination of liquid level as a function of liquid volume within the node. Reference: Individual plant basedeck calculations.	Counts
92	RCS_ANNUL_ASECT	Input	RCS	Annulus		Dimension	RE	3	RV annulus cross-sectional areas. Each segment's area is calculated by dividing the segment volume by its height. Reference: Individual plant basedeck calculations.	Ft^2
93	RCS_ANNUL_HSECT	Input	RCS	Annulus		Dimension	RE	3	Heights of the segmented annulus sections. The sum of the heights must equal NODE_HEIGHT() of the annulus node (NODE_ANNUL). Reference: Individual plant basedeck calculations. Plant dependent.	Feet
94	N_AREA_SECT	Input	RCS	Core		Dimension	RE	1, 22	Cross-sectional areas of the segmented core's sections (node,section). N_SECTIONS(1) entries are expected -- 1 section below the active fuel, N_SECTIONS(1)-2 sections within the active fuel, and 1 section above the active fuel. Each section's area is calculated by dividing the section volume by its height. Reference: Individual plant basedeck calculations. Plant dependent.	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
95	N_HEIGHT_SECT	Input	RCS	Core		Dimension	RE	1, 22	Heights of the segmented core's sections (node,section). N_SECTIONS(1) entries are expected. The first section's height is the height within Node 1 below the active core. The last section's height is the height within Node 1 above the active core. The active core region height is divided by N_SECTIONS(1)-2 to attain the individual section heights for those sections. The total height of all N_SECTIONS(1) sections must be identical to NODE_HEIGHT(1). The total volume, i.e. the sum of the products of N_AREA_SECT(i) * N_HEIGHT_SECT(i) for all N_SECTIONS(1) pairs, must equal the product NODE_HEIGHT(1) * NODE_AREA(1). Reference: Individual plant basedeck calculations. Plant dependent.	Feet
96	PLT_RCS_PATH	Partition					RE	1400	Static RCS flow paths data	Partition
97	RCS_PATHS_NODALIZATION	Partition					IN	60	RCS paths nodalization variables	Partition
98	RCS_PATHS_TOTALS	Partition					IN	25	RCS flow paths totals	Partition
99	NUM_PATHS_MOM	Input	RCS	Paths		Model Design	IN		Number of momentum paths (50 max). Usually established based on plant design (CE or W). Determines the size of the active input array of momentum path variables. Reference: Individual plant basedeck calculations.	Counts
100	NUM_PATHS_EXT	Input	RCS	Paths		Model Design	IN		Number of external flow paths (25 max). External flow paths include charging, letdown, SIS, SDC (RHR), RCW drains, RCP seal controlled leaks, and gas injection paths. This variable should be set to the maximum of 25, independent of plant design.	Counts
101	NUM_PATHS_LEAK	Input	RCS	Paths		Model Design	IN		Number of leak flow paths (17 max). Leak flow paths include SGTR paths, SBLOCA and LBLOCA flow paths, rod ejection leak path, and RV O-ring seal leak path. This variable should be set to the maximum of 17, independent of plant design.	Counts
102	NUM_PATHS_INT	Input	RCS	Paths		Model Design	IN		Number of internal flow paths (8 max). Internal flow paths include spray, spray bleed, pressurizer reliefs and upper head vents. This variable is set to the maximum of 8, independent of plant design.	Counts
103	NUM_PATHS	Input	RCS	Paths		Model Design	IN		Total number of flow paths. Set to 100, independent of plant design.	Counts
104	NUM_SML_BRK	Input	RCS	Paths		Model Design	IN		Number of Small Break leak flow paths (4 max). Set to the maximum of 4.	Counts
105	NUM_PATHS_HL	Input	RCS	Paths		Model Design	IN		Number of hot leg flow paths (8 max) connecting the core node's upper plenum to the hot leg nodes. This is set to the actual number of hot leg flow paths used, 2*NUM_HL_NODES (i.e., 2 per hot leg, one in the upper half and one in the lower half of the pipe).	Counts
106	NUM_PATHS_CL	Input	RCS	Paths		Model Design	IN		Number of cold discharge leg flow paths (8 max) connecting the discharge cold leg nodes to the RV annulus node. This is set to the actual number of cold leg flow paths used, 2*NUM_CL_NODES (i.e. 2 per discharge cold leg, one in the upper half and one in the lower half of the pipe).	Counts
107	NUM_PATHS_NONM	Input	RCS	Paths		Model Design	IN		Number of RCS non-momentum flow paths. This parameter is set equal to the array size of 50, independent of plant design.	Counts

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
108	RCS_NUMIN_CHGS	Input	RCS	Paths	CVCS	Plant Design	IN		Number of RCS-CHGS connections (4 max). This variable is the actual number of charging inlet connections, excluding auxiliary pressurizer spray. Dependent on plant design.	Counts
109	RCS_NUMOUT_LDNS	Input	RCS	Paths	CVCS	Plant Design	IN		Number of RCS-letdown connections (4 max). This variable is the actual number of letdown outlet connections. Dependent on plant design.	Counts
110	RCS_NUMOUT_RCWDRAINS	Input	RCS	Paths	RCW	Plant Design	IN		Number of RCS-RCW drain connections (1 max). This variable is the actual number of drain connections.	Counts
111	RCS_NUMOUT_SDC	Input	RCS	Paths	SDC	Plant Design	IN		Number of RCS-SDC connections (2 max). This variable is the actual number of SDC inlet connections.	Counts
112	RCS_NUMIN_SIS	Input	RCS	Paths	SIS	Plant Design	IN		Number of RCS-SIS connections. This variable is the actual number of SIS inlet connections, typically one per discharge cold leg.	Counts
113	RCS_NUMMAX_RCP	Input	RCS	Paths	RCP	Model Design	IN		Maximum number of RCP paths. Always set to 4, independent of plant design.	Counts
114	RCS_NUMMAX_CHGSIN	Input	RCS	Paths	CVCS	Model Design	IN		Maximum number of Charging connections to the RCS, not including the auxiliary spray connection. Always set to 4 , independent of plant design.	Counts
115	RCS_NUMMAX_LDNSOUT	Input	RCS	Paths	CVCS	Model Design	IN		Maximum number of letdown connections to the RCS. Always set to 4 , independent of plant design.	Counts
116	RCS_NUMMAX_DRAINSOUT	Input	RCS	Paths	RCW	Model Design	IN		Maximum number of drains to RCW from the RCS. Always set to 1, independent of plant design.	Counts
117	RCS_NUMMAX_SDCOUT	Input	RCS	Paths	SDC	Model Design	IN		Maximum number of SDC connections to RCS (out). Always set to 2 independent of plant design.	Counts
119	RCS_NUMMAX_MOM	Input	RCS	Paths		Model Design	IN		Maximum number of momentum paths. Always set to 50, independent of plant design.	Counts
120	RCS_PATHS_NUMBERS	Partition					IN	35	RCS flow path identifying numbers	Partition
121	PATH_SURGE	Input	RCS	Paths	PZR	Model Design	IN		Surge line path number. Reference 1, Section 7.2.2.	Pointer
122	PATH_ANNUL_CORE	Input	RCS	Paths		Model Design	IN		Annulus-to-inner vessel path number. This parameter identifies the path connecting the annulus/lower-plenum node to the core node. Reference 1, Section 7.2.2.	Pointer
123	PATH_CORE_UHEAD	Input	RCS	Paths		Model Design	IN		Upper head-to-inner vessel path number. This parameter identifies the path connecting the RV upper head node to the core node. Reference 1, Section 7.2.2.	Pointer
124	PATH_SPRAY	Input	RCS	Paths	Spray	Model Design	IN		Pressurizer spray path number. This parameter identifies the path that delivers the main and auxiliary spray to the pressurizer node. Set to 93. Reference 1, Section 7.2.2.	Pointer
125	PATH_LB_LOCA	Input	RCS	Paths		Model Design	IN		Large Break LOCA path number. Set to 90. This input is required, although the LBLOCA as defined by the cue MAL_LB_LOCA is disabled. (A LOCA of any size may be defined via the SBLOCA inputs.) Reference 1, Section 7.2.2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
126	PATH_PUMP	Input	RCS	Paths	RCP	Model Design	IN	4	Array of RCP path numbers (in the same order as other RCP arrays). This array identifies the paths connecting the pump suction legs with their discharge legs. Reference 1, Section 7.2.2.	Pointer
127	PATH_HL	Input	RCS	Paths		Model Design	IN	8	Array of hot leg path numbers. This array identifies the paths connecting the core node's upper plenum to the hot leg nodes. Two paths are used for each hot leg to allow for liquid/steam counter-current flow when the hot legs are not full. NUM_PATHS_HL entries are expected. Reference 1, Section 7.2.2.	Pointer
128	PATH_CL	Input	RCS	Paths		Model Design	IN	8	Array of discharge cold leg path numbers. This array identifies the paths connecting the discharge cold leg nodes to the RV annulus node. Two paths are used for each discharge cold leg to allow for liquid/steam counter-current flow when the cold legs are not full. NUM_PATHS_CL entries are expected. Reference 1, Section 7.2.2.	Pointer
129	PATH_SG	Input	RCS	Paths	SG	Model Design	IN	4	Top of SG tube bundle path numbers. This array identifies the paths connecting each SG's hot-side tube bundle node (the upper node if there are two) to its cold-side tube bundle node (the upper node if there are two). NUM_SG entries are expected. Reference 1, Section 7.2.2.	Pointer
130	PATH_UCEA	Input	RCS	Paths		Model Design	IN		CEA to upper head path number. This parameter identifies the path connecting the CEA node to the RV upper head node. Reference 1, Section 7.2.2.	Pointer
131	RCS_PATHS_GEOMETRY	Partition					RE	1300	RCS paths geometry variables	Partition
132	P_NODE_INLET	Input Partition	RCS	Paths			IN	150	Path connection node numbers. This array/partition identifies the node(s) connected to each flow path, for both the momentum type and the non-momentum type of flow paths. All momentum flow paths connect two nodes each; the nodes at the path inlets are identified in this array/partition, while the nodes at the path exits are identified in the array P_NODE_EXIT. All non-momentum paths are joined to one node each; those are identified in this array/partition. Reference 1, Section 7.2.2.	Pointer
133	RCS_P_NODE_INLET_MOM	Input	RCS	Paths		Model Design	IN	100	Path inlet node numbers (momentum paths). This array identifies the node at the inlet of each momentum flow path. All momentum flow paths connect two nodes each; the nodes at the path inlets are identified in this array, while the nodes at the path exits are identified in the array P_NODE_EXIT. NUM_PATHS_MOM entries are expected. Reference 1, Section 7.2.2.	Pointer
134	RCS_P_NODE_INLET_NONM	Input Partition	RCS	Paths		Model Design	IN	50	Path connection node numbers (non-momentum paths). This array/partition identifies the node connected to each non-momentum flow path. All non-momentum paths are joined to one node each. Reference 1, Section 7.2.2.	Pointer
135	RCS_PATHEXT_PNODEIN	Input Partition					IN	25	External paths connection node numbers.	Pointer

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
136	RCS_RCPLEAK_PNODEIN	Input	RCS	Paths	RCP	Plant Design	IN	4	RCP seal leak connection nodes. This array represents the pump suction line nodes, which are the modeled exit points for RCP leakage. NUM_PUMPS entries are expected. Reference 1, Section 7.2.2.	Pointer
137	RCS_CHGS_PNODEIN	Input	RCS	Paths	CVCS	Plant Design	IN	4	Charging connection nodes. This array identifies the nodes that receive the charging flow, typically some or all of the discharge cold legs. RCS_NUMIN_CHGS entries are expected. Reference 1, Section 7.2.2.	Pointer
138	RCS_LDNS_PNODEIN	Input	RCS	Paths	CVCS	Plant Design	IN	4	Letdown connection nodes. This array identifies the nodes from which letdown is drawn, typically one or all of the pump suction legs. RCS_NUMOUT_LDNS entries are expected. Reference 1, Section 7.2.2.	Pointer
139	RCS_RCW_PNODEIN	Input	RCS	Paths	RCW	Plant Design	IN	1	RCW drains connection node. This parameter identifies the node from which RCW is drawn, typically set to one of the pump suction legs. Reference 1, Section 7.2.2.	Pointer
140	RCS_SDC_PNODEIN	Input	RCS	Paths	SDC	Plant Design	IN	2	Shutdown cooling (SDC; RHR) connection nodes. This array identifies the nodes from which SDC is drawn, typically set to one or more of the hot legs. RCS_NUMOUT_SDC entries are expected. Reference 1, Section 7.2.2.	Pointer
141	RCS_SIS_PNODEIN	Input	RCS	Paths	SIS	Plant Design	IN	8	Safety injection connection nodes. This array identifies the nodes that receive the safety injection flow (from all sources combined - HPSI, LPSI and SITs/accumulators), typically some or all of the discharge cold legs. RCS_NUMIN_SIS entries are expected. Reference 1, Section 7.2.2.	Pointer
142	RCS_GAS_PNODEIN	Input	RCS	Paths	Gas	Plant Design	IN	2	RCS gas injection connection nodes. This array identifies the nodes that receive gas injection flow, typically the pressurizer and/or the RV upper head. This array is currently not used. If GS_PRZR_NONC > 0, then gas injection is directed to the pressurizer via flow path 96 (relief valves). If GS_VES_NONC > 0, then gas injection is directed to the reactor vessel's upper head via flow path 97 (relief valves).	Pointer
143	RCS_PATHLEAK_PNODEIN	Input Partition					IN	17	Leak paths connection nodes	Pointer
144	RCS_SGTR_PNODEIN	Input	RCS	Paths	SG	Model Design	IN	8	RCS SG Tube Rupture connection nodes. This array identifies the nodes at which a tube rupture may occur, corresponding to members of the array MAL_SGTR. Typically set so that flow to the break is supplied from the inlet plenum and exit plenum. 2xNUM_SG entries are expected. Reference 1, Section 7.2.2.	Pointer
145	RCS_SBLOCA_PNODEIN	Input	RCS	Paths		Model Design	IN	4	RCS small break LOCA connection nodes. This array identifies the nodes at which a SBLOCA may occur, corresponding to members of the array MAL_SB_LOCA. Typically connected to a hot leg, suction leg, cold discharge leg and pressurizer. NUM_SML_BRK entries are expected. Reference 1, Section 7.2.2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
146	RCS_RODEJ_PNODEIN	Input	RCS	Paths		Model Design	IN		RCS rod ejection small break connection node. This parameter identifies the node at which a rod ejection leak may occur. Set value should be the RV upper head node number (NODE_UHEAD), independent of plant design. Reference 1, Section 7.2.2.	Pointer
147	RCS_ORING_PNODEIN	Input	RCS	Paths		Model Design	IN		RCS O-ring seal leak connection node. This parameter identifies the node at which an O-ring seal leak may occur. Set value should be the RV upper head node number (NODE_UHEAD), independent of plant design. Reference 1, Section 7.2.2.	Pointer
148	RCS_LBLOCA_PNODEIN	Input	RCS	Paths		Model Design	IN		RCS large break LOCA connection node. This parameter identifies the node at which a LBLOCA may occur. This input is required, although the LBLOCA as defined by the cue MAL_LB_LOCA is disabled. (A LOCA of any size may be defined via the SBLOCA inputs.) Reference 1, Section 7.2.2.	Pointer
149	RCS_PATHINT_PNODEIN	Input Partition					IN	8	RCS internal paths connection nodes	Pointer
150	RCS_SPRAY_PNODEIN	Input	RCS	Paths	Spray	Plant Design	IN		Pressurizer spray connection node. This parameter identifies the node to which the pressurizer spray (both main and auxiliary) is delivered. Set value should be the pressurizer node number (NODE_PRZR), independent of plant design. Reference 1, Section 7.2.2.	Pointer
151	RCS_SPRAYBLEED_PNODEIN	Input	RCS	Paths	Spray	Plant Design	IN	2	RCS pressurizer main spray bleed connection nodes. This array identifies the nodes from which the pressurizer main spray bleed is drawn, typically one or more discharge cold leg nodes, dependent of plant design. RCS_NUM_MSPRAYVLVS entries are expected. Reference 1, Section 7.2.2.	Pointer
152	RCS_PRZR_RELIEF_PNODEIN	Input	RCS	Paths	PZR	Plant Design	IN		Pressurizer relief valves connection node. This parameter identifies the node from which the pressurizer relief flow (PORV, safety valve and vent) is taken. Set value should be the pressurizer node number (NODE_PRZR), independent of plant design. Reference 1, Section 7.2.2.	Pointer
153	RCS_UHEAD_RELIEF_PNODEIN	Input	RCS	Paths	UH Vent	Plant Design	IN		Upper head relief valves connection node. This parameter identifies the node from which the RV upper head relief flow (vent) is taken. Set value should be the RV upper head node number (NODE_UHEAD), independent of plant design. Reference 1, Section 7.2.2.	Pointer
154	P_NODE_EXIT	Input	RCS	Paths		Model Design	IN	100	Path exit node numbers (momentum paths). This array identifies the node at the outlet of each momentum flow path. All momentum flow paths connect two nodes each; the nodes at the path exits are identified in this array, while the nodes at the path inlets are identified in the array RCS_P_NODE_INLET_MOM (or, identically, the first 50 entries of P_NODE_INLET). NUM_PATHS_MOM entries are expected. Reference 1, Section 7.2.2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
155	P_ELEV_INLET	Input Partition	RCS	Paths			RE	150	Path inlet elevation. Elevations are relative to a reference datum (zero elevation). The reference datum is arbitrary, but must be consistent for all base deck elevations, except where specifically defined differently. The reference datum is typically defined either at the lowest elevation in the RCS (usually at the bottom of the reactor vessel) or at the hot leg centerline. Reference 1, Section 7.2.2.	Feet
156	RCS_P_ELEV_INLET_MOM	Input	RCS	Paths		Dimension	RE	100	Inlet elevations of momentum flow paths. NUM_PATHS_MOM entries are expected. The elevation at the inlet of each path is plant dependent, relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations. The inlet elevations are defined at the circle center. That is, the intersection of momentum flow path number N with its inlet node forms a circle whose center is located at elevation RCS_P_ELEV_INLET_MOM(N) and whose radius is P_RADIUS(N). [If P_GEOM(N)=2 or 3, then the intersection is a semicircle, but the circle center is still located at RCS_P_ELEV_INLET_MOM(N).] This intersection must be wholly contained within the vertical extent of the node. That is, not part may extend below N_BOT of the node or above N_BOT+NODE_HEIGHT of the node.	Feet
157	RCS_P_ELEV_INLET_NONM	Input Partition	RCS			Dimension	RE	50	Path connection elevations of non-momentum flow paths.	Feet
158	RCS_PATHEXT_PELEVIN	Input Partition	RCS			Dimension	RE	25	External paths inlet elevations.	Feet
159	RCS_RCPLEAK_PELEVIN	Input	RCS	Paths	RCP	Dimension	RE	4	RCP seal leak connection elevations. These plant dependent elevations are within the nodes identified by RCS_RCPLEAK_PNODEIN. They are normally set at the top of the RCP volume, or the Cold Leg centerline elevation + the pump weir height. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) NUM_PUMPS entries are expected. Reference: Individual plant basedeck calculations.	Feet
160	RCS_CHGS_PELEVIN	Input	RCS	Paths	CVCS	Dimension	RE	4	Charging connection elevations. This is an array of plant dependent elevations, based on the physical tap locations within the nodes identified by RCS_CHGS_PNODEIN. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) RCS_NUMIN_CHGS entries are expected. Reference: Individual plant basedeck calculations.	Feet
161	RCS_LDNS_PELEVIN	Input	RCS	Paths	CVCS	Dimension	RE	4	Letdown connection elevations. This is an array of plant dependent elevations, based on the physical tap locations within the nodes identified by RCS_LDNS_PNODEIN. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) RCS_NUMOUT_LDNS entries are expected. Reference: Individual plant basedeck calculations.	Feet

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
162	RCS_RCW_PELEVIN	Input	RCS	Paths	RCW	Dimension	RE	1	RCW drains connection elevation. This is a plant dependent elevation, based on the physical tap location within the nodes identified by RCS_RCW_PNODEIN. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations.	Feet
163	RCS_SDC_PELEVIN	Input	RCS	Paths	SDC	Dimension	RE	2	Shutdown cooling (SDC; RHR) connection elevations. This is an array of plant dependent elevations, based on the physical tap locations within the nodes identified by RCS_SDC_PNODEIN. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) RCS_NUMOUT_SDC entries are expected. Reference: Individual plant basedeck calculations.	Feet
164	RCS_SIS_PELEVIN	Input	RCS	Paths	SIS	Dimension	RE	8	Safety injection connection elevations. This is an array of plant dependent elevations, based on the physical tap locations within the nodes identified by RCS_SIS_PNODEIN. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) RCS_NUMIN_SIS entries are expected. Reference: Individual plant basedeck calculations.	Feet
165	RCS_GAS_PELEVIN	Input	RCS	Paths	Gas	Dimension	RE	2	RCS gas injection connection elevations, corresponding to the array RCS_GAS_PNODEIN. This array is currently not used. If GS_PRZR_NONC > 0, then gas injection is directed to the pressurizer via flow path 96 (relief valves). If GS_VES_NONC > 0, then gas injection is directed to the reactor vessel's upper head via flow path 97 (relief valves).	Feet
166	RCS_PATHLEAK_PELEVIN	Input Partition					RE	17	Leak paths connection elevations	Feet
167	RCS_SGTR_PELEVIN	Input	RCS	Paths	SG	Dimension	RE	8	RCS SG tube rupture connection elevations. This is a plant dependent elevation, based on the tube bundle elevations. The elevation can be set anywhere between the bottom and top of the tube node within the nodes identified by RCS_SGTR_PNODEIN. The choice is based on the tube rupture scenario required. Normally basedecks are set with the tube rupture elevations at the tubesheet. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) 2xNUM_SG entries are expected. Reference: Individual plant basedeck calculations.	Feet

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
168	RCS_SBLOCA_PELEVIN	Input	RCS	Paths		Dimension	RE	4	RCS small break LOCA connection elevations. This is a plant dependent elevation, based on the elevation of the respective node in which the break is occurring (identified by RCS_SBLOCA_PNODEIN). The elevation can be set at anywhere between the bottom and top of the node. The choice is based on the SBLOCA scenario required. Normally basedecks are set with the break elevations at or near the bottom of the respective node. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) NUM_SML_BRK entries are expected. Reference: Individual plant basedeck calculations.	Feet
169	RCS_RODEJ_PELEVIN	Input	RCS	Paths		Dimension	RE		RCS rod ejection small break connection elevation. This is a plant dependent elevation, based on the elevation of the RV upper head node in which the break is occurring. The elevation may be based on the rod chosen for the scenario required. Normally basedecks are set with the break elevations at or near the top of the UH node. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations	Feet
170	RCS_ORING_PELEVIN	Input	RCS	Paths		Dimension	RE		RCS O-ring seal connection elevation. This is a plant dependent elevation. The elevation must be within the range of the inlet node (RV upper head). Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations	Feet
171	RCS_LBLOCA_PELEVIN	Input	RCS	Paths		Dimension	RE		RCS large break LOCA connection elevation. This is a plant dependent elevation. The elevation must be within the range of the node chosen as the inlet node (identified by RCS_LBLOCA_PNODEIN). Normally, the basedeck value is set at or close to the node bottom elevation. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations	Feet
172	RCS_PATHINT_PELEVIN	Input Partition					RE	8	RCS internal paths connection elevation	Feet
173	RCS_SPRAY_PELEVIN	Input	RCS	Paths	Spray	Dimension	RE		Pressurizer spray connection elevation. This is a plant dependent elevation, based on the physical spray nozzle location within the pressurizer. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) The most important elevation dimension associated with the spray nozzle is that point at which liquid level within the pressurizer would reach the bottom of the nozzle. Thus, the final calculated elevation is dependent upon the segmented volume/area/height calculations for the pressurizer. Reference: Individual plant basedeck calculations.	Feet

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
174	RCS_SPRAYBLEED_PELEVIN	Input	RCS	Paths	Spray	Dimension	RE	2	RCS pressurizer main spray bleed connection elevations. This is a plant dependent elevation, based on the physical tap locations within the nodes identified by RCS_SPRAYBLEED_PNODEIN. In most plants, the tap near the top of the discharge cold leg. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations.	Feet
175	RCS_PRZR_RELIEF_PELEVIN	Input	RCS	Paths	PZR	Dimension	RE		Pressurizer relief valves connection elevation. This is a plant dependent elevation, based on the physical tap location within the pressurizer. The elevation is the elevation of the bottom of the pressurizer + the height of the PSV tap above the pressurizer bottom. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations.	Feet
176	RCS_UHEAD_RELIEF_PELEVIN	Input	RCS	Paths	UH Vent	Dimension	RE		Upper head relief valves connection elevation. This is a plant dependent elevation, based on the physical tap location of the RV upper head vent. Normally, it is set at or close to the top of upper head. Elevations are relative to a reference datum. (See discussion of reference datum under P_ELEV_INLET.) Reference: Individual plant basedeck calculations.	Feet
177	P_ELEV_EXIT	Input	RCS	Paths		Dimension	RE	100	Exit elevations of momentum flow paths. NUM_PATHS_MOM entries are expected. The elevation at the outlet of each path is plant dependent, relative to a reference datum (zero elevation). The reference datum is arbitrary, but must be consistent for all base deck elevations, except where specifically defined differently. The reference datum is typically defined either at the lowest elevation in the RCS (usually at the bottom of the reactor vessel) or at the hot leg centerline. Reference: Individual plant basedeck calculations. The exit elevations are defined at the circle center. That is, the intersection of momentum flow path number N with its exit node forms a circle whose center is located at elevation P_ELEV_EXIT(N) and whose radius is P_RADIUS(N). [If P_GEOM(N)=2 or 3, then the intersection is a semicircle, but the circle center is still located at P_ELEV_EXIT(N).] This intersection must be wholly contained within the vertical extent of the node. That is, not part may extend below N_BOT of the node or above N_BOT+NODE_HEIGHT of the node.	Feet

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
178	P_GEOM	Input	RCS	Paths		Model Design	IN	100	Momentum flow paths' end geometry indicators: 0=point, 1=circle, 2=upper semicircle, 3=lower semicircle. The model design dictates the value chosen. Point connections are used for all vertical pipes. Upper and lower semicircles are used in the hot side loop piping and in the discharge cold legs, where dual flow paths are used. In a heterogeneous two-phase condition, the dual flow paths can carry countercurrent flows of liquid and steam if conditions so warrant. All other horizontal momentum flow paths use a circular end geometry. (There is no geometry input for the non-momentum flow paths; they all have point connections by default.) NUM_PATHS_MOM entries are expected. Reference 1, Section 4.9.	Pointer
179	P_RADIUS	Input	RCS	Paths		Dimension	RE	100	Path radii at momentum paths' end-points. P_RADIUS is not related to P_AREA. Plant design dependent. For paths with P_GEOM = 0, the P_RADIUS also = 0.0. For all circular and semi-circular path geometries, the pipe radius is physical fluid flow radius at the exit location. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Feet
180	PATH_TLOA	Input	RCS	Paths		Dimension	RE	100	Combined inertia length/area (dMom/dt) for each momentum flow path. These are plant dependent variables. They are calculated for each path examining each segment of a flow path length, and summing the Length/Flow-Area of all segments. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations	1 / Feet
181	PATH_KLOSS_POS	Input	RCS	Paths		T/H Dimension	RE	100	RCS momentum flow paths' geometric forward k-factors. The plant dependent loss factors are determined by flow tuning performed during basedeck compilation. Plant conditions are set to those used in reference documents, then k-factors are adjusted until the pressure drops due to geometric losses equal the reference values. This tuning is done concurrently with that for PATH_LEN_DIAM for the paths' frictional loss factors. For the above procedure, each path is assigned "pressure end points" (PEPs - different from the geometric "connection points" defined by P_ELEV_INLET and P_ELEV_EXIT). Each path's PEPs should be defined well within the connecting nodes, on the general fluid trajectory path. Each path's pressure drop is defined between its PEPs. For flow paths that follow each other in a loop, each path's upstream PEP should coincide with its upstream neighboring path's downstream PEP. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Dimensionless

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
182	PATH_KLOSS_NEG	Input	RCS	Paths		T/H Dimension	RE	100	RCS momentum flow paths' geometric reverse flow k-factors. Since plant tuning with reverse flow is not performed, these plant dependent variables are normally set to an independent reference, such as a LOCA calculation. In certain path locations, where forward and reverse flow geometries are equal, the tuned forward flow k-factors may also be used for reverse flow. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Dimensionless
183	P_AREA	Input	RCS	Paths		Dimension	RE	100	RCS momentum flow path areas. These plant dependent variables are used in conjunction with the k-factors and L/D's to determine the pressure losses (geometric and frictional) at all momentum flow paths around the RCS. Some paths have several different flow areas along their length. In that case, the most representative area is chosen. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Ft^2
184	PATH_LEN_DIAM	Input	RCS	Paths		T/H Dimension	RE	100	RCS momentum flow paths' length-to-(hydraulic)diameter ratio. These are plant dependent parameters. Preliminary values are calculated by summing the L/Dh for each segment in a flow path. The final values are obtained by RCS flow tuning. Plant conditions are set to those used in reference documents, then L/Dh's are adjusted until the pressure drops due to frictional losses equal the reference values. This tuning is done concurrently with that for PATH_KLOSS_POS for the geometric loss factors for each path. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Dimensionless
185	P_DIAM_HYD	Input	RCS	Paths		T/H Dimension	RE	100	Path hydraulic diameter. These are plant dependent variables. Hydraulic diameters are used in the calculation of local Reynolds numbers, which are part of the frictional pressure drop calculation. Some paths have several different hydraulic diameters along their length. In that case, the most representative diameter is chosen. NUM_PATHS_MOM entries are expected. Reference: Individual plant basedeck calculations.	Feet
186	PLT_RCS_VES	Partition					RE	60	RCS plant data: Inner vessel	Partition
187	PRES_ATWS_MIN	Input	RCS			Plant Design	RE		RV upper head O-ring seal leak - minimum leakage pressure. Used when extremely high pressure may be experienced, e.g. in an ATWS event. The 2 pressures PRES_ATWS_MIN/MAX and the two leak areas P_AREA_ATWS_MIN/MAX form a linear interpolation range for the leak area, which is then multiplied by RCS_UHEAD_RING_SEAL_MULT. The 2 pressures are set in base decks to very high values. Should an ATWS transient be modeled, the USER is required to set these values dependent upon the scenario.	Psia

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
188	P_AREA_ATWS_MIN	Input	RCS			Plant Design	RE		RV upper head O-ring seal leak - leak area at the minimum pressure. Used when extremely high pressure may be experienced, e.g. in an ATWS event. The 2 pressures PRES_ATWS_MIN/MAX and the two leak areas P_AREA_ATWS_MIN/MAX form a linear interpolation range for the leak area, which is then multiplied by RCS_UHEAD_RING_SEAL_MULT. The 2 leak areas are set in base decks to 0.0. Should an ATWS transient be modeled, the USER is required to set these values dependent upon the scenario.	Ft^2
189	PRES_ATWS_MAX	Input	RCS			Plant Design	RE		RV upper head O-ring seal leak - maximum leakage pressure. Used when extremely high pressure may be experienced, e.g. in an ATWS event. The 2 pressures PRES_ATWS_MIN/MAX and the two leak areas P_AREA_ATWS_MIN/MAX form a linear interpolation range for the leak area, which is then multiplied by RCS_UHEAD_RING_SEAL_MULT. The 2 pressures are set in base decks to very high values. Should an ATWS transient be modeled, the USER is required to set these values dependent upon the scenario.	Psia
190	P_AREA_ATWS_MAX	Input	RCS			Plant Design	RE		RV upper head O-ring seal leak - leak area at the maximum pressure. Used when extremely high pressure may be experienced, e.g. in an ATWS event. The 2 pressures PRES_ATWS_MIN/MAX and the two leak areas P_AREA_ATWS_MIN/MAX form a linear interpolation range for the leak area, which is then multiplied by RCS_UHEAD_RING_SEAL_MULT. The 2 leak areas are set in base decks to 0.0. Should an ATWS transient be modeled, the USER is required to set these values dependent upon the scenario.	Ft^2
191	P_AREA_RODEJ	Input	RCS			T/H Dimension	RE		CEA ejection leak area. Used only during an CEA ejection transient (MAL_ROD_EJECT not equal to 0.0). The leakage area is set in base decks to 0.0. Should an rod ejection transient be modeled, the USER is required to set this value dependent upon the scenario.	Ft^2
192	N_TOP_UPLEN	Input	RCS			T/H Dimension	RE		Top elevation of upper plenum portion of inner vessel node. This plant dependent parameter is set to the bottom elevation of the upper head node. I.e., N_BOT(NODE_UHEAD).	Feet
193	N_BOT_UPLEN	Input	RCS			T/H Dimension	RE		Bottom elevation of upper plenum portion of the inner vessel node. This plant dependent parameter is = elevation at the bottom of upper head - height of top section of the inner vessel node. I.e., N_BOT(NODE_UHEAD) - N_HEIGHT_SECT(1,N_SECTIONS(1))	Feet
194	KLOSS_UPLEN_POS	Input	RCS			T/H Dimension	RE		Upper plenum geometric form loss coefficient, for forward flow. This plant dependent variable is calculated from referenced pressure loss at given flow conditions. KLOSS_UPLEN_POS = (dP at fwd. flow)/(sp.vol. * W^2)	Dimensionless
195	KLOSS_UPLEN_NEG	Input	RCS			T/H Dimension	RE		Upper plenum geometric form loss coefficient, for reverse flow. This plant dependent variable is calculated from referenced pressure loss at given flow conditions. KLOSS_UPLEN_NEG = (dP at rev. flow)/(sp.vol. * W^2)	Dimensionless

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
196	CORE_BOT	Input	CORE	RCS		Dimension	RE		Active core bottom elevation, relative to the node bottom. This plant dependent dimension is also = the height of section 1 of node 1.	Feet
197	CORE_TOP	Input	CORE	RCS		Dimension	RE		Active core top elevation, relative to the node bottom. This plant dependent dimension is also = the sum of heights of sections 1 through N_SECTIONS(1)-1 of node 1.	Feet
198	AREA_CORE	Input	CORE	RCS		Dimension	RE		Active core flow area. This plant dependent variable is calculated as core fluid volume/height of fuel rods. Should equal N_AREA_SECT(2...). This parameter is used for calculating the Reynolds number of the core flow, for use in determining core heat transfer coefficients.	Ft^2
199	HA_CEA_CORE	Input	RCS	CORE		T/H Dimension	RE		CEA to Inner Vessel wall heat trans coefficient (hA). The plant dependent variable is calculated from the thickness, conductivity and surface area of the core shrouds in the inner vessel region. hA = (.5k/t)*A. Surface heat transfer is assumed infinite. This liquid heat transfer coefficient is one part of the total for node (1), which includes all the metal contained in the node.	Btu/sec-degF
200	PATH_CEA_LOW	Input	RCS	CORE		Model Design	IN		Inlet path, upper plenum to CEA guide tubes. This is one of the momentum flow paths. The path number is independent of individual plant design. When the CEA guide tubes are inserted, form losses for this path increase. See RCS_CEAIN_KTERM for detailed discussion. Reference 1, Section 7.2.2.	Pointer
201	PATH_CEA_UP	Input	RCS	CORE		Model Design	IN		Exit path, from CEA guide tubes to upper head. This is one of the momentum flow paths. The path number is same as PATH_UCEA, independent of individual plant design. When the CEA guide tubes are inserted, form losses for this path increase. See RCS_CEAIN_KTERM for detailed discussion. Reference 1, Section 7.2.2.	Pointer
203	CEAS_DIST	Input	RCS	CORE		Dimension	RE		Traveling distance of CEAs. Serves as part of the model that accounts for increased losses associated with flow through the CEA guide tubes when the rods are inserted. If RCS_CEAIN_KTERM=1.0, then CEAS_DIST becomes irrelevant. See RCS_CEAIN_KTERM for detailed discussion of the increased loss model.	Feet
204	EXCORE_BOT	Input	CORE	RCS		Dimension	RE		Lower excore detector elevation, relative to the bottom of the RV annulus node (NODE_ANNUL). CENTS calculates the circumferential specific volume distribution in the RV annulus at this elevation. The resulting array, SVOL_DOWNCOMER, is unused. Therefore, a value for EXCORE_BOT need not be input.	Feet
205	EXCORE_TOP	Input	CORE	RCS		Dimension	RE		Upper excore detector elevation, relative to the bottom of the RV annulus node (NODE_ANNUL). CENTS calculates the circumferential specific volume distribution in the RV annulus at this elevation. The resulting array, SVOL_DOWNCOMER, is unused. Therefore, a value for EXCORE_TOP need not be input.	Feet

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207	RTRV_BYPASS	Input	CORE	RCS		T/H Dimension	RE		Fraction of vessel flow bypassing core. This fraction is always used and is plant dependent. Vessel flow, in this case is referring to p_flow(1). Most often, bypass flow is given as a fraction of total vessel flow. For CE plants, TOTAL bypass flow (lbm/sec) = rtrv_bypass*p_flow(1)+p_flow(30)+p_flow(31). Reference: Individual plant basedeck calculations.	Fraction
208	RCS_KWEIGHT_HTILT	Input	CORE	RCS		T/H Dimension	RE	4, 4	Coeff. for cold leg to opposite hot leg mixing. This array specifies the fraction of flow from each cold leg which is transported to hot leg 1 or to hot leg 2 to determine mixing in the reactor vessel. The array is 4x4 in order to accommodate other plant types. Vessel mixing factors are most important for the analysis of the Steam Line Break. Semi-scale flow mixing tests have been performed for several CE plant designs. The results were very similar. This matrix of mixing data is plant design dependent. For a mixing factor of X i= hot leg and j= cold Leg i= 1 2 3 4 j= 1: (1-X) X 0 0 2: (1-X) X 0 0 3: X (1-X) 0 0 4: X (1-X) 0 0 Reference: Individual plant basedeck calculations. Reference 1, Section 7.2.5.	Fraction
209	HA_UHEAD_CORE	Input	RCS			T/H Dimension	RE		Upper head to IV heat transfer coef (hA). This is a plant dependent variable based on thickness, surface area and conductivity of the barrier (UGS plate for CE plants) between the upper head node and the outlet plenum region of node 1. The surface heat transfer coefficient is assumed infinite. Then ha_uhead_core = area of plate/ (thickness/conductivity). For steam at this interface it is usual to set this heat transfer coeff. to 0.0. Reference: Individual plant basedeck calculations.	Btu/sec-degF
210	PLT_RCS_PRZR	Partition					RE	40	RCS plant data: Pressurizer	Partition
211	NUM_HEATERS	Output	PZR	RCS		Plant Design	IN		Total number pressurizer heater banks. This is set by the code to equal NUM_PROP_HEATERS + NUM_BACK_HEATERS.	Counts
213	AREA_BLEED_MIN	Input	PZR	RCS		T/H Dimension	RE		Pressurizer spray bleed line minimum area. This is a plant dependent variable which is usually determined by initial data base tuning. The line area is adjusted until the correct continuous bleed spray flow is attained.	Ft^2
214	HCAP_HEATER	Input	PZR	RCS		T/H Dimension	RE	6	Heater gross heat capacity. This is a plant dependent variable = number of heaters * mass of one heater * specific heat of the heater material. This is calculated for each heater bank. Reference: Individual plant basedeck calculations.	Btu/degF

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215	XFER_HEATER	Input	PZR	RCS		T/H Dimension	RE	6	Heater overall heat transfer coefficient. This is a plant dependent variable. h = 1 / (1/hconv + t/k), where 1/hconv = 0 (i.e. heaters are essentially conduction limited) (user assumed), k = thermal conductivity for heater sheath material t = thickness of heater sheath wall . Reference: Individual plant basedeck calculations.	Btu/sec-degF
216	RESI_HEATER	Input	PZR	RCS		Component Design	RE	6	Heater electrical resistance. This is a plant dependent variable. Resistance = V^2/(P * No. of Heaters) V = bus voltage P * No. of heaters = power/heater * No. of heaters /bank Reference: Individual plant basedeck calculations.	Ohms
217	TOP_HEATERS	Input	PZR	RCS		Dimension	RE		Top elev of pressurizer heaters. This a plant dependent variable. The height is measured as a distance referenced from the bottom of the pressurizer. Reference: Individual plant basedeck calculations.	Feet
219	LEVL_PRZR_RTD	Input	PZR	RCS		Dimension	RE		Level of pressurizer RTD. This is a plant dependent variable. The height is measured as a distance referenced from the bottom of the pressurizer. Reference: Individual plant basedeck calculations.	Feet
220	LEVL_REF_BOT	Input	PZR	RCS		Dimension	RE		Bottom level of pressurizer reference leg. This is a plant dependent variable. The height is measured as a distance referenced from the bottom of the pressurizer. Reference: Individual plant basedeck calculations.	Feet
221	LEVL_REF_TOP	Input	PZR	RCS		Dimension	RE		Top level of pressurizer reference leg. This is a plant dependent variable. The height is measured as a distance referenced from the bottom of the pressurizer. Reference: Individual plant basedeck calculations.	Feet
223	DESIGN_FLOW_PORV	Input	PORV	RCS		Component Design	RE		PORV design flow rate. This is a plant dependent variable. It is used for calculating the relief valve vibration signals VIBR_VALVE_RELIEF and the relief valve temperature signals TEMP_VALVE_RELIEF. Those signals are not used. Therefore, the input data for DESIGN_FLOW_PORV may be omitted.	Lbm/sec
224	DESIGN_FLOW_SAFETY1	Input	PSV	RCS		Component Design	RE		PSV-1 design flow rate. This is a plant dependent variable. It is used for calculating the relief valve vibration signals VIBR_VALVE_RELIEF and the relief valve temperature signals TEMP_VALVE_RELIEF. Those signals are not used. Therefore, the input data for DESIGN_FLOW_SAFETY1 has no effect, but must be greater than zero. If omitting, set to 100.	Lbm/sec
225	DESIGN_FLOW_SAFETY2	Input	PSV	RCS		Component Design	RE		PSV-2 design flow rate. This is a plant dependent variable. It is used for calculating the relief valve vibration signals VIBR_VALVE_RELIEF and the relief valve temperature signals TEMP_VALVE_RELIEF. Those signals are not used. Therefore, the input data for DESIGN_FLOW_SAFETY2 has no effect, but must be greater than zero. If omitting, set to 100.	Lbm/sec
226	PLT_RCS_QT	Partition					RE	10	RCS plant data: Quench tank	Partition

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227	PRES_N2	Input	PZR	QT		Plant Design	RE		Quench Tank nitrogen supply pressure. This is a plant dependent variable. It is not usually part of a safety analysis basedeck because the QT in no way affects results of safety analysis. This input is intended as part of a simulator, best estimate basedeck for special analytical scenarios. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Psia
228	VOLU_QT	Input	PZR	QT		Plant Design	RE		Quench Tank total volume. This is a plant dependent variable. It is not usually part of a safety analysis basedeck because the QT in no way affects results of safety analysis. This input is intended as part of a simulator, best estimate basedeck for special analytical scenarios. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Ft^3
229	HEIGHT_QT	Input	PZR	QT		Dimension	RE		Quench Tank height assuming concentric circular cross section. This is a plant dependent variable. It is not usually part of a safety analysis basedeck because the QT in no way affects results of safety analysis. This input is intended as part of a simulator, best estimate basedeck for special analytical scenarios. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Feet
230	MASS_QT_MAX	Input	PZR	QT		Plant Design	RE		Quench Tank maximum mass of water. This is a plant dependent variable. It is not usually part of a safety analysis basedeck because the QT in no way affects results of safety analysis. This input is intended as part of a simulator, best estimate basedeck for special analytical scenarios. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Lbm
231	QT_RUPTURE_SPOINT.	Input	PZR	QT		Plant Design	RE		Quench Tank rupture disk setpoint pressure. This is a plant dependent variable. It is not usually part of a safety analysis basedeck because the QT in no way affects results of safety analysis. This input is intended as part of a simulator, best estimate basedeck for special analytical scenarios.	Psia
232	PLT_RCS_RCP	Partition					RE	450	RCS plant data: Reactor coolant pumps	Partition
233	NUM_PUMPS	Input	RCP	RCS		Plant Design	IN		Number of reactor coolant pumps (RCPs, 4 max). This is a plant dependent variable.	Counts
234	FRAC_TABL	Input	RCP	RCS		Model Design	RE	11	Independent variable array for RCP homologous curves: ratio of normalized speed to normalized flow, or its reciprocal, whichever is smaller.	Dimensionless
235	BAN	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (normal +flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
236	BVN	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (normal +flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
237	BAD	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (energy dissipation -flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
238	BVD	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (energy dissipation -flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
239	BAT	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (turbine -flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
240	BVT	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (turbine -flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
241	BAR	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (abnormal +flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
242	BVR	Input	RCP	RCS		Component Design	RE	11	RCP torque homologous curve (abnormal +flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump torque.	Dimensionless
243	HAN	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (normal +flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
244	HVN	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (normal +flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
245	HAD	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (energy dissipation -flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
246	HVD	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (energy dissipation -flow,+speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
247	HAT	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (turbine -flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
248	HVT	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (turbine -flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
249	HAR	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (abnormal +flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
250	HVR	Input	RCP	RCS		Component Design	RE	11	RCP head homologous curve (abnormal +flow,-speed). This is a pump dependent variable. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
251	HANC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (normal +flow,+speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HANC from the single phase head curve, HAN. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
252	HVNC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (normal +flow,+speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HVNC from the single phase head curve, HVN. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
253	HADC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (energy dissipation - flow,+speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HADC from the single phase head curve, HAD. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
254	HVDC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (energy dissipation - flow,+speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HVDC from the single phase head curve, HVD. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
255	HATC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (turbine -flow,-speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HATC from the single phase head curve, HAT. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
256	HVTC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (turbine -flow,-speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HVTC from the single phase head curve, HVT. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
257	HARC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (abnormal +flow,-speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HARC from the single phase head curve, HAR. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
258	HVRC	Input	RCP	RCS		Component Design	RE	11	RCP difference head homologous curve (abnormal +flow,-speed). This is a pump dependent variable. During two-phase flow conditions, degraded pump head is calculated by subtracting the product of the degraded head multiplier (hd_deg_mult) and HVRC from the single phase head curve, HVR. See Reference 1, Section 4.11.1 for definitions and use in determining pump head.	Dimensionless
259	FRAC_HD_TABL	Input	RCP	RCS		Component Design	RE	11	RCP head degradation void fraction (independent variable). This independent variable is used in conjunction with the difference head degradation multiplier, which is then multiplied by the difference homologous curves in determining the pump head in two-phase flow conditions.	Dimensionless
260	HD_DEG_TABL	Input	RCP	RCS		Component Design	RE	11	RCP head degradation multiplier. This multiplier is multiplied by the difference homologous curves and the product is then subtracted from the single phase head curve in determining the pump head in two-phase flow conditions.	Dimensionless
261	RATED_PUMP_SPEED	Input	RCP	RCS		Component Design	RE	4	Rated pump speed. This is pump dependent variable provided by the pump manufacturer. It is used in conjunction with the other rated pump conditions and with the homologous pump curves to determine pump head and torque.	Shaft RPM
262	RATED_VOL_FLOW	Input	RCP	RCS		Component Design	RE	4	Rated pump volumetric flow. This is pump dependent variable provided by the pump manufacturer. It is used in conjunction with the other rated pump conditions and with the homologous pump curves to determine pump head and torque.	Ft^3/sec
263	RATED_PUMP_DENS	Input	RCP	RCS		Component Design	RE	4	Rated pump density. This is pump dependent variable provided by the pump manufacturer. It is used in conjunction with the other rated pump conditions and with the homologous pump curves to determine pump head and torque.	Lbm/ft^3
264	RATED_PUMP_HD	Input	RCP	RCS		Component Design	RE	4	Rated pump head. This is pump dependent variable provided by the pump manufacturer. It is used in conjunction with the other rated pump conditions and with the homologous pump curves to determine pump head and torque.	Feet
265	RATED_PUMP_TORQ	Input	RCP	RCS		Component Design	RE	4	Rated pump torque. This is pump dependent variable provided by the pump manufacturer. It is used in conjunction with the other rated pump conditions and with the homologous pump curves to determine pump head and torque.	Ft-lbf
266	RATED_PUMP_SYNCH	Input	RCP	RCS		Component Design	RE	4	Pump synch speed at rated frequency. This is pump dependent variable provided by the pump manufacturer. It is used in calculating the pump electrical current. See Reference 1, Section 4.11.2 for definitions and equations.	Shaft RPM
267	NUM_POLES	Input	RCP	RCS		Component Design	IN		Number of poles per pump. This is pump dependent variable provided by the pump manufacturer. It is used in calculating the pump motor slip, which in turn is used in determining the electrical torque. See Reference 1, Section 4.11.2 for definitions and equations.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
268	WIND_TORQ_MULT	Input	RCP	RCS		Component Design	RE		Windage/friction torque constant. This is a pump dependent variable. This constant multiplied by (pump-speed / rated-pump-speed)^2 yields the pump frictional torque, which is one term in the conservation equation for pump speed. See Reference 1, Section 4.11.2 for definitions and equations.	Ft-lbf
270	NPTS_TAB	Input	RCP	RCS		Model Design	IN		Number of points in motor tables. This is a plant independent variable. It relates to CENTS the array size for the electrical torque tables. The maximum size is 22.	Counts
271	SLIP_TAB	Input	RCP	RCS		Component Design	RE	22	Table of electrical slip. The definition of slip is (1- angular speed/synchronous speed). This is the pump-dependent table of the independent variable, slip, for determining the normalized electrical torque (from TORQ_TAB) and normalized electrical current (from CURRENT_TAB). See Reference 1, Section 4.11.2 for definitions and equations. See also, the plant basedeck calculation.	Dimensionless
272	TORQ_TAB	Input	RCP	RCS		Component Design	RE	22	Table of normalized electrical torques, corresponding to the electrical slips in SLIP_TAB. This table is pump-dependent. It is the actual electrical torque (at a given speed or slip, and at the rated voltage) divided by the design rated electrical torque. This variable is used by CENTS to calculate electrical torque and pump speed. See Reference 1 Section 4.11.2 for definitions and equations. See also, the plant basedeck calculation.	Dimensionless
274	CURRENT_TAB	Input	RCP	RCS		Component Design	RE	22	Table of normalized electrical currents, corresponding to the electrical slips in SLIP_TAB. This table is pump-dependent. It is derived from design data of electrical current vs. electrical torque. It is defined as the actual current divided by the rated current. The rated current is defined as (rated electrical torque) * (rated pump speed) / (rated voltage). From this multiplier, the pump current is determined. Pump current is an "information only" output variable. It has no use other than to drive a "current meter".	Dimensionless
275	PRESS_LDN	Input	RCP	RCS	CVCS	Plant Design	RE		Letdown line pressure (for RCP leaks). This is a plant dependent input. It is used to determine the backpressure in calculating the amount of expected leakage from the RCPs.	Psia
276	RCP_VOLT_RATED	Input	RCP	RCS		Component Design.	RE		RCP rated voltage. This is plant dependent variable. It is used in calculating electrical torque which in turn is used in determining actual pump speed. See Reference 1, Section 4.11.2 for definitions and equations.	Volts
277	RCP_FREQ_RATED	Input	RCP	RCS		Component Design	RE		RCP rated electrical frequency. This is a pump dependent variable, but it is 60 Hz for all US plants.	Hertz
278	RCS_CONST	Partition					RE	200	RCS tunable constants	Partition
279	RCS_CONST_PRZR	Partition					RE	15	RCS pressurizer tunable constants	Partition
280	PRZR_SPRAY_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on pressurizer spray (excluding aux.). This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
281	PRZR_HEATER_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on total pressurizer heat. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is always set to 1.0 in the plant basedeck.	Dimensionless
282	PRZR_PORV_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on PORV relief flow rates. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless
283	PRZR_SAFETY_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on safety valve flow rates. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is always set to 1.0 in the plant basedeck.	Dimensionless
284	PRZR_VENT_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on pressurizer vent valve flows. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is always set to 1.0 in the plant basedeck.	Dimensionless
285	PRZR_RELIEF_RTD_TAU	Input	PZR	RCS		Component Design	RE		First order lag constant for the pressurizer relief valve RTDs. This variable is used always, but only for calculating the simulator output TEMP_VALVE_RELIEF, which is not referenced anywhere else in CENTS. It is used in conjunction with RCS_PRZR_VLVH_MAX_TAU and RCS_PRZR_VLV_REVH_TAU. They are time constants for calculating elements of TEMP_VALVE_RELIEF, the array of pressurizer relief valves' RTD temperatures.	Seconds
286	PRZR_QT_MULT	Input	PZR	RCS	QT	Multiplier	RE		Multiplier on control flow from QT to pressurizer This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Dimensionless
287	RCS_PRZR_FLASH_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier for pressurizer flashing calculation. Used in the pressurizer when it is in thermal nonequilibrium. This is a multiplier on the rate of flashing in the pressurizer. This multiplier is independent of plant design. It is used only for tuning or testing, and should always be set to 1.0 in actual transients.	Dimensionless
288	RCS_DM_FLASH_PRZR	Output	PZR	RCS		T/H Dimension	RE		Flashing rate in the pressurizer saturated region.	Lbm/sec
291	VLV_PRZR_KLOSS_UP	Input	PZR	RCS		T/H Dimension	RE		Loss coefficient, pressurizer to relief valves. This is a plant dependent variable based upon the geometry of the nozzle and piping between the pressurizer and the safety valve. See the plant basedeck calculation.	Composite Units

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
292	VLV_PRZR_KLOSS_DOWN	Input	PZR	RCS		T/H Dimension	RE		Loss coefficient, pressurizer-relief-valves to Quench Tank This is a plant dependent variable based upon the geometry of the outlet nozzle and piping between the safety valves and the quench tank. This is usually set to zero or a dummy value in the basedecks. Downstream backpressure from the safety valves is not considered as essential information for determining critical flow rates from the safety valves during plant transients at normal operating conditions.	Composite Units
293	RCS_CONST_UHEAD	Partition					RE	10	RCS upper head tunable constants	Partition
294	RTRV_KLOSS_CORE	Input	CORE	RCS		T/H Dimension	RE		Core pressure drop factor for buoyancy. This is a plant dependent variable. It is used only to calculate the output parameter BOUYANCY_CORE. This k =fL/Dh is derived from calculated basedeck parameters. See the plant basedeck calculation.	Dimensionless
295	RTRV_VENT_MULT	Input	CORE	RCS		Multiplier	RE		Multiplier on head vent valve flows. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless
296	RTRV_HEAD_SEAL_MULT	Input	CORE	RCS		Multiplier	RE		Multiplier on head seal pressure. This is a USER variable, used in calculating the inner O-ring region pressure, RCS_P_ORING. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless
297	RCS_Q_CEA_CORE_MULT	Input	CORE	RCS		Multiplier	RE		Multiplier heat transfer CEA-core. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless
298	RCS_UHEAD_RING_SEAL_MULT	Input	RCS			Multiplier	RE		Multiplier upper head ring seal area. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient (ATWS, O-ring seal leak) or varied for running parametrics. It is usually set to 1.0 in the plant basedeck. See P_AREA_ATWS_MIN et.al.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
299	RTRV_MIX_INLET	Input	RCS			T/H Dimension	RE	2	Core-inlet mixing factor: (1) low flow factor, (2) high flow factor. Used always (except during core uncovery or reverse flow). This variable and RTRV_MIX_OUTLET are mixing factors for the core inlet and outlet plena. They work together with RCS_KWEIGHT_TILT to determine the degree of mixing of core flow coming from the cold legs until it exits to the hot legs. The end result is an adjustment to hot-leg flow enthalpies and qualities (P_ENTH, P_ENTH_LIQ, P_QUAL), which provides the hot-leg enthalpy tilt whenever the cold-leg enthalpies are tilted. (RTRV_MIX_INLET is also used to calculate the array ENTH_QUAD_CORE which is the enthalpy distribution, by quadrants, of the core inlet flow. However, ENTH_QUAD_CORE is not used.) The arrays are plant-specific, but there is limited data available to support their calculation. They may be set to zero, with all the mixing effects coming only from RCS_KWEIGHT_TILT (which also comes from limited scale model flow testing, rather than "hard" plant mixing data). Reference 1, Section 7.2.5.	Fraction
300	RTRV_MIX_OUTLET	Input	RCS			T/H Dimension	RE	2	Core-outlet mixing factor: (1) low flow factor, (2) high flow factor. Used always (except during core uncovery or reverse flow). This variable and RTRV_MIX_INLET are mixing factors for the core inlet and outlet plena. They work together with RCS_KWEIGHT_TILT to determine the degree of mixing of core flow coming from the cold legs until it exits to the hot legs. The end result is an adjustment to hot-leg flow enthalpies and qualities (P_ENTH, P_ENTH_LIQ, P_QUAL), which provides the hot-leg enthalpy tilt whenever the cold-leg enthalpies are tilted. (RTRV_MIX_INLET is also used to calculate the array ENTH_QUAD_CORE which is the enthalpy distribution, by quadrants, of the core inlet flow. However, ENTH_QUAD_CORE is not used.) The arrays are plant-specific, but there is limited data available to support their calculation. They may be set to zero, with all the mixing effects coming only from RCS_KWEIGHT_TILT (which also comes from limited scale model flow testing, rather than "hard" plant mixing data). Reference 1, Section 7.2.5.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
301	RCS_CEAIN_KTERM	Input	RCS			Multiplier	RE		CEA's inserted, k-factor multiplier. Used always. This term accounts for the additional losses associated with flow through the CEA guide tubes when the rods are inserted. CENTS calculates a dynamic multiplier, RCS_CEA_MULT, which equals: (1) 1.0 when the CEAs are fully withdrawn, (2) RCS_CEAIN_KTERM when the CEAs are fully inserted, or (3) a linearly interpolated value when the CEAs are partly inserted. RCS_CEA_MULT then multiplies the calculated form loss k-factors through the CEA guide tubes, for the two momentum flow paths that connect to the CEA node (PATH_CEA_LOW and PATH_CEA_UP). Since the CEA guide tubes form a path that connects the core region to the upper head, RCS_CEAIN_KTERM can have an effect on the dynamics of bubble formation and bubble collapse in the upper head. This k-factor multiplier is dependent on plant design, as it represents the ratio of form loss k-factor with the rods inserted to the k-factor with the rods withdrawn.	Dimensionless
302	RCS_CONST_PUMPS	Partition					RE	13	RCS coolant pump tunable constants	Partition
303	RCP_MOM_INERTIA	Input	RCP	RCS		Component Design	RE	4	Reactor coolant pump rotor/flywheel inertia. This is a pump dependent variable provided by the manufacturer as part of the pump design (or as-built) data for each pump. It is used during pump coastdown (or speed change) transients to help determine the rate of the coastdown. The values given in the basedeck may be adjusted based upon known plant coastdown data, compared to CENTS simulated coastdown rates.	Lbf*ft2
304	RCP_HEAT_MULT	Input	RCP	RCS		Multiplier	RE		Reactor coolant pump heat rate multiplier. This is a USER variable, which is often set during initial plant tuning to give a pump heat addition rate equal to whatever groundrules heat rate is considered appropriate. CENTS calculates a heat addition rate based on pump rated inputs and plant conditions. This calculation usually provides heat addition rates which are very close to those required. Hence, the multiplier setting is usually close to 1.0. See the plant basedeck calculation. Reference 1, Section 4.11.1.	Dimensionless
305	RCP_MOM_INERTIA_SPLIT	Input	RCP	RCS		Component Design	RE		Fractional moment of inertia to the motor when sheared shaft occurs. Used only when a RCP sheared shaft malfunction is active. This is the fraction of a pump's inertia that stays with the motor when the shaft shears. The remaining inertia is assigned to the impeller. This is dependent on RCP design.	Fraction
310	RCS_CONST_LOOP	Partition					RE	4	Tunable constants for RCS loop variables	Partition
311	RCS_CONT_HEAT_MULT	Input	RCS			Multiplier	RE		Multiplier on cont. heat xfer rates. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
312	RCS_SGTR_FLOWMULT	Input	RCS			Multiplier	RE		SG tube rupture (SGTR) area multiplier. For each tube ruptured (MAL_SGTR is the input number of ruptured tubes), there are two broken ends. CENTS treats these two ends as separate breaks, with different flow enthalpies and flow fluxes, and with each presenting a break area SG_TUBE_AREA * RCS_SGTR_FLOWMULT. RCS_SGTR_FLOWMULT is normally set to 1.0. Reference 1, Section 7.5.2	Dimensionless
313	RCS_CONST_QT	Partition					RE	6	RCS quench tank addressable constants	Partition
314	QT_N2_MULT	Input	PZR	RCS	QT	Multiplier	RE		Multiplier on nitrogen supply flow. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Dimensionless
316	QT_VENT_MULT	Input	PZR	RCS	QT	Multiplier	RE		Multiplier on quench tank vent flow. This is a USER variable. It can be used as a tuning aid or for setting abnormal conditions for a given transient or varied for running parametrics. It is usually set to 1.0 in the plant basedeck. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Dimensionless
318	RCS_CONST_GENERAL	Partition					RE	133	General RCS addressable constants	Partition
319	RCS_ITER_DP	Input	RCS			T/H Dimension	RE		Equilibrium pressure search convergence band. Used in conjunction with RCS_ITER_DP_NE & RCS_ITER_DH_NE. Used always, except in nodes that are in low-pressure (< 200 psia) equilibrium. These are convergence criteria for the iterative nodal pressure search. In thermal nonequilibrium, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP_NE and the specific enthalpy change is less than RCS_ITER_DH_NE. In thermal equilibrium with the pressure above 200 psia, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP. (At lower pressures in equilibrium, the convergence dP is RCS_ITER_DPL.). These parameters are numerical in nature, and are independent of plant design. Reference 1, Section 4.4.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
320	RCS_ITER_DP_NE	Input	RCS			T/H Dimension	RE		Non-eq pres search conv band on pressure. Used in conjunction with RCS_ITER_DP & RCS_ITER_DH_NE. Used always, except in nodes that are in low-pressure (< 200 psia) equilibrium. These are convergence criteria for the iterative nodal pressure search. In thermal nonequilibrium, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP_NE and the specific enthalpy change is less than RCS_ITER_DH_NE. In thermal equilibrium with the pressure above 200 psia, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP. (At lower pressures in equilibrium, the convergence dP is RCS_ITER_DPL.). These parameters are numerical in nature, and are independent of plant design. Reference 1, Section 4.4.	Psia
321	RCS_ITER_DH_NE	Input	RCS			T/H Dimension	RE		Non-equilibrium pressure search convergence band, based on enthalpy changes. Used in conjunction with RCS_ITER_DP_NE & RCS_ITER_DP. Used always, except in nodes that are in low-pressure (< 200 psia) equilibrium. These are convergence criteria for the iterative nodal pressure search. In thermal nonequilibrium, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP_NE and the specific enthalpy change is less than RCS_ITER_DH_NE. In thermal equilibrium with the pressure above 200 psia, the solution converges when the pressure change from the previous iteration is less than RCS_ITER_DP. (At lower pressures in equilibrium, the convergence dP is RCS_ITER_DPL.). These parameters are numerical in nature, and are independent of plant design.	Btu/lbm
322	RCS_DROP_COND_MULT	Input	RCS			Multiplier	RE	50	Multiplier on droplet condensation (nodes with steam region present). Used in conjunction with N_XFER_INJ & AREA_INJ_MULT. Used IFF a node is in thermal nonequilibrium AND liquid is entering the node at an elevation that is within the node's steam space (except for the pressurizer spray). These are condensation rate multipliers, one for each node. They apply to the condensation of steam on cold liquid that enters a node in that node's steam space. N_XFER_INJ multiplies the calculated condensation rate for liquid injection from any path, except the pressurizer spray path. AREA_INJ_MULT and RCS_DROP_COND_MULT redundantly multiply the calculated condensation rate for liquid injection from any momentum path. (They are redundant since they both multiply the interfacial area available for condensation.). These multipliers are independent of plant design. They are used only for tuning or testing, and should always be set to NNN*1.0 in actual transients, where NNN is the number of nodes.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
323	RCS_KLOSS_MULT	Input	RCS			Multiplier	RE	100	Geometric losses multipliers. They are used always. They are applied to the individual PATH_KLOSS_POS & PATH_KLOSS_NEG variables. These multipliers are normally set equal to 1.0 unless the code USER requires pressure drops which are tailored to a given set of conditions. These multipliers also provide a means of tuning the pressure drops are the RCS loops without changing base KLOSS values.	Dimensionless
324	RCS_COND_SURF_MULT	Input	RCS			Multiplier	RE	50	Surface condensation multiplier. Used IFF a node is in thermal nonequilibrium. This is an array of condensation rate multipliers, one for each node. It applies to the condensation of steam at the surface of each node's liquid-steam interface. These multipliers are independent of plant design. They are used only for tuning or testing, and should always be set to NNN*1.0 in actual transients, where NNN is the number of nodes.	Dimensionless
325	RCS_CONST_LEAKS	Partition					RE	5	Constants for leak tables and correlations	Partition
326	RCS_SUPERCRIT_FLOW_MULT	Input	RCS			Multiplier	RE		Multiplier on supercritical mass flux. Used always. In the calculation of critical flow, if the upstream pressure exceeds the table limit (3000 psia), then this parameter multiplies the flux determined from the choked flow tables. Otherwise, the flux is multiplied by RCS_SUBCRIT_FLOW_MULT. These parameters are independent of plant design. RCS_SUPERCRIT_FLOW_MULT allows for pressures that exceed the table limits and has a typical value of 1.50.	Dimensionless
327	RCS_SUBCRIT_FLOW_MULT	Input	RCS			Multiplier	RE		Multiplier on leak tables (subcritical flow conditions). Used always. In the calculation of critical flow, if the upstream pressure is below the table limit (3000 psia), then this parameter multiplies the flux determined from the choked flow tables. Otherwise, the flux is multiplied by RCS_SUPERCRIT_FLOW_MULT. These parameters are independent of plant design. RCS_SUBCRIT_FLOW_MULT is used only for tuning or testing and should be set to 1.0 in normal transients.	Dimensionless
328	CONV_GPM_AREA	Input	RCS			T/H Dimension	RE	3	Gal/min-to-area conversion factor at nominal condition. (1) suction cold leg, (2) hot leg, (3) pressurizer. This is a plant dependent input variable. The input for hot leg and pressurizer are not used. It is only used in determining RCP seal leakage rates. The value is that area which provides a 1 gpm leakage at nominal pressure & temperature. To determine its value, initialize at nominal condition, convert 1 gpm to lbm/sec at the suction leg's density, set RCP_SEALS_LEAK=4*1.0, and use CENTS to determine the factor by trial-and-error See the plant basedeck calculation.	Composite Units
329	PLT_RCS_VLVAREA	Input Partition					RE	25	RCS valve areas	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
330	PLT_VLVAREA_UHEAD_CONT	Input	RCS			Dimension	RE		Area of vent valve from u-head to containment. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
331	PLT_VLVAREA_UHEAD_QT	Input	RCS	QT		Dimension	RE	2	Area vents valves u-head to quench tank. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
332	PLT_VLVAREA_PRZR_PORV	Input	PZR	RCS		Dimension	RE	4	Area pressurizer PORVs. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
333	PLT_VLVAREA_PRZR_SAFETY	Input	PZR	RCS		Dimension	RE	4	Area pressurizer safety valves. This is a calculated plant dependent variable based upon knowing the design critical flow rate at design pressure conditions.	Ft^2
334	PLT_VLVAREA_PRZR_MOV	Input	PZR	RCS		Dimension	RE	4	Area pressurizer movs (in series with PORVs). This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
335	PLT_VLVAREA_PRZR_CONT	Input	PZR	RCS		Dimension	RE		Area vent pressurizer to containment. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
336	PLT_VLVAREA_PRZR_QT	Input	PZR	RCS		Dimension	RE	2	Area vents pressurizer to q-tank (in series). This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data).	Ft^2
337	PLT_VLVAREA_PRZR_MSPRAY	Input	PZR	RCS		Dimension	RE	2	Area main spray control valves. This is a plant dependent variable. It may be adjusted during the initial plant tuning to provide a given flow rate for given plant conditions (based on provided test data or calculations).	Ft^2
338	PLT_VLVAREA_QT_GWS	Input	PZR	RCS	QT	Dimension	RE		Quench tank to Gas Waste System vent valve area. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data). This input is not used for safety analysis and the valve sizes are set to zero. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Ft^2
339	PLT_VLVAREA_QT_CONT	Input	PZR	RCS	QT	Dimension	RE		Quench tank to contain. vent viv area. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data). This input is not used for safety analysis and the valve sizes are set to zero.	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
340	PLT_VLVAREA_QT_NSUPPLY	Input	PZR	RCS	QT	Dimension	RE		Valve area nitrogen supply to QT. This is a plant dependent variable. It may be set to actual valve size, line size or adjusted to provide a given flow rate for given plant conditions (based on provided test data). This input is not used for safety analysis and the valve sizes are set to zero. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Ft^2
341	RCS_MORE_VARIABLES_504_RO	Partition					RE	41	RCS additional variables partition	Partition
342	RCS_PRZR_DH_SPRAY_EQ	Input	PZR	RCS		T/H Dimension	RE		Pressurizer spray delta-enthalpy for equilibrium. Used IFF the main spray is active beyond the minimum (or bleed) flow AND if the requested nonequilibrium mode of the pressurizer is NE_CANDIDATE(NODE_PRZR) = 3. (For realistic calculations, it SHOULD be 3 for subcooled liquid / superheated steam.) When the above 2 conditions are true AND the pressurizer's liquid inventory is within RCS_PRZR_DH_SPRAY_EQ Btu/lbm of saturation, AND the spray water is subcooled AND there is at least 1.5 ft of steam space AND RCS_PRZR_SPRAY_EQ is True, then the pressurizer is forced into thermal equilibrium. Otherwise, other logic determines the pressurizer's nonequilibrium state. So, typically this will kick in when spray causes rapid depressurization, and the liquid is approaching saturation due to the dropping pressure - this logic will force equilibrium just before saturation is reached.	Btu/lbm
343	RCS_PRZR_SPRAY_EQ	Input	PZR	RCS		T/H Dimension	LO		Pressurizer spray delta-enthalpy equilibrium flag. Used IFF the main spray is active beyond the minimum (or bleed) flow AND if the requested nonequilibrium mode of the pressurizer is NE_CANDIDATE(NODE_PRZR) = 3. (For realistic calculations, it SHOULD be 3 for subcooled liquid / superheated steam.) When the above 2 conditions are true AND the pressurizer's liquid inventory is within RCS_PRZR_DH_SPRAY_EQ Btu/lbm of saturation, AND the spray water is subcooled AND there is at least 1.5 ft of steam space AND RCS_PRZR_SPRAY_EQ is True, then the pressurizer is forced into thermal equilibrium. Otherwise, other logic determines the pressurizer's nonequilibrium state. So, typically this will kick in when spray causes rapid depressurization, and the liquid is approaching saturation due to the dropping pressure - this logic will force equilibrium just before saturation is reached.	True False

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
344	RCS_PRZR_DT_SUBH	Input	PZR	RCS		T/H Dimension	RE		Pressurizer delta-temperature boil heaters on. Used in conjunction with RCS_PRZR_DT_SUBC, RCS_PRZR_LVLDT_SUBC(2), and RCS_PRZR_TAU_DTSUB. These variables determine the extent to which change-of-phase processes occur in the pressurizer at thermal nonequilibrium -- boiling and flashing in the liquid region and condensation at the liquid-steam interface. This is given by the variable RCS_PRZR_DT_SUB_BOIL which is the amount of subcooling (degF) above which all boiling/flashing ceases and below which the surface condensation stops In the following, the first three variables above are referenced for short as DTH, DTC and LVLDT(2). First determine a temporary DTSBSS from a linear fit DTSBSS = DTC - F1 * F2 * (DTC - DTH) where F1 = (MixLevel - LVLDT(1)) / (LVLDT(2) - LVLDT(1)) F2 = HeaterHeat / 1000 MixLevel = przr mixture level, LEVL_MIX(NODE_PRZR) HeaterHeat = heat from the heaters, Btu/sec F1 and F2 are both bounded by [0.0,1.0]. Then, RCS_PRZR_DT_SUB_BOIL is determined as DTSBSS lagged with a time constant RCS_PRZR_TAU_DTSUB. The rates of flashing and boiling are calculated when the pressurizer is in thermal nonequilibrium. The liquid mass available for flashing is F3 * F4 * <total liquid mass>, and the heat input from the heaters and walls that results in boiling is F3 * F4 * <total heat from heaters and walls>. The two factors are: F3 = (MixLevel - LBOIL(2)) / (LBOIL(1) - LBOIL(2)) F4 = 1.0 - (TSAT - TLIQ) / RCS_PRZR_DT_SUB_BOIL F3 and F4 are both bounded by [0.0,1.0]. LBOIL is the array RCS_PRZR_L_BOIL(2) TSAT is the saturation temperature, TEMP_SAT(NODE_PRZR) TLIQ is the liquid temperature, TEMP_LIQ(NODE_PRZR) RCS_PRZR_DT_SUB_BOIL is the calculated subcooling DT for boiling/flashing. The rate of surface condensation is calculated when the pressurizer is in thermal nonequilibrium as condensation = <cond efficiency> * h * A * delta-T. The effective delta-T is given by delta-T = TSAT - TIQ - RCS_PRZR_DT_SUB_BOIL IF delta-T < 0, then: delta-T = 0 ELSE: 1 <= delta-T <= 5 RCS_PRZR_DT_SUBH and RCS_PRZR_DT_SUBC are plant design independent. RCS_PRZR_TAU_DTSUB is a long time constant that is used for stability, and is independent of plant design. RCS_PRZR_LVLDT_SUBC(2) are dependent on plant design, but their effect is expected to be weak: based on past	Del-DegF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
345	RCS_PRZR_TAU_DTSUB	Input	PZR	RCS		T/H Dimension	RE		Pressurizer time constant delta-temperature subcooling. Used in conjunction with RCS_PRZR_DT_SUBC, RCS_PRZR_DT_SUBH, and RCS_PRZR_LVLDT_SUBC(2). See RCS_PRZR_DT_SUBH for a full description.	Seconds
351	RCS_PRZR_L_BOIL	Input	PZR	RCS		T/H Dimension	RE	2	Boiling degradation parameters. The absolute values for this parameter are based on pressurizer height dimensions. The ability to achieve boiling into the steam space of the pressurizer degrades from full to nil at approximately 2.5 to 1.5 ft below the top of the pressurizer, based on sensitivity testing of CE plant models. Reference: Plant Basedeck Calculation, Hand Calc. #8	Feet
356	RCS_CRIT_FLOW_CHECK	Input	RCS			T/H Dimension	LO		Mom. paths critical flow check. This is a USER set variable. It determines whether CENTS checks for critical flow conditions along the RCS momentum flow paths. Though critical flow is only considered likely during certain LOCA conditions, it is set to true in the basedecks.	True False
359	RCS_PRZR_MSPRAY_TAU	Input	PZR	RCS		T/H Dimension	RE		Main spray flow time constant. Used always. Effectively used only when the pressurizer main spray valves are open (i.e., spray flow greater than minimum). This is a time constant used to lag the calculated main spray flow rate. The time constant (inertia effect) for the main spray flow is not explicitly described in the CENTS main spray flow calculation (Reference CENPD-282-P-A, Volume 1, Section 4.14.1). Normally, a small time constant is implemented to smooth the response without significantly affecting the flow response.	Seconds
361	RCS_PRZR_VLVH_MAX_TAU	Input	PZR	RCS		T/H Dimension	RE		Pressurizer relief valves heat transfer maximum time constant. This variable is used always, but only for calculating the simulator output TEMP_VALVE_RELIEF, which is not referenced anywhere else in CENTS. It is used in conjunction with PRZR_RELIEF_RTD_TAU and RCS_PRZR_VLV_REVH_TAU. They are time constants for calculating elements of TEMP_VALVE_RELIEF, the array of przr relief valves' RTD temperatures.	Seconds
362	RCP_FR_SP_RUB_RATCH	Input	RCP	RCS		Component Design	RE		RCP fractional speed in which the pawls rub on ratchet. Used in conjunction with RCP_TORQ_RUB_RATCH. Used always. These parameters determine the effect of the RCP anti-rotation device (ratchets) that engages whenever a pump coasts down toward standstill. The device engages when the pump speed (fraction of rated speed) falls below RCP_FR_SP_RUB_RATCH. With the device engaged, the calculated frictional torque RCP_TORQ_FRIC is subject to an imposed minimum of RCP_TORQ_RUB_RATCH. (In a normal pump coastdown, the effect is evident by a noticeable increase in the deceleration of the pump.). These parameters are dependent on the particular design of RCP and its anti-rotation device. The units of RCP_TORQ_RUB_RATCH are Ft-Lbf.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
363	RCP_TORQ_RUB_RATCH	Input	RCP	RCS		Component Design	RE		RCP torque pawls rub on ratchet. Used in conjunction with RCP_FR_SP_RUB_RATCH. Used always. These parameters determine the effect of the RCP anti-rotation device (ratchets) that engages whenever a pump coasts down toward standstill. The device engages when the pump speed (fraction of rated speed) falls below RCP_FR_SP_RUB_RATCH. With the device engaged, the calculated frictional torque RCP_TORQ_FRIC is subject to an imposed minimum of RCP_TORQ_RUB_RATCH. (In a normal pump coastdown, the effect is evident by a noticeable increase in the deceleration of the pump.). These parameters are dependent on the particular design of RCP and its anti-rotation device.	Ft-Lbf
364	RCS_PRZR_HAX_WALL	Input	PZR	RCS		T/H Dimension	RE		Pressurizer walls axial overall heat transfer coefficient. Used always. Overall heat transfer coefficient for axial heat transfer in the pressurizer wall. The wall heat model differs in the pressurizer from all other nodes, in that the pressurizer wall is divided into two sections separated by a moving boundary -- the wall region in contact with liquid and two-phase, and the wall sections in contact with steam. Since the two wall sections have different temperatures, there is some heat transfer between them: Heat = RCS_PRZR_HAX_WALL * delta-T. This variable is dependent on plant design, primary on the pressurizer wall thickness and material conductivity.	Btu/sec-degF
365	RCS_PRZR_LVLDT_SUBC	Input	PZR	RCS		T/H Dimension	RE	2	Pressurizer levels for boiling. Used in conjunction with RCS_PRZR_DT_SUBH, RCS_PRZR_DT_SUBC and RCS_PRZR_TAU_DTSUB. See RCS_PRZR_DT_SUBH for a full description.	Feet
366	RCS_P_ORING_FAIL	Input	RCS			Component Design	RE		Press. for vessel O-ring failure	Psia
374	RCS_PRZR_VLV_REVH_TAU	Input	PZR	RCS		T/H Dimension	RE		Pressurizer relief valves reverse heat transfer time constant. This variable is used always, but only for calculating the simulator output TEMP_VALVE_RELIEF, which is not referenced anywhere else in CENTS. It is used in conjunction with PRZR_RELIEF_RTD_TAU and RCS_PRZR_VLVH_MAX_TAU. They are time constants for calculating elements of TEMP_VALVE_RELIEF, the array of pressurizer relief valves' RTD temperatures.	Seconds
375	RCS_PHTR_RLD_MULT	Input	PZR	RCS		Multiplier	RE		Pressurizer proportional heater admittance multiplier. Used always. This is a multiplier on the admittance (1/resistance) of the proportional pressurizer heaters. The admittance is used in calculating each heater's electrical power as power = <bus voltage> * <voltage> * <admittance>. This multiplier is independent of plant design. It is used only for tuning or testing, and should always be set to 1.0 in actual transients.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
376	RCS_BHTR_RLD_MULT	Input	PZR	RCS		Multiplier	RE		Pressurizer backup heaters admittance multiplier. Used always. This is a multiplier on the admittance (1/resistance) of the backup pressurizer heaters. The admittance is used in calculating each heater's electrical power as power = <bus voltage> * <voltage> * <admittance>. This multiplier is independent of plant design. It is used only for tuning or testing, and should always be set to 1.0 in actual transients.	Dimensionless
379	PLT_SGS	Partition					RE	850	Steam generator data constants	Partition
380	PLT_SGS_INTERNAL	Partition					RE	230	SG data constants - SG internals	Partition
381	SG_DESIGN	Input	SG			Model Design	IN	4	Type of steam generator design (=1,2). There are two possible designs for SGs allowed for each plant. This variable is intended to allow differentiation of SG variables based upon modifications or replacement SGs which only effect some but not all SGs within a given plant.	Pointer
382	ASP_TBL	Partition					RE	15, 2	Table: c. s. area of evaporator region	Ft^2
383	ASP_TBL_DSGN1	Input	SG			Dimension	RE	15	Table: Cross-sectional area of evaporator region, Design #1. This table refers to the cross-sectional flow area in the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with the corresponding volume and height data, to determine the geometric proportions of these regions of the SG. This information is used to determine bubble rise and steam separation characteristics when SG level is at or above the separators. At lower levels, ASEP_SG performs this function. Note that abrupt changes in the area vs. height can cause improper mass flow rates and recirculation. Therefore, the area values are often "smoothed" to retain the proper SG performance. See plant basedeck calculations.	Ft^2
384	ASP_TBL_DSGN2	Input	SG			Dimension	RE	15	Table: Cross-sectional area of evaporator region, Design #2. This table refers to the cross-sectional flow area in the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with the corresponding volume and height data, to determine the geometric proportions of these regions of the SG. This information is used to determine bubble rise and steam separation characteristics when SG level is at or above the separators. At lower levels, ASEP_SG performs this function. Note that abrupt changes in the area vs. height can cause improper mass flow rates and recirculation. Therefore, the area values are often "smoothed" to retain the proper SG performance. See plant basedeck calculations.	Ft^2
385	HSP_TBL	Partition					RE	15, 2	Table: height in evaporator region	Feet

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
386	HSP_TBL_DSGN1	Input	SG			Dimension	RE	15	Table: height in evaporator region, design #1. This table refers to the independent variable of height to which cross-sectional flow area and volume are determined for the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with volume and area, to determine the geometric proportions of these regions of the SG. With volume, this information determines level in the region. With area, this information is used to determine bubble rise and steam separation characteristics when SG level is at or above the separators. At lower levels ASEP_SG performs this function. Note that abrupt changes in the area vs. height can cause improper mass flow rates and recirculation. Therefore, the area values are often times "smoothed" to retain the proper SG performance. See plant basedeck calculations.	Feet
387	HSP_TBL_DSGN2	Input	SG			Dimension	RE	15	Table: height in evaporator region, design #2. This table refers to the independent variable of height to which cross-sectional flow area and volume are determined for the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with volume and area, to determine the geometric proportions of these regions of the SG. With volume, this information determines level in the region. With area, this information is used to determine bubble rise and steam separation characteristics when SG level is at or above the separators. At lower levels ASEP_SG performs this function. Note that abrupt changes in the area vs. height can cause improper mass flow rates and recirculation. Therefore, the area values are often times "smoothed" to retain the proper SG performance. See plant basedeck calculations.	Feet
388	VST_TBL	Partition					RE	15, 2	Table: volume in evaporator region	Ft^3
389	VST_TBL_DSGN1	Input	SG			Dimension	RE	15	Table: volume in evaporator region, design #1. This table refers to the dependent variable of volume vs height determined for the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with height, to determine the geometric proportions of these regions of the SG. This information determines level in the region. See plant basedeck calculations.	Ft^3
390	VST_TBL_DSGN2	Input	SG			Dimension	RE	15	Table: volume in evaporator region, design #2. This table refers to the dependent variable of volume vs height determined for the evaporator/riser section or the steam dome region of the SG. It is used in conjunction with height, to determine the geometric proportions of these regions of the SG. This information determines level in the region. See plant basedeck calculations.	Ft^3
391	TBL2_NUM	Input	SG			Model Design	IN	2	Number of entries in evaporator geometry table. This number tells the CENTS code how many entries there are in each of the Volume/Area/Height tables, for each of the two possible design types. A maximum of 15 data points is available per table, per SG design.	Counts
392	HT3_TBL	Partition					RE	15, 2	Table: height in SG downcomer	Feet

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
393	HT3_TBL_DSGN1	Input	SG			Dimension	RE	15	Table: height in downcomer, design #1. This table refers to the independent variable of height to which volume is determined for the downcomer section of the SG. Note that the top of the downcomer region is often considered to be the level of the separator can deck. For ease in use of the CENTS code, the top elevation is often considered to be the top of the separators. This allows initialization of level to higher values, since the CENTS code does not allow initialization above the top of the can deck. It is used in conjunction with volume, to determine the geometric proportions of downcomer region of the SG. With volume, this information determines level in the downcomer. See plant basedeck calculations.	Feet
394	HT3_TBL_DSGN2	Input	SG			Dimension	RE	15	Table: height in downcomer, design #2. This table refers to the independent variable of height to which volume is determined for the downcomer section of the SG. Note that the top of the downcomer region is often considered to be the level of the separator can deck. For ease in use of the CENTS code, the top elevation is often considered to be the top of the separators. This allows initialization of level to higher values, since the CENTS code does not allow initialization above the top of the can deck. It is used in conjunction with volume, to determine the geometric proportions of downcomer region of the SG. With volume, this information determines level in the downcomer. See plant basedeck calculations.	Feet
395	V3_TBL	Partition					RE	15, 2	Table: volume in SG downcomer	Ft^3
396	V3_TBL_DSGN1	Input	SG			Dimension	RE	15	Table: volume in downcomer, design #1. This table refers to the dependent variable of volume vs height determined for the downcomer section of the SG. It is used in conjunction with height, to determine the geometric proportions of this region of the SG. This information determines level in the downcomer. See plant basedeck calculations.	Ft^3
397	V3_TBL_DSGN2	Input	SG			Dimension	RE	15	Table: volume in downcomer, design #2. This table refers to the dependent variable of volume vs height determined for the downcomer section of the SG. It is used in conjunction with height, to determine the geometric proportions of this region of the SG. This information determines level in the downcomer. See plant basedeck calculations.	Ft^3
398	TBL3_NUM	Input	SG			Model Design	IN	2	Number of entries in the downcomer geometry table. This number tells CENTS how many entries there are in the Volume/Height table for the downcomer, for each of the two possible design types. A maximum of 15 data points is available per table, per SG design.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
399	ASEP_SG	Input	SG			T/H Dimension	RE	4	Steam separation area at can deck, 100% steady state. This is a plant dependent variable. It can be calculated, and often is, to establish a preliminary value. However, the final basedeck value is always determined by tuning to achieve the correct masses and densities in the various SG nodes. It directly affects the bubble rise velocity, which in turn affects the above evaporator mass and density. This variable is usually tuned in conjunction with W32_FLOW_COEFF which affects the recirculation ratio. Normally all the SGs of a given design within the plant have the same final tuned value for this parameter. But, it is possible to tune each SG individually if separate data is available for each SG. See plant basedeck calculations.	Ft^2
400	EVAP_SS_ALPHA	Input	SG			T/H Dimension	RE	4	SG evaporator void fraction at 100% steady state. This is a plant dependent variable calculated from SG reference data concerning the steam volume of the evaporator/riser region divided by the total volume of the evaporator/riser region at full power conditions. Normally all the SGs of a given design within the plant have the same final tuned value for this parameter. But, it is possible to tune each SG individually if specific data is available for each SG. See plant basedeck calculations.	Fraction
402	PERIM	Input	SG			Dimension	RE	2	Perimeter of tube shroud in lower SG. This is a plant dependent variable, usually obtained as a direct dimension of the SG sectional drawing. One value of this parameter is available for each SG design type. This parameter, when multiplied by the height of water in the downcomer (SGS_HT3) and by SG_U23, determines the overall coefficient for evaporator-to-downcomer heat transfer through the shroud.	Feet
403	SF_CONC_IO	Input	SG			Dose	RE		Stripping factor for SG iodine nuc. conc. This is a plant independent variable. It dictates what fraction of the concentration of iodine in the liquid inventory of the SG will be transferred to the steam. It is determined by the USER as dictated by scenario requirements. Often times, it is set to .01.	Dimensionless
404	SG_U12	Input	SG			T/H Dimension	RE		Heat transfer coefficient between regions 1 & 2. This is a plant dependent variable. Region 1 is the steam dome and region 2 is the evaporator/riser region. The can deck is usually considered as the boundary metal between the two regions. The calculated heat transfer coefficient is considered to be conduction limited, with infinite heat transfer capability at the surface. Thus, HTC=1/R=1/(t/k). Note that there is seldom much, if any temperature difference between the two regions; therefore there is little heat transfer. See plant basedeck calculations.	$Btu/secft^2$ degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
405	SG_U23	Input	SG			T/H Dimension	RE		Heat transfer coefficient regions 2 & 3; also 2/4, 3/4(where an economizer is present). This is a plant dependent variable. Region 3 is the downcomer and region 2 is the evaporator/riser region. The tube shroud or "wrapper" is the boundary metal between the two regions. The calculated heat transfer coefficient is considered to be conduction limited, with infinite heat transfer capability at the surface. Thus, HTC=1/R=1/(t/k). See plant basedeck calculations.	Btu/secft^2 degF
406	SG_V2_ACTIVE	Input	SG			T/H Dimension	RE	2	Volume in region 2 to cover tubes. This is a plant dependent variable based on physical plant dimensions. The evaporator fluid volume at the level of the top of the tubes is the required value. There are parameter values available for each SG design type. See plant basedeck calculations.	Ft^3
409	TAURC1	Input	SG			T/H Dimension	RE		Time constant on SG recirculation flow W23. Used in conjunction with SGS_TAURC1_TUNE. Used always. CENTS applies a time constant to the SG recirculation flow (SGS_W23). TAURC1 is the time constant, and SGS_TAURC1_TUNE is a multiplying tuning factor on that time constant. The time constant formed by the product TAURC1 * SGS_TAURC1_TUNE is dependent on plant data, within the definition of the overall model. Its best value is usually determined by tuning. This is usually done by comparing the SG downcomer level trace immediately following scram against available plant data, and tuning this and other parameter until a good match is obtained. (The SGS model has more tuning factors that affect the circulation and recirculation flows than is necessary. Therefore, the usual practice is to tune SGS_TAURC1_TUNE and SGS_FK3_TUNE together, and SGS_TAURC2_MAX to a lesser extent.)	Seconds
413	VOLSGS	Input	SG			Dimension	RE	2	SG volume to main steam isolation valve. This is a plant dependent variable calculated to include the entire secondary side SG fluid volume + the volume of the steam line up to the main steam isolation valve. There are parameter values available for each SG design type. See plant basedeck calculations.	Ft^3
415	W32_FLOW_COEFF	Input	SG			T/H Dimension	RE	4	Downcomer to tube bundle flow coefficient, 100% steady state. This is a plant dependent variable = W32*(rho3*L3-rho2*L2)$^{0.5}$, where the downcomer is 3 and the evaporator is 2. It can be calculated to establish a preliminary value. However, the final basedeck value is always determined by tuning to achieve the correct recirculation ratio in the various SG nodes. This variable is usually tuned in conjunction with ASEP_SG. Normally all the SGs of a given design within the plant have the same final tuned value for this parameter. But, it is possible to tune each SG individually if specific SG data is available. See plant basedeck calculations.	Ft/s*SQRT(lb m)
416	SG_REF_LEGS	Partition					RE	18	SG level measurement taps	Partition
417	SG_REF_NUM	Input	SG			Component Design	IN	2	Number of level instrum. reference legs. This is a plant dependent variable. It indicates how many different SG level indication systems are in each of the two possible SG designs.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
418	SG_REF_BOT	Input	SG			Dimension	RE	2, 3	Lower tap height above tubesheet (design, leg#). These are plant dependent variables. The first two numbers are the height for leg #1(e.g. Narrow Range) for each SG design. The next two numbers are the height for leg #2 (e.g. Wide Range) for each SG design. The last two numbers are for the height of leg #3 for each SG design.	Feet
419	SG_REF_TOP	Input	SG			Dimension	RE	2, 3	Upper tap height above tubesheet (design, leg#). These are plant dependent variables. The first two numbers are the height for leg #1(e.g. Narrow Range) for each SG design. The next two numbers are the height for leg #2 (e.g. Wide Range) for each SG design. The last two numbers are for the height of leg #3 for each SG design.	Feet
420	TAU_REFLG_DN	Input	SG			T/H Dimension	RE	2	SG level measurement instrumentation reference leg time constant during cooldown. Used always. This is a time constant for the temperature of the SG reference leg, when the leg is cooling down. (TAU_REFLG_UP applies when the leg is heating up.) The reference leg temperature (SGS_TREFLG) responds to the local containment temperature (CONT_SG_TEMP), and determines the fluid density and the head in the leg. Thus the temperature has an effect (albeit small) on the measured SG downcomer level, which is used by the control systems. (The dimension accommodates two plant designs.) This time constant is dependent on the instrumentation system design of the simulated plant. Normally, the effect of this time constant is nil, since CONT_SG_TEMP is an input constant for each SG, and SGS_TREFLG is set equal to it at initialization. Therefore, an effect will be seen only if the user changes the containment temperature during the transient.	Seconds
421	TAU_REFLG_UP	Input	SG			T/H Dimension	RE	2	SG level measurement instrumentation reference leg time constant during heatup. Used always. This is a time constant for the temperature of the SG reference leg, when the leg is heating up. (TAU_REFLG_DN applies when the leg is cooling down.) The reference leg temperature (SGS_TREFLG) responds to the local containment temperature (CONT_SG_TEMP), and determines the fluid density and the head in the leg. Thus the temperature has an effect (albeit small) on the measured SG downcomer level, which is used by the control systems. (The dimension accommodates two plant designs.) This time constant is dependent on the instrumentation system design of the simulated plant. Normally, the effect of this time constant is nil, since CONT_SG_TEMP is an input constant for each SG, and SGS_TREFLG is set equal to it at initialization. Therefore, an effect will be seen only if the user changes the containment temperature during the transient.	Seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
422	SG_TUBE_AREA	Input	SG			Dimension	RE	2	SG tube internal flow area, one tube. This is a plant dependent variable. It represents the standard leak area for a SG tube rupture. For each tube ruptured (MAL_SGTR is the input number of ruptured tubes), there are two broken ends. CENTS treats these two ends as separate breaks, with different flow enthalpies and flow fluxes, and with each presenting a break area SG_TUBE_AREA * RCS_SGTR_FLOWMULT. Reference 1, Section 7.5.2.	Ft^2
423	ELEV_TUBE_SHEET	Input	SG	RCS		Dimension	RE	4	Tubesheet elevation above common reference. This is a plant dependent variable.	Feet
424	SG_ECONOMIZER	Input	SG			Flag	LO		SG economizer: T=exist, F=none. This is a plant dependent variable, set to True if the SG design includes an economizer, False otherwise.	True False
425	PLT_SGS_HEAT	Partition	SG				RE	70	SG data constants - SG heat transfer	Partition
426	ATUBES_MAX_CS	Input	SG	RCS		Dimension	RE	2	Primary flow area through tubes. This is a plant dependent variable. It equals the cross-sectional flow area of one tube * the number of unplugged tubes being modeled. Normally, this value is set with zero tubes plugged. Thus, there would be a value for each design type. The individual SG flow area is adjusted (for tube plugging) by using the multiplier SGT_Q_MULT for each SG.	Ft^2
427	ATUBES_MAX_HT	Input	SG			Dimension	RE	2	SG tubes heat transfer area. This is a plant dependent variable. It equals the secondary side surface area (in contact with water/steam) of all the tubes. Normally, this value is calculated with zero tubes plugged. The calculation is perimeter * avg. length of a tube * No. of tubes. Thus, there would be a value for each design type. The individual SG heat transfer area is adjusted (for tube plugging) by using the multiplier SGT_Q_MULT for each SG.	Ft^2
429	QSG_TBL	Input	SG			T/H Dimension	RE	20	Rosenow heat flux vs dT table, B/hr-ft2. Used always, in conjunction with TMP_TBL. These two arrays make up the Rosenow correlation of heat flux (QSG_TBL, Btu/hr-ft2) vs. temperature difference (TMP_TBL, degF). This correlation table is entered with the independent variable:delta-T = <local tube metal temp> - <evaporator coolant temp> to produce the correlation heat flux (CF). The secondary-side local heat transfer coefficient is, then: HTCOF = CF / delta-T * (SGS_P/14.7)**0.4 Btu/degF-hr-ft2. These arrays are a correlation that is independent of plant design.	Composite Units
430	TMP_TBL	Input	SG			T/H Dimension	RE	20	Delta temperature for Rosenow heat flux table. Used always, in conjunction with QSG_TBL. These two arrays make up the Rosenow correlation of heat flux (QSG_TBL, Btu/hr-ft2) vs. temperature difference (TMP_TBL, degF). This correlation table is entered with the independent variable:delta-T = <local tube metal temp> - <evaporator coolant temp> to produce the correlation heat flux (CF). The secondary-side local heat transfer coefficient is, then: HTCOF = CF / delta-T * (SGS_P/14.7)**0.4 Btu/degF-hr-ft2. These arrays are a correlation that is independent of plant design.	Del-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
431	RTUBES	Input	SG			T/H Dimension	RE	2	Thermal resistance of SG tubes. This is a plant & SG design dependent variable. It depends on the conductivity and thickness of the SG tube metal. Rtubes=(Do/(2k))*ln(Do/Di). During plant tuning to achieve the correct SG pressure to match referenced data, the multipliers sgt_htcrtc & sgt_htcrth are adjusted. This is essentially modifying Rtubes. See plant basedeck calculation.	Sec-ft^2-degF/Btu
432	SGMTCP	Input	SG			T/H Dimension	RE	2	Total heat capacity of tubes. This is a plant & SG design dependent variable = Mass of SG tubes * specific heat capacity of the metal, at normal operating conditions. The value for this variable is independent of tube plugging because the tube metal can adsorb or absorb heat during transient conditions regardless of whether it is plugged. See plant basedeck calculation.	Btu/degF
433	SGT_HYD_DIAM	Input	SG	RCS		T/H Dimension	RE	2	Hydraulic diameter of SG tubes primary flow. This is a plant & SG design dependent variable = inside diameter of a SG tube. See plant basedeck calculation.	Feet
434	SG_HCONV	Input	SG			T/H Dimension	RE		Convective htc outside SG wall. This is a plant dependent variable which depends upon the "effectiveness" of the SG insulation. This is often not well documented, thus assumptions are usually made to set heat transfer to a low value (1BTU/hr.ft^2.degF). See plant basedeck calculation.	Btu/secft^2 degF
435	SG_RWALL	Input	SG			T/H Dimension	RE	2	Thermal resistance of SG wall. This is a plant & SG design dependent variable =thickness/conductivity at normal operating conditions. See plant basedeck calculation.	Sec-ft^2-degF/Btu
436	WALL_AREA	Input	SG			Dimension	RE	2	SG surface area for heat loss to containment. This is a plant & SG design dependent variable. The surface area included is the secondary side SG shell. See plant basedeck calculation.	Ft^2
437	WALL_MCP	Input	SG			T/H Dimension	RE	2	SG wall heat capacity. This is a plant & SG design dependent variable = Mass * density * specific heat at normal operating conditions. The mass included is the secondary side SG shell. See plant basedeck calculation.	Btu/degF
439	PLT_SGS_MSLH	Partition					RE	240	SG data constants - steamline & header.	Partition
440	ASL_MAX	Input	MSL			Dimension	RE	2, 2	Steamline flow area (design,line). This is a plant & SG design dependent variable. Up to two lines as well as two SG designs are allowed. Thus the 2 x 2 matrix of values for this variable. This is the main line flow area; flow restrictions are specified separately via ASL_MIN and MSLH_AFRSL. Reference 1, Section 7.5.2.	Ft^2
441	HA_WALLI_MSLH	Input	MSL			T/H Dimension	RE		Inside MSLH wall heat transfer hA. This is a plant dependent variable. The heat transfer coefficient, h = hDB (Dittus-Boelter correlation). The area, A = length * inside perimeter of the piping. See plant basedeck calculation.	Btu/sec-degF
442	HA_WALLO_MSLH	Input	MSL			T/H Dimension	RE		Outside MSLH wall heat transfer hA. This is a plant dependent variable. The heat transfer coefficient is based upon insulation quality and thickness and tightness. It is often assumed , h = 65 Btu/hr.ft^2 * delT , where delT is approx. 400 F. The area, A = length * outside perimeter of the piping. See plant basedeck calculation.	Btu/sec-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
443	MCP_WALL_MSLH	Input	MSL			T/H Dimension	RE		Total heat cap of MSLH pipe wall. This is a plant dependent variable. The heat capacity = wall mass * specific heat. See plant basedeck calculation.	Btu/degF
444	SLI_FLOW_COEFF	Input	MSL			T/H Dimension	RE	8	Flow coefficient, steam nozzle to MSIV, at 100%. This is a plant dependent variable = A*sqrt(2*g*144*/K). The line loss coefficient, K, is calculated from known pressure drops at a given steam flow rate and pressure. The area, A, is ASL_MAX. See plant basedeck calculation.	Composite Units
445	SLO_FLOW_COEFF	Input	MSL			T/H Dimension	RE	8	Flow coefficient, MSIV to header, at 100% This is a plant dependent variable = sqrt(2*g*144/K). The line loss coefficient, K, is calculated from known pressure drops at a given steam flow rate and pressure. Note that the definition for this variable differs from SLI_FLOW_COEFF because line area is not included. See plant basedeck calculation.	Composite Units
447	VEL100	Input	MSL			T/H Dimension	RE	8	Steamline velocity at 100% flow. This is a plant dependent variable = (mass flow rate per line)/(steam density * line area). The mass flow rate and density can either be calculated from plant design power conditions or by iteration with CENTS trial runs and tuning. See plant basedeck calculation.	Ft/sec
448	VOL_MSLH	Input	MSL			Dimension	RE		Header and SL volume from MSIV to turb stop. This is a plant dependent variable = sum of line areas * lengths for all unisolable steam line piping from the MSIVs to the Turbine Stop Valves. This variable is important during transients where secondary steam pressure is changing. This volume capacity acts to slow the pressure changes by acting as an "accumulator". See plant basedeck calculation.	Ft^3
449	MSLB_AREA	Input	MSL	SG		Dimension	RE		Standard area for main steamline breaks. This is a transient dependent variable that should be set (or at least checked) by the USER. The area for steam line break is for a slot break. A double ended guillotine break should be modelled by setting the break area to a large number > 2* line area. Anything less than a very large number will act more like a slot break, where the various SGs are "competing" for steam flow, based on the pressure drops from each SG to the break.	Ft^2
450	MSLH_MSIV_AMAX	Input	MSL			Dimension	RE	2, 2	MSIV full-open flow area (design,line). This is a plant & SG design dependent variable. It is used during transients where the valves may close to determine when during the closing sequence that choke flow conditions may exist.	Ft^2
451	MSLH_MSIV_BYPASS_AMAX	Input	MSL			Dimension	RE	2, 2	MSIBV full-open flow area (design,line). This is a plant & SG design dependent variable. It is used during transients where the bypass valves may be open and the MSIVs are closed. This variable is used in the calculation of steam line flow rates and pressure drops for that plant condition. Normally, for standard safety analysis, the bypass valves are assumed to be shut.	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
452	MSLH_VALVE_AMAX	Input	MSL			Dimension	RE	50	Steamline ext valves full open flow areas. These are plant dependent variables. The full open valve area for the ADVs, MSSVs, turbine bypass & dump valves and the Turbine Admission Valve are normally modeled for the steam lines. Usually, the size of these valves is determined by calculation based upon known flow rates and design conditions. The CRITCO critical flow correlation is then used to back out an effective full open valve area. See plant basedeck calculation.	Ft^2
453	MSLH_VALVE_INLET	Input	MSL			Plant Design	IN	50	Steamline ext valves upstream region. These are plant dependent variables. This pointer indicates what region of the steam line is associated with the valve "entrance". The numbering scheme is based upon the number of steam lines/per SG * No. of SGs + the steam header. The highest number refers to the header and the lower numbers each refer to an individual steam line (upstream of the MSIV). Reference 1, Section 7.3.3.	Pointer
454	MSLH_VALVE_EXIT	Input	MSL			Plant Design	IN	50	Steamline ext valves downstream regions. These are plant dependent variables. This pointer indicates what region of the steam line is associated with the valve "exit". 1= atmosphere, 2= condenser, 3=containment, 4= turbine. Reference 1, Section 7.3.3.	Pointer
455	MSLH_VALVE_NUM	Input	MSL			Plant Design	IN		# of steamline external valves <50-NUM_SG*NUM_SL. This is a plant dependent variable. It represents the sum of all the ADVs, MSSVs, Turbine bypass & dump valves and TAV modeled in the basedeck. Note it does not include the MSIVs or MSIV bypass valves which are considered "internal" valves.	Counts
456	P_ATMOSPHERE	Input	MSL			T/H State	RE		Atmospheric pressure. This is a plant independent variable, though it may be adjusted slightly by the USER for different scenarios. It determines the expected backpressure for all MSLH valves which exit to atmosphere.	Psia
457	MSLH_TATM	Input	MSL			T/H State	RE		Atmospheric temperature at MSLH. This is a plant independent variable, though it may be adjusted by the USER for different scenarios. It is used to determine the dTemp for steam line wall heat transfer.	Degree F
458	SLI_CHECK_VALVE	Input	MSL			Plant Design	LO	2, 2	Steamline check valve: Yes (True)/No (False) (design,line). This is a plant dependent variable. Certain plants have an in-line check valve in their steam line, usually associated with the MSIV. This valve is intended to quickly shut should an accident condition exist which would cause reverse steam flow (i.e. an MSLB).	True False
459	SLI_DP100	Input	MSL			T/H Dimension	RE	8	Pressure drop, steam nozzle to MSIV, at 100% power. This is a plant dependent variable. If K_i is known, this may be calculated as (mass flow rate)^2 / (steam density) * K_i / (2*g*144*A^2) or it may be given directly from a reference. See plant basedeck calculation.	Psid

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
460	SLO_DP100	Input	MSL			T/H Dimension	RE	8	Pressure drop, MSIV to header, at 100%. This is a plant dependent variable. If K_o is known, this may be calculated as (mass flow rate)^2 / (steam density) * K_o / (2*g*144*A^2) or it may be given directly from a reference. See plant basedeck calculation.	Psid
461	ASL_MIN	Input	MSL	SG		Dimension	RE	2, 2	Steamline restrictor minimum flow area (design,line) between the SG nozzle and the MSIV, or between the SG nozzle and the break if the steamline has a break (MSLB). This is a plant dependent variable. It becomes important when an excess steam demand event is in progress, particularly a MSLB where critical flow conditions exist in the steam lines. This parameter can be set to the SG nozzle flow area when the MSLB is at the SG outlet nozzle. It can be adjusted by the code USER to be whatever the smallest flow area is between SGs and critical flow point. (See also MSLH_AFRSL.) Reference 1, Section 7.5.2.	Ft^2
462	NUM_SL	Input	MSL			Plant Design	IN		Number of steamlines per steam generator. This plant dependent variable tells CENTS how many entries are required in the various MSLH variable arrays.	Counts
463	PLT_SGS_FWS	Partition					RE	225	SG data constants - main & aux feedwater	Partition
464	FW_COEFF	Input	FW			T/H Dimension	RE	4	FW coeff at 100%. used for NUM_FWS_PUMPS=0 only. This input is used only during a FW line break to determine the pressure drop from the SG to the break location (usually set at the check valve location by setting FWLB_LOCATION = 0.0). The flow coefficient is determined by knowing the pressure drop from the valve to the SG for a given flow and temperature condition. FW_COEFF=((Mdot^2 * sp.vol.)/delP)$^{0.5}$. See basedeck calculation. The pressure at the break point for the feedline break flow calculation is calculated as follows: Pbreak = Psg - Frac*W^2/(rho* Fw_coeff^2) Where: Psg = Pressure at the SG nozzle (psia) rho = Feedline break flow density (lbm/ft3 W = Feed line break flow from the SG (lbm/sec) Frac = Fraction distance from the SG nozzle to the Feedwater check valve.	Composite Units
465	FWS_FLOW100	Input	FW			T/H Dimension	RE	4	Feedwater flow at 100% power, each SG. This input parameter is used by CENTS to calculate several variable concerning SG recirculation and masses in the downcomer and evaporator. See plant basedeck calculation.	Lbm/sec
466	WFW100	Input	FW			T/H Dimension	RE		Feedwater flow at 100% power, all SGs. This is the sum of FWS_FLOW100( ). This variable is not used by the code, and needs to be input only if accessed by controllers. See plant basedeck calculation.	Lbm/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
467	FWLB_AREA	Input	FW	SG		Dimension	RE		Standard area for feedwater line breaks. This break size is scenario dependent. It is set by the USER, usually during parametrics to determine the limiting event. Note that this break area is seen by CENTS as the area available for critical backflow from the affected SG. The "real" break size would be larger, because FW flow would also be exiting via the break.	Ft^2
468	FWS_NOZ_HEIGHT	Partition					RE	2, 3	Feedwater nozzle heights	Partition
469	HTNOZ	Input	FW	SG		Dimension	RE	2	Height of downcomer feedwater nozzle. This is a plant & SG design dependent variable. The heights are referenced to the top of the tube sheet.	Feet
470	HTNOZ_ECON	Input	FW	SG		Dimension	RE	2	Height of economizer feedwater nozzle. This is a plant & SG design dependent variable. The heights are referenced to the top of the tube sheet. It is only applicable to plants having economizers in their SGs.	Feet
471	HTNOZ_EFW	Input	FW	SG		Dimension	RE	2	Height of aux. feedwater nozzle. This is a plant & SG design dependent variable. The heights are referenced to the top of the tube sheet. For many designs, the auxiliary FW enters via the downcomer feed ring which would make it equal to HTNOZ.	Feet
472	NUM_FWS_PUMPS	Input	FW			Plant Design	IN		Number of feedwater pumps (max 4). A value greater than 0 turns on the detailed feedwater network model.	Counts
490	FWS_LINE_VOLUMES	Input Partition					RE	4, 2	FW line volumes downstream of valves. Required if NUM_FWS_PUMP > 0.	Ft^3
491	FWS_VOL	Input	FW			Dimension	RE	4	FW line volume after downcomer valve. Required if NUM_FWS_PUMP > 0.	Ft^3
492	FWS_ECON_VOL	Input	FW			Dimension	RE	4	FW line volume after economizer valve. Required if NUM_FWS_PUMP > 0.	Ft^3
496	NUM_AFW_PUMPS	Input	FW			Plant Design	IN		Number of AFW pumps (max 4)	Counts
497	PLT_SGS_SGBD	Partition					RE	30	SG data constants - SG blowdown system	Partition
498	SGBD_ACROSS	Input	SG	SGBD		Dimension	RE		Cross section area of SGBD tank. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Ft^2
499	HA_WALLI_SGBD	Input	SG	SGBD		T/H Dimension	RE		Inside SGBD tank heat transfer hA. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Btu/sec-degF
500	HA_WALLO_SGBD	Input	SG	SGBD		T/H Dimension	RE		Outside SGBD tank heat transfer hA. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Btu/sec-degF
501	MCP_WALL_SGBD	Input	SG	SGBD		T/H Dimension	RE		Total heat cap of SGBD tank wall. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Btu/degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
502	SGBD_VOL	Input	SG	SGBD		Dimension	RE		SGBD tank volume. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Ft^3
503	SGBD_SG_COEFF	Input	SG	SGBD		T/H Dimension	RE	8	Partition of flow coefficients, blowdown nozzles to tank.	Partition
504	SGBD_SURF_COEFF	Input	SG	SGBD		T/H Dimension	RE	4	Flow coeffs, surface blowdown nozzles to tank. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Composite Units
505	SGBD_BOT_COEFF	Input	SG	SGBD		T/H Dimension	RE	4	Flow coeffs, bottom blowdown nozzles to tank. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Composite Units
506	SGBD_SG_HTNOZ	Input	SG	SGBD		Dimension	RE	4	Partition of elevations of SG blowdown nozzles above tubesheet.	Partition
507	SGBD_SURF_HTNOZ	Input	SG	SGBD		Dimension	RE	2	Elevations of SG surface blowdown nozzles above tubesheet. Dimensioned on SG design (SG_DESIGN). Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Feet
508	SGBD_BOT_HTNOZ	Input	SG	SGBD		Dimension	RE	2	Elevations of SG bottom blowdown nozzles above tubesheet. Dimensioned on SG design (SG_DESIGN). Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Feet
509	SGBD_OUT_HTNOZ	Input	SG	SGBD		Dimension	RE	2	Hts above bottom, 2 BD tank outlet nozls. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Feet
510	SGBD_OUT_COEFF	Input	SG	SGBD		T/H Dimension	RE	2	Flow coeffs, 2 BD tank outlet nozzles. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Composite Units
511	SGBD_RELIEF_AMAX	Input	SG	SGBD		Dimension	RE		Bd tank relief valve full-open flow area. Not currently Used. To be used, all the blowdown system inputs would require appropriate values and the blowdown system would require activation by setting MOD_OFF_SGBD =. F.	Ft^2
512	PLT_SGS_MSLH2	Partition	MSLH				RE	40	SG data constants - enhanced steam line header model.	Partition
513	NUM_MSLH	Input	MSLH				IN		Number of MSLH nodes = 1 or 2. The one header model is chosen (MUM_MSLH=1) if shutting the Turbine Stop Valve (TSV) has no effect on the steam flow between SGs or from the intact SG to a break. If, however, shutting the TSV affects the flow rate between one steam line and the other, then the two-header model should be chosen (NUM_MSLH=2).	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
514	MSLH_AFRSL	Input	MSLH				RE	8	Steamline minimum flow area (i.e., flow restrictor) between the MSIV and the steamline header, or between the break and the header if the steamline has a break (MSLB). Any restrictions in line size, such as a flow measuring venturi, can be indicated by this parameter. This becomes important when an excess steam demand event is in progress, particularly a MSLB where critical flow conditions exist in the steam lines. If MSLH_AFRSL is 0.0, then it is treated as equal to ASL_MAX. (See also ASL_MIN.)	Ft^2
515	MSLH_FKBRK	Input	MSLH				RE	8	Steamline K-factor (flow resistance) from SG to the steamline break (MSLB) location. CENTS uses this line loss factor, in conjunction with the steamline flow coefficients, to calculate the pressure drops and flow balances from each SG to the break. This value must be less than the total flow resistance from the SG to the header node. If MSLH_FKBRK is 0.0, then the break location defaults to the equivalent of SLI_FLOW_COEFF, and a message is issued.	Composite Units
516	MSLH_ACROSS	Input	MSLH				RE		Steamline header cross tie flow area when the TSVs are shut (Turbine tripped). This variable, in conjunction with the cross tie k-factor and the line flow coefficients, determine the steam flow from one steam line to other(s) by calculating the pressure balance in the steam lines. It is only used when the 2-header model option is chosen.	Ft^2
517	MSLH_ACROSST	Input	MSLH				RE		Steamline header cross tie flow area with the turbine available. This variable, in conjunction with the cross tie k-factor and the line flow coefficients, determine the steam flow from one steam line to other(s) by calculating the pressure balance in the steam lines. It is only used when the 2-header model option is chosen.	Ft^2
518	MSLH_FKCROSS	Input	MSLH				RE		Steamline header cross tie flow resistance k-factor when TSVs are shut (turbine tripped). This variable, in conjunction with the cross tie line area and the line flow coefficients, determine the steam flow from one steam line to other(s) by calculating the pressure balance in the steam lines. It is only used when the 2-header model option is chosen.	Composite Units
519	MSLH_FKCROSST	Input	MSLH				RE		Steamline header cross tie flow resistance k-factor with the turbine on-line. This variable, in conjunction with the cross tie line area, the header flow area and the line flow coefficients, determine the steam flow from one steam line to other(s) by calculating the pressure balance in the steam lines. It is only used when the 2-header model option is chosen.	Composite Units
520	PLT_CTL	Partition					RE	20700	Control module variables	Partition
521	CTL_CONTROLLER_NUMBERS	Partition					IN	150	Controller numbers. Reference 2.	Partition
522	CTL_AFWS_CONTROLLERS	Input	Control	AFWS		Model Design	IN	4	AFWS flow controller number. This array is the numbers of the controllers which affect flow rate of AFW to the SGs. NUM_SG entries are required. Reference 2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
523	CTL_CEA_CONTROLLER	Input	Control	CORE	RCS	Model Design	IN		Control rod speed controller number. This variable is the number of the controller which calculates the control rod motion (non-scram). It is required even if the control rod motion is not modeled. Reference 2.	Pointer
524	CTL_CHGS_CONTROLLERS	Input	Control	CVCS	RCS	Model Design	IN	4	Charging pump controller numbers. This array is the numbers of the controllers which affect flow rate from charging pumps to the RCS. NUM_CHGS_PUMPS entries are required. Reference 2.	Pointer
525	CTL_FWS_CONTROLLERS	Input	Control	FWS		Model Design	IN	4	Main feedwater flow controller numbers. This array is the numbers of the controllers which affect flow rate of MFW to the SGs. NUM_SG entries are required. Reference 2.	Pointer
526	CTL_FWS_ECON_CONTROLLERS	Input	Control	FWS		Model Design	IN	4	Economizer FW valve controller numbers. This array is the numbers of the controllers which affect flow rate of MFW to the SGs, via the economizer. NUM_SG entries are required if SG_ECONOMIZER is True. Reference 2.	Pointer
527	CTL_FWS_PUMP_CONTROLLERS	Input	Control	FWS		Model Design	IN	4	Main FW pumps speed controller numbers. Reference 2.	Pointer
528	CTL_FWS_TRIP_CONTROLLER	Input	Control	FWS		Model Design	IN		Main feedwater trip controller number. Reference 2.	Pointer
529	CTL_HEATER_CONTROLLERS	Input	Control	PZR	RCS	Model Design	IN	2	Pressurizer heater controller numbers: proportional, backup. This array is the numbers of the controllers which affect operation / energizing of the heaters. Both entries are required. Reference 2.	Pointer
530	CTL_LETDOWN_CONTROLLERS	Input	Control	CVCS	RCS	Model Design	IN	4	Letdown flow controller numbers. This array is the numbers of the controllers which affects flow rate from the RCS via the letdown system. RCS_NUMOUT_LDNS entries are required. Reference 2.	Pointer
531	CTL_MSIV_CONTROLLERS	Input	Control	MSL		Model Design	IN	8	MSI valve controller numbers. This array is the numbers of the controllers which affect operation of the various MSIVs, usually during a transient which results in an MSIS condition. NUM_SG*NUM_SL entries are required. Reference 2.	Pointer
532	CTL_MSIS_TRIP_CONTROLLER	Input	Control	SG	MSL	Model Design	IN		MSI signal controller number. This variable is the number of the controller which determines whether the conditions exist for a Main Steam Isolation signal. This variable is required. Reference 2.	Pointer
533	CTL_MSLH_CONTROLLERS	Input	Control	MSL		Model Design	IN	50	MSLH valve controller numbers. Each valve in the MSLH system is controlled by its own separate valve controller which determines the fraction open for the valve. The pointers in this array determine which controller affects which valve's position. The order is the same as for MSLH_VALVE_AMAX, .. _INLET, .._EXIT. MSLH_VALVE_NUM entries are required. Reference 2.	Pointer
534	CTL_PORV_CONTROLLERS	Input	Control	PZR	RCS	Model Design	IN	4	Pressurizer PORV controller numbers. Each valve is controlled by its own separate valve controller which determines the fraction open for the valve. The pointers in this array determine which controller affects which valve's position. RCS_NUM_PORVS entries are required. Reference 2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
535	CTL_PSV_CONTROLLERS	Input	Control	PZR	RCS	Model Design	IN	4	Pressurizer safety valves controller numbers. Each valve is controlled by its own separate valve controller which determines the fraction open for the valve. The pointers in this array determine which controller affects which valve's position. RCS_NUM_SAFETYVLVS entries are required. Reference 2.	Pointer
536	CTL_RPS_CONTROLLERS	Input	Control	RCS		Model Design	IN	20	RPS channel controller numbers. Each reactor protection system function is controlled by its own separate controller which determines the corresponding trip channel status. The pointers in this array determine which controller affects which protection system function/channel. The channels so identified are used to energize the appropriate signal in the output array CTL_CORE_TRIP_SIG after scram, but they have no effect on the scram function. Reference 2.	Pointer
537	CTL_SIAS_TRIP_CONTROLLER	Input	Control	RCS		Model Design	IN		SIAS trip controller number. This variable is the number of the controller which determines whether the conditions exist for a Safety Injection Actuation signal. This variable is required. Reference 2.	Pointer
538	CTL_SPRAY_CONTROLLERS	Input	Control	RCS	PZR	Model Design	IN	2	Pressurizer spray controller numbers. This array is the numbers of the controllers which affect operation of the pressurizer main spray valves. Each valve is controlled by its own separate valve controller which determines the fraction open for the valve. RCS_NUM_MSPRAYVLVS entries are required. Reference 2.	Pointer
539	CTL_T_AVG_CONTROLLER	Input	Control	RCS		Model Design	IN		Controller number for loop average temperature. This variable is the number of the controller which calculates the RCS average temperature. This is intended to be part of the control systems for (as applicable): Turbine Runback/Setback, Steam Dump & Bypass, Pressurizer Level, Reactor Regulating System, or others as required. This variable is optional. Reference 2.	Pointer
540	CTL_T_REF_CONTROLLER	Input	Control	RCS		Model Design	IN		Controller number for demand reference temperature. This variable is the number of the controller which calculates the RCS reference temperature as a function of power. This is intended to be part of the control systems for (as applicable): Turbine Runback/ Setback, Reactor Regulating System, or others as required. This variable is optional. Reference 2.	Pointer
541	CTL_TURB_TRIP_CONTROLLERS	Input	Control	MSL		Model Design	IN	2	Turbine trip controller numbers (trip/close). Element 1 of this array is the number of the controller which determines whether the conditions exist for a Turbine Trip signal. Element 2 of this array is the number of the controller which determines the turbine valve (admission/stop) position immediately following a Turbine Trip. Both entries are required. Reference 2.	Pointer
542	CTL_CORE_TRIP_CONTROLLER	Input	Control	RCS	CORE	Model Design	IN		Core trip controller number. This variable is the number of the controller which determines whether the conditions exist for a Reactor Trip signal. This variable is required. Reference 2.	Pointer
543	CTL_POWER_CUTBACK_CONTROLLER	Input	Control	RCS	CORE	Model Design	IN		Reactor power cutback controller number. This variable is the number of the controller which determines whether the conditions exist for a Reactor Power Cutback signal. This variable is not required, unless a Cutback signal is to be modeled. Reference 2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
544	CTL_TURB_SETBACK_CONTROLLER	Input	Control	RCS	MSL	Model Design	IN		Turbine setback controller number. This variable is the number of the controller which determines whether the conditions exist for a Turbine Setback signal. This variable is not required, unless a Setback signal is to be modeled. Reference 2.	Pointer
545	CTL_TURB_RUNBACK_CONTROLLER	Input	Control	RCS	MSL	Model Design	IN		Turbine runback controller number. This variable is the number of the controller which determines whether the conditions exist for a Turbine Runback signal. This variable is not required, unless a Runback signal is to be modeled. Reference 2.	Pointer
546	CTL_PRZR_LVL_ERR_CONTROLLER	Input	Control	PZR	RCS	Model Design	IN		Pressurizer level error calculation controller number. This variable is the number of the controller which calculates the deviation of the pressurizer level from the program level. This variable is optional. Reference 2.	Pointer
547	CTL_PRZR_PROG_LVL_CONTROLLER	Input	Control	PZR	RCS	Model Design	IN		Pressurizer program level controller number. This variable is the number of the controller which calculates the correct pressurizer program level should be, based on power level. This variable is optional. Reference 2.	Pointer
548	CTL_FWS_BYPS_CONTROLLERS	Input	Control	FWS		Model Design	IN	4	FWS bypass valve controller number. This array is the numbers of the controllers which affect bypass valve demand signal. NUM_SG entries are required if bypass valve is modeled. Reference 2.	Pointer
549	CTL_FWS_ISOL_CONTROLLERS	Input	Control	FWS		Model Design	IN	4	FWS isolation valve controller number. This array is the numbers of the controllers which affect FWS isolation valve position. NUM_SG entries are required if FWS isolation valves modeled. Reference 2.	Pointer
550	CTL_AFWS_VALVE_CONTROLLERS	Input	Control	AFWS		Model Design	IN	14	AFWS control valve controller number. This array is the numbers of the controllers which affect the demand signal of the AFWS flow control valves. Reference 2.	Pointer
551	CTL_ATM_DUMP_NUM	Input	Control	MSL		Model Design	IN		Number of MSLH atm. dump valves. This is a plant dependent number. It tells CENTS how many ADVs there are in the MSLH system. The ADVs are defined by the controller system in conjunction with CTL_ATM_DUMP_PATH which dictates which MSLH path numbers represent the valves and CTL_MSLH_CONTROLLERS which determine the controllers which operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Counts
552	CTL_ATM_DUMP_PATH	Input	Control	MSL		Model Design	IN	10	Path number for MSLH atm. dump valve. This is a plant dependent number. It tells CENTS which MSLH path numbers represent the valves. The ADVs are defined by the controller system in conjunction with CTL_ATM_DUMP_NUM, how many ADVs there are in the MSLH system, and CTL_MSLH_CONTROLLERS which determine the controllers that operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
553	CTL_TAV_NUM	Input	Control	MSL		Model Design	IN		Number of turbine admission valves (TAV). This is a plant dependent number. It tells CENTS how many TAVs there are in the MSLH system. The TAVs are defined by the controller system in conjunction with CTL_TAV_PATH which dictates which MSLH path numbers represent the valves and CTL_MSLH_CONTROLLERS which determine the controllers which operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Counts
554	CTL_TAV_PATH	Input	Control	MSL		Model Design	IN	5	Path number for turbine admission valve(s). This is a plant dependent number. It tells CENTS which MSLH path numbers represent the valves. The TAVs are defined by the controller system in conjunction with CTL_TAV_NUM, how many TAVs there are in the MSLH system, and CTL_MSLH_CONTROLLERS which determine the controllers that operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Pointer
555	CTL_TURB_BYPASS_NUM	Input	Control	MSL		Model Design	IN		Number of turbine bypass valves(TBV). This is a plant dependent number. It tells CENTS how many TBVs there are in the MSLH system. The TBVs are defined by the controller system in conjunction with CTL_TURB_BYPASS_PATH which dictates which MSLH path numbers represent the valves and CTL_MSLH_CONTROLLERS which determine the controllers which operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Counts
556	CTL_TURB_BYPASS_PATH	Input	Control	MSL		Model Design	IN	5	Path number for turbine bypass valve. This is a plant dependent number. It tells CENTS which MSLH path numbers represent the valves. The TBVs are defined by the controller system in conjunction with CTL_TURB_BYPASS_NUM, how many TBVs there are in the MSLH system, and CTL_MSLH_CONTROLLERS which determine the controllers that operate the valves. Reference 1 Section 7.3.3, and Reference 2.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
557	DBADD	Output (Method A) Input (Method B)	Control			Model Design	IN	100	Offset locations of variables in Common. Always used, with DBCOM. These two arrays tell the Control System (CS) model where to find each variable that is referenced by the input array ELIN. For each variable, DBCOM points to a common block, and DBADD is the offset in the block. Reference 2. • CS Input Method A – Via the Input Processor (CSIP) CSIP initializes DBCOM and DBADD to represent the Correspondence Table (see Reference) – variables typically used by the CS – (a) at the first CONTROL command from CEER if the CS arrays are empty, or (b) following a CONTROL ... CLEAR ... directive. CSIP inserts additional pointer/offset data whenever it finds reference to a variable that is not represented in DBCOM/ DBADD. User input to DBCOM/DBADD is strongly discouraged. • CS Input Method B – Directly to the CS arrays (old method) DBCOM and DBADD are input, to represent the Correspondence Table (see above) and any other variables referenced by the particular CS implementation. These arrays are independent of plant design, except for the possibly unique use of certain variables in a particular plant CS design.	Pointer
558	DBCOM	Output (Method A) Input (Method B)	Control			Model Design	IN	100	Pointers to Common blocks. Always used, with DBADD. These two arrays tell the Control System (CS) model where to find each variable that is referenced by the input array ELIN. For each variable, DBCOM points to a common block, and DBADD is the offset in the block. Reference 2. See Input Method discussion under DBADD, above.	Pointer
559	ELEMS	Output (Method A) Input (Method B)	Control			Model Design	IN	1000	No. of elements per controller. Always used. The number is based upon the design of each controller which is dependent on plant design. In conjunction with ELTYPE & ELIN, the entire configuration of the array of controllers is established. See Reference 2. • CS Input Method A – Via the Input Processor (CSIP): CSIP sets ELEMS for each controller, based on the input to CSIP. • CS Input Method B – Directly to the CS arrays (old method): ELEMS is input directly as part of the Control System basedeck.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
560	ELIN	Output (Method A) Input (Method B)	Control			Model Design	RE	10000	Inputs to controller elements. Always used. This array includes all the setpoints, variable references and inter-element communication used in each of the elements of each controller. These element inputs appear in the array sequentially, from the first element's first input to the last element's last input. In conjunction with ELEMS & ELTYPE, the entire configuration of the array of controllers is established. Reference 2. • CS Input Method A – Via the Input Processor (CSIP): CSIP sets ELIN for each element input, based on the input to CSIP. • CS Input Method B – Directly to the CS arrays (old method): ELIN is input directly as part of the Control System basedeck. Variables are referenced by a numeric pointer which can be found in the Variable Correspondence Table (see Reference).	Pointer
561	ELTYPE	Output (Method A) Input (Method B)	Control			Model Design	IN	3000	Controller element type cues. Always used. This array indicates each element's type (e.g., Add, Mult). In conjunction with ELEMS & ELIN, the entire configuration of the array of controllers is established. Reference 2. • CS Input Method A – Via the Input Processor (CSIP): CSIP sets ELTYPE for each element, based on the input to CSIP. • CS Input Method B – Directly to the CS arrays (old method): ELTYPE is input directly as part of the Control System basedeck.	Pointer
562	GROUPS	Output (Method A) Input (Method B)	Control			Model Design	IN		Total number of controllers. The controller deck for each plant uses a specific number of controllers to define all the required functions and to provide informational controllers. Reference 2. • CS Input Method A – Via the Input Processor (CSIP): CSIP sets GROUPS, based on the input to CSIP. • CS Input Method B – Directly to the CS arrays (old method): GROUPS is input directly as part of the Control System basedeck. CENTS uses GROUPS to determine the actual number of controllers to be expected in a given deck.	Counts
563	NOTAB	Input	Control			Model Design	IN	100	No. of entries in user function table. This provides CENTS with the number of active X vs. Y values in each table. The number of non zero entries in this 30 value array can also be used to see how many active X,Y tables there are. These tables are used by the controllers for various functions such as pressure vs. flow for various pump combinations, etc. A maximum of 30 tables is possible. Reference 2	Counts
564	PTTAB	Input	Control			Model Design	IN	100	Pointer to start of user function table. This variable indicates to CENTS the location of the first value for each X,Y table used by the controllers. Thus, for table #2 or PTTAB (2), a value of 10 would indicate that the first entry for table 2 is XTAB(10) & YTAB(10). A maximum of 30 tables is possible. Reference 2	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
565	SEQNCE	Output / Input (Method A) Input (Method B)	Control			Model Design	IN	1000	Order of execution of controllers. This array determines the sequence in which controllers are executed at each time step. This is important and will affect results, since the output of some controllers is used as input to others. Thus, the sequence determines whether any given reference to the output of another controller is "backward" (from the current time step) or "forward" (from the previous step). Reference 2. • CS Input Method A – Via the Input Processor (CSIP): As each controller is defined via the input to CSIP, CSIP inserts the new controller into SEQNCE at the end of the sequence. Following a CONTROL ... ORDER ... directive, CSIP reorganizes this array to optimize the sequence for minimum number of forward references. The User may then adjust the sequence, if necessary. • CS Input Method B – Directly to the CS arrays (old method) : SEQNCE is input directly as part of the Control System basedeck. Care should be taken to avoid forward references.	Pointer
566	XTAB	Input	Control			Model Design	RE	2000	Ind. variable values for user function. This single array of values provides each of the independent variable (X) values for all the X, Y Tables used by the controllers. In conjunction with NOTAB & PTTAB, CENTS determines which values correspond to each table. A maximum of 1000 entries is possible for all 30 possible tables, combined. Reference 2	Undefined
567	YTAB	Input	Control			Model Design	RE	2000	Dep. variable values for user function. This single array of values provides each of the dependent variable (Y) values for all the X, Y Tables used by the controllers. In conjunction with NOTAB & PTTAB, CENTS determines which values correspond to each table. A maximum of 1000 entries is possible for all 30 possible tables, combined. Reference 2	Undefined
570	INPED	Input	Control			Model Design	LO		Control system structure display cue. Used in conjunction with INPED_SEQNCE, INPED_PAGE, CTL_DBG(202). The flags INPED and CTL_DBG are always checked. These user flags control the CENTS output of GCS controllers' structures and/or their dynamic debug outputs. INPED activates the structure display, and CTL_DBG limits that display to selected controllers. (This method of displaying the controllers structure is an alternative to the CONTROL ... PRINT directive.) CTL_DBG also activates the dynamic debug output of controller calculations when used with INPED=F. These flags are strictly user controls, independent of plant design. Reference 2.	True False

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
571	INPED_SEQNCE	Input	Control			Flag	LO		Controller structure display order: T=seqnce, F=input. Used in conjunction with INPED, INPED_PAGE, CTL_DBG(202). Used when INPED is True to determine the order in which controllers' structure is displayed – in the original input order (F), or in the order of execution (T). This flag is strictly a user control, independent of plant design. (The CONTROL ... PRINT directive ignores this flag, displaying the controllers' structure in the original input order.) Reference 2.	True False
572	INPED_PAGE	Input	Control			Model Design	IN		Lines/page in INPED output. 0=no paging. Used in conjunction with INPED, INPED_SEQNCE, CTL_DBG(202). Used when INPED is True to set the requested number of lines per page of structure display (no page breaks if set to 0). This flag is strictly a user control, independent of plant design. (The CONTROL ... PRINT directive ignores this flag, displaying the controllers' structure with no page breaks.) Reference 2.	Counts
573	CTL_DBG	Input	Control			Model Design	LO	1002	Controller cues for edits of structure or dynamic debug. Used in conjunction with INPED, INPED_PAGE, INPED_SEQNCE. The flags INPED and CTL_DBG are always checked. These user flags control the CENTS output of GCS controllers' structures and/or their dynamic debug outputs. INPED activates the structure display, and CTL_DBG limits that display to selected controllers. (This method of displaying the controllers structure is an alternative to the CONTROL ... PRINT directive.) CTL_DBG also activates the dynamic debug output of controller calculations when used with INPED=F. These flags are strictly user controls, independent of plant design. Reference 2.	True False
574	CTL_CONSTS	Partition	Control			Model Design	RE	10	Useful constants	Partition
575	CTL_ZERO	Constant	Control			Model Design	RE		Floating point zero (0.0). This is one of several constants which is used repeatedly in controller file logic. Therefore, a special input variable has been established for it. Its variable correspondence number is 99001. This variable is independent of plant design. Its value cannot be changed. Reference: Modeler's Manual for CENTS Reference 2.	Dimensionless
576	CTL_HALF	Constant	Control			Model Design	RE		Floating point one-half (0.5). This is one of several constants which is used repeatedly in controller file logic. Therefore, a special input variable has been established for it. Its variable correspondence number is 99002. This variable is independent of plant design. Its value cannot be changed. Reference 2.	Dimensionless
577	CTL_ONE	Constant	Control			Model Design	RE		Floating point one (1.0). This is one of several constants which is used repeatedly in controller file logic. Therefore, a special input variable has been established for it. Its variable correspondence number is 99003. This variable is independent of plant design. Its value cannot be changed. Reference 2.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
578	CTL_M_ONE	Constant	Control			Model Design	RE		Floating point minus-one (-1.0). This is one of several constants which is used repeatedly in controller file logic. Therefore, a special input variable has been established for it. Its variable correspondence number is 99004. This variable is independent of plant design. Its value cannot be changed. Reference 2.	Dimensionless
579	CTL_LIMITS	Partition	Control			Model Design	IN	10	Dimensioned limits of the control system	Partition
580	ELMAX	Constant	Control			Model Design	IN		Maximum total number of elements in the entire controller array. This array size is independent of plant design. Its value cannot be changed. The current size is 3000 elements.	Counts
581	LSTMAX	Constant	Control			Model Design	IN		Maximum total number of last-values. This array size is independent of plant design. Its value cannot be changed. The current size is 1000 last values.	Counts
582	INMAX	Constant	Control			Model Design	IN		Max total number of controller inputs. This array size is independent of plant design. Its value cannot be changed. The current size is 10000 inputs.	Counts
583	GRPMAX	Constant	Control			Model Design	IN		Maximum number of controller groups. This array size is independent of plant design. Its value cannot be changed. The current size is 1000 groups.	Counts
584	CTLMAX	Constant	Control			Model Design	IN		Dimension of CTL_CONTROLLER_NUMBERS. This array size is independent of plant design. Its value cannot be changed. The current size is 150.	Counts
585	TABMAX	Constant	Control			Model Design	IN		Maximum number of user-defined functions. This parameter is independent of plant design. Its value cannot be changed. The current size is 100 functions.	Counts
586	FCTMAX	Constant	Control			Model Design	IN		Maximum total number of user-defined function table entries. This array size is independent of plant design. Its value cannot be changed. The current size is 2000.	Counts
587	CTL_WARN	Input	Control			Flag	IN		User control over the display of Control System warnings (Reference 2): If CTL_WARN = 0, all warning messages are suppressed, except for a reminder at the first time that warning conditions are detected. If CTL_WARN = 1, each warning message appears only once. This is the normal mode. If CTL_WARN = 2, all applicable warning messages appear each time the system undergoes re-preprocessing.	Pointer
588	INPED_FILE	Input	Control			Flag	LO		Control system structure display target: T=output to file, F=display to console. Reference 2	True False
589	CHT_COMMON	Segment					RE	1500	Core heat transfer segment	Segment
590	CHT_INPUTS	Partition					RE	50	Input variables from other models	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
591	CHT_NREGIONS_RAD	Input	Core	CHT		Model Design	IN		Number of radial regions in the fuel pin heat transfer mesh, up to 10. Usually set at N=10. The first N-2 regions are the fuel pellet, the next is the gap, and the last is the clad. This parameter relates to CORE_RAD_OUT & CHT_FRAC_HT_GEN. Used always. It is used in the heat transfer algorithm. Independent of core design. Reference: Individual plant basedeck calculations, and Reference 1, Section 7.1.2.	Counts
592	CORE_RAD_OUT	Input	CORE	RCS		Dimension	RE	10	Outer radii of radial regions of the fuel rod, C.H.T. mesh. The number of entries in this array should equal CHT_NREGIONS_RAD, which is usually set to N=10. The radii are dependent upon the fuel design. The first N-2 mesh regions are concentric regions of the fuel pellet. The N-1'th mesh is the gap region and the N'th is the clad. Reference:Individual plant basedeck calculations.	Feet
593	MATTYP	Input	CORE	RCS		Flag	IN	10	Radial fuel rod region material (1/2/3=Fuel/Clad/Gap). This array is used in conjunction with CORE_RAD_OUT & CHT_NREGIONS_RAD. Usually, the first eight mesh regions are established as concentric regions of the fuel pellet. The 9th mesh is the gap region and the 10th is the clad. Reference: Individual plant basedeck calculations.	Pointer
594	CORE_HYD_DIA	Input	Core	CHT		T/H Dimension	RE		Core hydraulic diameter for flow in the active fuel region of the core. Dependent on core design.	Feet
595	FUEL_DENSITY	Input	Core	CHT		Dimension	RE		Density of uranium fuel. This parameter represents the fuel pellet density, normally given in gm/cc and converted to lbm/ft^3. Dependent on core design. Reference: Individual plant basedeck calculations.	Lbm/ft^3
596	CORE_HT_AREA	Input	Core	CHT		T/H Dimension	RE		Core heat transfer area at the clad/coolant interface. To calculate: pin perimeter x pin height x number of fuel pins in the core. Dependent on core design. Reference: Individual plant basedeck calculations.	Ft^2
597	CHT_COND_FUEL_MULT	Input	CORE	RCS		Multiplier	RE		Multiplier fuel conductivity. This is a USER controlled input, independent of plant design. Usually, it is set to 1.0 in the basedeck. It can be used to perform parametrics studies on core temperature or heat transfer capabilities.	Dimensionless
598	CHT_GAP_HCAP	Input	CORE	RCS		T/H Dimension	RE		Fuel-clad gap thermal heat capacity. This is a plant and fuel reload dependent variable. The density of the gas in gap is calculated assuming the ideal gas law. Then CHT_GAP_HCAP = density * Cp for the gas mixture. See plant basedeck calculation.	Btu/ft^3-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
599	CHT_PRESS_SUPERCRIT	Input	CORE	RCS		T/H Dimension	RE		Pressure for supercritical DNB calculation. Used in conjunction with CHT_H_SUPER_MULT. Used always. This is the "supercritical pressure" for the purpose of calculating heat flux. When vessel pressure exceeds this value (typically 2700 psia), CENTS does the following: (1) it forces the heat transfer mode to be in "forced convection", even if other conditions call for the "pool boiling" mode, and (2) it calculates the heat flux coefficient as CHT_H_SUPER_MULT * CHT_HTCOF_SUB, where the latter is the calculated heat transfer coefficient to subcooled liquid. These parameters are independent of plant design.	Psia
600	CHT_CHF_MULT	Input	CORE	RCS		Multiplier	RE		Multiplier on calculated critical heat flux. Used always, as long as the core heat transfer is in forced convection. This multiplier is independent of plant design. It is used only for tuning or testing, and should always be set to 1.0 in actual transients.	Dimensionless
601	CHT_CONST_LEV	Input	CORE	RCS		T/H State	RE		Time constant for level calculation in the core. Used always. The model calculates core heat transfer rates and distributions. It requires the current height of the two-phase region in order to determine the mode of heat transfer (forced convection or pool boiling) and to determine the local heat transfer coefficients at various elevations. Oscillations or rapid fluctuations (even of small magnitude) of the two-phase height can result in corresponding fluctuations in the core heat transfer that are inherently self-sustaining. Therefore, the model uses a "smoothed" two-phase height for all its calculations: <smoothed height> = <actual height> + CHT_CONST_LEV * (<previous smoothed height> - <actual height>). This "pseudo time constant" for lagging height in heat transfer calculations is for stability only. It is independent of plant design. A value of 0.0 results in no lag.	Fraction
602	TGAPIN	Input	CORE	RCS		T/H Dimension	RE		New initial core gap conductance for system initialization.	Btu/hr-ft2-degF
603	CHT_FRAC_HT_GEN	Input	CORE	RCS		T/H State	RE	11	Fraction of power generated in each of the radial regions of the fuel rod (fuel, gap & clad) and in the coolant. The number of entries in this array should equal N+1, where N=CHT_NREGIONS_RAD (which is usually set to 10; hence usually 11 entries). The sum of all entries in this array must equal 1.0. The first N-2 mesh regions are concentric regions of the fuel pellet. The N-1'th mesh is the gap region, the N'th is the clad, and the N+1'th is the coolant. The power generation fractions are dependent on the fuel design. Reference: core physics calculations.	Fraction
604	CHT_NNOD_BO	Partition					IN		Number of core axial nodes	Partition
605	CHT_NUM_NODE	Input	Core	CHT		Model Design	IN		No. of core axial nodes, used in core heat transfer mesh, max. 20. Must equal N_SECTIONS(1)-2, typically 20, independent of plant design.	Counts
607	CHT_PROPERTIES	Partition	CORE	RCS		T/H State	RE	25	CHT steam and liquid properties	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
608	CHT_ENTH_SAT_LIQ_M1	Output	CORE	RCS		T/H State	RE		Enthalpy of saturated liquid in the core node, at the previous time step. Used by CENTS to calculate the flashing rate during depressurization.	Btu/lbm
609	CHT_ENTH_SAT_LIQ	Output	CORE	RCS		T/H State	RE		Core average saturated liquid enthalpy.	Btu/lbm
610	CHT_ENTH_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam enthalpy.	Btu/lbm
611	CHT_SVOL_SAT_LIQ	Output	CORE	RCS		T/H State	RE		Core average saturated liquid specific volume.	Ft^3/lbm
612	CHT_SVOL_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam specific volume.	Ft^3/lbm
613	CHT_TEMP_SAT	Output	CORE	RCS		T/H State	RE		Core average saturated temperature.	Degree F
614	CHT_DHF_DP	Output	CORE	RCS		T/H State	RE		Core average derivative of saturated liquid enthalpy wrt pressure.	Composite Units
615	CHT_DHG_DP	Output	CORE	RCS		T/H State	RE		Core average derivative of saturated steam enthalpy wrt pressure.	Composite Units
616	CHT_DTSAT_DP	Output	CORE	RCS		T/H State	RE		Core average partial derivative of subcooled temperature wrt pressure.	Composite Units
617	CHT_DTSAT_DH	Output	CORE	RCS		T/H State	RE		Core average partial derivative of subcooled temperature wrt enthalpy.	Composite Units
618	CHT_DVSATL_DP	Output	CORE	RCS		T/H State	RE		Core average partial derivative of subcooled liquid specific volume wrt pressure.	Composite Units
619	CHT_DVSATG_DP	Output	CORE	RCS		T/H State	RE		Core average partial derivative of superheated steam specific volume wrt pressure.	Composite Units
620	CHT_DVSATL_DH	Output	CORE	RCS		T/H State	RE		Core average partial derivative of subcooled liquid specific volume wrt enthalpy.	Composite Units
621	CHT_DVSATG_DH	Output	CORE	RCS		T/H State	RE		Core average partial derivative of superheated steam specific volume wrt enthalpy.	Composite Units
622	CHT_VISCOS_WAT	Output	CORE	RCS		T/H State	RE		Core average liquid viscosity.	Lbm/ft-sec
623	CHT_VISCOS_STM	Output	CORE	RCS		T/H State	RE		Core average steam viscosity.	Lbm/ft-sec
624	CHT_VISCOS_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam viscosity.	Lbm/ft-sec
625	CHT_COND_WAT	Output	CORE	RCS		T/H State	RE		Core average liquid thermal conductivity.	Btu/sec-ft-degF
626	CHT_COND_STM	Output	CORE	RCS		T/H State	RE		Core average steam thermal conductivity.	Btu/sec-ft-degF
627	CHT_COND_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam thermal conductivity.	Btu/sec-ft-degF
628	CHT_PRAN_WAT	Output	CORE	RCS		T/H State	RE		Core average liquid Prandtl Number.	Dimensionless
629	CHT_PRAN_STM	Output	CORE	RCS		T/H State	RE		Core average steam Prandtl Number.	Dimensionless
630	CHT_PRAN_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam Prandtl Number.	Dimensionless
631	CHT_SPEC_HT_WAT	Output	CORE	RCS		T/H State	RE		Core average liquid specific heat capacity.	Btu/lbm-degF
632	CHT_SPEC_HT_SAT_STM	Output	CORE	RCS		T/H State	RE		Core average saturated steam specific heat capacity.	Btu/lbm-degF
633	CHT_STATE	Partition					RE	25	CHT Internal variables for restart	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
634	CHT_BOILING	Output	CORE	RCS		Flag	LO		Flag for heat transfer mode T=boiling (natural circulation), F=forced circulation. This is a plant independent variable that flags when the core heat transfer model shifts modes from natural circulation (pool boiling) to forced circulation. The shift from forced circulation to NC is made for the following conditions: core pressure <supercritical, and either RCP d/p <2.0 psid or flow reversal in the core region. Reference 1, Section 7.1.2.	True False
635	CHT_FLUX_CRIT	Output	CORE	RCS		T/H State	RE		Core Critical heat flux	Btu/sec-ft^2
636	CHT_TERM	Output	CORE	RCS		T/H State	RE		Core Transition boiling term	Composite Units
637	CHT_TERM2	Output	CORE	RCS		T/H State	RE		Core Departure from nucleate boiling term	Composite Units
638	CHT_TEMP_CRIT	Output	CORE	RCS		T/H State	RE		Core Critical temperature	Degree F
639	CHT_HTCOF_NB	Output	CORE	RCS		T/H State	RE		Core Nucleate boiling heat transfer coefficient	Btu/secft^2 degF
640	CHT_HTCOF_SUB	Output	CORE	RCS		T/H State	RE		Core heat transfer coefficient to subcooled liquid	Btu/secft^2 degF
641	CHT_FLASH_RATE_LAST	Output	CORE	RCS		T/H State	RE		Core flashing rate at the previous time step	Lbm/sec
642	CHT_LEVL_MIX_LAST	Output	CORE	RCS		T/H State	RE		Core mixture level at the previous time step	Feet
643	CHT_AVG_HEAT_FLUX	Output	CORE	RCS		T/H State	RE		Core-wide average heat flux	MegBtu/hr-ft^2
644	CHT_TEMP_FUEL_AV	Output	CORE	RCS		T/H State	RE		Average temperature of fuel	Degree F
647	CHT_QUAL	Output	CORE	RCS		T/H State	RE	20	Core node section coolant quality in forced convection	Fraction
648	CHT_TEMP_CROSS	Output	CORE	RCS		T/H State	RE	20	Core crossover temperature	Degree F
649	CHT_HTCOF_FB	Output	CORE	RCS		T/H State	RE	20	Core film boiling heat transfer coefficient	Btu/secft^2 degF
650	CHT_FLX_DNB	Output	CORE	RCS		T/H State	RE	20	Critical heat flux in forced convection	Btu/sec-ft^2
651	CHT_TEMP_NB_FC	Output	CORE	RCS		T/H State	RE	20	Critical temperature in forced convection	Degree F
653	CHT_FLOW_STM_BO	Output	CORE	RCS		T/H State	RE	20	Steam flow rate - pool boiling mode. This plant independent output variable is calculated for each of the axial nodes in the core. Reference 1, Section 7.1.2.	Lbm/sec
654	CHT_GAP_COND	Output	CORE	RCS			RE	20	Fuel-clad gap thermal conductivity. It is calculated by the code at INITIALization as: TGAPIN * (gap thickness) / 3600.	Btu/sec-ft-degF
655	CHT_HT_GEN_ZR_WAT	Output	CORE	RCS		T/H State	RE	20	Heat rate of Zr-water reaction. High cladding temperatures, which can occur during core uncovery, result in zirc oxidation, generation of hydrogen and heat. This variable is the CENTS calculated heat measured for each node section, using the Baker-Just correlation. Reference 1, Section 7.1.2 and 3.1.3.	Btu/sec
656	CHT_IHT	Output	CORE	RCS		Flag	IN	20	Cue for heat transfer regime by node. When CHT_BOILING = T, the heat transfer regime is determined by CENTS at the bottom of each node section (and core exit). The regimes are: 1=subcooled; 2=Nucleate Boiling; 4=Transition Boiling; 5= Stable film boiling; 7= Steam; & 8= Supercritical steam. Reference 1, Section 7.1.2.	Dimensionless
657	CHT_SPEC_HT_STM	Output	CORE	RCS		T/H State	RE	20	Core average steam specific heat capacity.	Btu/lbm-degF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
658	CHT_HTCOF_ST	Output	CORE	RCS		T/H State	RE	20	Core heat transfer coefficients to steam for each core section.	Btu/secft^2 degF
659	CHT_HT_FLUX	Output	CORE	RCS		T/H State	RE	20	Heat flux into moderator for each core section.	Btu/sec-ft^2
660	CHT_TEMP_SURF	Output	CORE	RCS		T/H State	RE	20	Node temperature at the clad-moderator interface for each core section.	Degree F
661	CFTH_RCSAXIAL_Q	Output	CORE	RCS		T/H State	RE	20	Total power in each core axial section. The power in each section is calculated by CENTS based on the current core power and the input axial power distribution. The power in each section is used to calculated the core thermal-hydraulic conditions.	Btu/sec
662	CHT_HEAT_LIQ	Output	CORE	RCS		T/H State	RE	20	Rod heat transfer to liquid	Btu/sec
663	CHT_HEAT_STM	Output	CORE	RCS		T/H State	RE	20	Rod heat transfer to steam	Btu/sec
664	CHT_AXIAL_DATA_ALL	Output	CORE	RCS		T/H State	RE	50	Partition for Core Axial temperature and enthalpy	Partition
665	CHT_ENTH_COOL	Output	CORE	RCS		T/H State	RE	21	Coolant enthalpy at bottom of each core section. For N core sections, the N+1'th value is the core exit enthalpy. Reference 1, Section 7.1.2.	Btu/lbm
666	CHT_TEMP_COOL	Output	CORE	RCS		T/H State	RE	21	Coolant temperature at bottom of each core section. For N core sections, the N+1'th value is the core exit temperature. Reference 1, Section 7.1.2.	Degree F
667	CHT_ROD_RADIAL	Output	CORE	RCS		T/H State	RE	600	Partition containing fuel rod radial temperature, conductivity, and heat capacity.	Partition
668	CHT_TEMP_ROD	Output	CORE	RCS		T/H State	RE	10, 20	Temp. distribution in fuel rod	Degree F
669	CHT_COND_ROD	Output	CORE	RCS		T/H State	RE	10, 20	Rod th. cond. at last prop. calc.	Btu/sec-ft-degF
670	CHT_HT_CAP_ROD	Output	CORE	RCS		T/H State	RE	10, 20	Rod heat cap. at last prop. calc.	Btu/ft^3-degF
671	CHT_SECTIONS_OUTPUT	Partition					RE	41	Mass and enthalpy of the fluid in each of the core axial sections	Partition
672	CHT_M_CORE_SECT	Output	CORE	RCS		T/H State	RE	20	Mass in core sections	Lbm
673	CHT_H_CORE_SECT	Output	CORE	RCS		T/H State	RE	20	Enthalpy of liq in core sections	Btu/Lbm
674	CHT_USE_NEW_ENTHALPY_OPTION	Input	CORE	RCS		T/H State	RE		1 => Use the new (version 02280) CHT enthalpy rise calculation	Dimensionless
675	POWER_COMMON	Segment					RE	1700	Segment for core power variables	Segment
676	POW_USER_COMMON	Partition					RE	80	Variables for user control of power	Partition
677	POW_USER_INP	Partition					RE	60	User control input variables	Partition
679	POW_USER_IFUPOW	Input	CORE	RCS		Flag	LO		User option for using power table. This flag allows the code USER to bypass the core power calculation of CENTS. When this is set to True, and simultaneously CTL_CORE_CONTROL_AUTO is False, then a table of power (POW_USER_POWT) vs. time (POW_USER_TPOWT) substitutes for the CENTS point kinetics calculation.	True False
680	POW_USER_POWZ	Input	CORE	RCS		Plant Design	RE		Plant design full steady-state power. This plant dependent variable indicates the rated core power. It is used with initial power fraction, KFRAIN, to calculate the initial core power at the start of any transient.	Megawatts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
681	POW_USER_NPOWT	Input	CORE	RCS		Model Design	IN		No. of pairs in power vs time table. If POW_USER_IFUPOW=T and CTL_CORE_CONTROL_AUTO=F, then this array indicates to CENTS how many power vs. time entries (20 maximum) there are in POW_USER_POWT & POW_USER_TPOWT.	Counts
682	POW_USER_POWT	Input	CORE	RCS		Model Design	RE	20	Power values for power vs time table. If POW_USER_IFUPOW=T and CTL_CORE_CONTROL_AUTO=F, then this array indicates to CENTS the USER required power in the power vs. time table.	Fraction
683	POW_USER_TPOWT	Input	CORE	RCS		Model Design	RE	20	Time values for power vs time table. If POW_USER_IFUPOW=T, then this variable indicates to CENTS the USER required power in the power vs. time table.	Seconds
684	POW_USER_STATE	Partition	CORE	RCS			RE	10	User power state variables	Partition
685	POW_USER_QC	Output	CORE	RCS		Physics	RE		Final kinetics fission power fraction	Fraction
686	POW_USER_QCD	Output	CORE	RCS		Physics	RE		Final kinetics decay power fraction	Fraction
687	POW_KIN_COMMON	Partition					RE	630	Power kinetics variables	Partition
688	POW_KIN_INP	Partition					RE	580	Kinetics input variables	Partition
689	POW_KIN_ALPHA	Input	CORE	RCS		Physics	RE	11	Fission products disintegration energies. This array provides a normalized fractional energy for each fission product group. This is a plant independent array obtained from WAPD-TM-534, 5/66. Reference 1, Section 3.1.1.	Fraction
690	POW_KIN_DLAM	Input	CORE	RCS		Physics	RE	11	Decay constants for fission products. This array is associated with the fission product groups whose fractional energies are in POW_KIN_ALPHA. This is a plant independent array obtained from WAPD-TM-534, 5/66. Reference 1, Section 3.1.1. These input parameters are used in the calculation of decay heat. A decay heat term is calculated both before and after trip. The decay heat term is added to the calculated fission power to give total core power. Decay power is important for the long-term behavior of the system after trip. It affects requirements on aux feedwater delivery and also can affect the amount of calculated steam released which is important to dose calculations. CENTS uses an 11 group model in the calculation of decay heat. It is important to note the following: Infinite operation at the initial power is assumed. This could be important for events initialized at low or zero power because at those conditions it might be appropriate to base the decay heat on full power. Uncertainties are not included. Heavy element decay is not included. If decay power after trip is important for some event, the user should use the decay heat table by setting the variable POW_DKHT_DHCBEG to an appropriate value.	1/seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
691	POW_KIN_BETA	Input	CORE	RCS		Physics	RE	6	Effective delayed neutron fractions. The six groups of delayed neutron precursors are plant, reload and time in core life dependent. Therefore, they become inputs which the code USER must review and update. The basedeck values are strictly representative values which provide for stable steady state code behavior for purposes of tuning and basedeck verification. Minimum beta fraction results in a faster power rise for power-increasing events.	Fraction
692	POW_KIN_PLAM	Input	CORE	RCS		Physics	RE	6	Decay constants for delayed neutrons. The decay constants for the six groups of delayed neutron precursors are plant, reload and time in core life dependent. Therefore, they become inputs which the code USER must review and update. The basedeck values are strictly representative values which provide for stable steady state code behavior for purposes of tuning and basedeck verification.	1/seconds
693	POW_KIN_BBAR	Output	CORE	RCS		Physics	RE		Total delayed neutrons fraction.	Fraction
695	POW_KIN_DKCONZ	Output	CORE	RCS		Physics	RE		Reference boric acid reactivity. This output parameter represents the moderator boric acid reactivity for initial conditions in the system. It is used in conjunction with moderator temperature reactivity, unless the moderator density option is used. In that case, the boric acid reactivity must be considered as part of the density change reactivity. Reference 1, Section 7.1.1.	Reactivity
696	POW_KIN_DKCTMZ	Output	CORE	RCS		Physics	RE		Reference moderator temp reactivity. This output parameter represents the moderator temperature reactivity for initial conditions in the system. It is used in conjunction with boric acid reactivity, unless the moderator density option is used. In that case, the boric acid reactivity must be considered as part of the density change reactivity. Reference 1, Section 7.1.1.	Reactivity
697	POW_KIN_DKDENZ	Output	CORE	RCS		Physics	RE		Reference moderator density reactivity. This output parameter represents the moderator density reactivity for initial conditions in the system; the boric acid reactivity must be considered as part of the density reactivity. It is used normally for transients where voiding is expected to occur in the core region Otherwise, the moderator temperature & boric acid reactivity option is used. Reference 1, Section 7.1.1.	Reactivity
698	POW_KIN_DKTMPZ	Output	CORE	RCS		Physics	RE		Reference Doppler reactivity. This output parameter represents the reactivity associated with fuel temperature for initial conditions in the system. Reference 1, Section 7.1.1.	Reactivity
699	POW_KIN_DKINSZ	Output	CORE	RCS		Physics	RE		Reference control rod insertion reactivity. This output parameter represents the reactivity associated with control rod regulating system for initial rod position in the core. Reference 1, Section 7.1.1.	Reactivity
701	POW_KIN_NDKCON	Input	CORE	RCS		Model Design	IN		No. pairs, reactivity vs boric acid concentration table. This input parameter tells CENTS the size of the array. The maximum number is 30 values. Reference 1, Section 7.1.1.	Counts
702	POW_KIN_NDKCTM	Input	CORE	RCS		Model Design	IN		No. pairs, reactivity vs. moderator temperature table. This input parameter tells CENTS the size of the array. The maximum number is 30 values. Reference 1, Section 7.1.1.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
703	POW_KIN_NDKDEN	Input	CORE	RCS		Model Design	IN		No. pairs, react vs moder density table. This input parameter tells CENTS the size of the array. The maximum number is 30 values. Reference 1, Section 7.1.1.	Counts
704	POW_KIN_NDKTMP	Input	CORE	RCS		Model Design	IN		No. pairs, Doppler reactivity vs fuel temperature table. This input parameter tells CENTS the size of the array. The maximum number is 30 values. Reference 1, Section 7.1.1.	Counts
705	POW_KIN_NQDK	Input	CORE	RCS		Model Design	IN		No. pairs, control rod scram reactivity vs time table. This input parameter tells CENTS the size of the array. The maximum number is 30 values. Reference 1, Section 7.1.1.	Counts
706	POW_KIN_SIGD2	Output	CORE	RCS		Physics	RE		Total fission (1.0 - sum POW_KIN_ALPHA). The value of this parameter normally is calculated to be .93, independent of plant design.	Fraction
707	POW_KIN_STARL	Input	CORE	RCS		Physics	RE		Prompt neutron lifetime. This is a plant, cycle and time in cycle dependent variable, established by the USER for each analysis. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. Minimum l* has no effect for most events. It has an effect on prompt critical or near-prompt critical events. For these cases, minimum l* results in a faster power rise.	Seconds
708	POW_KIN_TSS	Input	CORE	RCS		Physics	RE		Maximum kinetics time step. This is an output variable which is set internally. A dummy value is required for the first pass.	Seconds
709	POW_KIN_DKCON	Input	CORE	RCS		Physics	RE	30	Boric acid reactivity, for reactivity vs concentration table. This is a plant, cycle & time in cycle dependent array, established by the USER. It is used only if POW_KIN_BORON_FB_OPTION=T. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. It is used in conjunction with moderator temperature reactivity, unless the moderator density option is used. In that case, the boric acid reactivity must be considered as part of the density change reactivity. This table is typically used only for steam line break analyses. For other analyses, the boron concentration does not change. Other analyses use the option to calculate reactivity as a function of moderator temperature. A dummy table is input into the base deck. Reference 1, Section 7.1.1.	Reactivity
710	POW_KIN_TDKCON	Input	CORE	RCS		Physics	RE	30	Boric acid concentration for reactivity vs concentration table. This is a plant, cycle & time in cycle dependent array, established by the USER. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. It is used only if POW_KIN_BORON_FB_OPTION=T. Reference 1, Section 7.1.1.	Parts/million

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
711	POW_KIN_DKCTM	Input	CORE	RCS		Physics	RE	30	Moderator temperature reactivity for reactivity vs temperature table. This is a plant, cycle & time in cycle dependent array, set by the USER. It is used only if POW_KIN_MOD_TEMP_FB_OPTION=T. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. It is used in conjunction with boric acid reactivity, unless the moderator density option is used. Reference 1, Section 7.1.1.	Reactivity
712	POW_KIN_TDKCTM	Input	CORE	RCS		Physics	RE	30	Moderator temperature for reactivity vs temperature table. This is a plant, cycle & time in cycle dependent array, established by the USER. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. It is used only if POW_KIN_MOD_TEMP_FB_OPTION=T. Reference 1, Section 7.1.1.	Degree F
713	POW_KIN_DKDEN	Input	CORE	RCS		Physics	RE	30	Moderator density reactivity for reactivity vs density table. This is a plant, cycle & time in cycle dependent array, set by the USER. It is used only if POW_KIN_MOD_DENSITY_FB_OPTION=T. If used, then boric acid reactivity needs to be considered when determining the density reactivity. The basedeck values are often set to zero for this variable because moderator temperature and boric acid reactivity are used for tuning and testing of the input deck. Reference 1, Section 7.1.1.	Reactivity
714	POW_KIN_TDKDEN	Input	CORE	RCS		Physics	RE	30	Moderator density for reactivity vs density table. This is a plant, cycle & time in cycle dependent array, established by the USER. It is used only if POW_KIN_MOD_DENSITY_FB_OPTION=T. Reference 1, Section 7.1.1.	Lbm/ft^3
715	POW_KIN_DKTMP	Input	CORE	RCS		Physics	RE	30	Reactivity for Doppler reactivity vs fuel temperature table. This is a plant, cycle & time in cycle dependent array, set by the USER. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. Always used, but the calculated reactivity is used only if POW_KIN_DOPPLER_FB_OPTION=T. Reference 1, Section 7.1.1.	Reactivity
716	POW_KIN_TDKTMP	Input	CORE	RCS		Physics	RE	30	Fuel temperature for Doppler reactivity vs fuel temperature table. This is a plant, cycle & time in cycle dependent array, set by the USER. The basedeck value is strictly a representative value which provides for stable steady state code behavior for purposes of tuning and basedeck verification. Always used, but the calculated reactivity is used only if POW_KIN_DOPPLER_FB_OPTION=T. Reference 1, Section 7.1.1.	Degree F

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
717	POW_KIN_QDK	Input	CORE	RCS		Physics	RE	30	Scram reactivity for reactivity vs time table. This is a plant, cycle & time in cycle dependent array, set by the USER. The total scram rod worth, the delay for de-energizing the control rod UV coils and the ASI must all be considered when establishing this table. The basedeck values are strictly representative values which provides for stable steady state code behavior for purposes of tuning and basedeck verification. Disabled if POW_KIN_SCRAM_ROD_OPTION=F. See the plant basedeck calculation for an example of the calculation to establish this table. Reference 1, Section 7.1.1.	Reactivity
718	POW_KIN_TQDK	Input	CORE	RCS		Physics	RE	30	Time for Scram reactivity vs time table. This is a plant, cycle & time in cycle dependent array, set by the USER. The total scram rod worth, the delay for de-energizing the control rod UV coils and the ASI must all be considered when establishing this table. The basedeck values are strictly representative values which provides for stable steady state code behavior for purposes of tuning and basedeck verification. Disabled if POW_KIN_SCRAM_ROD_OPTION=F. See the plant basedeck calculation for an example of the calculation to establish this table. Reference 1, Section 7.1.1.	Seconds
719	POW_KIN_T	Output	CORE	RCS		T/H State	RE		Average core fuel temperature. This is the independent variable calculated and used by CENTS to determine the interpolation point into the doppler reactivity feedback table. Reference 1, Section 7.1.1.	Degree F
720	POW_KIN_DENCOR	Output	CORE	RCS		T/H State	RE		Core average moderator density. If the moderator density reactivity option is chosen by the USER, then this is the independent variable calculated and used by CENTS to determine the interpolation point into the moderator density reactivity feedback table. Reference 1, Section 7.1.1.	Lbm/ft^3
721	POW_KIN_DKINS	Input	CORE	RCS		Physics	RE	100	Reactivity for reactivity vs CEA position table. This is a plant, cycle & time in cycle dependent array, set by the USER. The rod worth for the given ASI must be considered when establishing this table. Used only before Scram (CTL_CORE_TRIP=F) if the flag POW_KIN_REG_ROD_OPTION=T. Normally, for safety analysis, this flag is False, so basedeck values are set to zero. Reference 1, Section 7.1.1.	Reactivity
722	POW_KIN_TDKINS	Input	CORE	RCS		Physics	RE	100	Position (steps) for reactivity vs CEA position table. This is a plant, cycle & time in cycle dependent array, set by the USER. The rod worth for the given ASI must be considered when establishing this table. Used only before Scram (CTL_CORE_TRIP=F) if the flag POW_KIN_REG_ROD_OPTION=T. Normally, for safety analysis, this flag is False, so basedeck values are set to zero. Reference 1, Section 7.1.1.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
723	POW_KIN_NDKINS	Input	CORE	RCS		Model Design	IN		No. pairs in regulating rod worth vs position table. The maximum value is 100 data pairs. Normally, for safety analysis, POW_KIN_REG_ROD_OPTION=F. Thus basedeck values are set to zero. Reference 1, Section 7.1.1.	Counts
724	POW_IFUPOW_TIM	Output	CORE	RCS		Model Design	RE		Time elapsed since switch to user-power via POW_USER_IFUPOW=T. Used to provide the requested power as a function of time elapsed since switch to user-power. Reference 1, Section 7.1.1.	Seconds
725	POW_KIN_CUTBACK	Input	CORE	RCS		Physics	RE	10	Reactivity for Reactor Power Cutback (RPC) reactivity insertion table. This is a plant, cycle & time in cycle dependent array, set by the USER. The rod worth for the given ASI must be considered when establishing this table. Used only when the RPC signal is active (CTL_RPCS_TRIP=T) if the flag POW_KIN_CUT_ROD_OPTION=T. Normally, for safety analysis, this flag is False, so basedeck values are set to zero. Reference 1, Section 7.1.1.	Reactivity
726	POW_KIN_TCUTBACK	Input	CORE	RCS		Physics	RE	10	Times for Reactor Power Cutback (RPC) reactivity insertion table. This is a plant, cycle & time in cycle dependent array, set by the USER. Used only when the RPC signal is active (CTL_RPCS_TRIP=T) if the flag POW_KIN_CUT_ROD_OPTION=T. Normally, for safety analysis, this flag is False, so basedeck values are set to zero. Reference 1, Section 7.1.1.	Seconds
727	POW_KIN_NCUTBACK	Input	CORE	RCS		Model Design	IN		No. points in RPC react insertion table. The maximum value is 10 data pairs. Normally, for safety analysis, POW_KIN_CUT_ROD_OPTION=F. Thus, basedeck values are set to zero. Reference 1, Section 7.1.1.	Counts
728	POW_KIN_SOURCE	Input	CORE	RCS		Physics	RE		Kinetics source term - fraction of FP. Used always. Neutron source term for subcritical calculation. Although the exact source term is core specific, it is has little or no effect. Therefore, it may be treated as independent of plant design. This value is only significant for initially subcritical conditions. The initial subcriticality is calculated by CENTS based on this parameter and on the initial power level. This considered a user input.	Fraction
729	POW_KIN_DK_INIT	Output	CORE	RCS		Physics	RE		Initial subcriticality. Calculated by CENTS at INITIALization as - POW_KIN_SOURCE / KFRAIN.	Reactivity
730	POW_KIN_OUT	Partition					RE	10	Kinetics output variables	Partition
731	POW_KIN_DKT	Output					RE		Total reactivity. This is the summation of all the reactivity feedbacks at each time step.	Reactivity
732	POW_KIN_DK	Output	CORE	RCS		Model Design	RE		User-specified reactivity (e.g. stuck rod). IFF POW_USER_IFUPOW=True, then this output describes the reactivity feedback, in dk/k, at each time step as dictated by the change in core power from the USER input table.	Reactivity

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
733	POW_KIN_DKBOR	Output	CORE	RCS		Physics	RE		Boric acid reactivity. IFF POW_KIN_BORON_FB_OPTION=T, then this output is the reactivity feedback in dk/k related to the boric acid concentration.	Reactivity
734	POW_KIN_DKMOD	Output	CORE	RCS		Physics	RE		Core moderator density reactivity. IFF POW_KIN_MOD_DENSITY_FB_OPTION=T, then this output is the reactivity feedback in dk/k related to the moderator density.	Reactivity
735	POW_KIN_DKDOP	Output	CORE	RCS		Physics	RE		Fuel temperature Doppler reactivity. This output is the reactivity feedback in dk/k related to the fuel temperature. It is used only if POW_KIN_DOPPLER_FB_OPTION=T.	Reactivity
736	POW_KIN_DKTMD	Output	CORE	RCS		Physics	RE		Moderator temperature reactivity. IFF POW_KIN_MOD_TEMP_FB_OPTION=T, then this output is the reactivity feedback in dk/k related to the moderator temperature.	Reactivity
737	POW_KIN_DKROD	Output	CORE	RCS		Physics	RE		Control rod regulating system reactivity. This output is the reactivity feedback in dk/k related to the control rod regulating system. Normally the reactivity worth for this system is set to zero in the basedeck. It is zero after Scram (CTL_CORE_TRIP=T). It is always zero if POW_KIN_REG_ROD_OPTION=F.	Reactivity
738	POW_KIN_DKSCRAM	Output	CORE	RCS		Physics	RE		Scram rods reactivity. This output is the reactivity feedback in dk/k related to the control rod scram worth vs. time after reactor trip. It is zero unless POW_KIN_SCRAM_ROD_OPTION=True.	Reactivity
739	POW_KIN_DKCUT	Output	CORE	RCS		Physics	RE		Reactor power cutback reactivity. This output is the reactivity feedback in dk/k related to the reactor cutback system. Normally the reactivity worth for this system is set to zero in the basedeck. It is zero unless POW_KIN_CUT_ROD_OPTION=True.	Reactivity
740	POW_KIN_DKHERMC	Output	CORE	RCS		Physics	RE		Hermite 3-D credit reactivity. This output is the reactivity feedback in dk/k related to Hermite credits. It is zero unless POW_KIN_HERM_CREDIT_OPTION=True. Reference 1, Appendix E.	Reactivity
741	POW_KIN_STATE	Partition					RE	25	Kinetics state variables	Partition
742	POW_KIN_CHI2	Output	CORE	RCS		Physics	RE	11	Normalized concentration for fission products. This is the normalized fraction of each of the eleven groups of fission products (based upon 100% steady state = 1.0).	Fraction
743	POW_KIN_EX2	Output	CORE	RCS		Physics	RE	6	Normalized concentration for delayed neutrons. This output represents the normalized fraction of each of the six groups of delayed neutron precursors (based upon 100% steady state = 1.0).	Fraction
744	POW_KIN_QD2	Output	CORE	RCS		T/H State	RE		Current kinetics decay heat fraction. If the reactor is critical, then this variable remains Sum(POW_KIN_ALPHA) * CTL_CORE_POWER_FRACTION. When the reactor scrams and the prompt core power drops off, then this value decays down based upon the delayed neutron kinetics inputs. When the decay heat table is used to determine the interpolated value from the table is used.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
745	POW_KIN_QF2	Output	CORE	RCS		Physics	RE		Current prompt power fraction. If the reactor is critical, then this variable remains (1 - Sum(POW_KIN_ALPHA)) * CTL_CORE_POWER_FRACTION. When the reactor scrams and the prompt core power drops off, then this value decays down based upon the delayed neutron kinetics inputs. When the decay heat table is used to determine the interpolated value from the table is used.	Fraction
746	POW_KIN_EN2	Output	CORE	RCS		Physics	RE		Temporary prompt power fraction.	Fraction
747	POW_CORE_TRIP_FRACTION	Output	CORE	RCS		T/H State	RE		Core Power fraction at the time of reactor trip.	Fraction
748	POW_DKHT_COMMON	Partition					RE	100	Partition for decay heat variables	Partition
749	POW_DKHT_INP	Partition					RE	85	Partition for decay heat inputs	Partition
750	POW_DKHT_TIMDHT	Input	CORE	RCS		T/H State	RE	40	Time for ANS decay heat vs time table. This array of up to forty values represents the independent variable of time after reactor trip vs. the table lookup for decay heat fraction.	Seconds
751	POW_DKHT_ANSDHC	Input	CORE	RCS		T/H State	RE	40	Decay heat fraction for decay heat vs time table. This array of up to forty values represents the dependent variable of decay heat fraction vs. time after reactor trip.	Fraction
752	POW_DKHT_NDHC	Input	CORE	RCS		Model Design	IN		No. of pairs in decay heat vs time table. This variable indicates the active number (maximum 40) of data pairs in the decay heat vs. time tables.	Counts
753	POW_DKHT_DHCBEG	Input	CORE	RCS		T/H Dimension	RE		Power fraction for switch to decay heat. After scram, CENTS continues to calculate power from the physics equations, until the calculated power falls below POW_DKHT_DHCBEG. At this time, the model switches to the decay heat curve. POW_DKHT_DHCBEG is a scenario dependent variable which must be established by the USER so that a switchover occurs at the time when the two power levels are equal. Alternatively, a WHEN command can be set up that will make the transfer bumpless by forcing it at exactly the right time. For details, see POW_USER_QCD_LOOKUP, and Reference 1, Section 7.1.1.	Fraction
754	POW_DKHT_DHCFCT	Input	CORE	RCS		Multiplier	RE		Multiplier on tabular decay heat. This input parameter provides a convenient method for the USER to adjust the decay heat level for conservatism or parametrics, etc. It is input based on the assumed long-term core power operation, and on the required conservatism.	Dimensionless
755	POW_DKHT_STATE	Partition					RE	5	Switch to decay heat variables	Partition
756	POW_DKHT_IFDHC	Output	CORE	RCS		Flag	LO		Signal: switched to decay heat. This Output flag identifies that the power level at which the switch to decay heat should occur, POW_DKHT_DHCBEG, has been reached.	True False
757	POW_DKHT_TIMDHC	Output	CORE	RCS			RE		Time of switch to decay heat.	Seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
758	POW_USER_QCD_LOOKUP	Output	CORE	RCS			RE		Current decay power fraction from the decay heat curve, as a function of time since scram (which is 0.0 before scram), multiplied by the decay heat multiplier POW_DKHT_DHCFCT. This output variable is calculated at every time step, whether or not the model has switched from physics calculated power to the decay heat table. Using this output, a WHEN command can be set up that will make the transfer to the decay heat table bumpless by forcing it at exactly the right time. For details, Reference 1, see Section 7.1.1.	Fraction
759	POW_ZRH2O_COMMON	Partition					RE	8	Zirconium oxidation variables	Partition
760	POW_ZRH2O_INP	Partition					RE	5	Zr-H2O input variables	Partition
761	POW_ZRH2O_NYZIR	Input	CORE	RCS		Flag	LO		Option: calculate zirc-oxidation. This flag is a USER controlled input. When True, it indicates to CENTS that a Zr oxidation heat addition calculation should be performed (using the Baker & Just correlation) and incorporated into the power solution by CENTS.	True False
762	POW_ZRH2O_FZBJ	Input	CORE	RCS		Multiplier	RE		Multiplier on Baker-Just generated heat. This is a USER controlled multiplier on the Zr oxidation rate. Reference 1, Section 3.1.3 and Table 7.3.	Dimensionless
763	POW_ZRH2O_STATE	Partition					RE	1	Zr-H2O state variables	Partition
764	POW_ZRH2O_H2M	Output	CORE	RCS		Zr Reaction	RE		Hydrogen release rate due to Zr-H2O. Reference 1, Section 3.1.3 and Table 7.3.	Lbm/sec
765	POW_INITIAL_CONDITIONS	Partition					RE	20	Power initial conditions	Partition
766	KFRAIN	Input	CORE	RCS		T/H Dimension	RE		New initial core power fraction. This plant independent input variable should be set by the USER for each scenario. It provides power fraction input required by CENTS to create the initial plant T/H conditions. Kfrain * POW_USER_POWZ is the initial heat generation rate in Megawatts. Reference 1, Appendix D.	Fraction
767	POW_KIN_HERMITE_INPUT	Partition					RE	380	Hermite-torq 3D fb reactivity input	Partition
768	POW_KIN_HERMITE_PARAM	Partition					RE	30	Hermite-torq 3D feedback reactivity parameters	Partition
769	POW_KIN_HERM_TD	Input	CORE	RCS		CESEC Emulation	RE		Time delay for Hermite credit 3D feedback. Reference 1, Appendix E.	Seconds
770	POW_KIN_HERM_MULT	Input	CORE	RCS		CESEC Emulation	RE		Fraction of Hermite 3D feedback taken. Reference 1, Appendix E.	Fraction
771	POW_KIN_TEMP_TILT_MIN	Input	CORE	RCS		CESEC Emulation	RE		Minimum temperature tilt. Reference 1, Appendix E.	Degree F
772	POW_KIN_POWTOFLOW_MIN	Input	CORE	RCS		CESEC Emulation	RE		Minimum power to flow ratio (3D feedback). Reference 1, Appendix E.	Dimensionless
773	POW_KIN_FLOWFRAC_MIN	Input	CORE	RCS		CESEC Emulation	RE		Minimum flow fraction (3D feedback). Reference 1, Appendix E.	Fraction
774	POW_KIN_TEMP_TILT_MAX	Input	CORE	RCS		CESEC Emulation	RE		Maximum temperature tilt (3D feedback). Reference 1, Appendix E.	Degree F
775	POW_KIN_POWTOFLOW_MAX	Input	CORE	RCS		CESEC Emulation	RE		Maximum power to flow ratio (3D fb). Reference 1, Appendix E.	Dimensionless
776	POW_KIN_HERM_POW_REF	Input	CORE	RCS		CESEC Emulation	RE		Power for normalization (3D feedback). Reference 1, Appendix E.	Megawatts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
777	POW_KIN_HERM_FLOW_REF	Input	CORE	RCS		CESEC Emulation	RE		Flow for normalization (3D feedback). Reference 1, Appendix E.	Lbm/sec
778	POW_KIN_HERM_N_FLOWFR	Input	CORE	RCS		CESEC Emulation	IN		Number of flow fractions (3D feedback). Reference 1, Appendix E.	Counts
779	POW_KIN_CORE_W_FRACTAB	Input	CORE	RCS		CESEC Emulation	RE	8	Core flow fraction table for Hermite 3D feedback. Reference 1, Appendix E.	Fraction
780	POW_KIN_HERM_CREDITTAB	Input	CORE	RCS		CESEC Emulation	RE	350	Hermite reactivity table trivariant (3D feedback). Reference 1, Appendix E.	Composite Units
781	POW_KIN_MIXING_INPUT	Partition					RE	10	Hermite-torq 3D feedback mixing input	Partition
784	POW_KIN_EDGE_WEIGHT	Input	CORE	RCS		CESEC Emulation	RE		Edge temperature geom weight (3D feedback). Variable Pow_kin_edge_weight is a multiplier on the difference in inlet enthalpy to calculate the cold edge conditions. The enthalpy calculation is: Hedge = Hcore in + edge_weight*(HCLmin -HCLavg) + factor*delHCore The input deck includes the standard setup: Cold edge reactivity is not calculated. The option to calculate cold edge temperature is enabled. The weighting factors are set to values which are typically used in the SLB analyses. Reference 1, Appendix E.	Fraction
785	POW_KIN_DH_FACTOR	Input	CORE	RCS		CESEC Emulation	RE		Core enthalpy rise fraction (3D feedback). Variable POW_KIN_DH_FACTOR is the fraction of the core enthalpy rise which is added to the core inlet temperature in the calculation of the cold edge temperature. Reference 1, Appendix E.	Fraction
786	POW_KIN_FEEDBACK_OPTIONS	Partition					RE	15	Core reactivity feedback options	Partition
787	POW_KIN_SCRAM_ROD_OPTION	Input	CORE	RCS		Physics	LO		Scram control rod reactivity option. If True, enables calculation of scram rod reactivity. Reference 1, Section 7.1.1.	Active Inactive
788	POW_KIN_REG_ROD_OPTION	Input	CORE	RCS		Physics	LO		Regulating rod reactivity option. If True, enables calculation of regulating rod reactivity. Reference 1, Section 7.1.1.	Active Inactive
789	POW_KIN_CUT_ROD_OPTION	Input	CORE	RCS		Physics	LO		Reactor Power cutback system (RPCS) reactivity option. If True, enables calculation of RPCS reactivity insertion. Reference 1, Section 7.1.1.	Active Inactive
790	POW_KIN_DOPPLER_FB_OPTION	Input	CORE	RCS		Physics	LO		Doppler reactivity option. If True, enables calculation of the Doppler reactivity feedback. Reference 1, Section 7.1.1.	Active Inactive
791	POW_KIN_BORON_FB_OPTION	Input	CORE	RCS		Physics	LO		Moderator boric acid reactivity option. If True, enables calculation of the boron reactivity feedback. Reference 1, Section 7.1.1.	Active Inactive
792	POW_KIN_MOD_TEMP_FB_OPTION	Input	CORE	RCS		Physics	LO		Moderator temperature reactivity option. If True, enables calculation of the moderator temperature reactivity feedback. Reference 1, Section 7.1.1.	Active Inactive
793	POW_KIN_MOD_DENSITY_FB_OPTION	Input	CORE	RCS		Physics	LO		Moderator density reactivity option. If True, this flag tells the code to calculate reactivity as a function of the variable moderator density. This option is normally used only for the steam line break analysis, and is otherwise set to False in the base deck. Reference 1, Section 7.1.1.	Active Inactive

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
794	POW_KIN_MOD_DENSITY_OPTION	Input	CORE	RCS		CESEC Emulation	LO		Option flag - cold edge moderator density feedback. This flag activates a CESEC emulation model which is not physical. This is a user flag, independent of plant design. It causes the moderator density to be calculated at the cold edge of the core, for input to the moderator density reactivity feedback calculation. Otherwise, core average conditions are used. This option has no effect unless the flag POW_KIN_MOD_DENSITY_FB_OPTION is True. Reference 1, Section 7.1.1 and Appendix E.	True False
795	POW_KIN_HERM_CREDIT_OPTION	Input	CORE	RCS		CESEC Emulation	LO		Hermite credit 3D feedback reactivity - option flag. The Hermite credit table is only used for the Steam Line Break analysis. This table is user option. Normally, this flag is False, and dummy values are supplied in the base deck. Reference 1, Section 7.1.1 and Appendix E.	Active Inactive
796	POW_EXCORE_OUT	Partition					RE	74	Variables for excore detectors	Partition
797	POW_EXCORE_DISP	Partition					RE	25	Excore readings - used for display only	Partition
798	EXCORE_POWERD	Output	CORE	RCS		Display	RE	8	Total excore power readings - 4 lower, 4 upper (display)	Fraction
799	EXCORE_POWER	Output	CORE	RCS		Display	RE	4	Total excore power readings - 4 circumferential locations (display)	Fraction
800	EXCORE_OFFSET	Output	CORE	RCS		Display	RE	4	Excore axial offsets - 4 circumferential locations (display)	Dimensionless
801	EXCORE_POWER_AV	Output	CORE	RCS		Display	RE		Average excore power (display)	Fraction
802	EXCORE_OFFSET_AV	Output	CORE	RCS		Display	RE		Average excore axial offset (display)	Dimensionless
804	POW_EXCORE_DATA	Partition					RE	25	Excore readings: used by controls & RPS	Partition
805	POW_EXCORE_POWERD	Output	CORE	RCS		Physics	RE	8	Total excore power readings - 4 lower, 4 upper	Fraction
806	POW_EXCORE_POWER	Output	CORE	RCS		Physics	RE	4	Total excore power readings - 4 circumferential locations	Fraction
807	POW_EXCORE_OFFSET	Output	CORE	RCS		Physics	RE	4	Excore axial offsets - 4 circumferential locations	Dimensionless
808	POW_EXCORE_POWER_AV	Output	CORE	RCS		Physics	RE		Average excore power	Fraction
809	POW_EXCORE_OFFSET_AV	Output	CORE	RCS		Physics	RE		Average excore axial offset	Dimensionless
816	POW_USER_QAXL	Output					RE	20	Axial power shape	Dimensionless
817	POW_ZRH2O_IZX	I/O	CORE	RCS		Zr Reaction	LO	20	Indicator: non-reacted clad is present, separately for each section. If POW_ZRH2O_NYZIR=T and the zirc-water reaction is desired, then the first CHT_NUM_NODE elements of this array must be initialized to True. Reference 1, Section 3.1.3 and Table 7.3.	True False
818	POW_ZRH2O_PCZR	Output	CORE	RCS		Zr Reaction	RE	20	Percent zirconium reacted. Reference 1, Section 3.1.3 and Table 7.3.	Percent
819	POW_ZRH2O_ZX	Output	CORE	RCS		Zr Reaction	RE	20	Thickness of reacted cladding. Reference 1, Section 3.1.3 and Table 7.3.	Feet
820	POW_ZRH2O_QZRH2O	Output	CORE	RCS		Zr Reaction	RE	20	Zr-H2O heat generation flux. Reference 1, Section 3.1.3 and Table 7.3.	Btu/sec-ft^2
821	KSHAPIN	Input	CORE	RCS		T/H Dimension	RE	50	Core power shape. This results in the fraction of power generated in each of the axial sections. This input is obtained from ASI information. Note that the basedeck data represents one shape which requires review by the USER to ensure applicability to a given scenario. The exact definition of KSHAPIN depends on the input option AXPD_INPUT_OPT. See AXPD_INPUT OPT for full details. Reference 1, Section 7.1.1.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
822	ZSHAPIN	Input	CORE	RCS		T/H Dimension	RE	50	Fraction of core height, used in conjunction with the power shape KSHAPIN if AXPD_INPUT_OPT = 1. See AXPD_INPUT OPT for full details. Reference 1, Section 7.1.1.	Fraction
823	AXPD_INPUT_OPT	Input	CORE	RCS		Flag	IN		Axial power shape input option: 0=node average, 1=end points, 2=direct. See AXPD_INPUT OPT for full details. Reference 1, Section 7.1.1. AXPD_INPUT_OPT = 0 KSHAPIN is the node average powers for equally spaced axial sections. CENTS finds the number of input points by counting the non-zero elements in KSHAPIN. The user must zero out any unused array elements. The input shape need not be normalized. AXPD_INPUT_OPT = 1 KSHAPIN is the pointwise powers, as a function of ZSHAPIN which is the normalized axial heights. AXPD_NUM_POINTS is the number of points in KSHAPIN and ZSHAPIN. If points are not provided for ZSHAPIN= 0.0 or ZSHAPIN= 1.0, the power at these points is found by extrapolation. The input shape KSHAPIN need not be normalized. AXPD_INPUT_OPT = 2 No processing of the KSHAPIN array is performed. The first CHT_NUM_NODE of the KSHAPIN array are transferred to the array POW_USER_QAXL.	Dimensionless
824	AXPD_NUM_POINTS	Input	CORE	RCS		Model Design	IN		Number of points in the input pointwise axial power distribution KSHAPIN as a function of the normalized axial heights ZSHAPIN. Used only if AXPD_INPUT_OPT = 1. See AXPD_INPUT OPT for full details. Reference 1, Section 7.1.1.	Dimensionless
825	AXPD_PRINT_NORMALIZATION	Input	CORE	RCS		Flag	IN		The details of the normalization of KSHAPIN are printed if this flag is set to 1. Reference 1, Section 7.1.1.	Dimensionless
826	RCS_COMMON	Segment					RE	12000	RCS global common variables	Segment
827	MODEL_OFF	Partition					LO	10	Turns off models	Partition
828	MOD_OFF_RCP	Input	RCP	RCS		Flag	LO		Turns off RCP model. Except during model testing, this flag should always be set to False, which keeps the pump model active. This flag is only used for debug in order to isolate some problem to one of the major models.	True False
830	MOD_OFF_CHT	Input	CORE	RCS		Flag	LO		Turns off CHT model. Except during model testing, this flag should always be set to False, which keeps the Core heat transfer model active. This flag is only used for debug in order to isolate some problem to one of the major models. This flag is only used for debug in order to isolate some problem to one of the major models.	True False
831	MOD_OFF_RCS	Input	RCS			Flag	LO		Turns off RCS model. Except during model testing, this flag should always be set to False, which keeps the RCS model active.	True False

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
832	MOD_OFF_QT	Input	PZR	RCS		Flag	LO		Turns off QT model. This flag is most often set to true, unless specific Quench Tank transients are required to be analyzed. In that case, the Quench Tank inputs should be reviewed by the USER since they may be just dummy values, used as "place holders". This model is not needed for safety analyses.	True False
833	MOD_OFF_POWER	Input	CORE	RCS		Flag	LO		Turns off POWER model. Except during model testing, this flag should always be set to False, which keeps the POWER model active. This flag is only used for debug in order to isolate some problem to one of the major models.	True False
834	RCS_INTERNAL	Partition					RE	8400	RCS internal variables	Partition
835	RCS_NODE_VARIABLES	Partition					RE	3100	Node variables	Partition
836	RCS_NODE_PRESSURES	Partition					RE	100	Node pressure arrays	Partition
837	PRES_PRED	Output	RCS			T/H State	RE	50	Predicted node pressures.	Psia
838	PRESS	Output	RCS			T/H State	RE	50	RCS Node pressures	Psia
839	RCS_NODE_ENERGIES	Partition					RE	100	RCS Node energy arrays	Partition
840	ENGY_TOT	Output	RCS			T/H State	RE	50	RCS Node total energies	Btu
841	ENGY_STM	Output	RCS			T/H State	RE	50	RCS Node steam energies	Btu
842	RCS_NODE_MASSES	Partition					RE	200	RCS Node mass arrays	Partition
843	MASS_TOT	Output	RCS			T/H State	RE	50	RCS Node total masses	Lbm
844	MASS_LIQ	Output	RCS			T/H State	RE	50	RCS Node liquid masses	Lbm
845	MASS_STM	Output	RCS			T/H State	RE	50	RCS Node steam masses	Lbm
846	MASS_BUB	Output	RCS			T/H State	RE	50	Mass of entrained bubbles	Lbm
847	RCS_NODE_ENTHALPIES	Partition					RE	300	RCS Node enthalpy arrays	Partition
848	ENTH_TOT	Output	RCS			T/H State	RE	50	RCS Node average enthalpies	Btu/lbm
849	ENTH_LIQ	Output	RCS			T/H State	RE	50	RCS Node liquid enthalpies	Btu/lbm
850	ENTH_STM	Output	RCS			T/H State	RE	50	RCS Node steam enthalpies	Btu/lbm
851	ENTH_MIX	Output	RCS			T/H State	RE	50	RCS Node two-phase mixture enthalpies	Btu/lbm
852	ENTH_LIQ_SAT	Output	RCS			T/H State	RE	50	RCS Node saturated liquid enthalpies	Btu/lbm
853	ENTH_STM_SAT	Output	RCS			T/H State	RE	50	RCS Node saturated steam enthalpies	Btu/lbm
854	RCS_NODE_SPEC_VOLUME	Partition					RE	250	RCS Node specific volume arrays	Partition
855	SVOL_TOT	Output	RCS			T/H State	RE	50	RCS Node average specific volumes	Ft^3/lbm
856	SVOL_LIQ	Output	RCS			T/H State	RE	50	RCS Node liquid specific volumes	Ft^3/lbm
857	SVOL_STM	Output	RCS			T/H State	RE	50	RCS Node steam specific volumes	Ft^3/lbm
858	SVOL_LIQ_SAT	Output	RCS			T/H State	RE	50	RCS Node saturated liquid specific volumes	Ft^3/lbm
859	SVOL_STM_SAT	Output	RCS			T/H State	RE	50	RCS Node saturated steam specific volumes	Ft^3/lbm
860	RCS_NODE_TEMPERATURE	Partition					RE	350	RCS Node temperature arrays	Partition
861	TEMP_TOT	Output	RCS			T/H State	RE	50	RCS Node fluid temperatures. This is TEMP_LIQ if the node is 100% liquid, TEMP_STM if the node is 100% steam, and TEMP_SAT if the node is two-phase (even in thermal nonequilibrium).	Degree F
862	TEMP_LIQ	Output	RCS			T/H State	RE	50	RCS Node liquid temperatures	Degree F
863	TEMP_STM	Output	RCS			T/H State	RE	50	RCS Node steam temperatures	Degree F

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
864	TEMP_SAT	Output	RCS			T/H State	RE	50	RCS Node saturation temperatures	Degree F
865	TEMP_WALL	Output	RCS			T/H State	RE	50	RCS Node wall temperatures	Degree F
866	SUBC_LIQ	Output	RCS			T/H State	RE	50	RCS Node liquid subcooling	Del-DegF
867	TEMP_CONT	Input	RCS			T/H Dimension	RE	50	RCS Node containment temperatures. Typically, there is only one temperature set for the containment which is used for all RCS Nodes. This input parameter is set by the USER. CENTS does not model containment transients; therefore, this variable changes only by USER manipulation, such as with a RAMP statement.	Degree F
868	RCS_NODE_HEAT_RATES	Partition					RE	350	RCS Node heat rate arrays	Partition
869	HEAT_WALL	Output	RCS			T/H State	RE	50	RCS Node wall to coolant heat rates. This output is calculated based on fluid and wall temperature differences and N_HEAT_XFER_LIQ and/or _STM. HEAT_WALL=HEAT_LIQ+HEAT_STM	Btu/sec
870	HEAT_CONT	Output	RCS			T/H State	RE	50	RCS Node wall to containment heat rates. This output is calculated based on containment and wall temperature differences and N_HEAT_XFER_CONT.	Btu/sec
871	HEAT_EXT	Output	RCS			T/H State	RE	50	RCS Node external heat rates. External heat sources in the RCS typically refers to either the pressurizer heaters or the RCPs. Other RCS Nodes values are =0.0 Various CENTS outputs are equivalent. heat_ext(2)=(sumof)heat_heater(1,..,6)=heat_przr , heat_ext(9,10)=heat_pump(1,2)=rcp_heat(1,2) heat_ext(15,16)=heat_pump(3,4)=rcp_heat(3,4)	Btu/sec
872	HEAT_TOT	Output	RCS			T/H State	RE	50	RCS Node total heat rates. This output parameter is a summation of all the heat addition rates on the fluid within each RCS Node. HEAT_TOT=HEAT_LIQ+HEAT_STM+HEAT_EXT+HEAT_COND	Btu/sec
873	HEAT_STM	Output	RCS			T/H State	RE	50	RCS Node wall-to-steam heat rates = (TEMP_STM-TEMP_WALL)*N_HEAT_XFER_STM	Btu/sec
874	HEAT_LIQ	Output	RCS			T/H State	RE	50	RCS Node wall-to-liquid heat rates = (TEMP_LIQ-TEMP_WALL)*N_HEAT_XFER_LIQ	Btu/sec
875	HEAT_COND	Output	RCS			T/H State	RE	50	RCS Node condensation heat rates. This output is calculated by CENTS based upon the temperature difference between the liquid and the steam within a RCS Node and XFER_SURF_POFF or _PON	Btu/sec
876	RCS_NODE_LEVELS	Partition	RCS				RE	100	RCS Node coolant level arrays	Partition
877	LEVL_MIX	Output	RCS			T/H State	RE	50	RCS Node two-phase mixture levels	Feet
878	LEVL_LIQ	Output	RCS			T/H State	RE	50	Subcooled (or collapsed) liquid level	Feet
879	RCS_NODE_STEAM_FRAC	Partition	RCS				RE	150	RCS Node steam fraction arrays	Partition
880	QUAL_TOT	Output	RCS			T/H State	RE	50	RCS Node steam mass fractions (qualities)	Fraction
881	QUAL_MIX	Output	RCS			T/H State	RE	50	Two-phase mix mass fractions (qualities)	Fraction
882	VOID_FRAC	Output	RCS			T/H State	RE	50	RCS Node void fractions	Fraction
883	RCS_NODE_DERIVATIVES	Partition	RCS				RE	650	Derivative arrays	Partition
884	DPDM_TOT	Output	RCS			T/H State	RE	50	RCS Node Pressure derivatives, on total mass	Composite Units

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
885	DPDM_LIQ	Output	RCS			T/H State	RE	50	RCS Node Pressure derivatives, on liquid mass	Composite Units
886	DPDM_STM	Output	RCS			T/H State	RE	50	RCS Node Pressure derivatives, on steam mass	Composite Units
887	DPDU_TOT	Output	RCS			T/H State	RE	50	RCS Node Pressure derivatives, on total energy	Composite Units
888	DPDU_STM	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative on steam	Composite Units
891	DVDP_TOT	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative on total spec volume	Composite Units
892	DVDH_TOT	Output	RCS			T/H State	RE	50	RCS Node Enthalpy derivative on total spec volume	Composite Units
893	DHF_DP	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative of sat. liquid enthalpy	Composite Units
894	DHG_DP	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative of sat. steam enthalpy	Composite Units
895	DVF_DP	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative of sat. liquid spec. volume	Composite Units
896	DVG_DP	Output	RCS			T/H State	RE	50	RCS Node Pressure derivative of sat. steam spec. volume	Composite Units
897	RCS_NODE_BUBBLES	Partition	RCS				RE	100	RCS Node bubble release arrays	Partition
898	RELE_BUB	Output	RCS			T/H State	RE	50	RCS Node bubble release rates	Lbm/sec
899	DRFT_BUB	Output	RCS			T/H State	RE	50	RCS Node bubble drift velocities	Feet
900	RCS_NODE_CONDENSATION	Partition	RCS				RE	250	Steam to liquid condensation variables	Partition
901	COND_TOT	Output	RCS			T/H State	RE	50	Total steam condensation rate in RCS Node	Lbm/sec
902	COND_BOIL	Output	RCS			T/H State	RE	50	Change-of-phase rate due to vaporization	Lbm/sec
903	COND_SURF	Output	RCS			T/H State	RE	50	RCS Node Liquid-steam surface condensation rate	Lbm/sec
904	COND_INJ	Output	RCS			T/H State	RE	50	RCS Node Condensation rate due to incoming liquid	Lbm/sec
905	COND_BUB	Output	RCS			T/H State	RE	50	RCS Node Condensation rate of entrained bubbles	Lbm/sec
906	RCS_NODE_STATES	Partition	RCS				RE	150	Non-equilibrium and heterogeneity flags	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
907	NE_CANDIDATE	Input	RCS			Flag	IN	50	Thermal non-equilibrium (N/E) state in RCS nodes. This array of pointer flags is Modeler-supplied, to define the possible nonequilibrium states in each RCS node. For each node, this flag is applicable when, and only when, the node contains both liquid and steam simultaneously. Then, thermal N/E allows the two phases to coexist at two different temperatures. At each calculational time step, for each two-phase node, CENTS begins with the N/E state indicated in NE_CANDIDATE and tests its validity. If not valid, CENTS tests the lower states, until one is valid, or until state 0 which is always valid. The resulting N/E state is stored in the output array NON_EQ_STATE: 3 = Thermal N/E with subcooled liquid and superheated steam. 2 = Thermal N/E with saturated liquid and superheated steam. 1 = Thermal N/E with subcooled liquid and saturated steam. 0 = Thermal equilibrium only. Non-equilibrium not possible. For example, if subcooled water enters the node, then just enough steam will condense and release latent heat to saturate the water. For realistic calculations, NE_CANDIDATE should be 3 in at least the following RCS Nodes: inner vessel, upper head, pressurizer. It should be 1 in at least the following RCS Nodes (unless they have 3): downcomer, cold legs; it may be 0 in all other RCS Nodes, but a value of 1 is much preferred. This is an array of model pointer flags, and is independent of plant design, except for its dependence on the specific nodalization. Reference 1, Section 4.4.	Pointer
908	NON_EQ_STATE	Output	RCS			Flag	IN	50	Non-equilibrium state currently in existence in RCS nodes. See full description under NE_CANDIDATE. Reference 1, Section 4.4.	Pointer
909	N_HETERO	Output	RCS			Flag	LO	50	Flag indicating RCS Node is heterogeneous	True False
910	VOL_MIX	Output	RCS			T/H State	RE	50	Volume of two-phase mixture in node	Partition
911	RCS_SECT_NODE_VARIABLES	Partition					RE	71	RCS sectionalized node variables	Partition
912	RCS_MBUB_SS	Output	RCS			T/H State	RE		SS bubble mass sect. Node.	Lbm
913	RCS_RELE_PRIME	Output	RCS			T/H State	RE		Derivative of bubble release rate.	Composite Units
914	RCS_VOID_TOP	Output	RCS			T/H State	RE		SS surf. void fraction	Fraction
915	RCS_VOID_TRAN	Output	RCS			T/H State	RE		Trans. surf. void fraction	Fraction
916	RCS_TRANS_CORR	Output	RCS			T/H State	RE		Transient bub. rel. correction	Dimensionless
917	QUAL_MIX_SECT	Output	RCS			T/H State	RE	1, 22	Array of core axial section, two-phase mix qualities.	Fraction
918	MASS_BUB_SECT	Output	RCS			T/H State	RE	1, 22	Array of core axial section bubble masses	Lbm
919	SLIP_SECT	Output	RCS			T/H State	RE	1, 22	Array of core axial section slip ratios	Fraction
920	RCS_PATH_VARIABLES	Partition					RE	2750	Path variables	Partition
921	RCS_PATH_FLOW_RATES	Partition					RE	250	Path flow rate arrays	Partition
922	P_FLOW	Output Partition					RE	150	Path mass flow rates	Lbm/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
923	RCS_P_FLOW_MOM	Output	RCS			T/H State	RE	100	Momentum paths mass flow rate	Lbm/sec
924	RCS_P_FLOW_NONM	Output Partition					RE	50	Non momentum paths mass flow rate	Lbm/sec
925	RCS_PATHEXT_FLOW	Output Partition					RE	25	External paths mass flow rate	Lbm/sec
926	RCS_RCPLEAK_FLOW	Input	RCS	RCP		T/H State	RE	4	RCP leak mass flow	Lbm/sec
927	RCS_CHGS_FLOW	Output	RCS	CVCS		T/H State	RE	4	Charging mass flow	Lbm/sec
928	RCS_LDNS_FLOW	Output	RCS	CVCS		T/H State	RE	4	RCS- letdown mass flow	Lbm/sec
929	RCS_RCW_FLOW	Output	RCS	RCW		T/H State	RE	1	RCS RCW drains flow	Lbm/sec
930	RCS_SDC_FLOW	Output	RCS			T/H State	RE	2	RCS shutdown cooling flow	Lbm/sec
931	RCS_SIS_FLOW	Output	RCS	SIS		T/H State	RE	8	RCS safety injection flow	Lbm/sec
932	RCS_PATHLEAK_FLOW	Output Partition					RE	17	Leak paths mass flow rate	Lbm/sec
933	RCS_SGTR_FLOW	Output	RCS	SG		T/H State	RE	8	RCS SG tube rupture flow	Lbm/sec
934	RCS_SBLOCA_FLOW	Output	RCS			T/H State	RE	4	RCS small break LOCA flow	Lbm/sec
935	RCS_RODEJ_FLOW	Output	RCS			T/H State	RE		RCS rod ejection small break flow	Lbm/sec
936	RCS_ORING_FLOW	Output	RCS			T/H State	RE		RCS O-ring seal flow	Lbm/sec
937	RCS_LBLOCA_FLOW	Output	RCS			T/H State	RE		RCS large break LOCA flow	Lbm/sec
938	RCS_PATHINT_FLOW	Output Partition					RE	8	RCS internal paths mass flow rate	Lbm/sec
939	RCS_SPRAY_FLOW	Output	RCS	PZR		T/H State	RE		RCS pressurizer spray flow	Lbm/sec
940	RCS_SPRAYBLEED_FLOW	Output	RCS	PZR		T/H State	RE	2	RCS pressurizer spray bleed flow	Lbm/sec
941	RCS_PRZR_RELIEF_FLOW	Output	RCS	PZR		T/H State	RE		Pressurizer relief valves flow	Lbm/sec
942	RCS_UHEAD_RELIEF_FLOW	Output	RCS			T/H State	RE		Upper head relief valves flow	Lbm/sec
943	P_FLOW_CRIT	Output	RCS			T/H State	RE	100	Path critical flow rates	Lbm/sec
944	RCS_PATH_ENTHALPIES	Partition					RE	400	Path flow enthalpies	Partition
945	P_ENTH	Output Partition					RE	150	Path average enthalpies	Btu/lbm
946	RCS_P_ENTH_MOM	Output	RCS			T/H State	RE	100	Momentum paths enthalpy	Btu/lbm
947	RCS_P_ENTH_NONM	Output Partition					RE	50	Non momentum paths enthalpy	Btu/lbm
948	RCS_PATHEXT_ENTH	Output Partition					RE	25	External paths enthalpy	Btu/lbm
949	RCS_RCPLEAK_ENTH	Output	RCS	RCP		T/H State	RE	4	RCP leak enthalpy	Btu/lbm
950	RCS_CHGS_ENTH	Output	RCS	CVCS		T/H State	RE	4	Charging enthalpy	Btu/lbm
951	RCS_LDNS_ENTH	Output	RCS	CVCS		T/H State	RE	4	RCS- letdown enthalpy	Btu/lbm
952	RCS_RCW_ENTH	Output	RCS	RCW		T/H State	RE	1	RCS RCW drains enthalpy	Btu/lbm
953	RCS_SDC_ENTH	Output	RCS			T/H State	RE	2	RCS shutdown cooling enthalpy	Btu/lbm
954	RCS_SIS_ENTH	Output	RCS	SIS		T/H State	RE	8	RCS safety injection enthalpy	Btu/lbm
955	RCS_PATHLEAK_ENTH	Output Partition					RE	17	Leak paths enthalpy	Btu/lbm
956	RCS_SGTR_ENTH	Output	RCS	SG		T/H State	RE	8	RCS SG tube rupture enthalpy	Btu/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
957	RCS_SBLOCA_ENTH	Output	RCS			T/H State	RE	4	RCS small break LOCA enthalpy	Btu/lbm
958	RCS_RODEJ_ENTH	Output	RCS			T/H State	RE		RCS rod ejection small break enthalpy	Btu/lbm
959	RCS_ORING_ENTH	Output	RCS			T/H State	RE		RCS o-ring seal enthalpy	Btu/lbm
960	RCS_LBLOCA_ENTH	Output	RCS			T/H State	RE		RCS large break LOCA enthalpy	Btu/lbm
961	RCS_PATHINT_ENTH	Output Partition					RE	8	RCS internal paths enthalpy	Btu/lbm
962	RCS_SPRAY_ENTH	Output	RCS	PZR		T/H State	RE		RCS pressurizer spray enthalpy	Btu/lbm
963	RCS_SPRAYBLEED_ENTH	Output	RCS	PZR		T/H State	RE	2	RCS pressurizer spray bleed enthalpy	Btu/lbm
964	RCS_PRZR_RELIEF_ENTH	Output	RCS	PZR		T/H State	RE		Pressurizer relief valves enthalpy	Btu/lbm
965	RCS_UHEAD_RELIEF_ENTH	Output	RCS			T/H State	RE		Upper head relief valves enthalpy	Btu/lbm
966	P_ENTH_LIQ	Output	RCS			T/H State	RE	100	Path liquid enthalpies	Btu/lbm
967	P_ENTH_STM	Output	RCS			T/H State	RE	100	Path steam enthalpies	Btu/lbm
968	P_SVOL	Output	RCS			T/H State	RE	100	Path average specific volumes	Ft^3/lbm
969	RCS_PATH_QUALITIES	Partition					RE	500	Path flow qualities	Partition
970	P_QUAL	Output Partition					RE	150	Path average steam fractions (quality)	Fraction
971	RCS_P_QUAL_MOM	Output	RCS			T/H State	RE	100	Momentum paths quality	Fraction
972	RCS_P_QUAL_NONM	Output Partition					RE	50	Non momentum paths quality	Fraction
973	RCS_PATHEXT_QUAL	Output Partition					RE	25	External paths quality	Fraction
974	RCS_RCPLEAK_QUAL	Output	RCS	RCP		T/H State	RE	4	RCP leak quality	Fraction
975	RCS_CHGS_QUAL	Output	RCS	CVCS		T/H State	RE	4	Charging quality	Fraction
976	RCS_LDNS_QUAL	Output	RCS	CVCS		T/H State	RE	4	RCS- letdown quality	Fraction
977	RCS_RCW_QUAL	Output	RCS	RCW		T/H State	RE	1	RCS RCW drains qual	Fraction
978	RCS_SDC_QUAL	Output	RCS			T/H State	RE	2	RCS shutdown cooling qual	Fraction
979	RCS_SIS_QUAL	Output	RCS	SIS		T/H State	RE	8	RCS safety injection qual	Fraction
980	RCS_PATHLEAK_QUAL	Output Partition					RE	17	Leak paths quality	Fraction
981	RCS_SGTR_QUAL	Output	RCS	SG		T/H State	RE	8	RCS SG tube rupture qual	Fraction
982	RCS_SBLOCA_QUAL	Output	RCS			T/H State	RE	4	RCS small break LOCA qual	Fraction
983	RCS_RODEJ_QUAL	Output	RCS			T/H State	RE		RCS rod ejection small break qual	Fraction
984	RCS_ORING_QUAL	Output	RCS			T/H State	RE		RCS O-ring seal qual	Fraction
985	RCS_LBLOCA_QUAL	Output	RCS			T/H State	RE		RCS large break LOCA qual	Fraction
986	RCS_PATHINT_QUAL	Output Partition	RCS				RE	8	RCS internal paths quality	Fraction
987	RCS_SPRAY_QUAL	Output	RCS	PZR		T/H State	RE		RCS pressurizer spray qual	Fraction
988	RCS_SPRAYBLEED_QUAL	Output	RCS	PZR		T/H State	RE	2	RCS pressurizer spray bleed qual	Fraction
989	RCS_PRZR_RELIEF_QUAL	Output	RCS	PZR		T/H State	RE		Pressurizer relief valves qual	Fraction
990	RCS_UHEAD_RELIEF_QUAL	Output	RCS			T/H State	RE		Upper head relief valves qual	Fraction
991	P_VOID	Output	RCS			T/H State	RE	100	Path average steam void fractions	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
992	P_STM_UP	Output Partition	RCS				RE	150	Fraction of path fluid from upstream steam region (modified flow quality)	Fraction
993	RCS_P_STM_UP_MOM	Output	RCS			T/H State	RE	100	Fraction of path fluid from upstream steam region (modified flow quality), momentum paths	Fraction
994	RCS_P_STM_UP_NONM	Output Partition	RCS				RE	50	Fraction of path fluid from upstream steam region (modified flow quality), non-momentum paths	Fraction
995	RCS_PATHEXT_STM_UP	Output Partition	RCS				RE	25	External paths steam quality	Fraction
996	RCS_RCPLEAK_STM_UP	Output	RCS	RCP		T/H State	RE	4	RCP leak steam quality	Fraction
997	RCS_CHGS_STM_UP	Output	RCS	CVCS		T/H State	RE	4	Charging steam quality	Fraction
998	RCS_LDNS_STM_UP	Output	RCS	CVCS		T/H State	RE	4	RCS- letdown steam quality	Fraction
999	RCS_RCW_STM_UP	Output	RCS	RCW		T/H State	RE	1	RCS RCW drains steam quality	Fraction
1000	RCS_SDC_STM_UP	Output	RCS			T/H State	RE	2	RCS shutdown cooling steam quality	Fraction
1001	RCS_SIS_STM_UP	Output	RCS	SIS		T/H State	RE	8	RCS safety injection steam quality	Fraction
1002	RCS_PATHLEAK_STM_UP	Output Partition					RE	17	Leak paths steam quality	Fraction
1003	RCS_SGTR_STM_UP	Output	RCS	SG		T/H State	RE	8	RCS SG tube rupture steam quality	Fraction
1004	RCS_SBLOCA_STM_UP	Output	RCS			T/H State	RE	4	RCS small break LOCA steam quality	Fraction
1005	RCS_RODEJ_STM_UP	Output	RCS			T/H State	RE		RCS rod ejection small break steam quality	Fraction
1006	RCS_ORING_STM_UP	Output	RCS			T/H State	RE		RCS o-ring seal steam quality	Fraction
1007	RCS_LBLOCA_STM_UP	Output	RCS			T/H State	RE		RCS large break LOCA steam quality	Fraction
1008	RCS_PATHINT_STM_UP	Output Partition					RE	8	RCS internal paths steam quality	Fraction
1009	RCS_SPRAY_STM_UP	Output	RCS	PZR		T/H State	RE		RCS pressurizer spray steam quality	Fraction
1010	RCS_SPRAYBLEED_STM_UP	Output	RCS	PZR		T/H State	RE	2	RCS pressurizer spray bleed steam quality	Fraction
1011	RCS_PRZR_RELIEF_STM_UP	Output	RCS	PZR		T/H State	RE		Pressurizer relief valves steam quality	Fraction
1012	RCS_UHEAD_RELIEF_STM_UP	Output	RCS			T/H State	RE		Upper head relief valves steam quality	Fraction
1013	P_STM_DOWN	Output	RCS			T/H State	RE	100	Frac of fluid to downstream steam region	Fraction
1014	RCS_PATH_PRESS_DROPS	Partition					RE	900	Path flow pressure drops	Partition
1015	DP_MOM	Output	RCS			T/H State	RE	100	Momentum pressure drop	Psid
1016	DP_FRIC	Output	RCS			T/H State	RE	100	Friction pressure drop	Psid
1017	DP_ELEV	Output	RCS			T/H State	RE	100	Elevation pressure drop	Psid
1018	DP_LOSS	Output	RCS			T/H State	RE	100	Form loss pressure drop	Psid
1019	DP_HEAD	Output	RCS			T/H State	RE	100	Head pressure drop	Psid
1020	DP_EXT	Output	RCS			T/H State	RE	100	Externally driven pressure drop	Psid
1021	DP_TOT	Output	RCS			T/H State	RE	100	Total pressure drop	Psid
1022	DP_ACTUAL	Output	RCS			T/H State	RE	100	Actual pressure drop (adjacent nodes)	Psid
1023	DP_CHECK	Output	RCS			T/H State	RE	100	Pressure drop check (DP_ACTUAL - DP_TOT)	Psid
1024	RCS_PATH_DERIVATIVES	Partition					RE	200	Path momentum terms	Partition
1025	ESUBK	Output	RCS			T/H State	RE	100	Path momentum time derivative	Composite Units

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1026	FSUBK	Output	RCS			T/H State	RE	100	Derivative of esubk by flow rate	Composite Units
1027	RCS_PATH_UPDOWN	Partition					RE	400	Path flow direction dependent arrays	Partition
1028	P_NODE_UP	Output	RCS			T/H State	IN	100	Node currently upstream of path	Pointer
1029	P_NODE_DOWN	Output	RCS			T/H State	IN	100	RCS Node currently downstream of path	Pointer
1030	P_ELEV_UP	Output	RCS			T/H State	RE	100	Elevation of currently upstream end	Feet
1031	P_ELEV_DOWN	Output	RCS			T/H State	RE	100	Elevation of currently downstream end	Feet
1032	RCS_STEAM_GENERATOR	Partition					RE	16	Steam generator variables	Partition
1033	HEAT_SG	Output	SG	RCS		T/H State	RE	8	Steam generator heat transfer rates	Btu/sec
1034	RCS_PUMPS	Partition					RE	20	Main coolant pump variables	Partition
1035	SPEED_PUMP	Output	RCP	RCS		Pump Prop.	RE	4	Main coolant pump speeds	Shaft RPM
1036	HEAT_PUMP	Output	RCP	RCS		T/H State	RE	4	Main coolant pump heat rates	Btu/sec
1038	HEAD_PUMP	Output	RCP	RCS		Pump Prop.	RE	4	Main coolant pump heads	Feet
1039	DP_PUMP	Output	RCP	RCS		T/H State	RE	4	Main coolant pump pressure rises. How different from	Psid
1040	RCS_CORE	Partition					RE	80	Reactor core variables	Partition
1041	HEAT_CORE	Output	CORE	RCS		T/H State	RE		Total core-to-coolant heat transfer rate	Btu/sec
1042	FLOW_CORE_IN	Output	CORE	RCS		T/H State	RE		Core inlet flow rate (total minus all bypass flow).	Lbm/sec
1043	BORON_CORE	Output	CORE	RCS		Solutes	RE		Core average boron concentration	Parts/million
1044	LEVL_LIQ_VESSEL	Output	CORE	RCS		T/H State	RE		Collapsed liquid level in vessel downcomer	Feet
1045	LEVL_MIX_VESSEL	Output	CORE	RCS		T/H State	RE		Two-phase mixture level in vessel downcomer	Feet
1046	LEVL_MIX_CORE	Output	CORE	RCS		T/H State	RE		Two-phase mixture level in core	Feet
1047	SVOL_DOWNCOMER	Output	CORE	RCS		T/H State	RE	2, 10	Downcomer specific volumes at excore detectors	Ft^3/lbm
1048	BOUYANCY_CORE	Output	CORE	RCS		T/H State	RE		Core coolant buoyancy ratio	Fraction
1049	DP_LOSS_UPLEN	Output	CORE	RCS		T/H State	RE		Pressure loss in the inner vessel upper plenum, between N_BOT_UPLEN and N_TOP_UPLEN.	Psid
1050	RCS_Q_CEA_CORE	Output	CORE	RCS		T/H State	RE		Heat transfer rate from CEA node to core node	Btu/sec
1051	ENTH_QUAD_CORE	Output	CORE	RCS		T/H State	RE	4	Core inlet radial enthalpy distribution	Btu/lbm
1052	RCS_DELH_HLTILT	Output	CORE	RCS		T/H State	RE	4	Hot leg inlet delta enthalpy tilt	Btu/lbm
1053	RCS_Q_UHEAD_CORE	Output	CORE	RCS		T/H State	RE		Heat transfer rate u-head to core node	Btu/sec
1054	RCS_PRESSURIZER	Partition					RE	80	Pressurizer variables	Partition
1055	VOLT_HEATER	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heater effective voltages in each heater bank.	Volts
1056	ADMI_HEATER	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heater admittances per bank (=1/R).	Mho admittance
1057	HEAT_ELEC	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heater electrical heat rates per bank.	Btu/sec
1058	ENGY_HEATER	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heater stored heats per bank.	Btu
1059	TEMP_HEATER	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heater temperature in each bank.	Degree F
1060	HEAT_HEATER	Output	PZR	RCS		T/H State	RE	6	Pressurizer heater-to-coolant heat rates per bank.	Btu/sec
1061	HEAT_PRZR	Output	PZR	RCS		T/H State	RE		Total pressurizer heater heat rate = Sum (HEAT_HEATER).	Btu/sec
1062	LEVL_PRZR_DP	Output	PZR	RCS		T/H State	RE		Pressure drop for pressurizer level instrument.	Feet
1063	TEMP_PRZR_REF	Input	PZR	RCS		T/H State	RE		Pressurizer reference leg temperature	Degree F
1064	TEMP_PRZR_SURGE	Output	PZR	RCS		T/H State	RE		Surge line water temperature	Degree F

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1065	TEMP_PRZR_RTD	Output	PZR	RCS		T/H State	RE		Pressurizer rtd temperature = temp_liq(2) or temp_stm(2), depending upon whether the pressurizer water level is above or below the rtd level.	Degree F
1066	P_FLOW_SPRAY	Output	PZR	RCS		T/H State	RE		Pressurizer spray total flow rate = - P_FLOW(143)	Lbm/sec
1067	P_ENTH_SPRAY	Output	PZR	RCS		T/H State	RE		Pressurizer spray enthalpy	Btu/lbm
1068	P_BORON_SPRAY	Output	PZR	RCS		Solutes	RE		Pressurizer spray boron concentration	Parts/million
1069	P_FLOW_AUX_SPRAY	Output	PZR	RCS		T/H State	RE		Auxiliary spray flow rate	Lbm/sec
1070	P_ENTH_AUX_SPRAY	Output	PZR	RCS		T/H State	RE		Auxiliary spray flow enthalpy	Btu/lbm
1071	P_BORON_AUX_SPRAY	Output	PZR	RCS		Solutes	RE		Auxiliary spray flow boron concentration	Parts/million
1072	P_FLOW_BLEED	Output	PZR	RCS		T/H State	RE	4	Spray bleed flows from cold legs = P_FLOW(144,145).	Lbm/sec
1073	P_FLOW_RELIEF	Output	PZR	RCS		T/H State	RE		Total pressurizer relief flow rate. This is the combined line flow rate, from all sources, inclusive of flow to the QT and containment.	Lbm/sec
1074	P_ENTH_RELIEF	Output	PZR	RCS		T/H State	RE		Pressurizer relief flow enthalpy. This is the combined discharge line flow enthalpy.	Btu/lbm
1075	P_SVOL_RELIEF	Output	PZR	RCS		T/H State	RE		Pressurizer relief flow specific volume. This is the combined discharge line flow specific volume.	Ft^3/lbm
1076	VIBR_VALVE_RELIEF	Output	PZR	RCS		Miscellaneous	RE	4	Array of pressurizer relief valve vibration signals. Used for display only.	Volts
1077	TEMP_VALVE_RELIEF	Output	PZR	RCS		T/H State	RE	3	Array of pressurizer relief valve exit temperatures.	Degree F
1078	P_NONC_PRZR_CONT	Output	PZR	RCS		Solutes	RE		Non-condensable flow from pressurizer to containment. This output parameter is calculated by CENTS from the corresponding valve open area and the critical flow tables, using the pressurizer pressure and fluid enthalpy at the exit location, and the non-condensable-fluid specific volume at the exit location. Reference 1, Section 4.12.	Lbm/sec
1079	P_NONC_PRZR_QT	Output	PZR	RCS	QT	Solutes	RE		Non-condensible flow, pressurizer to quench tank. This output parameter is calculated by CENTS from the corresponding valve open area and the critical flow tables, using the pressurizer pressure and fluid enthalpy at the exit location, and the non-condensable-fluid specific volume at the exit location. Reference 1, Section 4.12.	Lbm/sec
1080	P_FLOW_PRZR_QT	Output	PZR	RCS	QT	T/H State	RE		Pressurizer total flow rate to QT. Includes all safeties, PORVs, and vents.	Lbm/sec
1081	RCS_P_FLOW_PRZR_QT2	Output	PZR	RCS	QT	T/H State	RE		PORVs and safeties flow from pressurizer to Quench Tank. This flow to the QT does not include flow from the pressurizer vents, as does P_FLOW_PRZR_QT	Lbm/sec
1082	RCS_PRZR_PRES	Output	PZR	RCS		T/H State	RE		Pressurizer pressure (local variable). Same as PRESS(NODE_PRZR).	Psia
1083	P_ENTH_BLEED	Output	PZR	RCS		T/H State	RE	4	Spray bleed enthalpies from cold legs.	Btu/lbm
1084	VLV_PRZR_PRES_UP	Output	PZR	RCS		T/H State	RE		Upstream pressure at pressurizer relief valves.	Psia
1085	VLV_PRZR_PRES_DOWN	Output	PZR	RCS		T/H State	RE		Downstream pressure at pressurizer relief valves. With the QT model turned off, this variable is set equal to containment pressure.	Psia
1086	RCS_UPPER_HEAD	Partition					RE	25	Reactor vessel upper head variables	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1087	P_FLOW_UHEAD_QT	Output	RCS	QT		T/H State	RE		Upper head to quench tank flow rate. This output parameter is calculated by CENTS from the corresponding valve open area and the critical flow tables, using the upper head pressure and fluid enthalpy at the exit location, and the non-condensable-fluid specific volume at the exit location.	Lbm/sec
1088	P_ENTH_UHEAD_QT	Output	RCS	QT		T/H State	RE		Upper head to quench tank flow enthalpy.	Btu/lbm
1089	P_FLOW_UHEAD_CONT	Output	RCS			T/H State	RE		Upper head to containment vent flow rate. This output parameter is calculated by CENTS from the corresponding valve open area and the critical flow tables, using the upper head pressure and fluid enthalpy at the exit location, and the non-condensable-fluid specific volume at the exit location.	Lbm/sec
1090	P_ENTH_UHEAD_CONT	Output	RCS			T/H State	RE		Upper head to containment vent enthalpy	Btu/lbm
1091	ENTH_UHEAD_TOP	Output	RCS			T/H State	RE		Enthalpy in upper head vent line. If the level in the UH is above elevation of the upper head relief valve / vent, then this variable equals ENTH_TOT( ). If not, then = ENTH_STM( ).	Btu/lbm
1092	SVOL_UHEAD_TOP	Output	RCS			T/H State	RE		Specific volume at upper head vent line. If the level in the UH is above elevation of the upper head relief valve / vent, then this variable equals SVOL_TOT( ). If not, then = SVOL_STM( ).	Ft^3/lbm
1097	P_NONC_UHEAD_CONT	Output	RCS			Solutes	RE		Non-condensible flow from upper head to containment. This output variable = quality of nonc * flow rate to containment.	Lbm/sec
1098	P_NONC_UHEAD_QT	Output	RCS			Solutes	RE		Non-condensible flow from upper head to the quench tank. This output variable = quality of nonc * flow rate to QT.	Lbm/sec
1099	RCS_UHEAD_PRES	Output	RCS			T/H State	RE		Upper head pressure (local variable).	Psia
1100	RCS_CEA_MULT	Output	RCS			Multiplier	RE	2	CEA paths k factor multipliers. Calculated by CENTS based on RCS_CEAIN_KTERM and the CEA position. See RCS_CEAIN_KTERM for detailed discussion.	Dimensionless
1101	RCS_CEA_AV	Output	RCS			Dimension	RE		CEA average position, used in calculating RCS_CEA_MULT.	Feet
1102	RCS_QUENCH_TANK	Partition					RE	20	Quench tank variables	Partition
1103	PRES_QT	Output / Init	PZR	QT	RCS	T/H State	RE		Quench tank pressure. This output is calculated from the ideal gas law. Reference 1, Section 4.16. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Psia
1104	ENTH_QT	Output	PZR	QT	RCS	T/H State	RE		Quench tank enthalpy. This output is used if-and-only-if the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Btu/lbm
1105	ENGY_QT	Output	PZR	QT	RCS	T/H State	RE		Quench tank liquid energy. This output is calculated from liquid mass * liquid enthalpy. Reference 1, Section 4.16. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Btu
1106	LEVL_QT	Output	PZR	QT	RCS	T/H State	RE		Quench tank liquid level. This output is calculated by CENTS from the mass and specific volume of the liquid and the formulas for volume of a horizontal circular-cylinder volume. Reference 1, Section 4.16. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Feet

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1107	MASS_WAT_QT	Output / Init	PZR	QT	RCS	T/H State	RE		Mass of water in quench tank. This parameter is calculated by CENTS by dM/dt=Sum (Flow rates, W). Reference 1, Section 4.16.	Lbm
1108	MASS_GAS_QT	Output	PZR	QT	RCS	T/H State	RE		Mass of nitrogen in quench tank. This parameter is calculated by CENTS by dM(nc)/dt=Sum (Flow rates(nc), Wnc). Reference 1, Section 4.16. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Lbm
1109	TEMP_QT	Output / Init	PZR	QT	RCS	T/H State	RE		Quench tank temperature. This parameter is an input required for initialization of the code. Thereafter, it is an output. Reference 1, Section 4.16. As an output, it is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Degree F
1110	TEMP_QT_SURGE	Output	PZR	QT	RCS	T/H State	RE		Quench tank in-surge temperature. This parameter is calculated by CENTS from the known flow rates into the QT and fluid conditions for those flow rates. Reference 1, Section 4.16.	Degree F
1111	RUPTURE_QT	Output / Init	PZR	QT	RCS	Flag	LO		Rupture disk ruptured when True. This flag is required as an input for initialization. Thereafter, it becomes an output. When the QT pressure exceeds the rupture pressure, CENTS sets this parameter to true. Reference 1, Section 4.16. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	True False
1112	CONC_SOLU_QT	Output	PZR	QT	RCS	T/H State	RE	5	Solute concs in quench tank: B,H,I,Cs,Xe. These parameters are calculated by CENTS solving the concentration equation, d(XM)/dt=Sum(Wi * Xi). X=solute concentration, W=flow rate. Reference 1, Section 4.16. These outputs are used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Composite Units
1113	P_NONC_QT_CONT	Output	PZR	QT	RCS	T/H State	RE		Quench tank to cont vent non-cond flow. This output is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F). Reference 1, Section 4.16.	Lbm/sec
1128	RCS_SOLUTE	Partition					RE	1030	Variables for coolant solute concentrations	Partition
1129	RCS_P_SOLU	Output	RCS			Solutes	RE	50, 5	Non momentum paths solute concentrations	Composite Units
1130	RCS_P_BORON	Output	RCS			Solutes	RE	50	Non-momentum paths, boron concentration. This output parameter array is determined by CENTS as follows. For flow out of node through a non-momentum path, the boron concentration is the same as the upstream path. For flow into a node from a non-momentum path, the concentration is usually zero, except for charging, aux.spray and SIS flow. For these, the boron concentration is set by CHGS_RCS_BORON or SIS_RCS_BORON, which are both USER defined inputs. Reference 1, Sections 4.15 and 5.8.2.	Parts/million

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1131	RCS_P_HYD	Output	RCS			Solutes	RE	50	Non momentum paths hydrogen. This output parameter array is determined by CENTS as follows. For flow out of node through a non-momentum path, the hydrogen concentration is the same as the upstream path. For flow into a node from a non-momentum path, the concentration is usually zero, except for charging and aux.spray. For these, the hydrogen concentration is set by CHGS_RCS_HYD or RCS_P_HYD_AUX_SPRAY, which are both USER defined inputs. Reference 1, Sections 4.15 and 5.8.2.	Lbm/lbm
1132	RCS_P_IOD	Output	RCS			Solutes	RE	50	Non momentum paths iodine concentration. This output parameter array is determined by CENTS as follows. For flow out of node through a non-momentum path, the iodine concentration is the same as the upstream path. For flow into a node from a non-momentum path, the concentration is usually zero, except for charging and aux.spray. For these, the iodine concentration is set by CHGS_RCS_IOD or RCS_P_IOD_AUX_SPRAY, which are both USER defined inputs. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1133	RCS_P_PART	Output	RCS			Solutes	RE	50	Non momentum paths particulates concentration. This output parameter array is determined by CENTS as follows. For flow out of node through a non-momentum path, the particulates concentration is the same as the upstream path. For flow into a node from a non-momentum path, the concentration is usually zero, except for charging and aux.spray. For these, the hydrogen concentration is set by CHGS_RCS_PART or RCS_P_PART_AUX_SPRAY, which are both USER defined inputs. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1134	RCS_P_XEN	Output	RCS			Solutes	RE	50	Non momentum paths xenon concentration. This output parameter array is determined by CENTS as follows. For flow out of node through a non-momentum path, the Xenon concentration is the same as the upstream path. For flow into a node from a non-momentum path, the concentration is usually zero, except for charging and aux.spray. For these, the Xenon concentration is set by CHGS_RCS_XEN or RCS_P_XEN_AUX_SPRAY, which are both USER defined inputs. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1135	RCS_P_HYD_AUX_SPRAY	Output	RCS			Solutes	RE		Aux spray hydrogen concentration. This is set by CENTS equal to CHGS_RCS_HYD, since the water source for both charging and Aux spray are the same. Reference 1, Sections 4.15 and 5.8.2.	Lbm/lbm
1136	RCS_P_IOD_AUX_SPRAY	Output	RCS			Solutes	RE		Aux spray iodine concentration. This is set by CENTS equal to CHGS_RCS_IOD, since the water source for both charging and Aux spray are the same. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1137	RCS_P_PART_AUX_SPRAY	Output	RCS			Solutes	RE		Aux spray particulate concentration. This is set by CENTS equal to CHGS_RCS_PART, since the water source for both charging and Aux spray are the same. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1138	RCS_P_XEN_AUX_SPRAY	Output	RCS			Solutes	RE		Aux spray xenon concentration. This is set by CENTS equal to CHGS_RCS_XEN, since the water source for both charging and Aux spray are the same. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1140	RCS_CONC_SOLU	Output	RCS			Solutes	RE	50, 5	Node solution concentrations. Reference 1, Sections 4.15 and 5.8.2.	Composite Units
1141	RCS_CONC_BORON	Output / Init	RCS			Solutes	RE	50	RCS Node boron concentrations. This parameter array is both a CENTS calculated output and a USER adjusted input. For instance, RBINIT is used at initialization to set the boron concentration of all nodes to a given value. After initialization, RCS_CONC_BORON(I) = this initial value. If the USER wanted to adjust the boron in the pressurizer or RV UH nodes, then RCS_CONC_BORON (2),(4) could be re-established at x ppm. CENTS would then calculate any changes to x as the given transient progressed, thus reverting RCS_CONC_BORON to an output role. Reference 1, Sections 4.15 and 5.8.2.	Parts/million
1142	RCS_CONC_HYD	Output / Init	RCS			Solutes	RE	50	RCS Node hydrogen concentrations. This parameter array is both a CENTS calculated output and a USER adjusted input. For instance, hyd. conc. = 0.0 at initialization. After initialization, RCS_CONC_HYD(I) = 0.0. If the USER wanted to adjust the hydrogen in the pressurizer or RV UH nodes for example, then RCS_CONC_HYD (2),(4) could be re-established at x lbm/lbm. CENTS would then calculate any changes to x as the given transient progressed, thus reverting RCS_CONC_HYD to an output role affected by transport of the hydrogen and releases from the Zr-water reaction model. Reference 1, Sections 4.15 and 5.8.2.	Lbm/lbm
1143	RCS_CONC_IOD	Output / Init	RCS			Solutes	RE	50	RCS Node iodine concentrations. This parameter array is both a CENTS calculated output and a USER adjusted input. For instance, RCS_DOSE_INIT_IOD is used at initialization to set the iodine concentration of all nodes to a given value. After initialization, RCS_CONC_IOD(I) = this initial value. If the USER wanted to adjust the iodine in the pressurizer or RV UH nodes as an example, then RCS_CONC_IOD (2),(4) could be re-established at x microC/lbm. CENTS would then calculate any changes to x as the given transient progressed, thus reverting RCS_CONC_IOD to an output role. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1144	RCS_CONC_PART	Output / Init	RCS			Solutes	RE	50	RCS Node particulates concentrations. This parameter array is both a CENTS calculated output and a USER adjusted input. For instance, particulate conc. = 0.0 at initialization. After initialization, RCS_CONC_PART(I) = 0.0. If the USER wanted to adjust the particulates in any or all nodes, then RCS_CONC_HYD (I) could be re-established at x microC/lbm. CENTS would then calculate any changes to x as the given transient progressed, thus reverting RCS_CONC_PART to an output role affected by transport of the particulate and releases from the core damage model. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1145	RCS_CONC_XEN	Output / Init	RCS			Solutes	RE	50	RCS Node xenon concentrations. This parameter array is both a CENTS calculated output and a USER adjusted input. For instance, Xenon conc. = 0.0 at initialization. After initialization, RCS_CONC_XEN(I) = 0.0. If the USER wanted to adjust the Xenon in any or all nodes, then RCS_CONC_XEN(I) could be re-established at x microC/lbm. CENTS would then calculate any changes to x as the given transient progressed, thus reverting RCS_CONC_XEN to an output role affected by transport of the Xenon and releases from the core damage model. Reference 1, Sections 4.15 and 5.8.2.	Microcurie/lbm
1146	RCS_RELE_SOLU	Output	RCS			Solutes	RE	50, 5	RCS Node solute accumulation rates. Reference 1, Sections 4.15 and 5.8.2.	Composite Units
1147	RCS_RELE_SOLU_CORE	Partition					RE	5	Core solute releases. 1-5:Bo,Hy,Io,Ce,Xe	Composite Units
1148	CORE_BORON_REL	Input					RE		Core boron release. This is a fictitious quantity. Must be set = 0.0	Composite Units
1149	CORE_HYD_REL	I/O	CORE	RCS		Solutes	RE		Core hydrogen release. This input parameter is not required for code initialization. If POW_ZRH2O_NYZIR=True (User flag: Zr oxidation calculation is performed) then this variable is set to the calculated H2 release rate, POW_ZRH2O_H2M. If POW_ZRH2O_NYZIR=False, then this variable can be set by the USER to simulate different core clad failure analyses.	Lbm/sec
1150	CORE_IOD_REL	Input	CORE	RCS		Solutes	RE		Core iodine release. This input parameter is not required for code initialization. This is a USER defined input parameter which simulates a certain amount of core damage. Once released into node 1, the iodine is then distributed & tracked through the system by CENTS. Reference 1, Sections 4.15, 7.1.3 & 7.2.7.	Microcurie/sec
1151	CORE_PART_REL	Input	CORE	RCS		Solutes	RE		Core particulate (cesium) release. This input parameter is not required for code initialization. This is a USER defined input parameter which simulates a certain amount of core damage. Once released into node 1, the particulate is then distributed & tracked through the system by CENTS. Reference 1, Sections 4.15, 7.1.3 & 7.2.7.	Microcurie/sec
1152	CORE_XEN_REL	Input	CORE	RCS		Solutes	RE		Core xenon release. This input parameter is not required for code initialization. This is a USER defined input parameter which simulates a certain amount of core damage. Once released into node 1, the Xenon is then distributed & tracked through the system by CENTS. Reference 1, Sections 4.15, 7.1.3 & 7.2.7.	Microcurie/sec
1153	RCS_DOSE_VARIABLES	Partition					RE	20	Dose Model variables	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1154	RCS_DOSE_INIT_IOD	Input	DOSE	RCS		Solutes	RE		Dose Model Initial RCS Iodine Conc. This input is scenario dependent, entered by the code USER. It defines the initial iodine concentration in all the RCS nodes, collectively. Note that after initialization, the iodine concentration in all nodes will be RCS_CONC_IOD(I) = RCS_DOSE_INIT_IOD. At that point individual node(x) concentration can be adjusted by USER modification of RCS_CONC_IOD(x). Reference 1, Section 5.8.2 and Appendix D.	Microcurie/lbm
1155	RCS_DOSE_FLASH	Input	DOSE	RCS		Solutes	RE		Dose model flashing factor flag. This USER defined input apportions the iodine entering the SG from the RCS during a tube leak, by allocating the fraction of iodine to the steam space of the SG, with the remainder going to the liquid in the SG secondary. RCS_DOSE_FLASH=0.0 is best-estimate, 1.0 is conservative, and 2.0 is most conservative. Reference 1, Section 7.3.5.	Dimensionless
1156	RCS_DOSE_BF	Input	DOSE	RCS		Plant Design	RE		Dose model breathing factor. This is a USER supplied input. Note that the units are normally in m^3/sec and require conversion to ft^3 /sec. Reference 1, Section 7.3.5.	FT^3/sec
1157	RCS_DOSE_CF	Input	DOSE	RCS		Plant Design	RE		Dose model conversion factor. This a plant independent variable, which converts the units of iodine released to the atmosphere from curies to REM. Reference 1, Section 7.3.5.	Rem/Curie
1158	RCS_DOSE_XOQ2	Input	DOSE	RCS		Plant Design	RE		Dose model 2Hr site dispersion factor. This is a plant dependent input based upon the documented weather patterns at a given utility. It accounts for the iodine dispersion into the atmosphere from the release point to the site boundary, during the first 2 hrs after the release. It is used in determining 2 hr dose rates. Reference 1, Section 7.3.5.	sec/FT^3
1159	RCS_DOSE_XOQ8	Input	DOSE	RCS		Plant Design	RE		Dose model 8hr site dispersion factor. This is a plant dependent input based upon the documented weather patterns at a given utility. It accounts for the iodine dispersion into the atmosphere from the release point to the site boundary, during the first 2 hrs after the release. It is used in determining 2 hr dose rates. Reference 1, Section 7.3.5.	sec/FT^3
1160	RCS_DOSE_CONT_LEAK	Input	DOSE	RCS		Plant Design	RE		Dose Model Containment Leak Rate. This is a USER defined input. It is used by the code to calculate the iodine being released to the atmosphere via the containment. Reference 1, Section 7.3.5.	Frac./day
1161	RCS_DOSE_COND_DF	Input	DOSE	RCS		Plant Design	RE		Dose Model Turb & cond Decontamination Factor. This is a USER defined input which indicates the scrubbing capability of the turbine and condenser to remove iodine. 1/RCS_DOSE_COND_DF is the fraction of iodine going the turbine & condenser which would escape to the atmosphere. Reference 1, Section 7.3.5.	Dimensionless
1162	RCS_DOSE_TOT_CURIE	Output	DOSE	RCS			RE		Dose Model Total Curies of Iodine affecting offsite doses, released from all sources. This is a CENTS calculated output = MSLH_IO_INT_ATM+MSLH_IO_CONT_INT_LEAK +(MSLH_IO_INT_COND+MSLH_IO_INT_TURB)*RCS_DOSE_COND_DF. Reference 1, Section 7.3.5.	Curies

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1163	RCS_DOSE_2HR	Output	DOSE	RCS			RE		Dose Model Total 2 Hour DOSE Accum. This is the CENTS calculated 2 hr dose = RCS_DOSE_TOT_CURIE * RCS_DOSE_CF * RCS_DOSE_BF * RCS_DOSE_XOQ2 . Reference 1, Section 7.3.5.	REM
1164	RCS_DOSE_8HR	Output	DOSE	RCS			RE		Dose Model Total 8 Hour DOSE Accum. This is the CENTS calculated 8 hr dose = RCS_DOSE_TOT_CURIE * RCS_DOSE_CF * RCS_DOSE_BF * RCS_DOSE_XOQ8 . Reference 1, Section 7.3.5.	REM
1165	RCS_PAST_VALUES	Partition					RE	651	Retained variables from last execution	Partition
1166	ENGY_STM_LAST	Output	RCS			T/H State	RE	50	RCS node steam energy at last time step	Btu
1167	ENGY_TOT_LAST	Output	RCS			T/H State	RE	50	RCS node total energy at last time step	Btu
1168	MASS_LIQ_LAST	Output	RCS			T/H State	RE	50	RCS node mass of liquid at last time step	Lbm
1169	MASS_STM_LAST	Output	RCS			T/H State	RE	50	RCS node mass of steam at last time step	Lbm
1170	MASS_BUB_LAST	Output	RCS			T/H State	RE	50	RCS node mass of bubbles at last time step	Lbm
1171	MASS_TOT_LAST	Output	RCS			T/H State	RE	50	RCS node total mass at last time step	Lbm
1172	PRES_LAST	Output	RCS			T/H State	RE	50	RCS node pressures from last execution	Psia
1173	ENTH_LIQ_LAST	Output	RCS			T/H State	RE	50	RCS node liquid enthalpies from last exec.	Btu/lbm
1174	ENTH_STM_LAST	Output	RCS			T/H State	RE	50	RCS node steam enthalpies from last exec.	Btu/lbm
1175	ENTH_LIQ_SAT_LAST	Output	RCS			T/H State	RE	50	RCS node saturated liquid enthalpy, last step	Btu/lbm
1176	P_FLOW_LAST	Output	RCS			T/H State	RE	150	RCS path flow rates at last time step	Lbm/sec
1177	RCS_CORE_FLASH_LAST	Output	RCS			T/H State	RE		Core flashing rate at last execution	Lbm/sec
1178	RCS_STATUS	Partition					RE	156	Variables associated with RCS abort	Partition
1179	FATAL_INPUT_ERROR	Output	RCS			Flag	LO		RCS model abort on input data error(s)	True False
1180	FATAL_OUTPUT_ERROR	Output	RCS			Flag	LO		RCS model abort on calculation error(s)	True False
1183	MASS_BUB_PRED	Output	RCS			T/H State	RE	50	Predicted bubble masses for path props.	Lbm
1185	RCS_SEARCH_ITER	Output	RCS				IN	50	Number of iterations in pressure search.	Counts
1186	RCS_SEARCH_TYPE	Output	RCS			Flag	IN	50	Pressure search used.	Pointer
1187	CORE_SURF_AREA_LAST	Output	RCS			T/H State	RE		Vessel flow area at two-phase boundary.	Ft^2
1188	RCS_VALVES	Partition					RE	25	Variables associated with RCS valves	Partition
1189	RCS_VLV_AREA	Partition					RE	25	RCS valve areas	Ft^2
1190	AREA_VALVE_UHEAD	Output	RCS			Dimension	RE	3	Array of upper head vent valve areas. This array is a CENTS calculated output. The 1st valve in the array is the vent to containment. The next two are the vent(s) to the QT. Related variables are vlv_uhead_cont & vlv_uhead_qt, which are inputs setting the valves' fraction open. Other related variables are plt_vlvarea_uhead_cont & plt_vlvarea_uhead_qt, which are the "full open" valve areas.	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1191	AREA_VALVE_PRZR	Output	PZR	RCS		Dimension	RE	15	Array of presssurizer relief valve areas. This array is a CENTS calculated output. The first 4 valves in the array are the PORVs, the next 4 valves are for PSVs, the third set of 4 are for PORV MOV block valves, next is the vent valve to containment and the last two are for vents to the QT. Related variables are vlv_przr_porv, vlv_przr_safety, vlv_przr_mov, vlv_przr_cont & vlv_przr_qt, which are inputs setting the valves' fraction open for those valves without controllers(vents & MOVs) and outputs dictated by controller function for the PORVs and PSVs. Other related variables are plt_vlvarea_przr_porv, plt_vlvarea_przr_safety, plt_vlvarea_przr_mov, plt_vlvarea_przr_cont & plt_vlvarea_przr_qt, which are the "full open" valve areas.	Ft^2
1192	AREA_VALVE_SPRAY	Output	PZR	RCS		Dimension	RE	2	Array of presssurizer main spray valves. This array is a CENTS calculated output. Related variables are vlv_przr_mspray, which are outputs dictated by controller action the valves' fraction open. Other related variables are plt_vlvarea_przr_mspray, which are the "full open" valve areas and vlv_przr_mspray_sig which are set by the controllers, if in auto, or by the USER, if the control system is in manual.	Ft^2
1193	AREA_VALVE_QT	Output	PZR	RCS		Dimension	RE	3	Array of quench tank valve areas. This array is a CENTS calculated output. The 1st valve in the array is the vent from the QT to GWS. the 2nd valve is the vent to containment and the last is the nitrogen supply valve. Related variables are vlv_qt_gws, vlv_qt_cont & vlv_uhead_nsupply, which are inputs setting the valves' fraction open. Other related variables are plt_vlvarea_qt_gws, plt_vlvarea_qt_cont & plt_vlvarea_qt_nsupply, which are the "full open" valve areas. Note that the QT model is normally deactivated for safety analysis events by setting MOD_OFF_QT = T or by zeroed inputs.	Ft^2
1194	RCS_MALFUNCTION	Partition					RE	30	Malfunction flags and variables	Partition
1198	P_AREA_LEAK	Output	RCS				RE	17	Leak flow path areas. This is the CENTS calculated output array of leak flowpath areas generated from USER supplied input cues as to the size and source of the leaks. Reference 1, Section 7.5.1.	Ft^2
1199	RCS_PRZR_FLOW_VALVES	Partition				T/H State	RE	10	Pressurizer valves flow	Partition
1200	RCS_P_FLOW_PORV	Output	PZR	RCS		T/H State	RE	4	PORVs mass flow rate. This plant independent output variable is always used, as long as RCS_NUM_PORVS > 0. Flow is based on system differential pressures across the valve, fluid conditions at the valve and valve opening.	Lbm/sec
1201	RCS_P_FLOW_SAFETY	Output	PZR	RCS		T/H State	RE	4	Pressurizer safety valves mass flow rate. This plant independent output variable is always used. Flow is based on system differential pressures across the valve, fluid conditions at the valve and valve opening.	Lbm/sec
1202	P_FLOW_PRZR_CONT	Output	PZR	RCS		T/H State	RE		Pressurizer to containment vent flow rate. This is a scenario dependent output, based on system differential pressures across the valve, fluid conditions at the valve and valve opening.	Lbm/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1203	RCS_P_FLOW_PRZR_QT1	Output	PZR	RCS	QT	T/H State	RE		Pressurizer to quench tank vent flow rate. This is a scenario dependent output, based on system differential pressures across the valve, fluid conditions at the valve and valve opening. Note that the QT model must be "on" (MOD_OFF_QT=F) for any flow to exit the pressurizer via these vents.	Lbm/sec
1204	RCP_COMMON	Partition					RE	100	Coolant pump model global common	Partition
1205	RCP_INTERNAL	Partition					RE	88	Pump model internal variables	Partition
1206	RCP_ELECTRIC	Partition					RE	28	Coolant pump motor electrical variables	Partition
1207	RCP_VOLT	Output	RCP	RCS		Pump Prop.	RE	4	Pump motor input voltages. This Output variable is set through rcpl_volt_frac * rated bus voltage. It is always used in determining pump motor parameters. Reference 1, Section 4.11	Volts
1208	RCP_FREQ	Output	RCP	RCS		Pump Prop.	RE	4	Pump motor electrical frequencies. This output mirrors the input parameter rcp_freq_rated. It is always used in determining pump motor parameters.	Hertz
1211	RCP_SLIP	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump motor slip. Reference 1, Section 4.11	Fraction
1213	RCP_MECHANICAL	Partition					RE	40	Coolant pump mechanical variables	Partition
1214	RCP_TORQ_HYD	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump hydraulic torques. This output parameter is always used. Reference 1, Section 4.11	Ft-lbf
1215	RCP_TORQ_ELEC	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump electrical torques. This output parameter is always used. Reference 1, Section 4.11	Ft-lbf
1216	RCP_TORQ_FRIC	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump friction torques. This output parameter is always used. Reference 1, Section 4.11	Ft-lbf
1217	RCP_HEAT	Output	RCP	RCS		T/H State	RE	4	Coolant pump fluid heat rates. This output parameter is always used. Reference 1, Section 4.11	Btu/sec
1218	RCP_VIBR	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump vibrations	G's vibration
1219	RCP_SPEED_PUMP	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump impeller speed. This output parameter is always used. Reference 1, Section 4.11	Radians/second
1220	RCP_SPEED_MOTOR	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump motor speed. This output parameter is always used. Reference 1, Section 4.11	Radians/second
1221	RCP_VIBR_AMP	Output	RCP	RCS		Pump Prop.	RE	4	Pump vibration amplitude at rated speed	G's vibration
1222	RCP_SPEED_DERIV	Output	RCP	RCS		Pump Prop.	RE	4	Coolant pump speed derivatives	Composite Units
1223	RCP_MALFUNCTION	Partition					RE	12	Coolant pump malfunction variables	Partition
1227	RCP_RCS_LEAK	Partition					RE	4	RCP seals leak partition	Partition
1228	RCP_SEALS_LEAK	Input	RCP	RCS		T/H Dimension	RE	4	RCP seals leakage rated cond. This variable is set in the basedeck for normal RCP seal leakage. Rcp_seals_leak is set to a nominal value of x.x gpm/pump. This is the difference between the nominal steady state charging and letdown. For accident conditions, it can be set by the USER to any desired leakrate. Reference 1, Table 7.25	Gal/min
1229	RCS_OPTIMIZATION	Partition					RE	820	RCS optimization partition	Partition
1230	RCS_NSTEP_CALCULATIONS	Partition					RE	160	Partition vars updated every n steps	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1231	RCS_ICOUNT_MUKPR_P	Output	RCS				IN		Counter mu-k-Pr calculations. CENTS counts the number of time steps since the last recalculation of properties. This output indicates the number of time steps since the last recalculation.	Counts
1232	RCS_NUM_MUKPR_P	Input	RCS			Model Design	IN		Number steps between each mu-k-Pr calculation. This is the maximum number of time steps that the RCS model may execute before forcing a recalculation of the kinematic properties. This was introduced into CENTS in order to save execution time. If this is no longer a concern, then continuous recalculation of properties is preferable (RCS_NUM_MUKPR_P = 1).	Counts
1233	RCS_P_VISCOS	Output	RCS			T/H State	RE	100	RCS momentum path liquid viscosity. This kinematic parameter is calculated every RCS_NUM_MUKPR_P time steps, except every time step if the RCS pressure changes very rapidly.	Lbm/ft-sec
1234	RCS_P_CONDUCT	Output	RCS			T/H State	RE	100	RCS momentum path liquid conductivity. This kinematic parameter is calculated every RCS_NUM_MUKPR_P time steps, except every time step if the RCS pressure changes very rapidly.	Btu/sec-ft-degF
1235	RCS_P_PRANDTL	Output	RCS			T/H State	RE	100	RCS momentum path liquid Prandtl number. This kinematic parameter is calculated every RCS_NUM_MUKPR_P time steps, except every time step if the RCS pressure changes very rapidly.	Dimensionless
1236	RCS_ICOUNT_FLOWLIM_P	Output	RCS			Flag	IN		Counter for critical flow calculations. CENTS counts the number of time steps since the last recalculation of critical flows in the momentum paths. This output indicates the number of time steps since the last recalculation.	Counts
1237	RCS_NUM_FLOWLIM_P	Input	RCS			Model Design	IN		Number of time steps between each momentum paths critical flow calculation. Used when the input flag RCS_CRIT_FLOW_CHECK is True. This is the maximum number of time steps that the RCS model may execute before forcing a recalculation of the critical flows for choking check in the RCS momentum paths.	Counts
1238	RCS_MORE_VARIABLES_A	Partition					RE	153	RCS_more variables A	Partition
1239	RCS_MORE_VARIABLES_I	Partition					RE	20	RCS more variables partition I	Partition
1242	RCS_PRZR_CONT_HEAT_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier on wall heat transfer from the pressurizer to containment. This is a scenario dependent input, available to the code USER to vary the heat loss from the pressurizer to containment. This multiplier would be applied to N_HEAT_XFER_CONT.	Dimensionless
1243	CHT_H_SUPER_MULT	Input	RCS			Multiplier	RE		Supercritical heat transfer coefficient multiplier. Used always. Used in conjunction with CHT_PRESS_SUPERCRIT, which is the "supercritical pressure" for the purpose of calculating heat flux. When vessel pressure exceeds this value (typically 2700 psia), CENTS does the following: (1) it forces the heat transfer mode to be in "forced convection", even if other conditions call for the "pool boiling" mode, and (2) it calculates the heat flux coefficient as CHT_H_SUPER_MULT * CHT_HTCOF_SUB, where the latter is the calculated heat transfer coefficient to subcooled liquid. These parameters are independent of plant design.	Dimensionless
1244	CHT_HEAT_FRAC	Output	CORE	RCS		T/H State	RE		Total core heat transfer to coolant, as a fraction of the total power rating.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1254	RCS_PRZR_FLASH_TAU	Input	PZR	RCS		T/H Dimension	RE		Time constant for pressurizer flashing. It is always used. It is a time constant for flashing in the pressurizer. The flashing rate is calculated when the pressure drops. Then, the flashing rate is lagged with a small time constant in order to assure stability in a process that will otherwise responds instantaneously to pressure fluctuations. This variable is independent of plant design.	Fraction
1255	RCS_UHEAD_CONT_HEAT_MULT	Input	RCS			Multiplier	RE		Multiplier on upper head heat loss to containment.	Dimensionless
1256	RCS_CRIT_MODEL	Input	RCS			Flag	IN		Liq/2-phs choked flow model: 0=HEM, 1=HF. This plant independent, scenario dependent flag is normally set to Homogeneous Equilibrium Flow model. This choke flow correlation provides the best representation for steam or two phase flow from the PSVs. If a SBLOCA or SGTR is simulated the USER may consider switching to Henry-Fauske flow model for depicting sub-cooled critical flow.	Pointer
1257	RCS_MORE_VARIABLES_II	Partition					RE	28	RCS more variables partition II	Partition
1258	RCS_SPRAY_EFF	Output	PZR	RCS			RE		Spray efficiency, calculated based on the local conditions.	Fraction
1259	RCS_SPRAY_EFF_MULT	Input	PZR	RCS		Multiplier	RE		Spray efficiency multiplier. This plant independent variable is normally set to 1.0. For testing or tuning purposes the user may wish to adjust this variable to achieve more or less rate of change in pressurizer pressure during spray flow situations.	Dimensionless
1260	RCS_L_EFF_SPR	Input	PZR	RCS		T/H Dimension	RE	2	Levels for spray efficiency calculation. The absolute values for this variable is dependent upon the height of the spray nozzle head within the pressurizer. By running sensitivity cases on various CE plant models, the spray efficiency varies from nil to full efficiency at levels approximately 0.0 to 5.0 ft below the spray nozzle. Reference: Plant Basedeck Calculation, Hand Calc. #8.	Feet
1261	RCS_T_SURGE_TAU	Input	PZR	RCS		T/H Dimension	RE		Time constant for surge line temperature. Always used, but only for calculating the simulator output TEMP_PRZR_SURGE, which is not referenced anywhere else in CENTS. Usually set to a small value (1 to 2 sec.), it is independent of plant design.	Dimensionless
1267	CHT_TERM_MAX	Input	CORE	RCS		T/H Dimension	RE		Maximum term for transition boiling in the core. Always used. Upper limit on the term CHT_TERM that is calculated as part of the McDonough, Milich & King correlation for transition boiling. This upper limit is universally applied, independent of plant design.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1277	RCS_SPRAY_DELH_DEG	Input	PZR	RCS		T/H Dimension	RE		Delta enthalpy for spray degradation. Used always, in conjunction with RCS_SPRAY_PDEG_TERM & RCS_SPRAY_PRES_DEG, as long as the pressurizer is in thermal nonequilibrium and there is pressurizer main spray flow. CENTS determines a spray condensation efficiency based on steam height, steam pressure and subcooling of the liquid inventory. CENTS calculates three efficiency factors for those three effects. The spray condensation rate is then given by the standard condensation formulation multiplied by all three factors. If RCS_SPRAY_PRES_DEG is True, the efficiency factor due to pressure is: RCS_SPRAY_PDEG_TERM + (1. - RCS_SPRAY_PDEG_TERM) * PRESS(I)/1000. bounded by the range [0.05, 1.0]. If the flag is False, then there is no low-pressure-induced degradation, i.e. the factor is 1.0. The efficiency factor due to subcooling introduces degradation of the condensation due to spray when the pressurizer's liquid inventory is close to saturation -- i.e., within RCS_SPRAY_DELH_DEG (Btu/lbm) of the saturation line. The efficiency factor is: (ENTH_LIQ_SAT(I) - ENTH_LIQ(I)) / RCS_SPRAY_DELH_DEG bounded by the range [0.0, 1.0]. If RCS_SPRAY_DELH_DEG is zero, then there is no degradation near the saturation curve. The flag RCS_SPRAY_PRES_DEG is a model flag, used to disable the calculation for testing purposes. It is independent of plant design. This flag should always be True during realistic transients. RCS_SPRAY_PDEG_TERM is a model constant which has been found to work best when set to 0.0. It is independent of plant design. RCS_SPRAY_DELH_DEG is a model constant which has been found to work best when set to 5.0 Btu/lbm. It is independent of plant design.	Btu/lbm
1278	RCS_SPRAY_EFF1	Output	PZR	RCS			RE		Spray efficiency term, calculated as a condensation degradation term when close to saturation.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1279	RCS_SPRAY_PRES_DEG	Input	PZR			T/H Dimension	LO		Sprays pressure dependent degradation. Used always, in conjunction with RCS_SPRAY_PDEG_TERM & RCS_SPRAY_DELH_TERM, as long as the pressurizer is in thermal nonequilibrium and there is pressurizer main spray flow. CENTS determines a spray condensation efficiency based on steam height, steam pressure and subcooling of the liquid inventory. CENTS calculates three efficiency factors for those three effects. The spray condensation rate is then given by the standard condensation formulation multiplied by all three factors. If RCS_SPRAY_PRES_DEG is True, the efficiency factor due to pressure is: RCS_SPRAY_PDEG_TERM + (1. - RCS_SPRAY_PDEG_TERM) * PRESS(I)/1000. bounded by the range [0.05, 1.0]. If the flag is False, then there is no low-pressure-induced degradation, i.e. the factor is 1.0. The efficiency factor due to subcooling introduces degradation of the condensation due to spray when the pressurizer's liquid inventory is close to saturation -- i.e., within RCS_SPRAY_DELH_DEG (Btu/lbm) of the saturation line. The efficiency factor is: (ENTH_LIQ_SAT(I) - ENTH_LIQ(I)) / RCS_SPRAY_DELH_DEG bounded by the range [0.0, 1.0]. If RCS_SPRAY_DELH_DEG is zero, then there is no degradation near the saturation curve. The flag RCS_SPRAY_PRES_DEG is a model flag, used to disable the calculation for testing purposes. It is independent of plant design. This flag should always be True during realistic transients. RCS_SPRAY_PDEG_TERM is a model constant which has been found to work best when set to 0.0. It is independent of plant design. RCS_SPRAY_DELH_DEG is a model constant which has been found to work best when set to 5.0 Btu/lbm. It is independent of plant design.	True False
1280	RCS_SPRAY_EFF2	Output	PZR				RE		Spray efficiency term, calculated as a condensation degradation term at low pressure.	Fraction
1282	RCS_QUAL_MIN_NE	Input	RCS			T/H Dimension	RE		Minimum quality for non equilibrium calculation. Used always. To be considered for thermal nonequilibrium, a node must contain both liquid and steam. That is, the quality must be less than 1.0 and greater than RCS_QUAL_MIN_NE. RCS_QUAL_MIN_NE should be set to a small number (1.E-3 to 1.E-2), but not zero. (A value of 0.0 may send the node into nonequilibrium with just a miniscule amount steam present, and the condensation model may then condense more steam than is available, causing a pressure spike.). RCS_QUAL_MIN_NE is independent of plant design.	Fraction
1283	RCS_PRZR_L_COND_OFF	Input	PZR	RCS		T/H Dimension	RE		Level cut-off for pressurizer surface condensation. The absolute value for this parameter is based on pressurizer height dimensions. The ability to condense steam on the water surface is dependent upon the surface area available, which decreases considerably in the upper head of the pressurizer. At approximately 1.5 ft below the top of the pressurizer condensation ceases, based on sensitivity testing of CE plant models. Reference: Plant Basedeck Calculation, Hand Calc. #8	Feet

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1284	RCS_SPRAY_PDEG_TERM	Input	PZR	RCS		T/H Dimension	RE		Spray degradation pressure term. Used always, in conjunction with RCS_SPRAY_PRES_DEG & RCS_SPRAY_DELH_TERM, as long as the pressurizer is in thermal nonequilibrium and there is pressurizer main spray flow. CENTS determines a spray condensation efficiency based on steam height, steam pressure and subcooling of the liquid inventory. CENTS calculates three efficiency factors for those three effects. The spray condensation rate is then given by the standard condensation formulation multiplied by all three factors. If RCS_SPRAY_PRES_DEG is True, the efficiency factor due to pressure is: RCS_SPRAY_PDEG_TERM + (1. - RCS_SPRAY_PDEG_TERM) * PRESS(I)/1000. bounded by the range [0.05, 1.0]. If the flag is False, then there is no low-pressure-induced degradation, i.e. the factor is 1.0. The efficiency factor due to subcooling introduces degradation of the condensation due to spray when the pressurizer's liquid inventory is close to saturation -- i.e., within RCS_SPRAY_DELH_DEG (Btu/lbm) of the saturation line. The efficiency factor is: (ENTH_LIQ_SAT(I) - ENTH_LIQ(I)) / RCS_SPRAY_DELH_DEG bounded by the range [0.0, 1.0]. If RCS_SPRAY_DELH_DEG is zero, then there is no degradation near the saturation curve. The flag RCS_SPRAY_PRES_DEG is a model flag, used to disable the calculation for testing purposes. It is independent of plant design. This flag should always be True during realistic transients. RCS_SPRAY_PDEG_TERM is a model constant which has been found to work best when set to 0.0. It is independent of plant design. RCS_SPRAY_DELH_DEG is a model constant which has been found to work best when set to 5.0 Btu/lbm. It is independent of plant design.	Dimensionless
1285	RCS_MORE_VARIABLES_III	Partition					RE	6	RCS more variables III post 406A.	Partition
1288	RCS_PRZR_HWALLF_MULT	Input	PZR	RCS		Multiplier	RE		Multiplier for pressurizer conductivity on wall heat transfer coefficient. It is used whenever condensation occurs on the pressurizer wall. The multiplier RCS_PRZR_HWALLF_MULT is used to tune the rate of condensation on the pressurizer wall. It multiplies the condensation degradation function (see discussion for RCS_PRZR_KH_STM and RCS_PRZR_KP_STM). The multiplier RCS_PRZR_HLIQ_MULT is used to tune the rate of heat transfer from liquid to the wall in the pressurizer. These tuning factors are dependent on plant design. They are determined during the final testing of a database as the final adjustment to achieve steady state. In steady state, the surge line flow is nearly zero and the pressurizer is effectively isolated from the RCS. Therefore, the pressurizer needs to achieve its own independent steady state. By adjusting RCS_PRZR_HWALLF_MULT until the pressure is steady and RCS_PRZR_HLIQ_MULT until the mixture bubble mass is steady, we achieve the proper rates of wall condensation and liquid heat transfer for the steady state conditions. The resultant multiplier values are then used for all conditions.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1289	RCS_PRZR_COND_WALL	Output	PZR	RCS		T/H State	RE		Pressurizer condensation on wall.	Lbm/sec
1290	RCS_MORE_VARIABLES_IIIA	Partition					RE	5	RCS more variables IIIA	Partition
1291	RCS_PRZR_HLIQ_MULT	Input	PZR	RCS		Multiplier	RE		Pressurizer wall htcof to liq. mult. It is used always. The multiplier RCS_PRZR_HLIQ_MULT is used to tune the rate of heat transfer from liquid to the wall in the pressurizer. The multiplier RCS_PRZR_HWALLF_MULT is used to tune the rate of condensation on the pressurizer wall. It multiplies the condensation degradation function (see earlier discussion for RCS_PRZR_KH_STM and RCS_PRZR_KP_STM). These tuning factors are dependent on plant design. They are determined during the final testing of a database as the final adjustment to achieve steady state. In steady state, the surge line flow is nearly zero and the pressurizer is effectively isolated from the RCS. Therefore, the pressurizer needs to achieve its own independent steady state. By adjusting RCS_PRZR_HWALLF_MULT until the pressure is steady and RCS_PRZR_HLIQ_MULT until the mixture bubble mass is steady, we achieve the proper rates of wall condensation and liquid heat transfer for the steady state conditions. The resultant multiplier values are then used for all conditions.	Dimensionless
1293	RCS_PRZR_TREF_TAU	Input	PZR	RCS		T/H Dimension	RE	2	Pressurizer reference leg time constants. Used to calculate a temperature that is used only in an instrument signal to the simulator panels. The temperature of the pressurizer's reference leg is driven by the local containment temperature, by applying a lag function to the temperature, with the lag being RCS_PRZR_TREF_TAU(1) if the leg temperature is decreasing and RCS_PRZR_TREF_TAU(2) if it is increasing. The temperature, TEMP_PRZR_REF, determines the enthalpy, density, liquid column head in the leg, and the instrument pressure difference. The latter is LEVL_PRZR_DP. None of those quantities are used anywhere else in CENTS, but LEVL_PRZR_DP is sent to a simulator instrument display. NOTE: The variables for instrument-calculated measured level, CTL_PRZR_ILEVEL and CTL_PRZR_LEVEL_INST are used by the CENTS control system, but are calculated in a separate algorithm. They are not affected by RCS_PRZR_TREF_TAU.	Seconds
1295	RCS_MORE_VARIABLES_IIIB	Partition					RE	4	RCS more variables IIIA	Partition
1297	RCS_PRZR_LEVEL	Output	PZR	RCS		T/H State	RE		RCS pressurizer level (inch from ref.leg bot.)	Inches
1298	RCS_MORE_VARIABLES_IV	Partition					RE	10	RCS more variables IV	Partition
1300	RCS_PRZR_DT_SUBC	Input	PZR	RCS		T/H State	RE		Pressurizer delta-temperature for flashing. Used in conjunction with RCS_PRZR_DT_SUBH, RCS_PRZR_LVLDT_SUBC(2), and RCS_PRZR_TAU_DTSUB. See RCS_PRZR_DT_SUBH for a full description.	Del-DegF

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1302	RCP_DELSPEED_LOCKED	Input	RCP	RCS		Component Design	RE		RCP locked rotor delta speed (rad/sec). Used only during a "locked RCP rotor" malfunction transient, during the time that the pump shaft speed decelerates to zero. This variables specifies the rate at which the pump speed decelerates, in rad/sec per time step. I.e., at each time step, subprogram RCP does: RCP_SPEED_PUMP = AMAX1 (RCP_SPEED_PUMP - RCP_DELSPEED_LOCKED, 0.0). Since the rate of pump shaft deceleration is impossible to predict in a locked-rotor situation, the value of RCP_DELSPEED_LOCKED just needs to be reasonable. It is therefore independent of plant design.	Radians/second
1303	RCP_FRIC_COEFF	Input	RCP	RCS		Component Design	RE		RCP windage and friction coefficient. This variable is defined as the (pump friction torque)/(motor speed [in radians/sec]^2)	Composite Units
1307	RCS_ITER_DPL	Input	RCS				RE		Dp for convergence at low pressure(equilibrium). Used whenever the system pressure is below 200 psia. This is a convergence criterion for the iterative pressure search. I.e., the solution converges when the pressure change from the last iteration is less than RCS_ITER_DPL. It is used whenever a node's pressure is below 200 psia AND the node is in equilibrium. (At higher pressures in equilibrium, the convergence dP is RCS_ITER_DP, and in nonequilibrium it is RCS_ITER_DP_NE.). This parameter is numerical in nature, and is independent of plant design. Reference 1, Section 4.4.	Psig
1309	RCS_MORE_VARIABLES_V	Partition					RE	8	RCS more variables V	Partition
1313	RCS_PRZR_MASS_STM	Output	PZR	RCS			RE		Pressurizer steam mass	Lbm
1314	RCS_PRZR_MASS_AIR	Output	PZR	RCS			RE		Pressurizer air mass	Lbm
1315	RCS_MORE_VARIABLES_VI	Partition					RE	14	RCS more variables VI	Partition
1320	RCS_W_PRZR_CONT	Output	PZR	RCS			RE		Mass flow from pressurizer to containment.	Lbm/sec
1321	RCS_W_PRZR_QT	Output	PZR	RCS			RE		Mass flow from pressurizer to quench tank (valves).	Lbm/sec
1322	RCS_PRZR_QUAL_RELIEF	Output	PZR	RCS		Initial Cond.	RE		Pressurizer relief valve flow quality.	Fraction
1327	RCS_PRZR_FRAC_AIR	Output	PZR	RCS		Initial Cond.	RE		Air mass fraction in pressurizer.	Fraction
1328	RCS_PRZR_KH_STM	Input	PZR	RCS		Initial Cond.	RE		K for enthalpy degradation of the heat transfer coefficient of steam. Used always, in conjunction with RCS_PRZR_KP_STM. These are parameters for the degradation function used in calculating steam condensation on the pressurizer wall. The condensation heat transfer is calculated based on the various physical parameters (temperatures, steam height, air fraction, heat transfer coefficients), and is then multiplied by a degradation: 1 - (1 - RCS_PRZR_KH_STM) * (2250 - PRESS) / (2250 - RCS_PRZR_KP_STM), where PRESS is steam pressure, and the degradation is limited to [0,1]. Typical values for these parameters are KH=0.2 and KP=0.0, respectively, independently of plant design.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1329	RCS_PRZR_KP_STM	Input	PZR	RCS		Initial Cond.	RE		K for pressure degradation of the heat transfer coefficient for steam. Used always, in conjunction with RCS_PRZR_KH_STM. These are parameters for the degradation function used in calculating steam condensation on the pressurizer wall. The condensation heat transfer is calculated based on the various physical parameters (temperatures, steam height, air fraction, heat transfer coefficients), and is then multiplied by a degradation: 1 - (1 - RCS_PRZR_KH_STM) * (2250 - PRESS) / (2250 - RCS_PRZR_KP_STM), where PRESS is steam pressure, and the degradation is limited to [0,1]. Typical values for these parameters are KH=0.2 and KP=0.0, respectively, independently of plant design.	Psia
1330	RCS_MORE_VARIABLES_504_SR	Partition					RE	58	RCS more variables partition	Partition
1332	RCS_PRZR_DT_SUB_BOIL	Input	PZR	RCS		T/H Dimension	RE		Pressurizer delta-temperature for boiling. Used always. RCS_PRZR_DT_SUB_BOIL is the amount of subcooling (degF) above which all boiling/flashing ceases and below which the surface condensation stops, in the pressurizer. (See RCS_PRZR_DT_SUBH, RCS_PRZR_DT_SUBC).	Del-DegF
1333	RCS_RCP_VOIDF	Output	RCP	RCS		T/H State	RE	4	RCP void fraction	Fraction
1337	RCS_PRZR_COND_SURF	Output	PZR	RCS		T/H State	RE		Pressurizer steam condensation on liquid surface.	Lbm/sec
1338	RCS_PRZR_LEVL_LAST	Output	PZR	RCS		T/H State	RE		Pressurizer level last step	Feet
1339	RCS_PRZR_T_WALL	Output	PZR	RCS		T/H State	RE	2	Pressurizer walls temp. 1:liq, 2: stm	Degree F
1340	RCS_PRZR_Q_CONT	Output	PZR	RCS		T/H State	RE	2	Pressurizer walls heat to containment	Btu/sec
1341	RCS_PRZR_QAX_WALL	Output	PZR	RCS		T/H State	RE		Pressurizer walls axial heat transfer. This output variable is the heat transferred from the wall region exposed to steam to that exposed to liquid (as determined by the water level at the last time step).	Btu/sec
1342	RCS_PRZR_DT_SUBSS	Output	PZR	RCS		T/H State	RE		Pressurizer measure of subcooling to start boiling, in a steady-state mode.	Del-DegF
1343	RCS_P_ORING	Output	RCS			T/H State	RE		Inner O-ring region pressure. If the o-ring has not failed, then pressure is the minimum of the core node & upper head nodal pressures x rtrv_head_seal_mult, set by the USER. If the O-ring has failed (reached RCS_ORING_FAIL=T, where pressure at the o-ring is .ge. RCS_P_ORING_FAIL set by the USER), then RCS_P_ORING is the maximum of the(failure pressure) and (the minimum pressure in the upper head and core nodes).	Psia
1344	RCS_ORING_FAIL	Input	RCS			Flag	LO		Vessel O-ring failure flag. CENTS sets to true when pressure in both the core and upper head nodes are .ge. the USER set failure pressure, RCS_P_ORING_FAIL. Otherwise it is always False.	True False
1347	RCS_RCP_SVOL	Output	RCP	RCS		T/H State	RE	4	Specific volume in the flow path going through each RCP.	Ft^3/lbm
1354	RCS_FAILURE_STATUS	Partition					LO	3	RCS failure status partition	Partition
1356	RCS_STEP_FAILURE	Output	RCS			Flag	LO		RCS step failure flag. Indicates failure of the flow solution matrix inversion.	True False
1358	RCS_TIME_CONTROL	Partition					RE	45	Time control partition	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1359	RCS_TIME_SCALE	Output					RE		Time scale for RCS	Dimensionless
1362	RCS_DELTA_T	Output					RE		RCS integration delta t	Seconds
1390	RCS_MOD_OUTPUTS	Partition					RE	60	RCS model global common outputs	Partition
1396	RCS_MOD_OUTPUTS_CORE	Partition					RE	3	RCS outputs to 1-D core	Partition
1397	CHT_TCOOL_AV	Output	CORE	RCS		T/H State	RE		Core coolant average temperature.	Degree F
1398	CHT_SVOLCOOL_AV	Output	CORE	RCS		T/H State	RE		Core coolant average specific volume	Ft^3/lbm
1399	RCS_BORON_CORE	Output	CORE	RCS		Solutes	RE		Core node boron concentration	Parts/million
1400	RCS_MOD_OUTPUTS_CHT	Partition					RE	53	RCS outputs to Core Heat Transfer. These are copies of the values calculated in the RCS models.	Partition
1401	RCS_CHT_PRESS	Output	CORE	RCS		T/H State	RE		Core node pressure	Psia
1402	RCS_CHT_ENTHLIQ	Output	CORE	RCS		T/H State	RE		Core node liquid enthalpy	Btu/lbm
1403	RCS_CHT_ENTHSTM	Output	CORE	RCS		T/H State	RE		Core node steam enthalpy	Btu/lbm
1404	RCS_CHT_QUAL	Output	CORE	RCS		T/H State	RE		Core node quality	Fraction
1405	RCS_CHT_FLOWIN	Output	CORE	RCS		T/H State	RE		Core node inlet flow (total minus bypass)	Lbm/sec
1406	RCS_CHT_ENTHIN	Output	CORE	RCS		T/H State	RE		Core node inlet enthalpy	Btu/lbm
1407	RCS_CHT_QUALIN	Output	CORE	RCS		T/H State	RE		Core node inlet quality	Fraction
1408	RCS_CHT_LEVMIX	Output	CORE	RCS		T/H State	RE		Core node mixture height	Feet
1409	RCS_CHT_LEVSAT	Output	CORE	RCS		T/H State	RE		Core node saturation line height	Feet
1410	RCS_CHT_QWALL	Output	CORE	RCS		T/H State	RE		Core node lower plenum wall heat.	Btu/sec
1411	RCS_CHT_TWALL	Output	CORE	RCS		T/H State	RE		Core node lower plenum wall temperature	Degree F
1412	RCS_CHT_MASSLIQ	Output	CORE	RCS		T/H State	RE		Core node liquid mass	Lbm
1413	RCS_CHT_MASSBUB	Output	CORE	RCS		T/H State	RE	22	RCS bubble mass in core (sections)	Lbm
1414	RCS_MOD_INPUTS	Partition					RE	205	RCS modified inputs	Partition
1415	RCS_MOD_INPUTS_BOP	Partition					RE	50	RCS modified inputs from BOP systems	Partition
1416	CHGS_RCS_FLOW	Output	RCS	CVCS		T/H State	RE	4	Charging system flows (RCS connections). This output parameter from the charging system model supplies the flow from the charging system to the RCS. In the absence of a detailed CVCS model, this flow is calculated by the Control System model.	Lbm/sec
1417	CHGS_RCS_ENTH	Output	RCS	CVCS		T/H State	RE		Charging system enthalpy (RCS connection). This output parameter from the charging system model supplies the enthalpy of flow from the charging system to the RCS. In the absence of a detailed CVCS model, this enthalpy is calculated by the Control System model.	Btu/lbm
1418	CHGS_RCS_BORON	Input / Init	RCS	CVCS		Solutes	RE		Charging system boron concentration (RCS connection). In the absence of a detailed CVCS model, this parameter is set =RBINIT during INITIALization, and then remains constant, unless changed by the USER during a transient.	Parts/million
1419	CHGS_RCS_HYD	Input / Init	RCS	CVCS		Solutes	RE		Charging system hydrogen concentration (RCS connection). In the absence of a detailed CVCS model, this parameter is set =0.0 during INITIALization, and then remains constant, unless changed by the USER during a transient.	Lbm/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1420	CHGS_RCS_IOD	Input / Init	RCS	CVCS		Solutes	RE		Charging system Iodine conc (RCS connection). In the absence of a detailed CVCS model, this parameter is set =0.0 during INITIALization, and then remains constant, unless changed by the USER during a transient.	Microcurie/lbm
1421	CHGS_RCS_PART	Input / Init	RCS	CVCS		Solutes	RE		Charging sys particulate conc (RCS connection). In the absence of a detailed CVCS model, this parameter is set =0.0 during INITIALization, and then remains constant, unless changed by the USER during a transient.	Microcurie/lbm
1422	CHGS_RCS_XEN	Input / Init	RCS	CVCS		Solutes	RE		Charging system xenon conc.(RCS connection). In the absence of a detailed CVCS model, this parameter is set =0.0 during INITIALization, and then remains constant, unless changed by the USER during a transient.	Microcurie/lbm
1423	CHGS_ASPRAY_FLOW	Output	RCS	CVCS		T/H State	RE		Auxiliary spray flow rate. In the absence of a detailed CVCS model, this flow is calculated by the Control System model.	Lbm/sec
1424	LDNS_RCS_FLOW	Output	RCS	CVCS		T/H State	RE	4	Letdown system flow (RCS connections). This output parameter from the CVCS model indicates the flow to the letdown line from the RCS. In the absence of a detailed CVCS model, this flow is calculated by the Control System model.	Lbm/sec
1425	RCW_RCS_FLOW	Input	RCS	RCW		T/H State	RE	1	Drain flow to waste system (RCS connection). In the absence of a RCW model, this parameter remains constant, unless changed by the USER during a transient.	Lbm/sec
1426	SDC_RCS_FLOW	Input / Init	RCS			T/H State	RE	2	Shutdown cooling out-flow (RCS connection). In the absence of a detailed SDC model, this parameter is set =0.0 during INITIALization, and then remains constant, unless changed by the USER during a transient.	Lbm/sec
1427	SIS_RCS_FLOW	Output	RCS	SIS		T/H State	RE	8	SIS flows (RCS connections). This output parameter from the SIS model indicates the flow from the SI lines to the RCS. This flow for each SI line is the combination of the HPSI, LPSI and SIT flow contributions.	Lbm/sec
1428	SIS_RCS_ENTH	Output	RCS	SIS		T/H State	RE	8	SIS enthalpy (RCS connections). This output parameter from the SIS model indicates the enthalpy of flow from the SI lines to the RCS. This enthalpy is calculated from the inputs CTL_HLPSI_H and CTL_SIS_SIT_H, weighted by the flow rates from each source (HPSI, LPSI and SITs).	Btu/lbm
1429	SIS_RCS_BORON	Output	RCS	SIS		Solutes	RE	8	SIS boron concentration (RCS connection). This output parameter from the SIS model indicates the boron concentration of flow from the SI lines to the RCS. This boron concentration is calculated from the inputs CTL_HLPSI_BC and CTL_SIS_SIT_BC, weighted by the flow rates from each source (HPSI, LPSI and SITs).	Parts/million
1430	SI_TANK_FLOW	Output	RCS	SIS		T/H State	RE	4	Safety injection tank flow. This output parameter from the SIS model indicates SIT flow based upon relative RCS and SIT pressures, flow area, k factors, etc. When added to HPSI and LPSI flow rates, this output becomes a part of SIS_RCS_FLOW.	Lbm/sec
1431	RCS_MOD_INPUTS_VLVCONTR	Partition					RE	30	RCS mod inputs from valve controllers	Partition
1432	VLV_RCS_POS	Partition			Valves		RE	24	RCS valve positions (fraction)	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1433	VLV_UHEAD_CONT	Input	UH Vent	RCS	Valves	Hardware State	RE		Upper head to contain valve position. This input parameter is set by the USER to vent the upper head of the RV to the containment. This vent path may be used anytime, though its primary intent is for use during shutdown, cooled down conditions.	Fraction
1434	VLV_UHEAD_QT	Input	UH Vent	RCS	Valves	Hardware State	RE	2	Upper head to quench tank valve position. This input parameter is set by the USER to vent the upper head of the RV to the quench tank. This vent path may be used anytime, though its primary intent is for use during shutdown, cooled down conditions. It requires that the quench tank inputs be developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Fraction
1435	VLV_PRZR_PORV	Output	PZR	RCS	Valves	Hardware State	RE	4	Pressurizer PORV position. In Automatic mode, the position is determined by the controller logic, which sets the valve signal as a function of pressurizer pressure, and operates the valve. In Manual mode, the USER sets the PORV signal via VLV_PRZR_PORV_SIG, and the model operates the PORV accordingly.	Fraction
1436	VLV_PRZR_SAFETY	Output	PZR	RCS	Valves	Hardware State	RE	4	Pressurizer safety valves position. This parameter is determined by the PSV controller for each safety valve as a function of the pressurizer pressure and the PSV setpoints.	Fraction
1437	VLV_PRZR_MOV	Input	PZR	RCS	Valves	Hardware State	RE	4	Pressurizer Motor-Operated Valve positions, in series with the PORVs. This valve position is normally set to 1.0 if PORVs are modeled. If set to any other position < 1.0, each valve will partially or completely isolate its PORV.	Fraction
1438	VLV_PRZR_CONT	Input	PZR	RCS	Valves	Hardware State	RE		Vent valve position, pressurizer to containment. This input parameter is set by the USER to vent the pressurizer to the containment. This vent path may be used anytime, though its primary intent is for use during shutdown, cooled down conditions.	Fraction
1439	VLV_PRZR_QT	Input	PZR	RCS	QT	Hardware State	RE	2	Pressurizer to quench tank vent valves position. This input parameter is set by the USER to vent the pressurizer to the quench tank. This vent path may be used anytime, though its primary intent is for use during shutdown, cooled down conditions. It requires that the quench tank inputs be developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Fraction
1440	VLV_PRZR_MSPRAY	Output	PZR	RCS	Valves	Hardware State	RE	2	Main spray control valves. This parameter provides valve position information. In Automatic mode, the position is determined by the controller logic, which sets the valve signal as a function of pressurizer pressure, and operates the valve. In Manual mode, the USER sets the spray valve signal via VLV_PRZR_MSPRAY_SIG, and the model operates the spray valve accordingly.	Fraction
1441	VLV_QT_GWS	Input	PZR	RCS	QT	Hardware State	RE		Quench tank to GWS vent valve position. This input is required iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Fraction
1442	VLV_QT_CONT	Input	PZR	RCS	QT	Hardware State	RE		Quench tank to containment vent valve position. This input is required iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Fraction

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1443	VLV_QT_NSUPPLY	Input	PZR	RCS	QT	Hardware State	RE		Nitrogen supply to QTank valve position. This input is required iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Fraction
1444	VLV_RCS_SIG	Partition					RE	6	RCS valve signals	Partition
1445	VLV_PRZR_MSPRAY_SIG	I/O	PZR	RCS		Control Sig.	RE	2	Pressurizer main spray valve signals. Calculated by the Control System in Auto mode. Set by the user or remain constant in Manual mode.	Fraction
1446	VLV_PRZR_PORV_SIG	I/O	PZR	RCS		Control Sig.	RE	4	Pressurizer PORV signals. Calculated by the Control System in Auto mode. Set by the user or remain constant in Manual mode.	Fraction
1447	RCS_MOD_INPUTS_VOLTCONTR	Partition					RE	20	RCS mod inputs voltage controllers	Partition
1448	PRSI_HEATER_VOLT_FRAC	Output	PZR	RCS		Heater Prop.	RE	6	Pressurizer heaters voltage (fraction). Calculated by the Control System.	Fraction
1449	RCPI_VOLT_FRAC	Input	RCP	RCS		Pump Prop.	RE	4	RCP voltage (fraction). Set by USER to 0.0 to trip RCP.	Fraction
1450	RCS_HEATER_VOLT_BUS	Input	PZR	RCS			RE	6	Heater bus voltages. This is the input which dictates the full bus voltage available for each heater bus.	Volts
1451	RCPI_FREQ_FRAC	Input	RCP	RCS			RE	4	RCP electric motor frequency (fraction)	Fraction
1452	RCS_MOD_INPUTS_MALFUNCTIONS	Partition					RE	52	RCS_modified malfunctions	Partition
1453	MAL_SB_LOCA	Input	RCS				RE	4	Small break LOCA areas	Ft^2
1454	MAL_LB_LOCA	Input	RCS				RE		Large break LOCA area	Ft^2
1455	MAL_SGTR	Input	RCS				RE	4	SG tube rupture (SGTR) indicator - number of ruptured tubes. For each tube ruptured, there are two broken ends. CENTS treats these two ends as separate breaks, with different flow enthalpies and flow fluxes, and with each presenting a break area SG_TUBE_AREA * RCS_SGTR_FLOWMULT. Reference: CE-CES-0198-P, Rev.004, Section 8.	Pointer
1457	MAL_ROD_EJECT	Input	RCS				RE		Rod ejection plus CEDM rupture (fraction of the area P_AREA_RODEJ). This creates a SBLOCA without the reactivity effect, which can be done separately.	Fraction
1458	MAL_RCS_VALVE	Input Partition	RCS	Valves		Malfunction	RE	25	RCS valves malfunction. This partition/array of malfunction valve positions is used to fail-open the valves. The resulting valve area used in the calculation is the greater of PLT_RCS_VLVAREA( ) * VLV_RCS_POS( ) and PLT_RCS_VLVAREA( ) * MAL_RCS_VALVE( )	Fraction
1459	MAL_VLV_UHEAD_CONT	Input	UH Vent	RCS	Valves	Malfunction	RE		Upper head to containment fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_UHEAD_CONT * VLV_UHEAD_CONT and PLT_VLVAREA_UHEAD_CONT * MAL_VLV_UHEAD_CONT	Fraction
1460	MAL_VLV_UHEAD_QT	Input	UH Vent	RCS	Valves	Malfunction	RE	2	Upper head to quench tank fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_UHEAD_QT * VLV_UHEAD_QT and PLT_VLVAREA_UHEAD_QT * MAL_VLV_UHEAD_QT	Fraction

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1461	MAL_VLV_PRZR_PORV	Input	PZR	RCS	Valves	Malfunction	RE	4	Pressurizer PORV fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_PORV * VLV_PRZR_PORV and PLT_VLVAREA_PRZR_PORV * MAL_VLV_PRZR_PORV	Fraction
1462	MAL_VLV_PRZR_SAFETY	Input	PZR	RCS	Valves	Malfunction	RE	4	Pressurizer safety valves fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_SAFETY * VLV_PRZR_SAFETY and PLT_VLVAREA_PRZR_SAFETY * MAL_VLV_PRZR_SAFETY	Fraction
1463	MAL_VLV_PRZR_MOV	Input	PZR	RCS	Valves	Malfunction	RE	4	Pressurizer MOV fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_MOV * VLV_PRZR_MOV and PLT_VLVAREA_PRZR_MOV * MAL_VLV_PRZR_MOV	Fraction
1464	MAL_VLV_PRZR_CONT	Input	PZR	RCS	Valves	Malfunction	RE		Pressurizer to containment vent valve fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_CONT * VLV_PRZR_CONT and PLT_VLVAREA_PRZR_CONT * MAL_VLV_PRZR_CONT	Fraction
1465	MAL_VLV_PRZR_QT	Input	PZR	RCS	QT	Malfunction	RE	2	Pressurizer to quench tank vent valves fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_QT * VLV_PRZR_QT and PLT_VLVAREA_PRZR_QT * MAL_VLV_PRZR_QT	Fraction
1466	MAL_VLV_PRZR_MSPRAY	Input	PZR	RCS	Valves	Malfunction	RE	2	Main spray control valves fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_PRZR_MSPRAY * VLV_PRZR_MSPRAY and PLT_VLVAREA_PRZR_MSPRAY *MAL_VLV_PRZR_MSPRAY	Fraction
1467	MAL_VLV_QT_GWS	Input	PZR	RCS	QT	Malfunction	RE		Quench tank to GWS vent valve fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_QT_GWS * VLV_QT_GWS and PLT_VLVAREA_QT_GWS * MAL_VLV_QT_GWS	Fraction
1468	MAL_VLV_QT_CONT	Input	PZR	RCS	QT	Malfunction	RE		Quench tank to containment vent valve fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_QT_CONT * VLV_QT_CONT and PLT_VLVAREA_QT_CONT * MAL_VLV_QT_CONT	Fraction
1469	MAL_VLV_QT_NSUPPLY	Input	PZR	RCS	QT	Malfunction	RE		Nitrogen supply to QTank valve fail-open malfunction valve position. The valve area used in the calculation is the greater of: PLT_VLVAREA_QT_NSUPPLY * VLV_QT_NSUPPLY and PLT_VLVAREA_QT_NSUPPLY * MAL_VLV_QT_NSUPPLY	Fraction
1470	MAL_RCP_SHAFTBREAK	Input	RCP	RCS		Malfunction	LO	4	RCP shaft break malfunction	True False
1471	MAL_RCP_LOCKED	Input	RCP	RCS		Malfunction	LO	4	RCP locked rotor malfunction	True False
1474	RCS_MOD_INPUTS_CONT	Partition					RE	2	RCS modified inputs from containment	Partition
1475	CONT_PRES	Input	RCS				RE		Containment pressure	Psia
1476	QT_MOD_INPUTS	Partition					RE	5	Quench tank modified inputs	Partition

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1477	DMW_QT_FLOW	Input	PZR	RCS			RE		Demineralized water flow to quench tank. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Lbm/sec
1478	DMW_QT_ENTH	Input	PZR	RCS			RE		Demineralized water enthalpy. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Btu/lbm
1479	RCW_QT_FLOW	Input	PZR	RCS			RE		Mass flow QT to RCW. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Lbm/sec
1480	GWS_QT_PRES	Input	PZR	RCS			RE		GWS pressure. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Psia
1481	GWS_QT_FLOW	Input	PZR	RCS			RE		Gas flow quench tank to GWS. This input is used iff the quench tank inputs are developed for a given plant basedeck and the QT model is "on" (MOD_OFF_QT=F).	Lbm/sec
1482	RCS_INPUTS_PRZR_RELIEF	Partition					RE	33	Pressurizer relief valves discharge model	Partition
1483	VLV_PRZR_QUAL_DF	Input	PZR	RCS	Przr Relief		RE		Pressurizer Relief Valve Flow Option - Transition Quality. If the relief flow quality > VLV_PRZR_QUAL_DF, then the relief flow is calculated by method 1. Otherwise, the integer VLV_PRZR_FLOW_OPTION determines the method. The available methods are: 1 - Standard choked flow formulation (HEM or H-F correlation) for throat pressure and critical flux. If throat pressure < downstream pressure, a Bernouli formulation is applied for orifice type flow. 2 - A Bernouli formulation for orifice type flow is applied independently of throat pressure. It is multiplied by a discharge coefficient Cd that is given by the table VLV_PRZR_FLOW_TABLE (Cd) vs. VLV_PRZR_PROP_TABLE (subcooling, DegF). 3 - The flux is given directly by the table of VLV_PRZR_FLOW_TABLE (flux, lbm/sec-ft2) vs. VLV_PRZR_PROP_TABLE (upstream pressure, Psia). Option 1 is to be used for realistic transients, independently of plant design. See discussion of VLV_PRZR_FLOW_OPTION.	Fraction

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1484	VLV_PRZR_FLOW_OPTION	Input	PZR	RCS	Przr Relief		IN		Pressurizer Relief Valve Flow Option - Calculation Method. If the relief flow quality > VLV_PRZR_QUAL_DF, then the relief flow is calculated by method 1. Otherwise, this parameter determines the method. The available methods are: 1 - Standard choked flow formulation (HEM or H-F correlation) for throat pressure and critical flux. If throat pressure < downstream pressure, a Bernouli formulation is applied for orifice type flow. 2 - A Bernouli formulation for orifice type flow is applied independently of throat pressure. It is multiplied by a discharge coefficient Cd that is given by the table VLV_PRZR_FLOW_TABLE (Cd) vs. VLV_PRZR_PROP_TABLE (subcooling, DegF). 3 - The flux is given directly by the table of VLV_PRZR_FLOW_TABLE (flux, lbm/sec-ft2) vs. VLV_PRZR_PROP_TABLE (upstream pressure, Psia). Option 1 is to be used for realistic transients, independently of plant design. If Option 1, then method 1 is always used, and the other variables are not used. Options 2 and 3 are used for special effects and studies, and the other parameters are dependent on plant data for valve flow and/or Cd.	Pointer
1485	VLV_PRZR_NPOINTS_TAB	Input	PZR	RCS	Przr Relief		IN		No. of points in Pressurizer relief valve flow discharge table, VLV_PRZR_FLOW_TABLE(15) versus VLV_PRZR_PROP_TABLE(15). Maximum 15. If VLV_PRZR_FLOW_OPTION = 1, then the table is not used.	Counts
1486	VLV_PRZR_FLOW_TABLE	Input	PZR	RCS	Przr Relief		RE	15	Pressurizer relief valve flow table: dependent variable. Used when the relief flow quality > VLV_PRZR_QUAL_DF and VLV_PRZR_FLOW_OPTION = 2 or 3: 2 - A Bernouli formulation for orifice type flow is applied independently of throat pressure. It is multiplied by a discharge coefficient Cd that is given by this table VLV_PRZR_FLOW_TABLE (Cd) vs. VLV_PRZR_PROP_TABLE (subcooling, DegF). 3 - The flux is given directly by this table of VLV_PRZR_FLOW_TABLE (flux, lbm/sec-ft2) vs. VLV_PRZR_PROP_TABLE (upstream pressure, Psia). The table contains VLV_PRZR_NPOINTS_TAB points.	Undefined

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1487	VLV_PRZR_PROP_TABLE	Input	PZR	RCS	Przr Relief		RE	15	Pressurizer relief valve flow table: independent variable. Used when the relief flow quality > VLV_PRZR_QUAL_DF and VLV_PRZR_FLOW_OPTION = 2 or 3: 2 - A Bernouli formulation for orifice type flow is applied independently of throat pressure. It is multiplied by a discharge coefficient Cd that is given by the table VLV_PRZR_FLOW_TABLE (Cd) vs. this table VLV_PRZR_PROP_TABLE (subcooling, DegF). 3 - The flux is given directly by the table of VLV_PRZR_FLOW_TABLE (flux, lbm/sec-ft2) vs. this table VLV_PRZR_PROP_TABLE (upstream pressure, Psia). The table contains VLV_PRZR_NPOINTS_TAB points.	Undefined
1488	RCS_INITIAL_CONDITIONS	Partition					RE	15	RCS initial conditions	Partition
1489	RPINIT	Input	RCS			Initialization	RE		New initial pressurizer pressure (psia, in steam space). This is a case dependent variable set by the USER to determine the initial conditions. CENTS uses this input as one of the required parameters to initialize the code. It is used in conjunction with RLINIT(pressurizer level), RWINIT(RCS total flow), RTCLIN(RCS cold leg temperature), RBINIT(RCS initial boron concentration), kfrain(initial power fraction), SLINIT(SG water level), CTL_FWS_H(Initial FW enthalpy). These variables dictate the initial T/H conditions required by CENTS to calculate an overall plant heat and flow balance. Reference 1, Appendix D.	Psia
1490	RLINIT	Input	RCS			Initialization	RE		New initial pressurizer level (feet, actual level). This is a case dependent variable set by the USER to determine the initial conditions. CENTS uses this input as one of the required parameters to initialize the code. It is used in conjunction with RPINIT(pressurizer pressure), RWINIT(RCS total flow), RTCLIN(RCS cold leg temperature), RBINIT(RCS initial boron concentration), kfrain(initial power fraction), SLINIT(SG water level), CTL_FWS_H(Initial FW enthalpy). These variables dictate the initial T/H conditions required by CENTS to calculate an overall plant heat and flow balance. Reference 1, Appendix D.	Feet
1491	RWINIT	Input	RCS			Initialization	RE		New initial total loop flow rate(lbm/sec, reactor vessel total flow or sum of loop flows). This is a case dependent variable set by the USER to determine the initial conditions. CENTS uses this input as one of the required parameters to initialize the code. It is used in conjunction with RPINIT(pressurizer pressure), RLINIT(pressurizer level), RTCLIN(RCS cold leg temperature), RBINIT(RCS initial boron concentration), kfrain(initial power fraction), SLINIT(SG water level), CTL_FWS_H(Initial FW enthalpy). These variables dictate the initial T/H conditions required by CENTS to calculate an overall plant heat and flow balance. Reference 1, Appendix D.	Lbm/sec

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1492	RTCLIN	Input	RCS			Initialization	RE		New initial cold leg temperature(degree F, at the RCP discharge). This is a case dependent variable set by the USER to determine the initial conditions. CENTS uses this input as one of the required parameters to initialize the code. It is used in conjunction with RPINIT(pressurizer pressure), RLINIT(pressurizer level), RWINIT(RCS total flow), RBINIT(RCS initial boron concentration), kfrain(initial power fraction), SLINIT(SG water level), CTL_FWS_H(Initial FW enthalpy). These variables dictate the initial T/H conditions required by CENTS to calculate an overall plant heat and flow balance. Reference 1, Appendix D.	Degree F
1493	RBINIT	Input	RCS			Initialization	RE		New initial boron concentration(ppm). This is a case dependent variable set by the USER to determine the initial conditions. CENTS uses this input as one of the required parameters to initialize the code. It is used in conjunction with RPINIT(pressurizer pressure), RLINIT(pressurizer level), RWINIT(RCS total flow), RTCLIN(RCS cold leg temperature), kfrain(initial power fraction), SLINIT(SG water level), CTL_FWS_H(Initial FW enthalpy). These variables dictate the initial T/H conditions required by CENTS to calculate an overall plant heat and flow balance. Reference 1, Appendix D.	Parts/million
1494	RKPUMP	Input/Init	RCS				RE	4	Pump head multiplier.	Fraction
1496	SG_TUBE_SECTIONS	Partition						1051	SG Tube Section Data	Partition
1497	NUM_SG_SECT	Input	RCS	SG		Model Design	IN	16	Number of sections (requested) in each of the SG nodes identified in the array NODE_SG. Input order must correspond to the input order in NODE_SG. This sectionalizing scheme for SG #1 is automatically applied to the remaining SG(s). Reference 1, Sections 5.3 and 7.3.2.	Counts
1498	RCS_SG_NSECT	Output	RCS	SG		Model Design	IN	16	Number of sections in each SG node (dynamic). The values in this array normally equal NUM_SG_SECT. However, if flow through the node is in the reverse direction or if the fluid is subcooled, then RCS_SG_NSECT is 1. These two conditions are subject to hysteresis as defined by RCS_SG_SECT_DW and RCS_SG_SECT_DH. Reference 1, Sections 5.3 and 7.3.2.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1499	RCS_SG_SECT_DH	Input	RCS	SG		Model Design	RE		Tolerance for SG node saturation hysteresis. Typical value = 10.. Used in switching logic for number of sections. In positive, single-phase flow, the requested number of sections from NUM_SG_SECT is used. However, in two-phase or reverse flow, the code reduces the number of sections to 1 per node, since the sectioning scheme is not guaranteed to match the overall nodal state under those conditions. Thus, as an example, if each of 4 tube nodes had 10 sections in the sectioning scheme, the number of sections comprising the entire tube length of each SG can vary between 4 and 40. The actual (dynamic) number of sections employed in each node is stored in the array RCS_SG_NSECT. The switching logic is that the number of sections collapses to one per node if that node reaches saturation enthalpy. It stays at one section unless the node becomes subcooled by at least the value of RCS_SG_SECT_DH. Usually the User will make this value sufficiently large to keep the node from erratic switching in the number of sections. Reference 1, Section 5.3.	BTU/Lbm
1500	RCS_SG_SECT_DW	Input	RCS	SG		Model Design	RE		Tolerance for SG node flow hysteresis. Used in switching logic for number of sections. Typical value = 2000. In positive, single-phase flow, the requested number of sections from NUM_SG_SECT is used. However, in two-phase or reverse flow, the code reduces the number of sections to 1 per node, since the sectioning scheme is not guaranteed to match the overall nodal state under those conditions. Thus, as an example, if each of 4 tube nodes had 10 sections in the sectioning scheme, the number of sections comprising the entire tube length of each SG can vary between 4 and 40. The actual (dynamic) number of sections employed in each node is stored in the array RCS_SG_NSECT. The switching logic is that the number of sections collapses to one per node if that node's fluid flow reverses direction. It stays at one section unless the node flow increases to the value of RCS_SG_SECT_DW. Usually the User will make this value sufficiently large to keep the node from erratic switching in the number of sections. Reference 1, Section 5.3.	Lbm/sec
1501	RCS_SG_SECT_LH	Output	RCS	SG		T/H State	LO	16	State of SG node saturation hysteresis. Used in switching logic for number of sections. Reference 1, Section 5.3.	True False
1502	RCS_SG_SECT_LW	Output	RCS	SG		T/H State	LO	16	State of SG node flow hysteresis. Used in switching logic for number of sections. Reference 1, Section 5.3.	True False

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1503	RCS_SG_SECT_TEMP	Output	RCS	SG		T/H State	RE	20, 8	Primary coolant temperatures of tube sections. Note: The (20,8) dimensions are interfaces to the SGS model. The second dimension is keyed to SG "sides". Each SG has 2 "sides" – a hot side and a cold side – for up to 4 steam generators. The order of the second dimension is: SG #1 hot side, SG #1 cold side, etc. The first dimension is the RCS node sections, with the pair of vertically stacked nodes being lumped into a single column of up to 20 sections. The order of the first dimension is bottom to top. Reference: Reference 1, Sections 5.3 and 7.3.2.	Degree F
1504	RCS_SG_SECT_QP	Output	RCS	SG		T/H State	RE	20, 8	Primary side heat transfer rates of tube sections. Note: The (20,8) dimensions are interfaces to the SGS model. The second dimension is keyed to SG "sides". Each SG has 2 "sides" – a hot side and a cold side – for up to 4 steam generators. The order of the second dimension is: SG #1 hot side, SG #1 cold side, etc. The first dimension is the RCS node sections, with the pair of vertically stacked nodes being lumped into a single column of up to 20 sections. The order of the first dimension is bottom to top. Reference: Reference 1, Sections 5.3 and 7.3.2.	Btu/sec
1505	RCS_SG_SECT_QS	Output	RCS	SG		T/H State	RE	20, 8	Secondary side heat transfer rates of tube sections. Note: The (20,8) dimensions are interfaces to the SGS model. The second dimension is keyed to SG "sides". Each SG has 2 "sides" – a hot side and a cold side – for up to 4 steam generators. The order of the second dimension is: SG #1 hot side, SG #1 cold side, etc. The first dimension is the RCS node sections, with the pair of vertically stacked nodes being lumped into a single column of up to 20 sections. The order of the first dimension is bottom to top. Reference: Reference 1, Sections 5.3 and 7.3.2.	Btu/sec
1506	RCS_SG_SECT_TTUBE	Output	RCS	SG		T/H State	RE	20, 8	Tube metal temperatures of tube sections. Note: The (20,8) dimensions are interfaces to the SGS model. The second dimension is keyed to SG "sides". Each SG has 2 "sides" – a hot side and a cold side – for up to 4 steam generators. The order of the second dimension is: SG #1 hot side, SG #1 cold side, etc. The first dimension is the RCS node sections, with the pair of vertically stacked nodes being lumped into a single column of up to 20 sections. The order of the first dimension is bottom to top. Reference: Reference 1, Sections 5.3 and 7.3.2.	Degree F
1507	RCS_SG_SECT_PRESS	Output	RCS	SG		T/H State	RE	20, 8	Primary pressures of tube sections. Note: The (20,8) dimensions are interfaces to the SGS model. The second dimension is keyed to SG "sides". Each SG has 2 "sides" – a hot side and a cold side – for up to 4 steam generators. The order of the second dimension is: SG #1 hot side, SG #1 cold side, etc. The first dimension is the RCS node sections, with the pair of vertically stacked nodes being lumped into a single column of up to 20 sections. The order of the first dimension is bottom to top. Reference 1, Sections 5.3 and 7.3.2.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1508	SGS_NSECT	Output	RCS	SG		T/H State	IN	8	Number of sections in each SG side (i.e. hot side & cold side). If there are four tube nodes per SG, then the two hot side nodes' sections are added together and the two cold side nodes' sections are added together for each SG. Reference 1, Section 5.3.	Counts
1509	RCS_SG_SECT_TOPT	Input	RCS	SG		Model Design	IN		Optional primary temperature model for heat transfer. 0 => Exit temp. 1 => LMTD-based temperature. The 0 option is included to allow the previous code model to be duplicated. Usually, the USER will choose LMTD based temperature as the most realistic representation of the fluid temperature. For Option 1 (LMTD) TEMPi = TSEC + (Tim – Ti) / ln [(Tim - TSEC) / (Ti - TSEC)], where, TEMPi = Mean temperature of section i; TSEC = Temperature of the SG evaporator region; Tim = Temperature at bottom of section; Ti = Temperature at top of section. Reference 1, Section 5.3.	Pointer
1510	RCS_SG_SECT_ENTH	Output	RCS	SG		T/H State	RE	11, 16	Section-bottom enthalpies (section,node). Reference 1, Section 5.3.	Btu/lbm
1511	SGTR_DATA	Partition	RCS	SG		SGTR		28	Data for SGTR Model	
1512	SGTR_TUBE_LENGTH	Input	RCS	SG		SGTR	RE	8	SGTR tube length. 2 values per generator. The first value is for the hot side, the second for the cold side. Reference 1, Section 5.7 and 7.5.	Feet
1513	SGTR_TUBE_ENTRANCE_K	Input	RCS	SG		SGTR	RE	8	SGTR Entrance K factor. Normally set to 0.5. Provide 2 values per steam generator. The first value is for the hot side, the second for the cold side. Reference 1, Section 5.7 and 7.5.	Dimensionless
1514	SGTR_BREAK_ELEV	Input	RCS	SG		SGTR	RE	4	SGTR elevation above tube sheet. Provide 1 value per steam generator. Reference 1, Section 5.7 and 7.5.	Feet
1515	SGTR_SLOT_BREAK_OPT	Input	RCS	SG		SGTR	LO	4	SGTR Option to calculate SGTR break flow using a slot break flow model rather than double ended guillotine break. Reference 1, Section 5.7 and 7.5.	Dimensionless
1516	SGTR_SLOT_BREAK_AREA	Input	RCS	SG		SGTR	RE	4	SGTR Slot area per tube, used only when the flag SGTR_SLOT_BREAK_OPTION is true. Reference 1, Section 5.7 and 7.5.	Ft^2
1517	SB_LOCA_PIPE_DATA	Partition	RCS			SBLOCA	RE	20	Data for SBLOCA pipe loss model	Partition
1518	SB_PIPE_AREA	Input	RCS			SBLOCA	RE	4	SBLOCA pipe flow area between RCS and break. Reference 1, Section 4.21.2 and 7.5.	Ft^2
1519	SB_PIPE_LOD	Input	RCS			SBLOCA	RE	4	SBLOCA pipe length/diameter from RCS to break. Reference 1, Section 4.21.2 and 7.5.	Dimensionless
1520	SB_PIPE_KGEOM	Input	RCS			SBLOCA	RE	4	SBLOCA pipe geometric loss k-factor from RCS to break, excluding entrance loss. Reference 1, Section 4.21.2 and 7.5.	Dimensionless
1521	SB_PIPE_KENT	Input	RCS			SBLOCA	RE	4	SBLOCA pipe entrance loss k-factor at the RCS connection. Reference 1, Section 4.21.2 and 7.5.	Dimensionless
1522	SB_DELTA_ELEV	Input	RCS			SBLOCA	RE	4	SBLOCA break elevation above RCS connection. Reference 1, Section 4.21.2 and 7.5.	Feet
1523	CVCS_DATA	Partition	RCS	CVCS		Piping Def	RE	50	CVCS model data	Partition
1524	LDN_PIPE_DATA	Partition	RCS	CVCS		Piping Def	RE	20	Input data for letdown line loss model. Reference 1, Section 4.21.1 and 7.5.	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1525	LDN_PIPE_AREA	Input	RCS	CVCS		Piping Def	RE	2	Letdown line flow area. (1) = line from RCS to regenerative heat exchanger (RHX). (2) = line from RHX to the break, if any. Reference 1, Section 4.21.1 and 7.5.	Ft^2
1526	LDN_PIPE_LOD	Input	RCS	CVCS		Piping Def	RE	2	Letdown line length/diameter. (1) = line from RCS to regenerative heat exchanger (RHX). (2) = line from RHX to the break, if any. Reference 1, Section 4.21.1 and 7.5.	Dimensionless
1527	LDN_PIPE_KGEOM	Input	RCS	CVCS		Piping Def	RE	2	Letdown line geometric loss factor, excluding entrance losses. (1) = line from RCS to regenerative heat exchanger (RHX). (2) = line from RHX to the break, if any. Reference 1, Section 4.21.1 and 7.5.	Dimensionless
1528	LDN_PIPE_KENT	Input	RCS	CVCS		Piping Def	RE	2	Letdown line entrance loss k-factor. (1) =at RCS connection. (2) = at entrance to regenerative heat exchanger. Reference 1, Section 4.21.1 and 7.5.	Dimensionless
1529	LDN_PIPE_DELTA_ELEV	Input	RCS	CVCS		Piping Def	RE	2	Letdown line elevation rise. (1) = line from RCS to regenerative heat exchanger (RHX). (2) = line from RHX to the break, if any. Reference 1, Section 4.21.1 and 7.5.	Feet
1530	MAL_LDN_BREAK	Input	RCS	CVCS		Break	RE		Letdown line break area. When MAL_LDN_BREAK > 0, the break is located in the letdown line downstream of the regenerative heat exchanger (RHX). When MAL_LDN_BREAK < 0, the break is located in the first letdown line upstream of the RHX. (The number of active letdown lines from the RCS to the RHX is RCS_NUMOUT_LDNS ≤ 4.) Reference 1, Section 4.21.1 and 7.5.	Ft^2
1531	CVCS_RHX_DATA	Partition	RCS	CVCS		State	RE	30	CVCS model calculated data	Partition
1532	CVCS_RHX_TLDN	Output	RCS	CVCS		State	RE	2	Letdown temperature at regenerative heat exchanger (1) inlet (2) exit.	DegreeF
1533	CVCS_RHX_TCH	Output	RCS	CVCS		State	RE	2	Charging temperature at regenerative heat exchanger (1) inlet (2) exit	DegreeF
1534	CVCS_RHX_HLDN	Output	RCS	CVCS		State	RE	2	Letdown enthalpy at regenerative heat exchanger (1) inlet (2) exit	Btu/lbm
1535	CVCS_RHX_HCH	Output	RCS	CVCS		State	RE	2	Charging enthalpy at regenerative heat exchanger (1) inlet (2) exit	Btu/lbm
1536	CVCS_RHX_WLDN	Output	RCS	CVCS		State	RE		Letdown mass flow rate	Lbm/sec
1537	CVCS_RHX_WCH	Output	RCS	CVCS		State	RE		Charging mass flow rate	Lbm/sec
1538	CVCS_RHX_HEAT	Output	RCS	CVCS		State	RE		Regenerative heat exchanger heat load	Btu/sec
1539	LDN_RCS_ENTH	Output	RCS	CVCS		State	RE	4	Enthalpy at letdown line RCS connections	Btu/lbm
1540	LDN_RCS_PRES	Output	RCS	CVCS		State	RE	4	Pressure at letdown line RCS connections	Psia
1541	SGS_COMMON	Segment					RE	1536	SG secondary global common variables	Segment
1542	SGS_INTERNAL	Partition					RE	400	SG secondary internal variables	Partition
1543	SGS_BOT_P	Output	SG			T/H State	RE	4	Fluid pressure at SG tube sheet	Psia
1544	SGS_CON_IO1	Output	SG			Solutes	RE	4	SG steam node iodine concentration	Microcurie/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1545	SGS_CON_IO2	Output	SG			Solutes	RE	4	SG evaporator and downcomer nodes iodine concentration	Microcurie/lbm
1546	SGS_CON_PT1	Output	SG			Solutes	RE	4	SG steam node particulates concentration	Microcurie/lbm
1547	SGS_CON_PT2	Output	SG			Solutes	RE	4	SG evaporator and downcomer nodes particulates concentration	Microcurie/lbm
1548	SGS_CON_XE1	Output	SG			Solutes	RE	4	SG steam node xenon concentration	Microcurie/lbm
1549	SGS_CON_XE2	Output	SG			Solutes	RE	4	SG evaporator and downcomer nodes xenon concentration	Microcurie/lbm
1550	SGS_CON_BORON1	Output	SG			Solutes	RE	4	SG steam node boron concentration	Parts/million
1551	SGS_CON_BORON2	Output	SG			Solutes	RE	4	SG evaporator and downcomer nodes boron concentration	Parts/million
1552	SGS_DELTV	Input	SG			Model Design	RE	4	Multiplier on steam velocity. This is an adjustment multiplier on the calculated steam separation velocity in the steam generator evaporator. It is a tuning factor available to tune for steady state, but is normally not used for this purpose. This is an array of tuning factors, independent of plant design. SGS_DELTV should normally be 1.0.	Dimensionless
1553	SGS_DP	Output	SG			T/H State	RE	3, 4	Level instrum. delta press (refleg, sg)	Psid
1554	SGS_DVDP	Output	SG			T/H State	RE	4	Slope of volume(pressure) curve. Used always, and recalculated always. This is the slope of the volume-vs-pressure curve, used in the steam generator iterative pressure solution. It is used as the initial guess for the slope, and is recalculated dynamically during the iterative solution. The initial slope will have no effect on the solution, as long as it is "in the ballpark". (Typical initial value: 20.)	$Feet^3$ / Psi
1555	SGS_ENTH1	Output	SG			T/H State	RE	4	SG steam node average specific enthalpy	Btu/lbm
1556	SGS_ENTH2	Output	SG			T/H State	RE	4	SG evaporator node average sp. enthalpy	Btu/lbm
1557	SGS_ENTH3	Output	SG			T/H State	RE	4	SG downcomer node average sp. enthalpy	Btu/lbm
1560	SGS_E1	Output	SG			T/H State	RE	4	SG steam dome node total energy.	Btu
1561	SGS_E2	Output	SG			T/H State	RE	4	SG evaporator node total energy	Btu
1562	SGS_E3	Output	SG			T/H State	RE	4	SG downcomer node total energy	Btu
1565	SGS_HF	Output	SG			T/H State	RE	4	SG saturated liquid specific enthalpy	Btu/lbm
1566	SGS_HG	Output	SG			T/H State	RE	4	SG saturated steam specific enthalpy	Btu/lbm
1567	SGS_HLEVEL	Output	SG			T/H State	RE	4	SG downcomer coolant level	Feet
1568	SGS_HT2	Output	SG			T/H State	RE	4	SG evaporator coolant level. This is the 2-phase level calculated by CENTS form the evaporators masses, specific volumes and volume to height dependency. Normally, until lower power levels (steaming rates), evaporator volume is full of 2-phase flow to the separators.	Feet
1569	SGS_HT3	Output	SG			T/H State	RE	4	SG downcomer coolant level. This is the actual 2-phase level in the downcomer calculated by CENTS.	Feet
1570	SGS_HTI	Output	SG			T/H State	RE	4, 3	Instrument-measured water levels (SG,leg). This is calculated by CENTS from the actual SG water level, and the known specific volumes and reference leg and calibration information for the instruments.	Feet
1571	SGS_M1	Output	SG			T/H State	RE	4	SG steam node total mass	Lbm
1572	SGS_M2	Output	SG			T/H State	RE	4	SG evaporator node total mass	Lbm
1573	SGS_M3	Output	SG			T/H State	RE	4	SG downcomer node total mass	Lbm
1576	SGS_P	Output	SG			T/H State	RE	4	SG steam node pressure	Psia

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1577	SGS_RECIRC	Output	SG			T/H State	RE	4	SG evaporator to downcomer flow ratio	Dimensionless
1578	SGS_RHO1	Output	SG			T/H State	RE	4	SG steam node density	Lbm/ft^3
1579	SGS_RHO2	Output	SG			T/H State	RE	4	SG evaporator node density	Lbm/ft^3
1580	SGS_RHO3	Output	SG			T/H State	RE	4	SG downcomer node density	Lbm/ft^3
1583	SGS_SV1	Output	SG			T/H State	RE	4	SG steam node average specific volume	Ft^3/lbm
1584	SGS_SV2	Output	SG			T/H State	RE	4	SG evaporator node average spec. volume	Ft^3/lbm
1585	SGS_SV3	Output	SG			T/H State	RE	4	SG downcomer node average spec. volume	Ft^3/lbm
1588	SGS_TREFLG	Output	SG			T/H State	RE	4	SG reference leg water temperature	Degree F
1589	SGS_TWALL	Output	SG			T/H State	RE	4	SG wall metal temperature	Degree F
1590	SGS_T1	Output	SG			T/H State	RE	4	SG steam node temperature	Degree F
1591	SGS_T2	Output	SG			T/H State	RE	4	SG evaporator node temperature	Degree F
1592	SGS_T3	Output	SG			T/H State	RE	4	SG downcomer node temperature	Degree F
1595	SGS_USTM	Output	SG			T/H State	RE	4	Steam velocity leaving separators	Ft/sec
1596	SGS_VF	Output	SG			T/H State	RE	4	SG saturated liquid specific volume	Ft^3/lbm
1597	SGS_VF2	Output	SG			T/H State	RE	4	SG evaporator node liquid spec. volume	Ft^3/lbm
1598	SGS_VF3	Output	SG			T/H State	RE	4	SG downcomer node liquid specific volume	Ft^3/lbm
1601	SGS_VG	Output	SG			T/H State	RE	4	SG saturated steam specific volume	Ft^3/lbm
1602	SGS_V1	Output	SG			T/H State	RE	4	SG steam node total volume	Ft^3
1603	SGS_V2	Output	SG			T/H State	RE	4	SG evaporator node total volume	Ft^3
1604	SGS_V3	Output	SG			T/H State	RE	4	SG downcomer node total volume	Ft^3
1607	SGS_WF1	Output	SG			T/H State	RE	4	SG steam node liquid mass	Lbm
1608	SGS_WF2	Output	SG			T/H State	RE	4	SG evaporator node liquid mass	Lbm
1609	SGS_WF3	Output	SG			T/H State	RE	4	SG downcomer node liquid mass	Lbm
1612	SGS_WG1	Output	SG			T/H State	RE	4	SG steam node steam mass	Lbm
1613	SGS_WG2	Output	SG			T/H State	RE	4	SG evaporator node steam mass	Lbm
1614	SGS_WG3	Output	SG			T/H State	RE	4	SG downcomer node steam mass	Lbm
1617	SGS_W13	Output	SG			T/H State	RE	4	Steam node to downcomer flowrate.	Lbm/sec
1618	SGS_W21	Output	SG			T/H State	RE	4	SG evaporator to steam node flow rate	Lbm/sec
1619	SGS_W23	Output	SG			T/H State	RE	4	Evaporator to downcomer circulation flow	Lbm/sec
1620	SGS_W31	Output	SG			T/H State	RE	4	Downcomer to steam node vaporization flow rate	Lbm/sec
1621	SGS_W32	Output	SG			T/H State	RE	4	SG downcomer to evaporator flow rate	Lbm/sec
1626	SGS_WOUTSG	Output	SG			T/H State	RE	8	SG steam outlet nozzle flow	Lbm/sec
1627	SGS_X1	Output	SG			T/H State	RE	4	SG steam node quality	Fraction
1628	SGS_X2	Output	SG			T/H State	RE	4	SG evaporator node quality	Fraction
1629	SGS_X3	Output	SG			T/H State	RE	4	SG downcomer node quality	Fraction
1632	SGS_FLOW_CHOKED	Output	SG			T/H State	LO	8	Flag: steam flow choked at restrictor	True False
1633	SGS_HEAT	Partition					RE	60	SG heat transfer variables	Partition
1634	SGT_RCS_QHOT	Output	SG	RCS		T/H State	RE	4	SG hot side RCS-to-tube heat transfer	Btu/sec
1635	SGT_SG_QHOT	Output	SG			T/H State	RE	4	Hot side tube-to-secondary heat transfer	Btu/sec
1636	SGT_RCS_QCOLD	Output	SG	RCS		T/H State	RE	4	SG entire cold side RCS-to-tube heat tr.	Btu/sec
1637	SGT_SG_QCOLD	Output	SG			T/H State	RE	4	Entire cold side tube-to-secy heat trans	Btu/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1640	SGT_TEMP_HOT	Output	SG			T/H State	RE	4	SG hot side tube metal temperature	Degree F
1641	SGT_TEMP_COLD	Output	SG			T/H State	RE	4	SG cold side tube metal temp, evaporator	Degree F
1643	SGS_HEAT_LOAD	Output	SG			T/H State	RE		Total secondary side heat load	Btu/sec
1644	SGS_Q_CONT	Output	SG			T/H State	RE	4	SG wall-to-containment heat rate	Btu/sec
1645	SGS_Q_WALL1	Output	SG			T/H State	RE	4	SG steam node steam-to-wall heat rate	Btu/sec
1646	SGS_Q_WALL3	Output	SG			T/H State	RE	4	SG downcomer node liq-to-wall heat rate	Btu/sec
1647	SGS_STEAMLINE	Partition					RE	390	SG steam line variables	Partition
1648	MSLH_STATE	Partition					RE	40	Steamline header variables	Partition
1649	MAL_MSLB_OUT	Input	MSL			Malfunction	IN		Steamline break in MSLH flag: 0=>no 1=>yes. The break area is MSLB_AREA. Reference 1, Section 7.5.2.	Flag
1650	MSLB_OUT_FLOW	Output	MSL				RE		Steamline break outside containment flow rate. Reference 1, Section 7.5.2.	Lbm/sec
1651	MSLH_CON_IO	Output	MSL			Solutes	RE		MSLH node iodine concentration. This variable refers to the concentration in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1652	MSLH_CON_PT	Output	MSL			Solutes	RE		MSLH node particulates concentration. This variable refers to the concentration in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1653	MSLH_CON_XE	Output	MSL			Solutes	RE		MSLH node xenon concentration. This variable refers to the concentration in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1654	MSLH_DVDH	Output	MSL			T/H State	RE		MSLH node partial derivative of sp. vol. with respect to enthalpy. Reference 1, Sections 5.6 and 7.3.3.	Composite Units
1655	MSLH_DVDP	Output	MSL			T/H State	RE		MSLH node partial sp. vol. with pressure. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Composite Units
1656	MSLH_H	Output	MSL			T/H State	RE		MSLH node enthalpy. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1657	MSLH_HF	Output	MSL			T/H State	RE		MSLH node saturated liquid enthalpy. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1658	MSLH_HG	Output	MSL			T/H State	RE		MSLH node saturated steam enthalpy. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1659	MSLH_M	Output	MSL			T/H State	RE		MSLH node mass. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Lbm
1660	MSLH_ML	Output	MSL			T/H State	RE		MSLH node liquid mass. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Lbm
1661	MSLH_P	Output	MSL			T/H State	RE		MSLH node pressure. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1662	MSLH_Q	Output	MSL			T/H State	RE		MSLH coolant-to-wall heat rate. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6, 7.3.3 and 7.4.	Btu/sec
1663	MSLH_Q_ATM	Output	MSL			T/H State	RE		MSLH wall-to-atmosphere heat rate. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6, 7.3.3 and 7.4.	Btu/sec
1664	MSLH_SV	Output	MSL			T/H State	RE		MSLH node specific volume. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1665	MSLH_SVF	Output	MSL			T/H State	RE		MSLH node saturated liquid specific vol. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1666	MSLH_SVG	Output	MSL			T/H State	RE		MSLH node saturated steam specific vol. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1667	MSLH_T	Output	MSL			T/H State	RE		MSLH node temperature. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Degree F
1668	MSLH_TWALL	Output	MSL			T/H State	RE		MSLH node pipe metal temperature. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs). Reference 1, Sections 5.6 and 7.3.3.	Degree F
1669	MSLH_WIN	Output	MSL			T/H State	RE	8	Steamline steam flow into the header	Lbm/sec
1670	MSLH_X	Output	MSL			T/H State	RE		MSLH node quality. This variable refers to the parameter value in the header (I.e. the volume downstream of the MSIVs).	Fraction
1671	STEAMLINE_STATE	Partition					RE	350	Steamlines & stmline ext. valves	Partition
1672	MAL_MSLB_IN	Input	MSL			Malfunction	IN	8	Steamline Break. The break area is MSLB_AREA. The precise break location along the steamline is determined by the K-factor MSLH_FKBRK. For steam line I, MAL_MSLB_IN(i) = : = 0, No break = 1, Break before the MSIV, discharging to the containment. = 2, Break before the MSIV, discharging to the atmosphere. = 3, Break after the MSIV, before the MSLH-side flow restrictor and the steamline check valve, discharging to the atmosphere. Reference 1, Section 7.5.2.	Flag
1673	MSLB_IN_FLOW	Output	MSL			T/H State	RE	8	Steamline break inside containment flowrate. Reference 1, Section 7.5.2.	Lbm/sec
1674	MSLH_HSL	Output	MSL			T/H State	RE	8	SG steamline enthalpy. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Btu/lbm
1675	MSLH_PSL	Output	MSL			T/H State	RE	8	SG steamline pressure. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Psia
1676	MSLH_TSL	Output	MSL			T/H State	RE	8	SG steamline temperature. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Degree F

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1677	MSLH_ISL	Output	MSL			Solutes	RE	8	SG steamline iodine concentrations. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Microcurie/lbm
1678	MSLH_CSL	Output	MSL			Solutes	RE	8	SG steamline partic concentrations. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Microcurie/lbm
1679	MSLH_XSL	Output	MSL			Solutes	RE	8	SG steamline xenon concentrations. This is the CENTS calculated parameter value in the steam line section between the SG and the MSIV.	Microcurie/lbm
1680	MSLH_MSIV_POS	Output	MSL			Hardware State	RE	8	MSIV fraction open.	Fraction
1681	MSLH_MSIV_SIG	I/O	MSL			Hardware State	RE	8	MSIV signal to the valve actuator. This is normally an output from the valve controller, when MSIS is in automatic control. If MSIS is in manual, then the USER can shut the MSIV by setting the parameter value to 0.0. In this case it is an input. Usually, the value for this parameter is 0.0 or 1.0.	Fraction
1682	MSLH_MSIV_BYPASS_POS	Input	MSL			Hardware State	RE	8	MSIV bypass fraction open. For safety analysis, this parameter is set to zero. It should be used only for special testing scenarios of plant warmup.	Fraction
1683	MSLH_VALVE_POS	Output	MSL			Hardware State	RE	50	Steamline external valves fraction open. This output array is calculated by the CENTS valve actuator controllers. The array includes the ADVs, MSSVs, SDBCS valves, etc.	Fraction
1684	MSLH_VALVE_SIG	I/O	MSL			Hardware State	RE	50	Steamline external valves signal. This is normally an output array of valve signals calculated by the CENTS controllers, when their associated control systems are in automatic. When a particular system (e.g. SDBCS) is in manual, then the valve signals can be USER controlled input which drives the valve actuator controllers to vary valve position.	Fraction
1685	SL_P_FLOW	Output	MSL			T/H State	RE	50	Steamline external valves flow rates. This output array is calculated by CENTS using the appropriate flow correlation, which is normally the CRITCO critical flow correlation when the plant is hot and at power.	Lbm/sec
1686	MSLH_AOUT	Partition	MSL			Hardware State	RE	9, 4	Steamline external valves combined areas	Partition
1687	MSLH_AOUT_ATM	Output	MSL			Hardware State	RE	9	External valves flow area, steamlines to atmosphere. This array represents the combined open area of all valves discharging to atmosphere for each steam line, plus the last entry is for the SL header. (Note, the array allows for up to 4 SGs, each with 2 SL's and one header. For a 2 SG plant with one SL each, only the first three values in the array are used.)	Ft^2

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1688	MSLH_AOUT_COND	Output	MSL			Hardware State	RE	9	External valves flow area, steamlines to condenser. This array represents the combined open area of all valves discharging to condenser for each steam line, plus the last entry is for the SL header. (Note, the array allows for up to 4 SGs, each with 2 SL's and one header. For a 2 SG plant with one SL each, only the first three values in the array are used.)	Ft^2
1689	MSLH_AOUT_CONT	Output	MSL			Hardware State	RE	9	External valves flow area, steamlines to containment. This array represents the combined open area of all valves discharging to containment for each steam line, plus the last entry is for the SL header. (Note, the array allows for up to 4 SGs, each with 2 SL's and one header. For a 2 SG plant with one SL each, only the first three values in the array are used.)	Ft^2
1690	MSLH_AOUT_TURB	Output	MSL			Hardware State	RE	9	External valves flow area, steamlines to turbine. This array represents the combined open area of all valves discharging to turbine for each steam line, plus the last entry is for the SL header. (Note, the array allows for up to 4 SGs, each with 2 SL's and one header. For a 2 SG plant with one SL each, only the first three values in the array are used.)	Ft^2
1691	MSLH_WOUT	Partition				T/H State	RE	9, 4	Steamline ext. valves combined flowrates	Partition
1692	MSLH_WOUT_ATM	Output	MSL			T/H State	RE	9	External valves flow rate, steamlines to atmosphere. This array represents the combined flow rate through all valves discharging to atmosphere, separately from each steam line and from the SL header. The array allows for up to 4 SGs, each with 2 SLs, plus one header. If 2 headers are modeled (NUM_MSLH=2), then the flows from both header nodes are combined in one array element. (E.g., For a 2 SG plant with one SL per SG, only the first 3 values in the array are used, regardless of the number of header nodes.)	Lbm/sec
1693	MSLH_WOUT_COND	Output	MSL			T/H State	RE	9	External valves flow rate, steamlines to condenser. This array represents the combined flow rate through valves discharging to condenser, separately from each steam line and from the SL header. The array allows for up to 4 SGs, each with 2 SLs, plus one header. If 2 headers are modeled (NUM_MSLH=2), then the flows from both header nodes are combined in one array element. (E.g., For a 2 SG plant with one SL per SG, only the first 3 values in the array are used, regardless of the number of header nodes.)	Lbm/sec
1694	MSLH_WOUT_CONT	Output	MSL			T/H State	RE	9	External valves flow rate, steamlines to containment. This array represents the combined flow rate through all valves discharging to containment, separately from each steam line and from the SL header. The array allows for up to 4 SGs, each with 2 SLs, plus one header. If 2 headers are modeled (NUM_MSLH=2), then the flows from both header nodes are combined in one array element. (E.g., For a 2 SG plant with one SL per SG, only the first 3 values in the array are used, regardless of the number of header nodes.)	Lbm/sec

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1695	MSLH_WOUT_TURB	Output	MSL			T/H State	RE	9	External valves flow rate, steamlines to turbine. This array represents the combined flow rate through all valves discharging to turbine, separately from each steam line and from the SL header. The array allows for up to 4 SGs, each with 2 SLs, plus one header. If 2 headers are modeled (NUM_MSLH=2), then the flows from both header nodes are combined in one array element. (E.g., For a 2 SG plant with one SL per SG, only the first 3 values in the array are used, regardless of the number of header nodes.)	Lbm/sec
1696	MSLH_OUTFLOW	Partition				T/H State	RE	5, 4	Steamline outflow quantities, inc. break	Partition
1697	MSLH_FLOW_ATM	Output	MSL			T/H State	RE		Total flow rate, steamline to atmosphere. This parameter is the combined flow from all steam line valves which exit to the atmosphere. Hence, it equals SUM(MSLH_WOUT_ATM(I))	Lbm/sec
1698	MSLH_ENTH_ATM	Output	MSL			T/H State	RE		Total flow enthalpy, steamline to atmosphere. This parameter is the weighted average enthalpy of all the steam flow from the steam line valves which exit to the atmosphere.	Btu/lbm
1699	MSLH_IO_ATM	Output	MSL			Solutes	RE		Tot flow iodine concentration, steamline to atmosphere. This parameter is the weighted average iodine concentration of all the steam flow from all steam line valves which exit to the atmosphere.	Microcurie/lbm
1700	MSLH_PT_ATM	Output	MSL			Solutes	RE		Tot flow particulate concentration, steamline to atmosphere. This parameter is the weighted average particulate (cesium) concentration of all the steam flow from all steam line valves which exit to the atmosphere.	Microcurie/lbm
1701	MSLH_XE_ATM	Output	MSL			Solutes	RE		Total flow xenon concentration, steamline to atmosphere. This parameter is the weighted average Xenon concentration of all the steam flow from all steam line valves which exit to the atmosphere.	Microcurie/lbm
1702	MSLH_FLOW_COND	Output	MSL			T/H State	RE		Total flow rate, steamline to condenser. This parameter is the combined flow from all steam line valves which exit to the condenser. Hence, it equals SUM(MSLH_WOUT_COND(I))	Lbm/sec
1703	MSLH_ENTH_COND	Output	MSL			T/H State	RE		Total flow enthalpy, steamline to condenser. This parameter is the weighted average enthalpy of all the steam flow from the steam line valves which exit to the condenser.	Btu/lbm
1704	MSLH_IO_COND	Output	MSL			Solutes	RE		Total flow iodine concentration, steamline to condenser. This parameter is the weighted average iodine concentration of all the steam flow from all steam line valves which exit to the condenser.	Microcurie/lbm
1705	MSLH_PT_COND	Output	MSL			Solutes	RE		Total flow particulate concentration, steamline to condenser. This parameter is the weighted average particulate (cesium) concentration of all the steam flow from all steam line valves which exit to the condenser.	Microcurie/lbm
1706	MSLH_XE_COND	Output	MSL			Solutes	RE		Total flow xenon concentration, steamline to condenser. This parameter is the weighted average Xenon concentration of all the steam flow from all steam line valves which exit to the condenser.	Microcurie/lbm
1707	MSLH_FLOW_CONT	Output	MSL			T/H State	RE		Total flow rate, steamline to containment. This parameter is the combined flow from all steam line valves which exit to the containment. Hence, it equals SUM(MSLH_WOUT_CONT(I)).	Lbm/sec

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1708	MSLH_ENTH_CONT	Output	MSL			T/H State	RE		Total flow enthalpy, steamline to containment. This parameter is the weighted average enthalpy of all the steam flow from the steam line valves which exit to the containment.	Btu/lbm
1709	MSLH_IO_CONT	Output	MSL			Solutes	RE		Total flow iodine concentration, steamline to containment. This parameter is the weighted average iodine concentration of all the steam flow from all steam line valves which exit to the containment.	Microcurie/lbm
1710	MSLH_PT_CONT	Output	MSL			Solutes	RE		Total flow particulate concentration, steamline to containment. This parameter is the weighted average particulate (cesium) concentration of all the steam flow from all steam line valves which exit to the containment.	Microcurie/lbm
1711	MSLH_XE_CONT	Output	MSL			Solutes	RE		Total flow xenon concentration, steamline to containment. This parameter is the weighted average Xenon concentration of all the steam flow from all steam line valves which exit to the containment.	Microcurie/lbm
1712	MSLH_FLOW_TURB	Output	MSL			T/H State	RE		Total flow rate, steamline to turbine. This parameter is the combined flow from all steam line valves which exit to the containment. Hence, it equals SUM(MSLH_WOUT_TURB(I)). Usually this involves only the TAV.	Lbm/sec
1713	MSLH_ENTH_TURB	Output	MSL			T/H State	RE		Total flow enthalpy, steamline to turbine. This parameter is the weighted average enthalpy of all the steam flow from the steam line valves which exit to the turbine.	Btu/lbm
1714	MSLH_IO_TURB	Output	MSL			Solutes	RE		Total flow iodine concentration, steamline to turbine. This parameter is the weighted average iodine concentration of all the steam flow from all steam line valves which exit to the turbine.	Microcurie/lbm
1715	MSLH_PT_TURB	Output	MSL			Solutes	RE		Total flow particulate concentration, steamline to turbine. This parameter is the weighted average particulate (cesium) concentration of all the steam flow from all steam line valves which exit to the turbine.	Microcurie/lbm
1716	MSLH_XE_TURB	Output	MSL			Solutes	RE		Total flow xenon concentration, steamline to turbine. This parameter is the weighted average Xenon concentration of all the steam flow from all steam line valves which exit to the turbine.	Microcurie/lbm
1717	MSLH_IO_INT_FLOW	Partition				Solutes	RE	10	Integrated iodine flows	Partition
1718	MSLH_IO_INT_ATM	Output	MSL			Solutes	RE		Integrated iodine flow to atmosphere	Curie
1719	MSLH_IO_INT_COND	Output	MSL			Solutes	RE		Integrated iodine flow to cond (w/o DF)	Curie
1720	MSLH_IO_INT_CONT	Output	MSL			Solutes	RE		Integrated iodine flow to containment	Curie
1721	MSLH_IO_INT_TURB	Output	MSL			Solutes	RE		Integrated iodine flow to turb (w/o DF)	Curie
1722	MSLH_IO_CONT_LEAK	Output	MSL			Solutes	RE		Iodine leak rate from containment.	Microcurie/sec
1723	MSLH_IO_CONT_INT_LEAK	Output	MSL			Solutes	RE		Integrated iodine leak from containment.	Curie
1724	MSLH_FLOW_CHOKED	Output	MSL			T/H State	LO	8	Flag: Flow is choked between the steamline header and the steamline break.	True False
1725	SGS_FWS	Partition					RE	180	SG feedwater system variables	Partition
1726	FWS_PUMP_PIN	Output	FW				RE		Main FW pumps suction pressure	Psia
1727	FWS_PUMP_P	Output	FW				RE	4	Main feedwater pump discharge pressure.	Psia
1729	FWS_VALVE_PRESSURES	Partition					RE	4, 2	Main FW valve discharge pressure.	Psia
1730	FWS_VALVE_P	Output	FW				RE	4	FW downcomer valve discharge pressure.	Psia

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1731	FWS_ECON_VALVE_P	Output	FW				RE	4	FW economizer valve discharge pressure.	Psia
1734	FWS_PUMP_FLOW	Output	FW				RE	4	Main feedwater pump delivered flow.	Gal/min
1735	FWS_LINE_FLOWS	Partition					RE	4, 2	Flow through main FW control valves.	Lbm/sec
1736	FWS_FLOW	I/O	FW			T/H State	RE	4	Main FW flow rate at downcomer valves. With the current simplified FWS controllers in auto, this parameter is the CENTS calculated output of flow to the downcomer feed ring of the SG. If the FWS controllers are in manual, then this variable becomes an input, controlled by the USER to manually dictate flow rate.	Lbm/sec
1737	FWS_ECON_FLOW	I/O	FW			T/H State	RE	4	Main FW flow rate at economizer valves. With the current simplified FWS controllers in auto, this parameter is the CENTS calculated output of flow to the economizer (Sys 80 design) of the SG. If the FWS controllers are in manual, then this variable becomes an input, controlled by the USER to manually dictate flow rate.	Lbm/sec
1738	FWS_FLOW_TOT	Output	FW			T/H State	RE	4	Total MFW flow to SG through downcomer and economizer valves.	Lbm/sec
1739	FWS_ENTH	Output	FW			T/H State	RE	4	Main feedwater flow spec. enthalpy.	Btu/lbm
1740	FWS_LINE_ENTHALPIES	Partition					RE	4, 2	Inventory enthalpies in main FW lines	Btu/lbm
1741	FWS_LINE_H	Output	FW			T/H State	RE	4	Downcomer feedwater line enthalpy. This output parameter = FWS_ENTH.	Btu/lbm
1742	FWS_ECON_LINE_H	Output	FW			T/H State	RE	4	Economizer feedwater line enthalpy. This output parameter = FWS_ENTH, for those systems with an economizer line.	Btu/lbm
1743	FWS_CON_IO	Input	FW			Solutes	RE	4	Main feedwater supply iodine concentration. This is USER defined input, normally set to 0.0.	Microcurie/lbm
1744	FWS_CON_PT	Input	FW			Solutes	RE	4	Main feedwater supply particulate concentration. This is USER defined input, normally set to 0.0.	Microcurie/lbm
1745	FWS_CON_XE	Input	FW			Solutes	RE	4	Main feedwater supply xenon concentration. This is USER defined input, normally set to 0.0.	Microcurie/lbm
1746	FWS_NOZZLE_FLOW	Partition				T/H State	RE	4, 2	Main FW flow rates at SG feed nozzles	Lbm/sec
1747	FWS_NOZ_FLOW	Output	FW			T/H State	RE	4	Main FW flow rate at downcomer nozzle. With the current simplified FW model, this output parameter = FWS_FLOW(I).	Lbm/sec
1748	FWS_ECON_NOZ_FLOW.	Output	FW			T/H State	RE	4	Main FW flow rate at economizer nozzle. With the current simplified FW model, this output parameter = FWS_ECON_FLOW(I).	Lbm/sec
1749	FWS_NOZZLE_ENTHALPY	Partition				T/H State	RE	4, 2	Main FW flow enthalpy at SG feed nozzles	Btu/lbm
1750	FWS_NOZ_ENTH	Output	FW			T/H State	RE	4	Main FW flow enthalpy at downcomer nozzles.	Btu/lbm
1751	FWS_ECON_NOZ_ENTH	Output	FW			T/H State	RE	4	Main FW flow enthalpy at economizer nozzles.	Btu/lbm
1752	FWS_NOZZLE_QUALITY	Partition				T/H State	RE	4, 2	Main FW flow quality at SG feed nozzles	Fraction
1753	FWS_NOZ_QUAL	Output	FW			T/H State	RE	4	Main FW flow quality at downcomer nozzle	Fraction
1754	FWS_ECON_NOZ_QUAL	Output	FW			T/H State	RE	4	Main FW flow quality at economizer nozzle	Fraction
1755	FWS_NOZZLE_TEMP	Partition				T/H State	RE	4, 2	Main FW flow temp at SG feed nozzles	Degree F
1756	FWS_NOZ_T	Output	FW			T/H State	RE	4	Main FW flow temp at downcomer nozzle	Degree F
1757	FWS_ECON_NOZ_T	Output	FW			T/H State	RE	4	Main FW flow temp at economizer nozzle	Degree F
1758	FWLB_IN	Partition				T/H State	RE	4, 2	Cues for feedline break inside chk valve	Fraction

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1759	MAL_FWLB_IN	Input	FW			T/H State	RE	4	Feedline break inside chk valve, DC line	Fraction
1760	MAL_FWLB_ECON_IN	Input	FW			T/H State	RE	4	Feedline break inside chk valve, EC line	Fraction
1761	FWLB_OUT	Partition				T/H State	RE	4, 2	Cues for feedline brk outside chk valve	Fraction
1762	MAL_FWLB_OUT	Input	FW			T/H State	RE	4	Feedline brk outside chk valve, DC line	Fraction
1763	MAL_FWLB_ECON_OUT	Input	FW			T/H State	RE	4	Feedline brk outside chk valve, EC line	Fraction
1764	FWLB_LOCATION	Partition				T/H State	RE	4, 2	Feedline break locations: 0=valve 1=nozz	Fraction
1765	FWLB_F	Input				T/H State	RE	4	Feedline break location, downcomer line	Fraction
1766	FWLB_ECON_F	Input				T/H State	RE	4	Feedline break location, economizer line	Fraction
1767	FWLB_W	Partition				T/H State	RE	4, 2	Feedline break flow rates	Lbm/sec
1768	FWLB_FLOW	Output	FW			T/H State	RE	4	Downcomer feedline break flow rate.	Lbm/sec
1769	FWLB_ECON_FLOW	Output	FW			T/H State	RE	4	Economizer feedline break flow rate.	Lbm/sec
1770	FWLB_H	Partition				T/H State	RE	4, 2	Feedline break flow enthalpies	Btu/lbm
1771	FWLB_ENTH	Output	FW			T/H State	RE	4	Downcomer feedline break flow enthalpy	Btu/lbm
1772	FWLB_ECON_ENTH	Output	FW			T/H State	RE	4	Economizer feedline break flow enthalpy	Btu/lbm
1773	FWLB_QUALITY	Partition				T/H State	RE	4, 2	Feedline break flow qualities	Fraction
1774	FWLB_QUAL	Output	FW			T/H State	RE	4	Downcomer feedline break flow quality	Fraction
1775	FWLB_ECON_QUAL	Output	FW			T/H State	RE	4	Economizer feedline break flow quality	Fraction
1776	FWLB_IODINE	Partition				Solutes	RE	4, 2	Feedline break flow iodine concentrations	Microcurie/lbm
1777	FWLB_IO	Output	FW			Solutes	RE	4	Downcomer feedline break flow iodine concentrations	Microcurie/lbm
1778	FWLB_ECON_IO	Output	FW			Solutes	RE	4	Economizer feedline break flow iodine concentrations	Microcurie/lbm
1779	FWLB_PART	Partition				Solutes	RE	4, 2	Feedline break flow particulate concentrations	Microcurie/lbm
1780	FWLB_PT	Output	FW			Solutes	RE	4	Downcomer feedline brk flow partic concentration	Microcurie/lbm
1781	FWLB_ECON_PT	Output	FW			Solutes	RE	4	Economizer feedline brk flow partic concentration	Microcurie/lbm
1782	FWLB_XENON	Partition				Solutes	RE	4, 2	Feedline break flow xenon concentration	Microcurie/lbm
1783	FWLB_XE	Output	FW			Solutes	RE	4	Downcomer feedline brk flow xenon concentration	Microcurie/lbm
1784	FWLB_ECON_XE	Output	FW			Solutes	RE	4	Economizer feedline brk flow xenon concentration	Microcurie/lbm
1785	AFWS_NOZ_FLOW	I/O	FW	AFW		T/H State	RE	4	Auxiliary feedwater flow rate to separate steam generator nozzle.	Lbm/sec
1786	AFWS_ENTH	I/O	FW	AFW		T/H State	RE	4	Auxiliary feedwater flow spec. enthalpy. This input is set by the USER if the feedwater model is turned off, otherwise it is calculated. Often it is set to the FWS enthalpy until a sweep volume of hot FW is 'pushed' into the SG by the AFW system. Then, the AFW enthalpy is reduced to CWST enthalpy. This can be accomplished using a CEER command WHEN statement.	Btu/lbm
1787	SGS_SGBD	Partition					RE	100	SG blowdown system variables	Partition
1788	SGBD_CON_IO	Output	SG	SGBD		Solutes	RE		SGBD tank iodine concentration. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Microcurie/lbm
1789	SGBD_CON_PT	Output	SG	SGBD		Solutes	RE		SGBD tank particulates concentration. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Microcurie/lbm

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1790	SGBD_CON_XE	Output	SG	SGBD		Solutes	RE		SGBD tank xenon concentration. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Microcurie/lbm
1791	SGBD_DVDH	Output	SG	SGBD		T/H State	RE		SGBD tank partial sp. vol with enthalpy. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Composite Units
1792	SGBD_DVDP	Output	SG	SGBD		T/H State	RE		SGBD tank partial sp. vol. with pressure. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Composite Units
1793	SGBD_H	Output	SG	SGBD		T/H State	RE		SGBD tank specific enthalpy. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Btu/lbm
1794	SGBD_HF	Output	SG	SGBD		T/H State	RE		SGBD tank saturated liquid enthalpy. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Btu/lbm
1795	SGBD_HG	Output	SG	SGBD		T/H State	RE		SGBD tank saturated steam enthalpy. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Btu/lbm
1796	SGBD_L	Output	SG	SGBD		T/H State	RE		SGBD tank water level. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Feet
1797	SGBD_M	Output	SG	SGBD		T/H State	RE		SGBD tank total mass. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Lbm
1798	SGBD_ML	Output	SG	SGBD		T/H State	RE		SGBD tank liquid mass. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Lbm
1799	SGBD_P	Output	SG	SGBD		T/H State	RE		SGBD tank pressure. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Psia
1800	SGBD_SV	Output	SG	SGBD		T/H State	RE		SGBD tank specific volume. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Ft^3/lbm
1801	SGBD_SVF	Output	SG	SGBD		T/H State	RE		SGBD tank sat. liquid specific volume. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Ft^3/lbm
1802	SGBD_SVG	Output	SG	SGBD		T/H State	RE		SGBD tank sat. steam specific volume. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Ft^3/lbm
1803	SGBD_T	Output	SG	SGBD		T/H State	RE		SGBD tank fluid temperature. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Degree F
1804	SGBD_TWALL	Output	SG	SGBD		T/H State	RE		SGBD tank wall metal temperature. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Degree F

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1805	SGBD_X	Output	SG	SGBD		T/H State	RE		SGBD tank quality. This output is used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Fraction
1806	SGBD_SG_POS	Partition				Hardware State	RE	8	SG blowdown line valves.	Partition
1807	SGBD_SURF_POS	Input	SG	SGBD		Hardware State	RE	4	Surface blowdown lines valve positions. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Fraction
1808	SGBD_BOT_POS	Input	SG	SGBD		Hardware State	RE	4	Bottom blowdown lines valve positions. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Fraction
1809	SGBD_SG_FLOW	Partition				T/H State	RE	8	SG blowdown line flow rates	Partition
1810	SGBD_SURF_FLOW	I/O	SG	SGBD		T/H State	RE	4	Surface blowdown line flow rates. This is normally an output, but with the SGBD system model deactivated, the USER may set blowdown flow rates with this variable as an input.	Lbm/sec
1811	SGBD_BOT_FLOW	I/O	SG	SGBD		T/H State	RE	4	Bottom blowdown line flow rates. This is normally an output, but with the SGBD system model deactivated, the USER may set blowdown flow rates with this variable as an input.	Lbm/sec
1812	SGBD_SG_ENTH	Partition				T/H State	RE	8	SG blowdown line flow enthalpies	Partition
1813	SGBD_SURF_ENTH	I/O	SG	SGBD		T/H State	RE	4	Surface blowdown line flow enthalpies. This is normally an output, but with the SGBD system model deactivated, if the USER inputs the blowdown flow rates, then this variable is also input for the flow enthalpy.	Btu/lbm
1814	SGBD_BOT_ENTH	I/O	SG	SGBD		T/H State	RE	4	Bottom blowdown line flow enthalpies. This is normally an output, but with the SGBD system model deactivated, if the USER inputs the blowdown flow rates, then this variable is also input for the flow enthalpy.	Btu/lbm
1815	SGBD_SG_IO	Partition	SG	SGBD		Solutes	RE	8	SG blowdown line flow iodine concs	Partition
1816	SGBD_SURF_IO	Output	SG	SGBD		Solutes	RE	4	Surface blowdown line flow iodine concentrations	Microcurie/lbm
1817	SGBD_BOT_IO	Output	SG	SGBD		Solutes	RE	4	Bottom blowdown line flow iodine concentrations	Microcurie/lbm
1818	SGBD_SG_PT	Partition	SG	SGBD		Solutes	RE	8	SG blowdown line flow partic concentrations	Partition
1819	SGBD_SURF_PT	Output	SG	SGBD		Solutes	RE	4	Surface blowdown line flow partic concentrations	Microcurie/lbm
1820	SGBD_BOT_PT	Output	SG	SGBD		Solutes	RE	4	Bottom blowdown line flow partic concentrations	Microcurie/lbm
1821	SGBD_SG_XE	Partition	SG	SGBD		Solutes	RE	8	SG blowdown line flow xenon concentrations	Partition
1822	SGBD_SURF_XE	Output	SG	SGBD		Solutes	RE	4	Surface blowdown line flow xenon concentrations	Microcurie/lbm
1823	SGBD_BOT_XE	Output	SG	SGBD		Solutes	RE	4	Bottom blowdown line flow xenon concentrations	Microcurie/lbm
1824	SGBD_SINK_POS	Partition	SG	SGBD		Hardware State	RE	3	SGBD tank discharge line valves	Partition
1825	SGBD_OUT_POS	Input	SG	SGBD		Hardware State	RE	2	SGBD tank outlet lines valve positions. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Fraction
1826	SGBD_RELIEF_POS	Input	SG	SGBD		Hardware State	RE		SGBD tank relief line valve position. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1827	SGBD_SINK_FLOW	Partition				T/H State	RE	3	SGBD tank discharge line flow rates	Partition
1828	SGBD_OUT_FLOW	Output	SG	SGBD		T/H State	RE	2	SGBD tank outlet lines flow rates. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Lbm/sec
1829	SGBD_RELIEF_FLOW	Output	SG	SGBD		T/H State	RE		SGBD tank relief line flow rate. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Lbm/sec
1830	SGBD_SINK_ENTH	Partition				T/H State	RE	3	SGBD tank discharge line flow enthalpies	Partition
1831	SGBD_OUT_ENTH	Output	SG	SGBD		T/H State	RE	2	SGBD tank outlet lines flow enthalpies. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Btu/lbm
1832	SGBD_RELIEF_ENTH	Output	SG	SGBD		T/H State	RE		SGBD tank relief line flow enthalpy. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Btu/lbm
1833	SGBD_SINK_IO	Output	SG	SGBD		Solutes	RE	3	SGBD tank discharge line flow iodine concentrations	Partition
1834	SGBD_OUT_IO	Output	SG	SGBD		Solutes	RE	2	SGBD tank outlet lines flow iodine concentrations	Microcurie/lbm
1835	SGBD_RELIEF_IO	Output	SG	SGBD		Solutes	RE		SGBD tank relief line flow iodine concentration	Microcurie/lbm
1836	SGBD_SINK_PT	Output	SG	SGBD		Solutes	RE	3	SGBD tank discharge line flow partic concentrations	Partition
1837	SGBD_OUT_PT	Output	SG	SGBD		Solutes	RE	2	SGBD tank outlet lines flow partic concentrations	Microcurie/lbm
1838	SGBD_RELIEF_PT	Output	SG	SGBD		Solutes	RE		SGBD tank relief line flow partic concentrations	Microcurie/lbm
1839	SGBD_SINK_XE	Output	SG	SGBD		Solutes	RE	3	SGBD tank discharge line flow xenon concentrations	Partition
1840	SGBD_OUT_XE	Output	SG	SGBD		Solutes	RE	2	SGBD tank outlet lines flow xenon concentrations	Microcurie/lbm
1841	SGBD_RELIEF_XE	Output	SG	SGBD		Solutes	RE		SGBD tank relief line flow xenon concentration	Microcurie/lbm
1842	SGBD_SINK_P	Partition				T/H State	RE	3	SGBD tank disch. line dwnstrm pressures	Partition
1843	SGBD_OUT_P	Input	SG	SGBD		T/H State	RE	2	SGBD tank outlet lines downstream pressures. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Psia
1844	SGBD_RELIEF_P	Input	SG	SGBD		T/H State	RE		SGBD tank relief line downstream pressure. Used IFF all the blowdown system inputs have appropriate values and the blowdown system is activated by setting MOD_OFF_SGBD =. F.	Psia
1845	MOD_OFF_SGBD	Input	SG	SGBD		Model Design	LO		Turns off SGBD model, when set to True.	True False
1846	SGS_TUNE	Partition					RE	50	SG adjustable constants	Partition
1847	CONT_SG_TEMP	Input	SG				RE	4	Containment temperature at SGS. This input parameter provides the same function as a SG boundary condition as does CONT_TEMP(I) for the RCS nodes.	Degree F
1849	P_CONDENSER	Input	MSL				RE		Condenser pressure. This input parameter is normally set to a typical low sub-atmospheric value. It is normally not of major importance for safety analysis, but would be of interest during cooldowns of the SG to pressures/temperatures below atmospheric conditions.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1850	SGS_ASEP_TUNE	Input	SG				RE		SGS steam separator area tuning factor. This is one of the major tuning factors used during initial setup of a plant basedeck to referenced conditions. This parameter effects the bubble rise velocity or steam separation rate, which in turn, dictates the fluid density in the evaporator, and to a lesser extent, the SG recirculation ratio. Often, at the completion of the tuning, ASEP_SG is adjusted so that ASEP_SG_TUNE can be set to a value of 1.0.	Dimensionless
1852	SGS_FK3_TUNE	Input	SG				RE		SGS downcomer flow coeff. tuning factor. This is one of the major tuning factors used during initial setup of a plant basedeck to referenced conditions. This parameter effects the SG recirculation ratio, and to a lesser extent, the fluid density in the evaporator. Often, at the completion of the tuning, ASEP_SG is adjusted so that ASEP_SG_TUNE can be set to a value of 1.0.	Dimensionless
1855	SGS_HASUB_OPTION	Input	SG				LO		Option for calculating subcooled region in the SG evaporator. Used always. This is a Logical flag to activate/disable the subcooled layer model in the steam generator heat transfer calculation. This flag should be True in all realistic calculations, to activate the model, independently of plant design.	True False
1856	SGS_PCNVRG	Input	SG				RE		Pressure convergence criterion. Used always. These is a convergence criterion for the iterative steam generator pressure search. This parameter is numerical in nature, independent of plant design.	Psia
1857	SGS_PMIN	Input	SG				RE		Minimum secondary-side pressure. Used always. This is the minimum pressure allowed in the steam generator, for model integrity. This parameter is independent of plant design.	Psia
1858	SGS_RECIRC_DELVOL	Input	SG				RE		Delta volume for adjusting recirc flow. Used always, in conjunction with SGS_RECIRC_MIN. CENTS uses these two parameters to dynamically calculate the steam generator recirculation ratio (RCR = SGS_W23 / FWS_FLOW100) as a function of the coolant volume in the evaporator. CENTS calculates a volume defect, which is the difference between the current evaporator coolant volume and the maximum volume to reach the can deck. If the volume defect is less than SGS_RECIRC_DELVOL, then RCR is calculated as a function of the volume defect. If the volume defect exceeds SGS_RECIRC_DELVOL, then a minimum RCR is imposed, RCR = SGS_RECIRC_MIN. (The coolant level may be lower: if the volume defect exceeds 2 * SGS_RECIRC_DELVOL, then RCR = 0.5 * SGS_RECIRC_MIN, and if the volume defect exceeds 4 * SGS_RECIRC_DELVOL, then RCR = 0.0.). SGS_RECIRC_DELVOL is dependent on plant design, within its definition in the RCR model. If sufficient dynamic data is available, then SGS_RECIRC_DELVOL may be determined by tuning it along with the other steam generator model tuning factors. Otherwise, typical values are used, ranging from 120 to 200 ft3. SGS_RECIRC_MIN is a numerical minimum, independent of plant design.	Ft^3

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1859	SGS_RECIRC_MIN	Input	SG				RE		Minimum recirculation for crossflow. Used always, in conjunction with SGS_RECIRC_DELVOL. CENTS uses these two parameters to dynamically calculate the steam generator recirculation ratio (RCR = SGS_W23 / FWS_FLOW100) as a function of the coolant volume in the evaporator. CENTS calculates a volume defect, which is the difference between the current evaporator coolant volume and the maximum volume to reach the can deck. If the volume defect is less than SGS_RECIRC_DELVOL, then RCR is calculated as a function of the volume defect. If the volume defect exceeds SGS_RECIRC_DELVOL, then a minimum RCR is imposed, RCR = SGS_RECIRC_MIN. (The coolant level may be lower: if the volume defect exceeds 2 * SGS_RECIRC_DELVOL, then RCR = 0.5 * SGS_RECIRC_MIN, and if the volume defect exceeds 4 * SGS_RECIRC_DELVOL, then RCR = 0.0.). SGS_RECIRC_DELVOL is dependent on plant design, within its definition in the RCR model. If sufficient dynamic data is available, then SGS_RECIRC_DELVOL may be determined by tuning it along with the other steam generator model tuning factors. Otherwise, typical values are used, ranging from 120 to 200 ft3. SGS_RECIRC_MIN is a numerical minimum, independent of plant design.	Dimensionless
1861	SGS_TAURC1_TUNE	Input	SG				RE		SG recirculation flow time constant tuning factor. Used in conjunction with TAURC1. Used always. CENTS applies a time constant to the SG recirculation flow (SGS_W23). TAURC1 is the time constant, and SGS_TAURC1_TUNE is a multiplying tuning factor on that time constant. The time constant formed by the product TAURC1 * SGS_TAURC1_TUNE is dependent on plant data, within the definition of the overall model. Its best value is usually determined by tuning. This is usually done by comparing the SG downcomer level trace immediately following scram against available plant data, and tuning this and other parameter until a good match is obtained. (The SGS model has more tuning factors that affect the circulation and recirculation flows than is necessary. Therefore, the usual practice is to tune SGS_TAURC1_TUNE and SGS_FK3_TUNE together, and SGS_TAURC2_MAX to a lesser extent.)	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1862	SGS_TAURC2_MAX	Input	SG				RE		SG downcomer flow, maximum time constant. Used always. This is an upper limit on the lag time constant that is applied to the SG circulation flow (SGS_W32). This time constant is weakly dependent on plant data, within the definition of the overall model. That is, its typical value is between 0.5 and 5.0, and a best value is usually determined by tuning. This is usually done by comparing the SG downcomer level trace immediately following scram against available plant data, and tuning this and other parameter until a good match is obtained. Note, however, that the SGS model has more tuning factors that affect the circulation flow than is necessary, and the other parameters have a considerably more pronounced effect than SGS_TAURC2_MAX. Therefore, the usual practice is to select a mid-range value (2.0 to 3.0) and tune the other parameters (SGS_TAURC1_TUNE and SGS_FK3_TUNE).	Seconds
1864	SGS_UADROP_PERIM	Input	SG				RE		Perimeter of the feedring. Note that this input parameter is the perimeter of the feedring around the SG, not the feedring pipe cross sectional perimeter dimension.	Feet
1865	SGS_UADROP_WFDMIN	Input	SG				RE		Minimum feedflow below which condensation efficiency = 1. Used when the SG downcomer water height is below the main feedwater nozzle. This parameter is used to determine an efficiency of condensation of steam on the incoming cold feedwater, as the water falls through the steam space. The parameter is the minimum feedwater flowrate, above which a condensation efficiency is calculated as a function of the feed flow rate and steam region height. Below this feed flow rate, the condensation efficiency is 1.0 (i.e., any feed water that is injected into the steam space condenses enough steam to become saturated by the time it reaches the water below). This is a model parameter that is independent of plant design. The value that is typically used was determined from engineering judgment to be between 0 and 100 lbm/sec, and its effect on transient results is minimal within that range.	Lbm/sec
1866	SGS_USTM_MIN	Input	SG				RE		Minimum steam separation velocity. Used always. This is a minimum steam separation velocity imposed on the Wilson correlation. The appropriate value for this parameter is dependent on the plant design, and is determined by tuning the model to available plant data for shrink and swell in low power conditions. The value that is typically used was determined from engineering judgment and from experience in tuning the model to be between 0.05 and 0.50 ft/sec.	Ft/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1867	SGS_VCNVRG	Input	SG				RE		Volume convergence criterion. Used always. This is a convergence criterion for the SG pressure search iterative solution. The iteration is converged when the change in SG volume from the last iteration (due to a change in pressure from the last iteration) is less than SGS_VCNVRG * VOLSGS. (VOLSGS is the total physical volume.) SGS_VCNVRG is also used the same way in SGFEED in the iterative solution for feedwater flow as a function of feedline junction pressure. Note, however, that SGFEED is called only if NUM_FWS_PUMPS > 0 . SGS_VCNVRG is strictly a numerical, dimensionless, convergence criterion, and is therefore independent of plant design.	Fraction
1868	SGS_WFMIN	Input	SG				RE		Region 2(evaporator) liquid mass for single-region switch. Used always. This is the minimum liquid mass in the downcomer or the evaporator region that can be accommodated by the SGS model without instability. When downcomer liquid mass is below SGS_WFMIN/2, it is immediately transferred to the evaporator region. When the evaporator region liquid mass is below SGS_WFMIN, the model combines all the regions into one and employs the one-region formulation. When the liquid mass exceeds 2*SGS_WFMIN, the model reverts back to the multi-region formulation. This is a model-switch parameter whose appropriate value depends on the multi-region model's stability in low inventory conditions, and is independent of plant design in the range of typical steam generator sizes.	Lbm
1869	SGS_X2_1	Input	SG				RE		Region 2 (evaporator) quality necessary to re-establish region 1 (steam dome). Used only when steam is introduced into the steam generator after it filled solid with water. When the steam generator goes solid, region 1 (dome steam region) disappears. When steam reappears in the evaporator region, region 1 will be re-established. To prevent this from happening prematurely, possibly resulting in cycling or pressure spikes, CENTS waits until the evaporator region quality exceeds SGS_X2_1. Since it is designed to prevent cycling or pressure spikes, this parameter is numerical in nature. Therefore, it is independent of plant design.	Fraction
1870	SGT_HTCRTC	Input	SG				RE	4	SG cold side heat transfer tuning factor. Used always, in conjunction with SGT_HTCRTH. These are tuning factors that multiply the thermal resistance of the steam generator tubes, on the cold side and the hot side, respectively. That is, the effective heat transfer coefficient on the secondary side is given by: 1 / heff = (1 / hfluid) + R * SGT_HTCRTC, where hfluid is the calculated fluid heat transfer coefficient at the tubes, and R is the thermal resistance of the tubes. These parameters are a tuning tool with which to do final tuning on the SG heat transfer, in order to balance the RCS into steady state. Their final values are then used in all transients. They are dependent on the plant specifics, and on the values of tuning parameters used elsewhere.	Composite Units

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1871	SGT_HTCRTH	Input	SG				RE	4	SG hot side heat transfer tuning factor. Used always, in conjunction with SGT_HTCRTC. These are tuning factors that multiply the thermal resistance of the steam generator tubes, on the hot side and the cold side, respectively. That is, the effective heat transfer coefficient on the secondary side is given by: 1 / heff = (1 / hfluid) + R * SGT_HTCRTH, where hfluid is the calculated fluid heat transfer coefficient at the tubes, and R is the thermal resistance of the tubes. These parameters are a tuning tool with which to do final tuning on the SG heat transfer, in order to balance the RCS into steady state. Their final values are then used in all transients. They are dependent on the plant specifics, and on the values of tuning parameters used elsewhere.	Composite Units
1872	SGT_HTCSCW	Input	SG				RE		Tube heat transfer coefficient in region 2 of the SG, if the tube surface is in contact with liquid or two-phase and the heat transfer is reversed. This is a physical parameter, independent of plant design.	Btu/secft^2 degF
1873	SGT_HTCSTM	Input	SG				RE		Tube heat transfer coefficient in region 2 of the SG, if the tube surface is in steam. This is a physical parameter, independent of plant design.	Btu/secft^2 degF
1874	SGT_Q_MULT	Input	SG	RCS			RE	4	Multiplier on SG tube heat transfer area and primary side flow area. Used always. This is a multiplier on the SG tubes heat transfer area AND on the SG tubes cross-sectional flow area. Thus, this multiplier is the means by which tube plugging is simulated. This multiplier is used to indicate the extent of tube plugging, and is *therefore dependent on the modeled plant's tube-plugging state.* The effect of tube plugging may also be indicated by reducing ATUBES_MAX_HT (total heat transfer area). However, this misses the effect on the primary side's Reynolds number and heat transfer coefficient.	Dimensionless
1875	MSLH_DPMIN_MULT	Input	MSL				RE		Minimum delta-P for the lagged portion of the steamline flow coefficient. It is stated as a fraction of SLI_DP100 and SLO_DP100, for the steamline upstream and downstream of the MSIV, respectively. Used always, having an effect in low steamline steam flow situations. The steamline model linearizes its equations by restating SQRT(delta-P) as (delta-P) / SQRT(delta-P), where the numerator is current and the denominator is lagged (evaluated at the previous time step). In order to eliminate the uncertainty associated with having a small delta-P in the denominator, the denominator is subjected to a minimum, given by MSLH_DPMIN_MULT * SLI_DP100 (or * SLO_DP100), where SLx_DP100 is the full-flow delta-P in the given line section. MSLH_DPMIN_MULT is a multiplier that is not strictly plant design dependent. However, successful practice has shown that its value should be such that MSLH_DPMIN_MULT * SLx_DP100 yields 7-10 psi (and SLx_DP100 are plant-design dependent).	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1876	SGS_VF_REF	Input	SG				RE		Liquid specific volume for level instrument calibration. In the basedeck, this input parameter is normally set for a hot zero power pressure/temperature state. However, for safety analysis it may be appropriate for the USER to set the parameter to the liquid specific volume for the transient initial conditions. Since level indicator uncertainties are normally accounted for in the trip setpoints, starting the transient with no decalibration in effect may be appropriate.	Ft^3/lbm
1877	SGS_VG_REF	Input	SG				RE		Steam specific volume for level instrument calibration. In the basedeck, this input parameter is normally set for a hot zero power pressure/temperature state. However, for safety analysis it may be appropriate for the USER to set the parameter to the steam specific volume for the transient initial conditions. Since level indicator uncertainties are normally accounted for in the trip setpoints, starting the transient with no decalibration in effect may be appropriate.	Ft^3/lbm
1878	SGS_VLEG_REF	Input	SG				RE		Reference leg specific volume for level instrument calibration. This input parameter is normally set for a "nominal" containment temperature, often 120F.	Ft^3/lbm
1881	SGS_CRIT_MODEL	Input	SG				IN		Liq/2-phase choked flow model: 0=HEM, 1=HF. Used always. This user-supplied flag selects the critical flow correlation to be used for the break flow at a feedwater line break: 0 for HEM, 1 for Henry-Fauske. This is a user model selection, independent of plant design.	Pointer
1882	SGS_MORE_VARIABLES	Partition					RE	120	SGS misc additional variables	Partition
1883	SGS_INITIAL_CONDITIONS	Partition					RE	15	SGS initial conditions	Partition
1884	SPINIT	I/O	SG			Initialization	RE		Initial steam generator pressure. This is the USER specified input for the SG dome pressure which CENTS uses during initialization. It is used as input only if SGS_INIT_OPTION = 0.0, in which case CENTS adjusts the effective SG tube heat transfer area to obtain the desired SG pressure SPINIT. If SGS_INIT_OPTION = 1, then CENTS calculates SPINIT as the appropriate SG dome pressure from known input parameters, including tube heat transfer area.	Psia
1885	SLINIT	Input	SG			Initialization	RE		Initial SG secondary side mixture level. This is a USER specified input for SG downcomer level, as measured from the top of the tube sheet. CENTS uses this parameter during code initialization as a needed input in the determination of SG secondary masses and other T/H conditions.	Feet
1886	FHINIT	Output	FW	SG		Initialization	RE		Initial feed water enthalpy. This output parameter indicates the FW enthalpy at time of initialization. The USER defined input which dictates this value is CTL_FWS_H(I:2).	Btu/lbm
1888	SGS_TUBE_AREA_DEGRAD	Partition					RE	10	Secondary tube area degradation model	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1889	SGS_TUBE_AREA_OPTION	Input	SG				LO		Option flag to degrade SG secondary side tube heat transfer, as a "CESEC compatibility model". Used in conjunction with SGS_MASS_FULL_TUBE_AREA and SGS_MASS_ZERO_TUBE_AREA. This flag is always tested. *Normally (this flag is False), the model calculates the degradation of* heat transfer as a function of the void fraction in the SG evaporator. However, if this flag is True, then an alternate, CESEC compatibility model computes the degradation as a function of the total liquid mass in the steam generator, as follows. When the total mass is < SGS_MASS_ZERO_TUBE_AREA, then the heat transfer is completely degraded (zero). When the total mass is > SGS_MASS_FULL_TUBE_AREA, there is no degradation. When the total mass is between these two masses, the degradation is *linearly interpolated. This model should not be used in realistic* calculations, but only when it is required to match the CESEC methodology. Therefore, SGS_TUBE_AREA_OPTION should be False in the basedeck, independently of plant design. If it is True, then the two mass parameters are dependent on the SG design - but in reality they are assigned the values used in CESEC. Reference 1, Appendix E.	True False
1890	SGS_MASS_FULL_TUBE_AREA	Input	SG				RE	4	Minimum mass for full SG secondary-side tube heat transfer. Used in conjunction SGS_MASS_ZERO_TUBE_AREA, but only if the flag SGS_TUBE_AREA_OPTION is True. In that case, a "CESEC compatibility" model computes the degradation of SG heat transfer as a function of the total liquid mass in the steam generator, as follows. When the total mass is < SGS_MASS_ZERO_TUBE_AREA, then the heat transfer is completely degraded (zero). When the total mass is > SGS_MASS_FULL_TUBE_AREA, there is no degradation. When the total mass is between these two masses, the degradation is linearly interpolated. This model should not be used in realistic calculations, but only when it is required to match the CESEC methodology. Therefore, SGS_TUBE_AREA_OPTION should be False in the basedeck, independently of plant design. If it is True, then the two mass parameters are dependent on the SG design - but in reality they are assigned the values used in CESEC. Reference 1, Appendix E.	Lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1891	SGS_MASS_ZERO_TUBE_AREA	Input	SG				RE	4	Mass for zero SG secondary-side tube heat transfer. Used in conjunction SGS_MASS_FULL_TUBE_AREA, but only if the flag SGS_TUBE_AREA_OPTION is True. In that case, a "CESEC compatibility" model computes the degradation of SG heat transfer as a function of the total liquid mass in the steam generator, as follows. When the total mass is < SGS_MASS_ZERO_TUBE_AREA, then the heat transfer is completely degraded (zero). When the total mass is > SGS_MASS_FULL_TUBE_AREA, there is no degradation. When the total mass is between these two masses, the degradation is linearly interpolated. This model should not be used in realistic calculations, but only when it is required to match the CESEC methodology. Therefore, SGS_TUBE_AREA_OPTION should be False in the basedeck, independently of plant design. If it is True, then the two mass parameters are dependent on the SG design - but in reality they are assigned the values used in CESEC. Reference 1, Appendix E.	Lbm
1892	FWS_ENTH_TABLE	Partition					RE	50	Table of main feedwater enthalpy vs load	Partition
1893	FWS_HTABLE_ENTH	Input	SG	FW			RE	20	Table: MFW norm enthalpy, (h-H1)/(H2-H1), where H1 & H2 refer to CTL_FWS_H(1,2). Used for NUM_FWS_PUMPS=0 only. Reference 1, Section 6.7.3.	Dimensionless
1894	FWS_HTABLE_LOAD	Input	SG	FW			RE	20	Table: turbine normalized load, W/Wrated. Used in conjunction with FWS_HTABLE_ENTH. Used for NUM_FWS_PUMPS=0 only. Reference 1, Section 6.7.3.	Dimensionless
1895	FWS_HTABLE_NUM	Input	SG	FW			IN		Table: number of entries for the FW enthalpy vs. load table. Used for NUM_FWS_PUMPS=0 only. Reference 1, Section 6.7.3.	Counts
1905	MSLH2_STATE	Partition	MSLH				RE	40	Steamline Header, node 2, state output variables.	Partition
1906	MSLH2_CON_IO	Output	MSLH			Solutes	RE		Steamline Header, node 2, iodine concentration. Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1907	MSLH2_CON_PT	Output	MSLH			Solutes	RE		Steamline Header, node 2, particulates concentration. Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1908	MSLH2_CON_XE	Output	MSLH			Solutes	RE		Steamline Header, node 2, xenon concentration. Reference 1, Sections 5.6 and 7.3.3.	Microcurie/lbm
1909	MSLH2_DVDH	Output	MSLH			T/H State	RE		Steamline Header, node 2, partial derivative of specific volume wrt enthalpy. Reference 1, Sections 5.6 and 7.3.3.	Composite Units
1910	MSLH2_DVDP	Output	MSLH			T/H State	RE		Steamline Header, node 2, partial derivative of specific volume wrt pressure. Reference 1, Sections 5.6 and 7.3.3.	Composite Units
1911	MSLH2_H	Output	MSLH			T/H State	RE		Steamline Header, node 2, enthalpy. Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1912	MSLH2_HF	Output	MSLH			T/H State	RE		Steamline Header, node 2, saturated liquid enthalpy. Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1913	MSLH2_HG	Output	MSLH			T/H State	RE		Steamline Header, node 2, saturated steam enthalpy. Reference 1, Sections 5.6 and 7.3.3.	Btu/lbm
1914	MSLH2_M	Output	MSLH			T/H State	RE		Steamline Header, node 2, mass. Reference 1, Sections 5.6 and 7.3.3.	Lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1915	MSLH2_ML	Output	MSLH			T/H State	RE		Steamline Header, node 2, liquid mass. Reference 1, Sections 5.6 and 7.3.3.	Lbm
1916	MSLH2_P	Output	MSLH			T/H State	RE		Steamline Header, node 2, pressure. Reference 1, Sections 5.6 and 7.3.3.	Psia
1917	MSLH2_Q	Output	MSLH			T/H State	RE		Steamline Header, node 2, coolant-to-wall heat rate. Reference 1, Sections 5.6, 7.3.3 and 7.4.	Btu/sec
1918	MSLH2_Q_ATM	Output	MSLH			T/H State	RE		Steamline Header, node 2, wall-to-atmosphere heat rate. Reference 1, Sections 5.6, 7.3.3 and 7.4.	Btu/sec
1919	MSLH2_SV	Output	MSLH			T/H State	RE		Steamline Header, node 2, specific volume. Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1920	MSLH2_SVF	Output	MSLH			T/H State	RE		Steamline Header, node 2, saturated liquid specific volume. Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1921	MSLH2_SVG	Output	MSLH			T/H State	RE		Steamline Header, node 2, saturated steam specific volume. Reference 1, Sections 5.6 and 7.3.3.	Ft^3/lbm
1922	MSLH2_T	Output	MSLH			T/H State	RE		Steamline Header, node 2, temperature. Reference 1, Sections 5.6 and 7.3.3.	Degree F
1923	MSLH2_TWALL	Output	MSLH			T/H State	RE		Steamline Header, node 2, pipe metal temperature. Reference 1, Sections 5.6 and 7.3.3.	Degree F
1924	MSLH2_X	Output	MSLH			T/H State	RE		Steamline Header, node 2, quality. Reference 1, Sections 5.6 and 7.3.3.	Fraction
1925	CONTROL_COMMON	Segment					RE	5120	Control, protective, and bop systems	Segment
1926	CTL_TIME_STEP	Output	Control			CTL_SETPT	RE		Time step length available to controllers.	Seconds
1927	CTL_CORE_CONTROL	Partition					RE	110	Core control partition	Partition
1928	CTL_CORE_SETPOINTS_FOR_TRIP	Partition					RE	45	Partition for RPS setpoints	Partition
1929	CTL_CORE_HI_POWER_FRAC_TRIP	Input	Control			RPS CTL_SETPT	RE		HI power fraction scram setpoint. Reference 1, Section 6.1.	Fraction
1930	CTL_CORE_HI_POWER_SUR_TRIP	Input	Control			RPS CTL_SETPT	RE		High power SUR scram setpoint. Reference 1, Section 6.1.	Decades/min
1931	CTL_CORE_LOW_PRZR_PRES_TRIP	Input	Control			RPS CTL_SETPT	RE		Low pressurizer pressure scram setpoint. Reference 1, Section 6.1.	Psia
1932	CTL_CORE_HI_PRZR_PRES_TRIP	Input	Control			RPS CTL_SETPT	RE		High pressurizer pressure scram setpoint. Reference 1, Section 6.1.	Psia
1933	CTL_CORE_HI_PRZR_LEVEL_TRIP	Input	Control			RPS CTL_SETPT	RE		High pressurizer level scram setpoint. Reference 1, Section 6.1.	Fraction
1934	CTL_CORE_OVER_TEMP_MRGN_TRIP	Input	Control			RPS CTL_SETPT	RE		Thermal margin setpts for over temp trip. Reference 1, Section 6.1.	Del-degF
1935	CTL_CORE_OVER_POWER_MRGN_TRIP	Input	Control			RPS CTL_SETPT	RE		Thermal margin setpts for over pwr trip. Reference 1, Section 6.1.	Del-degF
1936	CTL_CORE_RCSFLOW_FRAC_TRIP	Input	Control			RPS CTL_SETPT	RE		Low loop flow scram setpoint. Reference 1, Section 6.1.	Fraction
1937	CTL_CORE_SIAS_TRIP	Input	Control			RPS CTL_SETPT	RE		Scram due to SIAS - general purpose setpoint. Reference 1, Section 6.1.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1938	CTL_CORE_LOW_SG_PRES_TRIP	Input	Control			RPS CTL_SETPT	RE		Low SG pressure scram setpoint. Reference 1, Section 6.1.	Psia
1939	CTL_CORE_LOW_SG_LEVEL_TRIP	Input	Control			RPS CTL_SETPT	RE		Low SG level scram setpoint. Reference 1, Section 6.1.	Fraction
1940	CTL_CORE_HI_SG_LEVEL_TRIP	Input	Control			RPS CTL_SETPT	RE		High SG level scram setpoint. Reference 1, Section 6.1.	Fraction
1941	CTL_STEAM_FEED_MISMATCH_TRIP	Input	Control			RPS CTL_SETPT	RE		Steam-feed flow mismatch scram setpoint. Reference 1, Section 6.1.	Lbm/sec
1942	CTL_CORE_TURB_TRIP_DELAY	Input	Control			RPS CTL_SETPT	RE		Scram due to turb trip: time delay. Reference 1, Section 6.1.	Seconds
1943	CTL_CORE_HI_CONT_PRES_TRIP	Input	Control			RPS CTL_SETPT	RE		High containment pressure scram setpoint. Reference 1, Section 6.1.	Psia
1944	CTL_CORE_USER_DEFINED_TRIP	Input	Control			RPS CTL_SETPT	RE	10	Space for other scram setpoints. Reference 1, Section 6.1.	Undefined
1945	CTL_RCP_FLOW_STPOINT	Output	Control			RPS CTL_SETPT	RE	5	Low primary flow scram setpoints. These are calculated setpoints: for each RCP, this is CTL_CORE_RCSFLOW_FRAC_TRIP * rated volumetric flow * rated density. The last value in this array (at NUM_PUMPS+1) is the sum of the RCPs' flow setpoints. Reference 1, Section 6.1.	Lbm/sec
1946	CTL_CORE_HI_POWER_SUR_BYPS	Input	Control			RPS CTL_SETPT	RE	2	Hi power SUR scram-inhibit setpoints. Reference 1, Section 6.1.	Fraction
1947	CTL_CORE_POWER_RATIO	Output	Control			RPS CTL_SETPT	RE		Logarithmic rate of power change. Independent of plant design. Reference 1, Section 6.1.	Dimensionless
1948	CTL_STEAM_FEED_MISMATCH_BYPS	Input	Control			RPS CTL_SETPT	RE		Scram on flow mismatch: inhibit setpoint. Reference 1, Section 6.1.	Fraction
1949	CTL_CORE_TURB_TRIP_BYPS	Input	Control			RPS CTL_SETPT	RE		Scram on turbine trip: inhibit setpoint. Reference 1, Section 6.1.	Lbm/sec
1950	CTL_CORE_USER_DEFINED_BYPS	Input	Control			RPS CTL_SETPT	RE	10	Space for other scram inhibit setpoints. Reference 1, Section 6.1.	Undefined
1951	CTL_CORE_TRIP_OR	Partition					RE	25	Partition for scram overrides	Partition
1952	CTL_CORE_HI_POWER_FRAC_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Hi power fraction scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal
1953	CTL_CORE_HI_POWER_SUR_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		High power SUR scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal
1954	CTL_CORE_LOW_PRZR_PRES_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Low pressurizer pressure scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal
1955	CTL_CORE_HI_PRZR_PRES_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		High pressurizer pressure scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1956	CTL_CORE_HI_PRZR_LEVEL_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		High pressurizer level scram overrides. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal
1957	CTL_CORE_OVER_TEMP_MRGN_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Over-temp thermal margin scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Reference 1, Section 6.1.	Override Normal
1958	CTL_CORE_OVER_POWER_MRGN_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Over-power thermal margin scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1959	CTL_CORE_RCSFLOW_FRAC_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Low loop flow scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1960	CTL_CORE_SIAS_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Scram due to SIAS override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1961	CTL_CORE_LOW_SG_PRES_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Low SG pressure scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1962	CTL_CORE_LOW_SG_LEVEL_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Low SG level scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1963	CTL_CORE_HI_SG_LEVEL_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		High SG level scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1964	CTL_STEAM_FEED_MISMATCH_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Steam-feed flow mismatch scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1965	CTL_CORE_TURB_TRIP_DELAY_OR	Input	Control			RPS CTL_SETPT	RE		Scram due to turb trip: override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1966	CTL_CORE_HI_CONT_PRES_TRIP_OR	Input	Control			RPS CTL_SETPT	RE		Hi cont. pressure scram override. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1967	CTL_CORE_USER_DEFINED_TRIP_OR	Input	Control			RPS CTL_SETPT	RE	10	Space for other scram overrides. 0=Normal; 1=Override. User determines based on trips desired to be active. Independent of plant design. Reference 1, Section 6.1.	Override Normal
1968	CTL_TIME_CORE_TRIP	Output	Control			RPS CTL_SETPT	RE		Time elapsed after scram. Always used. Independent of plant design.	Seconds
1969	CTL_CORE_POWER	Output	Control			RPS CTL_SETPT	RE		Core power. Always used. Independent of plant design.	Btu/sec
1970	CTL_QCORE_TRIP	Output	Control			RPS CTL_SETPT	RE		Core power at time of trip. Always used. Independent of plant design.	Btu/sec
1971	CTL_CORE_POWER_FRACTION	Output	Control			RPS CTL_SETPT	RE		Core power, fraction of rated. Always used. Independent of plant design.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
1972	CTL_CORE_POWER_FRAC_LAST	Output	Control			RPS CTL_SETPT	RE		Core power fraction, at last time step. Always used. Independent of plant design.	Fraction
1973	CTL_NUM_RPS	Input	Control			RPS CTL_SETPT	IN		Number of RPS channels. Always used. Independent of plant design. Reference 1, Section 6.1.	Counts
1974	CTL_CORE_CONTROL_AUTO	Input	Control			RPS CTL_SETPT	LO		Flag: automatic control of core. This flag is set by the User. True (Auto) indicates that the RPS controllers are actively set to provide a trip, if a trip conditions develops. False (Manual) is used to override all RPS trip function controllers. Only a manual trip is available in that case (User sets CTL_CORE_TRIP= T). Always used. Independent of plant design. Reference 1, Section 6.1.	Auto Manual
1975	CTL_CORE_TRIP	I/O	Control			RPS CTL_SETPT	LO		Core tripped flag. This flag is set by the User or by CENTS. To simulate a manual trip the User can set CTL_CORE_TRIP= T via the command file or CENTS can set the flag to True if the RPS controllers indicate a trip condition. Always used. Independent of plant design. Reference 1, Section 6.1.	Trip Normal
1976	CTL_CORE_TRIP_SIG	Output	Control			RPS CTL_SETPT	LO	25	Scram signals. The scram channel that energizes first becomes True in this array. All other scram channels are prevented from becoming True, even if the channel energizing condition exists. Thus, the condition that caused the Scram can be interrogated at a later time. Reference 1, Section 6.1.	Active Inactive
1977	CTL_CORE_PTRIP	Output	Control			RPS CTL_SETPT	LO		Scram signal at last time step.	True False
1978	CTL_CEA_COMMON	Partition					RE	20	Control-element assembly model	Partition
1979	CTL_CEA_SETPOINTS	Partition					RE	6	Setpoints for reactor regulating system	Partition
1980	CTL_CEA_TREF_NO	Input	Control			CEA CTL_SETPT	RE		Reference (avg) primary temp at no load. Reference 1, Section 6.8.	Degree F
1981	CTL_CEA_TREF_FULL	Input	Control			CEA CTL_SETPT	RE		Reference (avg) primary temp, full load. Reference 1, Section 6.8.	Degree F
1982	CTL_CEA_GAIN_EXP	Input	Control			CEA CTL_SETPT	RE		Exponent for nonlinear gain=demand**exp. Used always. In the Control Rod Regulating System of Westinghouse-designed plants, the temperature error logic contains a nonlinear gain term, CTL_TURB_DEMAND**CTL_CEA_GAIN_EXP, where the first factor is the current turbine power demand. The resultant value, CTL_CEA_TURBLD_GAIN, is used by the modeler via the Generic Control System. CTL_CEA_GAIN EXP is dependent on the plant control system design, in many Westinghouse-designed plants. Reference 1, Section 6.8.	Dimensionless
1983	CTL_CEA_TURBLD_GAIN	Output	Control			CEA CTL_SETPT	RE		Nonlinear gain for Control Rod Regulating System of Westinghouse-designed plants. Used calculated. The temperature error logic of the CRRS contains a nonlinear gain term, CTL_TURB_DEMAND**CTL_CEA_GAIN_EXP, where the first factor is the current turbine power demand. The resultant value, CTL_CEA_TURBLD_GAIN, is used by the modeler via the Generic Control System. Reference 1, Section 6.8.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1984	CTL_CEAPOSITION_FRAC	Output	Control			CEA CTL_SETPT	RE		Fractional average rod position. 0.0=fully inserted, 1.0= fully withdrawn. Always used. Independent of plant design.	Fraction
1985	CTL_CEA_LAST_TIME	Output	Control			CEA CTL_SETPT	RE		CEA motion time - the time at which the rods last moved.	Seconds
1986	CTL_CEA_MAX	Input	Control			CEA CTL_SETPT	RE		Maximum CEA withdrawal position.	Steps
1987	CTL_CEA_MIN	Input	Control			CEA CTL_SETPT	RE		Minimum CEA withdrawal position.	Steps
1988	CTL_CEA_POS	Input	Control			CEA CTL_SETPT	RE		CEA withdrawal position. Used always. CTL_CEA_POS is the current position of the "average" control rod, measured in steps with zero at the fully inserted point (bottom). When the Reactor Regulating System is active, CTL_CEA_POS is calculated, based on rod speed signal received from the GCS controller. The power algorithm then determines the rod reactivity based on the current rod position CTL_CEA_POS. This variable is dynamic, independent of plant design.	Steps
1989	CTL_CEA_SPEED	I/O	Control			CEA CTL_SETPT	RE		CEA motion speed and direction. Reference 1, Section 6.8.	Steps/min
1990	CTL_CEA_STEP	Input	Control			CEA CTL_SETPT	RE		Step size of control rod motion. Used always. This parameter is the step size of control rod motion, in inches. This parameter is dependent on plant design. Reference 1, Section 6.8.	Inches
1991	CTL_CEA_AUTO	Input	Control			CEA CTL_SETPT	LO		Flag: Auto/Manual CEA (reactor regulating) control. If Auto, the controller logic drives the regulating rods. Reference 1, Section 6.8.	True False
1992	CTL_CEA_PERFECT	Input	Control			CEA CTL_SETPT	LO		Flag: CEA perfect controller. If True, creates a fictional perfect CEA controller that continually positions the control rods where they will exactly match the other reactivity components, thus ensuring a steady power state. Reference 1, Section 6.8.	True False
1993	CTL_CEA_ACCUM	Output	Control			CEA CTL_SETPT	RE		CEA control accumulated signal. Reference 1, Section 6.8.	Steps
1994	CTL_CEA_SPEED_LAST	Output	Control			CEA CTL_SETPT	RE		CEA speed and direction, last step.	Steps/min
1995	CTL_CVCS_COMMON	Partition					RE	85	Chemical & volume control system	Partition
1996	CTL_PRZR_LEVEL_SETPOINTS	Partition					RE	9	Pressurizer level setpoints	Partition
1997	CTL_PRZR_PLEVEL_TEMP	Input	Control			CVCS CTL_SETPT	RE	2	Pressurizer level-program temperature setpoints. These parameters are dependent on plant design. Normally based upon RCS average temperature. These parameter values allow a variable program pressurizer level at different core power levels. Reference 1, Section 6.2.	Degree F
1998	CTL_PRZR_PLEVEL	Input	Control			CVCS CTL_SETPT	RE	2	Pressurizer level-program level setpoints. These plant dependent setpoints are determined in conjunction with CTL_PRZR_PLEVEL_TEMP. They allow the pressurizer level to vary with power (or average RCS temperature). The units are most often set to a fraction of level span, but that can vary depending on how the level controller are established. Reference 1, Section 6.2.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
1999	CTL_PRZR_LIQ_SPVOL_REF	Input	Control			CVCS CTL_SETPT	RE		Pressurizer instrument reference liquid specific-volume. This plant dependent variable is based on the pressurizer liquid temperature and pressure at the time of the level instrument calibration. Normally it is set to saturated conditions for normal operating pressure, since this is the most likely state during calibration. Reference 1, Section 6.2.	Ft^3/lbm
2000	CTL_PRZR_STM_SPVOL_REF	Input	Control			CVCS CTL_SETPT	RE		Pressurizer instrument reference steam specific-volume. This plant dependent variable is based on the pressurizer steam temperature and pressure at the time of the level instrument calibration. Normally it is set to saturated conditions for normal operating pressure, since this is the most likely state during calibration. Reference 1, Section 6.2.	Ft^3/lbm
2001	CTL_LETDOWN_SETPOINTS	Partition					RE	6	Letdown control setpoints	Partition
2002	CTL_CVCS_LDN_ZSPOINT	Input	Control			CVCS CTL_SETPT	RE	2	Letdown level control setpoints. These plant dependent setpoints are based upon a deviation from the pressurizer program level. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction
2003	CTL_CVCS_LDN_W_GPM	Input	Control			CVCS CTL_SETPT	RE	2	Letdown flow setpoints. These plant dependent setpoints are used in conjunction with CTL_CVCS_LDN_ZSPOINT, based upon a deviation from the pressurizer program level. They set the letdown flow rate based on the calculated pressurizer level error. Reference 1, Section 6.2.	Gal/min
2004	CTL_CHARGING_SETPOINTS	Partition					RE	15	Charging pump control setpoints	Partition
2005	CTL_CVCS_CH1_SPOINT	Input	Control			CVCS CTL_SETPT	RE	2	Charging pump 1 control setpoints. Reference 1, Section 6.2.	Fraction
2006	CTL_CVCS_CH2_SPOINT	Input	Control			CVCS CTL_SETPT	RE	2	Charging pump 2 control setpoints. These plant dependent setpoints are based upon a deviation from the pressurizer program level. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction
2007	CTL_CVCS_CH3_SPOINT	Input	Control			CVCS CTL_SETPT	RE	2	Charging pump 3 control setpoints. These plant dependent setpoints are based upon a deviation from the pressurizer program level. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction
2008	CTL_CVCS_CH4_SPOINT	Input	Control			CVCS CTL_SETPT	RE	2	Charging pump 4 control setpoints. These plant dependent setpoints are based upon a deviation from the pressurizer program level. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2009	CTL_CH_PUMP_W_RATED	Input	Control			CVCS CTL_SETPT	RE	4	Charging pump rated flow. These plant dependent variables are based on pump design. This parameter is established assuming positive displacement charging pumps, though the controllers may be configured for variable flow is that is the pump design. In that case this array may have a different definition. Reference 1, Section 6.2.	Gal/min
2010	CTL_CVCS_CONTROL	Partition				CVCS CTL_SETPT	RE	24	CVCS control variables	Partition
2011	CTL_PRZR_PROG_LEVEL	Output	Control			CVCS CTL_SETPT	RE		Pressurizer programmed level. This is the CENTS controller calculated variable based upon controller design and the setpoint values for CTL_PRZR_PLEVEL_TEMP & CTL_PRZR_PLEVEL. It is the desired steady state pressurizer level for a given average RCS temperature. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction
2012	CTL_PRZR_LEVEL_ERROR	Output	Control			CVCS CTL_SETPT	RE		Pressurizer level error. This is the CENTS controller calculated variable measuring the deviation from CTL_PRZR_PROG_LEVEL. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.2.	Fraction
2013	CTL_PRZR_LEVEL_INST	Output	Control			CVCS CTL_SETPT	RE		Pressurizer instrumentation level reading. This CENTS calculated variable is dependent upon plant design and the transient plant condition. It is calculated based on the tap locations, the time dependent water volume and density (vs. calibration densities), and the pressurizer segment area - height relationship. Reference 1, Section 6.2.	Feet
2014	CTL_T_AVG	Output	Control			CVCS CTL_SETPT	RE		Average primary coolant temperature. Calculated by the controller CTL_T_AVG_CONTROLLER. Reference 2, Table 2.	Degree F
2015	CTL_T_REF	Output	Control			CVCS CTL_SETPT	RE		Demand reference temperature. Calculated by the controller CTL_T_REF_CONTROLLER. Reference 2, Table 2.	Degree F
2016	CTL_CH_PUMP_FRAC	I/O	Control			CVCS CTL_SETPT	RE	4	Charging pump fractional flow. This variable is set by the CENTS controllers if the charging pumps are in automatic or by the code User if the pumps are in manual control. Reference 1, Section 6.2; and Reference 2, Table 2.	Fraction
2017	CTL_CH_PUMP_AUTO	Input	Control			CVCS CTL_SETPT	LO	4	Flags: charging pumps automatic control. This variable array is independent of plant design. The code User may establish which of the charging pumps are operated manually by user input and which pumps operate via the controller system. T = Auto; F = Manual. In manual, the user controls the pumps via CTL_CH_PUMP_FRAC. The results are shown by CTL_CH_FLOW. Reference 1, Section 6.2.	Auto Manual

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2019	CTL_LDN_AUTO	Input	Control			CVCS CTL_SETPT	LO		Flag: letdown automatic control. This variable is independent of plant design. The code User may establish whether letdown is to be operated manually by user input or operate via the controller system. T = Auto; F = Manual. In manual, the User controls the letdown flow fraction via CTL_LDN_FRAC. The results are shown in CTL_LDN_FLOW. Reference 1, Section 6.2.	Auto Manual
2020	CTL_CVCS_RCS_VALVES	Partition					RE	10	CVCS-RCS valve connections	Partition
2021	CTL_CHV_FRAC	Input	Control			CVCS CTL_SETPT	RE	5	Fractional opening of charging valve. This plant independent array is established by the code User and used by CENTS, in conjunction with CTL_CHV_FRAC, to determine where the charging flow enters the RCS. If all lines are of equal size, and the flow is to be evenly split between the loops then the valve opening fractions would be set to equal fractions, totaling 1.0. Reference 1, Section 6.2.	Fraction
2022	CTL_CHV_RAREA	Input	Control			CVCS CTL_SETPT	RE	5	Charging valve relative flow areas. This plant dependent array is used by CENTS in conjunction with CTL_CHV_FRAC to determine where the charging flow enters the RCS. The all lines are of equal size then the array would all be set to 1.0. Reference 1, Section 6.2.	Dimensionless
2023	CTL_CVCS_TH_VARIABLES	Partition					RE	15	CVCS thermal-hydraulic variables	Partition
2024	CTL_HA_REG_HEAT_X	Input	Control			CVCS CTL_SETPT	RE		Regen. heat exchanger overall ht coeff. This plant dependent heat transfer variable is calculated in the basedeck calculations. The equation used is hA = 2*Wch*Cp*(Tchout - Tchin)/(Tldnin + Tldnout - Tchout - Tchin). Reference: Individual Basedeck Calculations. Reference 1, Section 6.2.	Btu/sec-degF
2025	CTL_LDN_FLOW	Output	Control			CVCS CTL_SETPT	RE		Letdown mass flow rate. This is a CENTS calculated output based upon controller operation or User defined input, if in manual control. Reference 1, Section 6.2.	Lbm/sec
2026	CTL_LDN_T	Output	Control			CVCS CTL_SETPT	RE	2	Letdown temperature at RHEX inlet/exit. These two temperatures are CENTS calculated output based upon charging flow, letdown flow and CTL_HA_REG_HEAT_X. Reference 1, Section 6.2.	Degree F
2027	CTL_LDN_H	Output	Control			CVCS CTL_SETPT	RE	2	Letdown enthalpy at RHEX inlet/exit. These two enthalpies are CENTS calculated output based upon CTL_LDN_T and system pressure. Reference 1, Section 6.2.	Btu/lbm
2028	CTL_LETDOWN_FRAC	I/O	Control			CVCS CTL_SETPT	RE	4	Letdown flow fraction. This is a CENTS calculated output based upon controller operation or User defined input, if in manual control. Reference 1, Section 6.2; and Reference 2, Table 2.	Fraction
2029	CTL_CH_FLOW	Output	Control			CVCS CTL_SETPT	RE		Total charging pumps delivery. This is a CENTS calculated output based upon the number of pumps running due to controller operation or User defined input, if in manual control. Note that this is the variable which is printed for charging flow in the standard output. However, this value is only correct if CTL_CHV_RAREA & CTL_CHV_FRAC contain non-zero values. Other charging flow variables are P_FLOW(105:108) or RCS_CHGS_FLOW. Reference 1, Section 6.2.	Lbm/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2030	CTL_CH_T	I/O	Control			CVCS CTL_SETPT	RE	2	Charging temperature at RHEX inlet/exit. CTL_CH_T(1) is the input temperature at the RHEX inlet. CTL_CH_T(2) is calculated by CENTS based upon charging flow, letdown flow and CTL_HA_REG_HEAT_X. Reference 1, Section 6.2.	Degree F
2031	CTL_CH_H	I/O	Control			CVCS CTL_SETPT	RE	2	Charging enthalpy at RHEX inlet/exit. CTL_CH_H1) is the input enthalpy at the RHEX inlet. CTL_CH_H(2) is calculated by CENTS based upon CTL_CH_T(2) and system pressure. Reference 1, Section 6.2.	Btu/lbm
2032	CTL_HEATERS_CONTROL	Partition					RE	18	Heaters control partition	Partition
2033	CTL_PRZR_HEATER_SETPOINTS	Partition					RE	10	Heater control setpoints	Partition
2034	CTL_PRZR_BHLEVEL_SPOINT	Input	Control			HTR CTL_SETPT	RE	2	Pressurizer heaters high-level on/off setpoints. These plant dependent setpoints establish when pressurizer heaters come on and reset due to a high program level error condition. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.3.	Fraction
2035	CTL_LEVEL_HEATER_OFF	Input	Control			HTR CTL_SETPT	RE		Heaters low-level cutoff setpoint. This plant dependent setpoint establishes when pressurizer heaters come on and reset due to a low level condition which could uncover the heaters. The units may be a fraction of span or in feet, inches etc., depending on how the controllers are established. Reference 1, Section 6.3.	Fraction
2036	CTL_PRES_PHEATER_OFF	Input	Control			HTR CTL_SETPT	RE		Proportional heaters high pressure setpoint. This plant dependent pressure setpoint establishes when pressurizer proportional heaters are totally off due to pressure above CTL_PRZR_REF_PRES. Reference 1, Section 6.3.	Psia
2037	CTL_PRES_PHEATER_ON	Input	Control			HTR CTL_SETPT	RE		Proportional heaters low pressure setpoint. This plant dependent pressure setpoint establishes when pressurizer proportional heaters are fully on due to pressure below CTL_PRZR_REF_PRES. Reference 1, Section 6.3.	Psia
2038	CTL_PRES_BHEATER_OFF	Input	Control			HTR CTL_SETPT	RE		Backup heaters high pressure setpoint. This plant dependent pressure setpoint establishes when pressurizer backup heaters are off due to pressure above CTL_PRZR_REF_PRES. Reference 1, Section 6.3.	Psia
2039	CTL_PRES_BHEATER_ON	Input	Control			HTR CTL_SETPT	RE		Backup heaters low pressure setpoint. This plant dependent pressure setpoint establishes when pressurizer backup heaters are on due to pressure above CTL_PRZR_REF_PRES. Reference 1, Section 6.3.	Psia
2040	CTL_PRZR_REF_PRES	Input	Control			HTR CTL_SETPT	RE		Reference pressure for pressurizer pressure control. This plant dependent pressure is the desired steady state reference pressurizer pressure. Heater and spray on/off setpoints are all based upon pressure deviations from this reference. Reference 1, Section 6.3.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2041	CTL_VOLT_PROP	I/O	Control			HTR CTL_SETPT	RE		Proportional heaters voltage. This is the CENTS calculated output which determines the extent to which the proportional heaters are energized. If this voltage is compared to CTL_PRZR_HEATERS_VOLT, then the fraction of full heater output can be determined. CENTS uses this voltage in conjunction with RESI_HEATER to determine the power or heat being generated by the proportional heaters. Reference 1, Section 6.3.	Volts
2042	CTL_VOLT_BACK	I/O	Control			HTR CTL_SETPT	RE		Backup heaters voltage. This is the CENTS calculated output which determines whether the backup heaters are energized. Since backup heaters are either full on or off, this voltage is either zero or equal to CTL_PRZR_HEATERS_VOLT. CENTS uses this voltage in conjunction with RESI_HEATER to determine the power or heat being generated by the backup heaters. Reference 1, Section 6.3.	Volts
2043	CTL_PRZR_HEATERS_VOLT	Input	Control			HTR CTL_SETPT	RE		Pressurizer heaters rated voltage. This plant dependent voltage is used as the reference voltage for fully energized heaters. Heater voltage and resistance are used by CENTS to calculate the heater power or heat input into the system. Reference 1, Section 6.3.	Volts
2044	CTL_HEATERS_CONTROL_AUTO	Input	Control			HTR CTL_SETPT	LO		Flag: automatic ctrl of pressurizer heaters. This is a plant independent, User defined input. In T=Auto, the controller output dictates heater operation. In F=Manual, the User controls heater operation via setting CTL_VOLT_PROP and CTL_VOLT_BACK. The results are shown by bank as HEAT_HEATER or as a total of all heaters in HEAT_PRZR. HEAT_ELEC is the array which indicates the electric heat being generated. Reference 1, Section 6.3.	Auto Manual
2045	CTL_PRZR_SPRAY_CONTROL	Partition					RE	5	Pressurizer main spray controls	Partition
2046	CTL_PRZR_SPRAY_SETPOINTS	Partition					RE	4	Pressurizer spray control setpoints	Partition
2047	CTL_PRZR_SPRAY_PRES_ON	Input	Control			SPRY CTL_SETPT	RE		Pressurizer spray control high-pressure on-setpoint. This plant dependent setpoint is based on a deviation from CTL_PRZR_REF_PRES. It may be used by the controllers as either the setpoint for full open spray valves or as a point where spray valves start to open. The exact definition is based entirely on how the spray controller is designed. Reference 1, Section 6.3.	Psia
2048	CTL_PRZR_SPRAY_PRES_OFF	Input	Control			SPRY CTL_SETPT	RE		Pressurizer spray control low-pressure off-setpoint. This plant dependent setpoint is based on a deviation from CTL_PRZR_REF_PRES. It may be used by the controllers as either the setpoint for fully shutting spray valves. It may also be the setpoint where spray valves start to open. The exact definition is based entirely on how the spray controller is designed. Reference 1, Section 6.3.	Psia
2049	CTL_PRZR_SPRAY_CONTROL_AUTO	Input	Control			SPRY CTL_SETPT	LO		Flag: automatic control of pressurizer spray. This is a plant independent, User defined input. In T=Auto, the controller output dictates pressurizer spray operation. In F=Manual, the User controls spray operation via setting VLV_PRZR_MSPRAY_SIG(J). The results are shown by P_FLOW_SPRAY. Reference 1, Section 6.3.	Auto Manual

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2050	CTL_PRESSURIZER_RELIEF	Partition					RE	26	Pressurizer PORV and SV control variables	Partition
2051	CTL_PRZR_RELIEF_SETPOINTS	Partition					RE	20	Pressurizer relief and safety valve setpoints	Partition
2052	CTL_PORV_PSET	Input	Control			PZR_RELIE F_SETPT	RE	4	PORV opening pressure setpoints. This is the plant dependent setpoint at which the PORVs just begin opening on an increasing pressure scenario. Reference 1, Section 6.3.	Psia
2053	CTL_PSV_PSET_OPEN	Input	Control			PZR_RELIE F_SETPT	RE	4	Pressurizer safeties full-open setpoints. This is the plant dependent setpoint at which the PSVs are fully open on an increasing pressure scenario. This pressure is usually the opening setpoint plus accumulation pressure. Reference 1, Section 6.3.	Psia
2054	CTL_PSV_PSET_CLOSE	Input	Control			PZR_RELIE F_SETPT	RE	4	Pressurizer safeties opening setpoints. This is the plant dependent setpoint at which the PSVs just begin opening on an increasing pressure scenario. Reference 1, Section 6.3.	Psia
2055	CTL_PSV_PSET_BLDN	Input	Control			PZR_RELIE F_SETPT	RE	4	Pressurizer safeties re-closing setpoints. This is the plant dependent setpoint at which the PSVs are fully shut on a decreasing pressure scenario. This pressure is usually the opening pressure minus the amount of the valve blowdown. Reference 1, Section 6.3.	Psia
2056	CTL_PORV_AUTO	Input	Control			PZR_RELIE F_SETPT	LO	4	Flags: automatic control of PORVs. This is a plant independent, User defined input. In T=Auto, the controller output dictates PORV operation. In F=Manual, the User controls PORV operation via setting VLV_PRZR_SIG(J). The results are shown by RCS_P_FLOW_PORV(J). Note that for plant with no PORVs, this variable is always set to F= Manual. Reference 1, Section 6.3.	Auto Manual
2057	CTL_SIS_COMMON	Partition					RE	200	Safety injection system	Partition
2058	CTL_SIAS_SETPOINTS	Partition					RE	8	Safety injection syst setpoints	Partition
2059	CTL_SIAS_PRZR_PRES_LOW	Input	Control			SIS CTL_SETPT	RE		Low pressure setpoint for SIAS. This is the plant dependent pressurizer pressure setpoint which initiates a Safety Injection Actuation Signal. Reference 1, Section 6.5.	Psia
2060	CTL_SIAS_SL_SH_DP	Input	Control			SIS CTL_SETPT	RE		Steamline flow trip setpoint. This plant dependent SIAS trip setpoint is not used by any CE plant. Reference 1, Section 6.5.	Psid
2061	CTL_SIAS_HI_CONT_PRES	Input	Control			SIS CTL_SETPT	RE		High containment press setpoint for SIAS. This is a plant dependent setpoint. Note that CENTS does not model changes in containment pressure, except as they are input by the user, possibly as a RAMP command in CEER. Reference 1, Section 6.5.	Psia
2062	CTL_SIAS_LOW_TAVG	Input	Control			SIS CTL_SETPT	RE		Low temperature setpoint for SIAS. This plant dependent SIAS trip setpoint is not currently used by any CE plant. Reference 1, Section 6.5.	Degree F
2063	CTL_SIAS_LOW_SL_PRES	Input	Control			SIS CTL_SETPT	RE		Low steamline pressure setpoint for SIAS. This plant dependent SIAS trip setpoint is not currently used by any CE plant. Reference 1, Section 6.5.	Psia
2064	CTL_SIS_CONTROL	Partition					RE	150	Safety injection syst control variables	Partition
2065	CTL_HPSI_NPOINTS_TAB	Input	Control			SIS CTL_SETPT	IN		No. of data points in the HPSI flow vs pressure table for each pump. This number is dictated by the number of data points in a given plant's HPSI flow data. Maximum 15. Reference 1, Section 6.5.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2066	CTL_HPSI_FLOW_TABLE	Input	Control			SIS CTL_SETPT	RE	45	Flows for HPSI flow-vs-pressure table. This is the plant dependent array of flow delivery values corresponding to the RCS pressures given in CTL_HPSI_PRES_TABLE. This array supports multiple sets of flow data points (maximum total 45), with CTL_HPSI_NPOINTS_TAB points per set, corresponding to the number of operating HPSI pumps, CTL_HPSI_PUMP_NUM: If 1 pump, then the HPSI delivery is given by the first set of CTL_HPSI_NPOINTS_TAB flow values from this array, versus the pressures from CTL_HPSI_PRES_TABLE. If 2 pumps, then CENTS uses the second set of flow values from this array, versus the same set of back pressures as for 1 pump. However, if this array contains only 1 set of flow values, then CENTS uses this set and multiplies by 2. In general, for N pumps, CENTS uses the N'th set of flow values from this array, versus the same set of back pressures as for 1 pump. However, if this array contains M sets of flow values, where M < N, then CENTS uses the M'th set and multiplies it by N/M. Each set of flow values must be monotonic in a direction that is opposite to that of CTL_HPSI_PRES_TABLE. This array gives the total flow delivered by the HPSI pump(s) to all the injection points. The actual delivery to the RCS is then determined by the array CTL_HPSI_SPLIT. Note that the array of flow values will require adjustment for minimum or maximum HPSI flow, depending upon which set of values has been used in the input. Reference 1, Section 6.5.	Gal/min
2067	CTL_HPSI_PRES_TABLE	Input	Control			SIS CTL_SETPT	RE	15	Back pressure for HPSI flow-vs-pressure table. This is the plant dependent array of injection point pressure values corresponding to the HPSI flows given in CTL_HPSI_FLOW_TABLE. Note that this pressure array is used for each of the flow data sets in CTL_HPSI_FLOW_TABLE, dependent on the number of operable HPSI pumps. The pressures in this array must be monotonically increasing or monotonically decreasing. Reference 1, Section 6.5.	Psia
2068	CTL_HPSI_PUMP_NUM	Input	Control			SIS CTL_SETPT	IN		Number of operating HPSI pumps. This variable is set by the user, for the number of HPSI pumps that are available in the scenario. The number of available pumps determines which set of flow variables is used in CTL_HPSI_FLOW_TABLE. If set to 1, then the first set of flow variables is used; if set to 2, then the second set is used; etc. However, if set higher than the number of flow sets that exist in CTL_HPSI_FLOW_TABLE, then see the discussion for CTL_HPSI_FLOW_TABLE. If set to 0, then the HPSI flow is 0.0. Reference 1, Section 6.5.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2069	CTL_HPSI_SPLIT	Input	Control			SIS CTL_SETPT	RE	8	HPSI flow split to injection points. This array, set by the user, indicates what fraction of the total HPSI flow enters via each of the SI connection to the RCS. Due to different line geometries and losses, the split fractions need not be equal. The total normally equals 1.0, but that is not required. For example, if the total is < 1.0, then the HPSI flow is correspondingly degraded. Reference 1, Section 6.5.	Fraction
2070	CTL_LPSI_NPOINTS_TAB	Input	Control			SIS CTL_SETPT	IN		No. of data points in the LPSI flow vs pressure table for each pump. This number is dictated by the number of data points in a given plant's LPSI flow data. Maximum 15. Reference 1, Section 6.5.	Counts
2071	CTL_LPSI_FLOW_TABLE	Input	Control			SIS CTL_SETPT	RE	45	Flows for LPSI flow-vs-pressure table. This is the plant dependent array of flow delivery values corresponding to the RCS pressures given in CTL_LPSI_PRES_TABLE. This array supports multiple sets of flow data points (maximum total 45), with CTL_LPSI_NPOINTS_TAB points per set, corresponding to the number of operating LPSI pumps, CTL_LPSI_PUMP_NUM: If 1 pump, then the LPSI delivery is given by the first set of CTL_LPSI_NPOINTS_TAB flow values from this array, versus the pressures from CTL_LPSI_PRES_TABLE. If 2 pumps, then CENTS uses the second set of flow values from this array, versus the same set of back pressures as for 1 pump. However, if this array contains only 1 set of flow values, then CENTS uses this set and multiplies by 2. In general, for N pumps, CENTS uses the N'th set of flow values from this array, versus the same set of back pressures as for 1 pump. However, if this array contains M sets of flow values, where M < N, then CENTS uses the M'th set and multiplies it by N/M. Each set of flow values must be monotonic in a direction that is opposite to that of CTL_LPSI_PRES_TABLE. This array gives the total flow delivered by the LPSI pump(s) to all the injection points. The actual delivery to the RCS is then determined by the array CTL_LPSI_SPLIT. Note that the array of flow values will require adjustment for minimum or maximum LPSI flow, depending upon which set of values has been used in the input. Reference 1, Section 6.5.	Gal/min
2072	CTL_LPSI_PRES_TABLE	Input	Control			SIS CTL_SETPT	RE	15	Back pressure for LPSI flow-vs-pressure table. This is the plant dependent array of injection point pressure values corresponding to the LPSI flows given in CTL_LPSI_FLOW_TABLE. Note that this pressure array is used for each of the flow data sets in CTL_LPSI_FLOW_TABLE, dependent on the number of operable LPSI pumps. The pressures in this array must be monotonically increasing or monotonically decreasing. Reference 1, Section 6.5.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2073	CTL_LPSI_PUMP_NUM	Input	Control			SIS CTL_SETPT	IN		Number of operating LPSI pumps. This variable is set by the user, for the number of LPSI pumps that are available in the scenario. The number of available pumps determines which set of flow variables is used in CTL_LPSI_FLOW_TABLE. If set to 1, then the first set of flow variables is used; if set to 2, then the second set is used; etc. However, if set higher than the number of flow sets that exist in CTL_LPSI_FLOW_TABLE, then see the discussion for CTL_LPSI_FLOW_TABLE. If set to 0, then the LPSI flow is 0.0. Reference 1, Section 6.5.	Counts
2074	CTL_LPSI_SPLIT	Input	Control			SIS CTL_SETPT	RE	8	LPSI flow split to injection points. This array, set by the user, indicates what fraction of the total LPSI flow enters via each of the SI connection to the RCS. Due to different line geometries and losses, the split fractions need not be equal. The total normally equals 1.0, but that is not required. For example, if the total is < 1.0, then the LPSI flow is correspondingly degraded. Reference 1, Section 6.5.	Fraction
2075	CTL_SIAS_TIME	Output	Control			SIS CTL_SETPT	RE		Time elapsed since SIAS. This variable is calculated by CENTS.	Seconds
2076	CTL_SIS_DELAY	Input	Control			SIS CTL_SETPT	RE		SI pumps time delay after SIAS. This plant dependent input dictates the delay from time of SIAS until HPSI/LPSI flow is available. After this delay time has elapsed, then the flow is dictated by the pressure-flow tables. Reference 1, Section 6.5.	Seconds
2077	CTL_SIAS_CONTROL_AUTO	Input	Control			SIS CTL_SETPT	LO		Flag: automatic control of SIAS. This is a plant independent, User defined input. In T=Auto, the controller output dictates SIAS operation. In F=Manual, the User controls the SIAS by setting CTL_SIAS_TRIP. Reference 1, Section 6.5.	Auto Manual
2078	CTL_SIAS_TRIP	I/O	Control			SIS CTL_SETPT	LO		Safety injection actuation signal. This is a plant independent variable. This flag is set by the User or by CENTS. To simulate a manual SIAS actuation, the User can set CTL_SIAS_TRIP= T via the command file. With SIAS control in Auto, CENTS can set the flag to True if the SIAS controller indicates a SIAS condition. Always used. Reference 1, Section 6.5; and Reference 2, Table 2.	Active Inactive
2079	CTL_SIAS_PTRIP	Output	Control			SIS CTL_SETPT	LO		SI signal at last time step. This plant independent flag variable is set by CENTS. Always used.	True False
2080	CTL_SIS_FLOW	Partition					RE	36	Safety injection system flow variables	Partition
2081	CTL_SIS_HLPSI_BC	Input	Control			SIS CTL_SETPT	RE		HPSI/LPSI flow boron concentration. This is a plant dependent input variable, set by the user. Often times set to 0.0 until a "sweep volume" of SI flow has entered the RCS. See individual plant basedeck calculation. Reference 1, Section 6.5.	Parts/million
2082	CTL_SIS_HLPSI_H	Input	Control			SIS CTL_SETPT	RE		HPSI/LPSI flow enthalpy. This is a plant dependent input variable, set by the user. Usually set to the enthalpy of the RWST water. Reference 1, Section 6.5.	Btu/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2083	CTL_SIS_SIT_BC	Input	Control			SIS CTL_SETPT	RE		SI tank flow boron concentration. This is a plant dependent input variable, set by the user. Often times set to 0.0 until a "sweep volume" of SI flow has entered the RCS. See individual plant basedeck calculation. Reference 1, Section 6.5.	Parts/million
2084	CTL_SIS_SIT_H	Input	Control			SIS CTL_SETPT	RE		SI tank flow enthalpy. This is a plant dependent input variable, set by the user. Usually set to an enthalpy based upon the temperature of the containment building atmosphere. Reference 1, Section 6.5.	Btu/lbm
2085	CTL_SIT_NUM	Input	Control			SIS CTL_SETPT	IN		Number of SI tanks. This is plant dependent variable based on system physical design.. Reference 1, Section 6.5.	Counts
2086	CTL_SIT_ELEV_PRES	Input	Control			SIS CTL_SETPT	RE	4	SI tank elevation heads. This is a plant dependent array of input variables. It is calculated as dP = (rhosit*hsit +rhoL*hL), where rho's densities and h's are heights of water. See individual plant basedeck calculation. Reference 1, Section 6.5.	Psid
2087	CTL_SIT_FLOW_COEFF	Input	Control			SIS CTL_SETPT	RE	4	SI tank flow coefficients. This is a plant dependent array of input variables. It is calculated as $Cs = 12*A*(2*g/(k*vf))^{0.5}$. See individual plant basedeck calculation. Reference 1, Section 6.5.	Composite Units
2088	CTL_SIT_GAS_CONST	Input	Control			SIS CTL_SETPT	RE		SI tank gas constant. This is a plant dependent input variable based on the gas used in the SI tanks. Normally set to 1.4 for nitrogen. Reference 1, Section 6.5.	Dimensionless
2089	CTL_SIT_GAS_PRES	I/O	Control			SIS CTL_SETPT	RE	4	SI tank gas pressures. This is a plant dependent input variable. It may be set to a minimum or maximum value by the user based upon the transient scenario. Reference 1, Section 6.5.	Psia
2090	CTL_SIT_GAS_VOLUME	I/O	Control			SIS CTL_SETPT	RE	4	SI tank gas volumes. This is a plant dependent input variable. It may be set to a minimum or maximum value by the user based upon the transient scenario. Reference 1, Section 6.5.	Ft^3
2091	CTL_SIT_ISO_VALVE	Input	Control			SIS CTL_SETPT	LO	4	SI tank isolation valves. This is a plant independent array of input variables, set by the User. If set to T= Open, then the SI tanks are available for operation if proper plant conditions exist. If set to F= Closed, then the SI tanks are isolated and will not affect any transient scenarios. Reference 1, Section 6.5.	Open Closed
2092	CTL_SIT_LIQ_SPVOL	Input	Control			SIS CTL_SETPT	RE	4	SI tank liquid specific volumes. This is a plant and scenario dependent array of input variables, based on the temperature and pressure of the fluid in the tanks. Reference 1, Section 6.5.	Ft^3/lbm
2093	CTL_SIT_LIQ_VOLUME	I/O	Control			SIS CTL_SETPT	RE	4	SI tank liquid volumes. This is a plant dependent array of input variables. It is usually set to a minimum or maximum value based upon the requirements of the individual transient scenario. Reference 1, Section 6.5.	Ft^3
2094	CTL_SDC_CONTROL	Partition					RE	6	Shutdown Cooling control variables	Partition
2095	CTL_SDC_DH	Input	Control	SDC		SDC CTL_SETPT	RE		Shutdown Cooling enthalpy drop. When Shutdown cooling is active, it is drawn from the hot leg(s), and returns cooler to the cold legs via the SI lines. The amount of cooling is given by the input CTL_SDC_DH. Reference 1, Section 6.5.	Btu/lbm

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2096	CTL_SDC_H_MIN	Input	Control	SDC		SDC CTL_SETPT	RE		Shutdown Cooling minimum return enthalpy. When Shutdown cooling is active, it is drawn from the hot leg(s), and returns cooler to the cold legs via the SI lines. The minimum return enthalpy is given by the input CTL_SDC_H_MIN. Reference 1, Section 6.5.	Btu/lbm
2097	CTL_SDC_SPLIT	Input	Control	SDC		SDC CTL_SETPT	RE	4	SDC flow split to injection points. When Shutdown cooling is active, it is drawn from the hot leg(s), and returns cooler to the cold legs via the SI lines. The SDC flow set by SDC_RCS_FLOW is returned, via each SI line multiplied by CTL_SDC_SPLIT(). The sum of the splits need not be 1. Reference 1, Section 6.5.	Fraction
2098	CTL_TURB_CONTROL	Partition					RE	14	Turbine controls	Partition
2099	CTL_TURB_SETPOINTS	Partition					RE	7	Turbine control setpoints	Partition
2100	CTL_TURB_TRIP_VALVE_TIME	Input	Control			TURB CTL_SETPT	RE		TAV full-range closing time on turbine trip. This is a plant dependent input variable. It usually represents the shutting time of the Turbine stop valves which are quick shutting valves in a trip condition. CENTS combines the operation of the TSV and TAV into one valve. Note that since the TAV may not be full open at the time of the trip, the closing time may not be equal to CTL_TURB_TRIP_VALVE_TIME, unless the trip controller is designed specifically to account for this. Reference 1, Section 6.6.	Seconds
2101	CTL_TURB_AOUT_TC	Input	Control			TURB CTL_SETPT	RE		Turb admission valve time constant. This is a plant dependent input variable. It represents the time for full open to shut or shut to open operation in a non-trip environment. Reference 1, Section 6.6.	Seconds
2102	CTL_TURB_TRIP_TIME	Output	Control			TURB CTL_SETPT	RE		Time elapsed since turbine trip. This is a plant independent variable calculated by CENTS. Always used.	Seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2103	CTL_TURB_DEMAND	I/O	Control			TURB CTL_SETPT	RE		Turbine steam demand. This is a plant independent variable which represents a steam flow demand to the turbine as a fraction of CTL_TURB_STEAM_RATED. It is established by the CENTS code as an output IFF CTL_TURB_CONTROL_AUTO and CTL_TURB_CONTROL_LOAD are both T=Auto. In that case, CENTS causes turbine load to follow the heat generation rate of the RCS. If CTL_TURB_CONTROL_AUTO = T and CTL_TURB_CONTROL_LOAD = F=Manual, then User must set CTL_TURB_DEMAND to the load fraction required for the power level desired to be maintained. This is the mode of operation most used in the plants, whereby TAV operation adjusts to maintain constant steam flow rate. However, even in this mode, CENTS initializes CTL_TURB_DEMAND during INITIALization, such that the secondary heat load equals the primary heat generation. Therefore, the User should set CTL_TURB_DEMAND immediately after the INITIALization. See CE-CES-0198-P Rev. 004, Section 3.4, for discussion on the proper setting of CTL_TURB_DEMAND for other than full power operation. IFF CTL_TURB_CONTROL_AUTO and CTL_TURB_CONTROL_LOAD are both F=Manual, then the User sets the TAV position via MSLH_VALVE_SIG(J), where J = the TAV in the array of main steam valves. In this last case CTL_TURB_DEMAND is inactive. Reference 1, Section 6.6.	Fraction
2104	CTL_TURB_STEAM_RATED	Input	Control			TURB CTL_SETPT	RE		Rated turbine steam flow. This is a plant dependent input variable. It is set by tuning the basedeck at full power with all the full power RCS initial conditions and FW enthalpy. The resulting steam flow to the turbine is then established as CTL_TURB_STEAM_RATED.	Lbm/sec
2105	CTL_TURB_CONTROL_AUTO	Input	Control			TURB CTL_SETPT	LO		Flag: automatic turbine control. This is a plant independent input variable set by User. In T=Auto, CENTS controllers calculate the TAV position, based upon CTL_TURB_CONTROL_LOAD. See CTL_TURB_DEMAND. Reference 1, Section 6.6.	Auto Manual
2106	CTL_TURB_CONTROL_LOAD	Input	Control			TURB CTL_SETPT	LO		Flag to match st. demand with heat load. This is a plant independent input variable set by User. See CTL_TURB_DEMAND for further discussion. Reference 1, Section 6.6.	Auto Manual
2107	CTL_TURB_TRIP	I/O	Control			TURB CTL_SETPT	LO		Signal: turbine tripped. This is a plant independent variable. This flag is set by the User or by CENTS. To simulate a manual Turbine trip, the User can set CTL_TURB_TRIP= T via the command file. With Turbine trip control in Auto, CENTS can set the flag to True if the turbine trip controller indicates a trip condition. Reference 1, Section 6.6; and Reference 2, Table 2.	Trip Normal

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2108	CTL_TURB_TRIP_AUTO	Input	Control			TURB CTL_SETPT	LO		Flag: automatic trip of turbine. This is a plant independent, User defined input. In T=Auto, the controller output dictates turbine trip condition. In F=Manual, the User controls the turbine trip by setting CTL_TURB_TRIP = T=Trip. Reference 1, Section 6.6.	Auto Manual
2110	CTL_MSIS_CONTROL	Partition					RE	14	Main steam isolation signal controls	Partition
2111	CTL_MSIS_SETPOINTS	Partition					RE	10	MSIS control setpoints	Partition
2112	CTL_MSIS_SG_PRES_TRIP	Input	Control			MSIS CTL_SETPT	RE		Low SG pressure MSIS trip setpoint. This plant dependent input variable is used if CTL_MSIS_CONTROL_AUTO = T=Auto. In this case the CENTS controllers compare SG pressure to the trip setpoint to determine if CTL_MSIS_TRIP = T = Active. Reference 1, Section 6.6.	Psia
2113	CTL_MSIS_CONT_PRES_TRIP	Input	Control			MSIS CTL_SETPT	RE		Containment pressure MSIS trip setpoint. This is a plant dependent setpoint. Note that CENTS does not model changes in containment pressure, except as they are input by the user, possibly via a RAMP. Reference 1, Section 6.6.	Psia
2114	CTL_MSIS_SG_SLFLOW_TRIP	Input	Control			MSIS CTL_SETPT	RE	4	High steamline flow MSIS trip setpoint. This array of setpoints is plant dependent. It is used only if the plant controllers are designed with a high steam flow MSIS. Reference 1, Section 6.6.	Lbm/sec
2115	CTL_MSIS_CONTROL_AUTO	Input	Control			MSIS CTL_SETPT	LO		Flag: MSIS automatic control. This is a plant independent, User defined input. In T=Auto, the controller output dictates an MSIS condition. In F=Manual, the User controls the MSIS condition by setting CTL_MSIS_TRIP = T=Trip. Reference 1, Section 6.6.	Auto Manual
2116	CTL_MSIS_TRIP	I/O	Control			MSIS CTL_SETPT	LO		Main steam isolation signal. This is a plant independent variable. This flag is set by the User or by CENTS. To simulate a manual MSIS condition, the User can set CTL_MSIS_TRIP= T via the command file. With MSIS control in Auto, CENTS can set the flag to True if the MSIS controller indicates a trip condition. Always used. Reference 1, Section 6.6; and Reference 2, Table 2.	Active Inactive
2117	CTL_ATM_DUMP_CONTROL	Partition					RE	6	Atmospheric dump valves controls	Partition
2118	CTL_ATM_DUMP_SETPOINTS	Partition					RE	4	SG ADVs setpoints	Partition
2119	CTL_ATM_DUMP_SPOINT	Input	Control			ADV CTL_SETPT	RE	2	Atmospheric dump valves setpoints. These setpoint variables are plant dependent. Their use is dependent upon the controller design. Normally, the design is such that the valves open to maintain the setpoint pressure. Reference 1, Section 6.6.	Psia
2120	CTL_ATM_DUMP_CONTROL_AUTO	Input	Control			ADV CTL_SETPT	LO		Flag: automatic ctrl of atm-dump valves. This is a plant independent, User defined input. In T=Auto, the controller output dictates an ADV operation. In F=Manual, the User controls the ADV operation by setting MSLH_VALVE_SIG(J) to the fraction open, where "J" is the appropriate valve number. Reference 1, Section 6.6.	Auto Manual
2121	CTL_TURB_BYPASS_CONTROL	Partition					RE	11	Turbine bypass controls	Partition
2122	CTL_TURB_BYPASS_SETPOINTS	Partition					RE	10	Turbine bypass valves setpoints	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2123	CTL_TURB_DUMP_OPEN	Input	Control			SDBS CTL_SETPT	RE		Pressure to open bypass valves. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, this pressure is the lower pressure limit for operation of the SDBC valves. Reference 1, Section 6.6.	Psia
2124	CTL_TURB_DUMP_DELP	Input	Control			SDBS CTL_SETPT	RE		Press. range of turb bypass ctrl system. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, this pressure differential is the operational pressure range with the lower pressure limit for operation set by CTL_TURB_DUMP_OPEN. But, for some plant controller designs, this variable is the upper pressure setpoint, in psia. Reference 1, Section 6.6.	Psid
2125	CTL_TURB_DUMP_QOPEN	Input	Control			SDBS CTL_SETPT	RE		Quick-opening time for turbine bypass valves. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally it is set to a fraction/second rate. Reference 1, Section 6.6.	1/seconds
2126	CTL_TURB_DUMP_NOPEN	Input	Control			SDBS CTL_SETPT	RE		Normal-open time for turb bypass valve. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally it is set to a fraction/second rate. Reference 1, Section 6.6.	1/seconds
2127	CTL_TURB_DUMP_QCLOSE	Input	Control			SDBS CTL_SETPT	RE		Quick-close time for turb bypass valve. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally it is set to a fraction/second rate. Reference 1, Section 6.6.	1/seconds
2128	CTL_TURB_DUMP_NCLOSE	Input	Control			SDBS CTL_SETPT	RE		Normal-close time for turb bypass valve. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally it is set to a fraction/second rate. Reference 1, Section 6.6.	1/seconds
2129	CTL_TURB_DUMP_MODE	Input	Control			SDBS CTL_SETPT	RE		Bypass control mode: 0=p-temp, 1=s-pres. This flag variable is plant dependent. Its use is dependent upon the controller design. In many controllers it is not used at all, in which case it is normally set to 0. Reference 1, Section 6.6.	Pointer
2130	CTL_TURB_BYPASS_CONTROL_AUTO	Input	Control			SDBS CTL_SETPT	LO		Flag: automatic turbine-bypass control. This is a plant independent, User defined input. In T=Auto, the controller output dictates an SDBC operation. In F=Manual, the User controls the Bypass valve operation by setting MSLH_VALVE_SIG(J) to the fraction open, where "J" is the appropriate valve number. Reference 1, Section 6.6.	Auto Manual
2131	CTL_SG_SAFETIES	Partition					RE	120	SG safety valves control variables	Partition
2132	CTL_SG_SV_SETPOINTS	Partition					RE	120	SG external safety valve setpoints	Partition
2133	CTL_SGSV_PSET_OPEN	Input	Control			MSSV CTL_SETPT	RE	24	SG safeties design-open pressure setpoints. These setpoint variables are plant dependent. Their use is dependent upon the controller and valve design. Normally, the design is such that the safety valves begin to open at this setpoint pressure. Reference 1, Section 6.6.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2134	CTL_SGSV_PSET_FULL	Input	Control			MSSV CTL_SETPT	RE	24	SG safeties full-open pressure setpoints. These setpoint variables are plant dependent. Their use is dependent upon the controller and valve design. Normally, the design is such that the safety valves are full open at this setpoint pressure, or it is CTL_SGSV_PSET_OPEN + accumulation. Reference 1, Section 6.6.	Psia
2135	CTL_SGSV_PSET_CLOSE	Input	Control			MSSV CTL_SETPT	RE	24	SG safeties closing pressure setpoints. These setpoint variables are plant dependent. Their use is dependent upon the controller and valve design. Normally, the design is such that the safety valves are close fully at this setpoint pressure, or it is CTL_SGSV_PSET_OPEN - blowdown. Reference 1, Section 6.6.	Psia
2136	CTL_SGSV_ASET_OPEN	Input	Control			MSSV CTL_SETPT	RE	24	SG safeties design-open fraction. These setpoint variables are plant dependent. Their use is dependent upon the controller and valve design. Normally, the design is such that the safety valves pop open to this fraction at CTL_SGSV_PSET_OPEN pressure. Reference 1, Section 6.6.	Fraction
2137	CTL_FWS_CONTROL	Partition					RE	70	Feedwater system controls	Partition
2138	CTL_FWS_SETPOINTS	Partition					RE	15	FWS control setpoints	Partition
2139	CTL_FWS_SG_LEVEL_LOAD	Input	Control			FW CTL_SETPT	RE	2	SG level program load setpoints. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Fraction
2140	CTL_FWS_SG_LEVEL_LOW	Input	Control			FW CTL_SETPT	RE		Main feedwater lo-level control setpoint. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Fraction
2141	CTL_FWS_SG_LEVEL_HIGH	Input	Control			FW CTL_SETPT	RE		Main feedwater hi-level control setpoint. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Fraction
2142	CTL_FWS_TURB_TRIP_FRAC	Input	Control			FW CTL_SETPT	RE		Main FW rampdown flow frac after trip. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2143	CTL_FWS_TURB_TRIP_DELAY	Input	Control			FW CTL_SETPT	RE		Main FW rampdown time after turb trip. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Seconds
2144	CTL_FWS_MAX_FLOW	Input	Control			FW CTL_SETPT	RE		Maximum feedwater flow to each SG. This plant dependent setpoint places an upper bound on FW flow rate to the SG when in automatic mode of operation. There is no bound upon what the User can input as FW flow rate in manual operation. Reference 1, Section 6.7.	Lbm/sec
2145	CTL_FWS_SPEED_MULT	Input	Control			FW CTL_SETPT	RE	4	Multp on FW pump speed signl: =0 to trip. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Dimensionless
2146	CTL_FWS_TRIP_SP	Input	Control			FW CTL_SETPT	RE		Feedwater trip setpoint. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow. Reference 1, Section 6.7.	Undefined
2147	CTL_FWS_H	Input	Control			FW CTL_SETPT	RE	2	Steady state FW enth: 1 at CST, 2 at SGS. These are plant dependent variables set by the User. The original intended use was to indicate the enthalpy at the condenser and at the entrance to the SG. Then if a trip occurred, the FW enthalpy would drop to the condenser enthalpy at a rate dictated by the time constant CTL_FWS_H_TC. In current operation, the value for CTL_FWS_H(1) = CTL_FWS_H(2) and is set at the enthalpy required for initialization. Then the User changes enthalpy as required during any transient. Reference 1, Section 6.7.	Btu/lbm
2148	CTL_FWS_H_MAX	Input	Control			FW CTL_SETPT	RE		Maximum feedwater enthalpy. Used for NUM_FWS_PUMPS=0 only.	Btu/lbm
2149	CTL_FWS_H_TC	Input	Control			FW CTL_SETPT	RE		Feedwater enthalpy time constant. Used for NUM_FWS_PUMPS=0 only. See CTL_FWS_H.	Seconds
2150	CTL_FWS_TRIP	I/O	Control			FW CTL_SETPT	LO		FWS trip signal. Reference 1, Section 6.7; and Reference 2, Table 2.	Active Inactive
2151	CTL_FWS_AUTO	Partition					LO	14	Flags for automatic control of FW system. Reference 1, Section 6.7.	Partition
2152	CTL_FWS_CONTROL_AUTO	Input	Control			FW CTL_SETPT	LO		Master FW flag: T=separate, F=all manual. This is a plant independent, User defined input. In T=Auto, the controller output dictates a FW flow rate. In F=Manual, the User controls the FW flow by setting FWS_FLOW(J). Reference 1, Section 6.7.	Auto Manual

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2153	CTL_FWS_VALVE_AUTO	Input	Control			FW CTL_SETPT	LO	4	Flags: auto control of downcmr FW valves. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow AND enthalpy. Reference 1, Section 6.7.	Auto Manual
2154	CTL_FWS_ECON_VALVE_AUTO	Input	Control			FW CTL_SETPT	LO	4	Flags: auto control of econmzr FW valves. This setpoint is not currently used by CENTS. If available, it would only be applicable to System 80 design plants. Reference 1, Section 6.7.	Auto Manual
2155	CTL_FWS_PUMP_AUTO	Input	Control			FW CTL_SETPT	LO	4	Flags: auto control of main FW pumps. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow AND enthalpy. Reference 1, Section 6.7.	Auto Manual
2156	CTL_FWS_TRIP_AUTO	Input	Control			FW CTL_SETPT	LO		Flag: automatic main feedwater trip. Reference 1, Section 6.7.	Auto Manual
2157	CTL_FWS_VALVE_SIG	Output Partition					RE	4, 2	Main FW valve demand signals	Fraction
2158	CTL_FWS_SIG	I/O	Control			FW CTL_SETPT	RE	4	Main FW downcomer valve demand signal. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow AND enthalpy. Reference 1, Section 6.7; and Reference 2, Table 2.	Fraction
2159	CTL_FWS_ECON_SIG	I/O	Control			FW CTL_SETPT	RE	4	Main FW economizer valve demand signal. This setpoint is not currently used by CENTS. If available, it would only be applicable to System 80 design plants. Reference 1, Section 6.7; and Reference 2, Table 2.	Fraction
2160	CTL_FWS_VALVE_POS	Output Partition					RE	4, 2	Main FW valve positions.	Fraction
2163	CTL_FWS_SPEED_SIG	I/O	Control			FW CTL_SETPT	RE	4	Main FW pumps speed demand signals. Reference 1, Section 6.7; and Reference 2, Table 2.	Fraction
2164	CTL_FWS_SPEED_FRAC	Output	Control			FW CTL_SETPT	RE	4	Main FW pumps normalized speed, actual. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow AND enthalpy. Reference 1, Section 6.7.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2165	CTL_FWS_SPEED_MAX	Input	Control			FW CTL_SETPT	RE		Main FW pumps reference speed. This setpoint is not currently used by CENTS. Normally FW flow is set equal to steam flow or alternatively a 3-element demand system is used, but a detailed FW system model is not currently available. In a safety analysis transient condition, it is expected that the User will take manual control of FWS to conservatively dictate FW flow AND enthalpy. Reference 1, Section 6.7.	Shaft RPM
2166	CTL_FWS_ISO_POS	Output	Control	FW		FW CTL_SETPT	RE	4	Main FW isolation valve position. Reference 1, Section 6.7.	Fraction
2167	CTL_FWS_BYP_SIG	Output	Control	FW		FW CTL_SETPT	RE	4	Main FW bypass valve demand signal. Reference 1, Section 6.7.	Fraction
2168	CTL_AFWS_CONTROL	Partition					RE	25	Aux feed system controls	Partition
2169	CTL_AFWS_SETPOINTS	Partition					RE	20	AFWS control setpoints	Partition
2170	CTL_AFWS_SG_LEVEL_LOW	Input	Control			AFW CTL_SETPT	RE	4	Low SG level setpoint for auxiliary feedwater. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, at this level AFWS is actuated. This setpoint is compared to either the actual downcomer water level calculated by CENTS, or it can be compared to the indicated water level which is based on the level indication model, complete with calibration conditions, etc. Reference 1, Section 6.7.	Fraction
2171	CTL_AFWS_SG_LEVEL_HIGH	Input	Control			AFW CTL_SETPT	RE	4	High level setpoint for auxiliary feedwater. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, at this level AFWS flow is terminated. This setpoint is compared to either the actual downcomer water level calculated by CENTS, or it can be compared to the indicated water level which is based on the level indication model, complete with calibration conditions, etc. Reference 1, Section 6.7.	Fraction
2172	CTL_AFWS_TOT_FLOW	Input	Control			AFW CTL_SETPT	RE		Total aux-feed flow capacity, all SGs. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, it is not used because full flow rate is highly dependent upon SG pressure. Many CENTS control systems use an XTAB YTAB tables of pressure vs. flow with different SG and pump combinations included. Reference 1, Section 6.7.	Lbm/sec
2173	CTL_AFWS_SGDP_HIGH	Input	Control			AFW CTL_SETPT	RE		SG differential pressure to cutout auxiliary feedwater to one SG. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, at this differential pressure flow is terminated to the SG with the lower pressure as a means of preventing flow to a ruptured SG. Reference 1, Section 6.7.	Psid
2174	CTL_AFWS_DELAY	Input	Control			AFW CTL_SETPT	RE		AFW time delay after trip. This setpoint variable is plant dependent. Its use is dependent upon the controller design. Normally, this is the delay from the time an actuation signal is activated until the AFW pumps and valves are operating and open providing flow to the SG. Reference 1, Section 6.7.	Seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2175	CTL_AFWS_FLOW_MULT	Input	Control			AFW CTL_SETPT	RE	4	Multiplier on auxiliary feedwater flow rate. This plant independent variable is set by the User. Normally it is set to 1.0 for realistic modeling of flow. For special test purposes, the User may require some other value for this multiplier. Reference 1, Section 6.7.	Dimensionless
2176	CTL_AFWS_TURB_PUMP	Input	Control			AFW CTL_SETPT	RE		AFWS turb-driven pump switch: 0=off,1=ok. This setpoint variable is plant dependent. Its use is dependent upon the controller and plant design. Normally, it is used to indicate a possible single failure of the turbine driven pump. Reference 1, Section 6.7.	Pointer
2177	CTL_AFWS_MOTOR_PUMP	Input	Control			AFW CTL_SETPT	RE		AFWS motor-drivn pump switch: 0=off,1=ok. This setpoint variable is plant dependent. Its use is dependent upon the controller and plant design. Normally, it is used to indicate a possible single failure of the turbine driven pump. Reference 1, Section 6.7.	Pointer
2178	CTL_AFWS_CONTROL_AUTO	Input	Control			AFW CTL_SETPT	LO		Flag: automatic control of aux feed. This plant independent variable is set by the User. In T=Auto, the controller output dictates AFWS operation. In F=Manual, the User controls the AFWS flow by setting AFWS_FLOW(J), "J" indicates the SG No. Reference 1, Section 6.7.	Auto Manual
2179	CTL_AFWS_SPEED_SIG	I/O	Control	FW	AFW	AFW CTL_SETPT	RE	4	AFW pumps speed demand signals. Reference 1, Section 6.7; and Reference 2, Table 2.	Fraction
2180	CTL_RPCS_CONTROL	Partition					RE	15	Reactor power cutback system	Partition
2181	CTL_RPCS_SETPOINTS	Partition					RE	5	RPCS setpoints	Partition
2182	CTL_RPCS_CONTROL_AUTO	Input	Control			RPCS CTL_SETPT	LO		Flag: automatic RPCS control. Reference 1, Section 6.8.	Auto Manual
2183	CTL_RPCS_TRIP	I/O	Control			RPCS CTL_SETPT	LO		Signal: RPC engaged. Reference 1, Section 6.8; and Reference 2, Table 2.	Trip Normal
2184	CTL_RPCS_PTRIP	Output	Control			RPCS CTL_SETPT	LO		RPC signal at last time step. Reference 1, Section 6.8.	Trip Normal
2185	CTL_RPCS_TRIP_TIME	Output	Control			RPCS CTL_SETPT	RE		Time elapsed since RP cutback engaged. Reference 1, Section 6.8.	Seconds
2186	CTL_TURB_SETBACK_CONTROL	Partition					RE	20	Turbine setback and runback systems	Partition
2187	CTL_TURB_SETBACK_SETPOINTS	Partition					RE	10	Turb setback & runback system setpoints	Partition
2188	CTL_TURB_SETBACK_AUTO	Input	Control			TURB SETBK SETPT	LO		Flag: automatic turbine setback control. Reference 1, Section 6.6.	Auto Manual
2189	CTL_TURB_RUNBACK_AUTO	Input	Control			TURB SETBK SETPT	LO		Flag: automatic turbine runback control. Reference 1, Section 6.6.	Auto Manual
2190	CTL_TURB_SETBACK_TRIP	I/O	Control			TURB SETBK SETPT	LO		Signal: turbine setback engaged. Reference 1, Section 6.6; and Reference 2, Table 2.	Trip Normal
2191	CTL_TURB_RUNBACK	I/O	Control			TURB SETBK SETPT	LO		Signal: turbine runback engaged. Reference 1, Section 6.6.; and Reference 2, Table 2.	True False
2192	CTL_MISC_SETPOINTS	Partition					RE	200	Miscellaneous user-defined setpoints	Undefined

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2193	CTL_SET_TEMP	Input	Control			Model Design	RE	20	Miscellaneous temperature setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Degree F
2194	CTL_SET_DELTEMP	Input	Control			Model Design	RE	20	Miscellaneous delta-temp setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Del-degF
2195	CTL_SET_DELTEMPD	Input	Control			Model Design	RE	20	Miscellaneous per-delta-temp setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Per-degF
2196	CTL_SET_PRES	Input	Control			Model Design	RE	20	Miscellaneous pressure setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Psia
2197	CTL_SET_PRESD	Input	Control			Model Design	RE	20	Miscellaneous per-pressure setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Per-psia
2198	CTL_SET_NODIM	Input	Control			Model Design	RE	60	Miscellaneous dimensionless setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Dimensionless
2199	CTL_SET_FLOW	Input	Control			Model Design	RE	10	Miscellaneous flowrate setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Lbm/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2200	CTL_SET_FLOWD	Input	Control			Model Design	RE	10	Miscellaneous per-flowrate setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Sec/lbm
2201	CTL_SET_PERTIME	Input	Control			Model Design	RE	20	Miscellaneous per-time setpoints. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	1/seconds
2202	CTL_TIME_CONSTANTS	Input	Control			Model Design	RE	150	Miscellan. user-defined time constants. These setpoints, if used, are totally dependent upon the design of the individual plant CENTS controllers. Many controllers are unique and require constants which may not have a specifically defined setpoint variable. This array provides a place to record these values. Each basedeck calculation should define the use of each constant in this array.	Seconds
2203	CTL_OUTPUT	Partition					RE	16	Output control partition	Partition
2204	CTL_OUTPUT_INTERVAL	Input	Output				IN		Output frequency for line output. CENTS produces a one-line output edit every CTL_OUTPUT_INTERVAL time steps. The user may change this to reduce the size of the output. Reference 1, Section 7.6.1.	Counts
2205	CTL_OUTPUT_OPTION	Input	Output				IN		Line output option. CTL_OUTPUT_OPTION modifies the one line output. If CTL_OUTPUT_OPTION > 0.0. pressurizer 2-phase level is printed. Otherwise, indicated pressurizer level is printed. Reference 1, Section 7.6.1.	Pointer
2206	CTL_OUTPUT_COUNT	Input	Output				IN	4	Output counter: calls/line/graph/title. CTL_OUTPUT_COUNT is the total number of timesteps since the specified output was generated. The base deck requires initial values which are then updated during the run. Reference 1, Section 7.6.1.	Counts
2207	CTL_OUTPUT_NTITLE	Input	Output				IN		Line output title frequency. CTL_OUTPUT_NTITLE specifies the number of lines which are printed before a new title line is printed. This should be set so that one title line is printed on each page of output. The value depends on the printer being used, font size, etc. and must be adjusted by the user for his setup. Reference 1, Section 7.6.1.	Counts
2210	CTL_OUTPUT_LOOP	Input	Output				IN	2	Select loops for the standard output. CTL_OUTPUT_LOOP specifies which 2 coolant loops (and associated steam generators) should be used for the standard output. For CE plants, the choice is 1,2 because there are only two loops. Reference 1, Section 7.6.1.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2211	CTL_OUTPUT_OPCL	Input	Output				IN		Determines which cold leg's temperature is displayed second in the standard output (Reference 1, Section 7.6.1.). That is, display the temperatures of cold legs L and M, where: L = CTL_OUTPUT_LOOP(1) M = CTL_OUTPUT_LOOP(2) + CTL_OUTPUT_OPCL.	Dimensionless
2214	CTL_TIME_BLOCK	Partition					RE	10	Time step control information for CENTS	Partition
2218	TIME	I/O					RE		Simulation time. This variable is continually updated as CENTS increments it by the value of TIME_SCALE. Since TIME is not used anywhere in the CENTS calculational models, the User may reset or change TIME. However, some of the CEER background operations may be affected, such as SCREEN and RECORD.	Seconds
2219	TIME_SCALE	Input					RE		Global calculational time step length.	Per unit
2220	TSTOP	I/O					RE		Value of time at which to pause. Normally set by CENTS in accordance with the current TIME and the parameter of the GO command. Placing "TSTOP=0" in a WHEN command will cause the execution to pause when the WHEN is activated.	Seconds
2225	CTL_INITIAL_CONDITIONS	Partition					RE	4	Flags for initial conditions	Partition
2230	INIT_ALL	Output					LO		Internal flag set by CENTS when initializing all the routines.	True False
2231	INIT_OFF_MODELS	Partition					LO	7	Off flags for initialization models	True False
2232	INIT_OFF_RCS	Input					LO		Initialization of RCS: off flag. The INIT_OFF_xxx flags are used to defeat the initialization of each of the major models. These should set to False in the base deck.	True False
2233	INIT_OFF_CHT	Input					LO		Initialization of CHT: off flag. The INIT_OFF_xxx flags are used to defeat the initialization of each of the major models. These should set to False in the base deck.	True False
2234	INIT_OFF_POW	Input					LO		Initialization of POW: off flag. The INIT_OFF_xxx flags are used to defeat the initialization of each of the major models. These should set to False in the base deck.	True False
2235	INIT_OFF_SGS	Input					LO		Initialization of SGS: off flag. The INIT_OFF_xxx flags are used to defeat the initialization of each of the major models. These should set to False in the base deck.	True False
2236	INIT_OFF_CON	Input					LO		Initialization of CONT: off flag. The INIT_OFF_xxx flags are used to defeat the initialization of each of the major models. These should set to False in the base deck.	True False
2238	INIT_ITER	Input					IN		Number of initialization passes. This is a plant independent variable set by the User to determine the number of code iterations on the steady state T/H solution. Init_iter is the number of iterations during the initialization. Experience has shown that 30 iterations is sufficient. This value can be dependent on the controller setup. The time steps assumed for the controllers during the initialization is 0.1 seconds so that the equivalent of 3.0 seconds pass - this is enough time to force the controllers to steady state so long as the time constants for lead/lags are less than 3.0 seconds. Reference 1, Appendix D.	Counts
2239	CTL_ILEVEL	Partition					RE	15	Instrument level readings for controls	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2240	CTL_SG_ILEVEL	Output	SG				RE	4, 3	SG level readings. This output array is the CENTS calculated WR and NR SG level indications. The first index is the SG, and the second index is the reference leg as defined in the partition SG_REF_LEGS. This parameter is based on CENTS calculation of actual SG downcomer level and the fluid conditions with respect to the calibration conditions for the level indication system. These parameters are used in the controller system as input for controller actuation for such systems as RPS, AFW, FWCS, etc. Reference 1, Sections 6.7.4 and 7.3.1.	Fraction
2241	CTL_PRZR_ILEVEL	Output	PZR	RCS			RE		Pressurizer level reading. This output is the CENTS calculated pressurizer level indication. This parameter is based on CENTS calculation of actual pressurizer level and the fluid conditions with respect to the calibration conditions for the level indication system. This parameter is used in the controller system as input for controller actuation for such systems as RPS, CVCS, Pressurizer heaters, etc. Reference 1, Section 6.2.2.	Fraction
2243	CTL_CONTROLLER	Partition					RE	3000	Control module variables	Partition
2244	ELLAST	Output	Control			Model Design	RE	1000	Saved "last values" of control elements. These "last values" are needed as input by that particular element type in the next time step calculation. See Reference 2.	Undefined
2245	GROUT	I/O	Control			Model Design	RE	1000	Control group output signals. This array of values represents the final output from each controller at every time step. For any controller for which the malfunction MAL_CTL() = T, the GROUT calculation is bypassed, and the User may input GROUT directly. See Reference 2.	Undefined
2246	MAL_CTL	Input	Control				LO	1000	Control group malfunction cues. See Reference 2.	Malfunc Normal
2247	CTL_DELAYS	Partition					RE	50	Partition for control system delays. Note: Some delay variables appear elsewhere: CTL_CORE_TURB_TRIP_DELAY, CTL_SIS_DELAY, CTL_FWS_TURB_TRIP_DELAY, CTL_AFWS_DELAY, SCRAM_DELAY.	Partition
2248	CTL_CORE_TRIP_DELAYS	Partition					RE	30	Partition for Scram channel delays	Partition
2249	CTL_CORE_HI_POWER_FRAC_TRIP_DL	Input	Control			Delay	RE		High power fraction scram delay	Seconds
2250	CTL_CORE_HI_POWER_SUR_TRIP_DL	Input	Control			Delay	RE		High power SUR scram delay	Seconds
2251	CTL_CORE_LOW_PRZR_PRES_TRIP_DL	Input	Control			Delay	RE		Low pressurizer pressure scram delay	Seconds
2252	CTL_CORE_HI_PRZR_PRES_TRIP_DL	Input	Control			Delay	RE		High pressurizer pressure scram delay	Seconds
2253	CTL_CORE_HI_PRZR_LEVEL_TRIP_DL	Input	Control			Delay	RE		High pressurizer level scram delays	Seconds
2254	CTL_CORE_OVER_TEMP_MRGN_TRIP_DL	Input	Control			Delay	RE		Over-temperature thermal margin scram delay	Seconds
2255	CTL_CORE_OVER_POWER_MRGN_TRIP_DL	Input	Control			Delay	RE		Over-power thermal margin scram delay	Seconds
2256	CTL_CORE_RCSFLOW_FRAC_TRIP_DL	Input	Control			Delay	RE		Low loop flow scram delay	Seconds
2257	CTL_CORE_SIAS_TRIP_DL	Input	Control			Delay	RE		Scram due to SIAS delay	Seconds
2258	CTL_CORE_LOW_SG_PRES_TRIP_DL	Input	Control			Delay	RE		Low SG pressure scram delay	Seconds
2259	CTL_CORE_LOW_SG_LEVEL_TRIP_DL	Input	Control			Delay	RE		Low SG level scram delay	Seconds
2260	CTL_CORE_HI_SG_LEVEL_TRIP_DL	Input	Control			Delay	RE		High SG level scram delay	Seconds

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2261	CTL_STEAM_FEED_MISMATCH_TRIP_DL	Input	Control			Delay	RE		Steam-feed flow mismatch scram delay	Seconds
2262	CTL_CORE_HI_CONT_PRES_TRIP_DL	Input	Control			Delay	RE		High containment pressure scram delay	Seconds
2263	CTL_CORE_USER_DEFINED_TRIP_DL	Input	Control			Delay	RE	10	Space for other scram delays	Seconds
2264	CTL_MISC_TRIP_DELAYS	Partition					RE	20	Partition for miscellaneous control system delays	Partition
2265	CTL_TURB_TRIP_DELAY	Input	Control			Delay	RE		Turbine trip signal delay	Seconds
2266	CTL_MSIS_TRIP_DELAY	Input	Control			Delay	RE		Main steamline isolation signal delay	Seconds
2267	CTL_FWS_TRIP_DELAY	Input	Control			Delay	RE		Main feedwater trip signal delay	Seconds
2268	CTL_RPCS_TRIP_DELAY	Input	Control			Delay	RE		Reactor Power Cutback signal delay	Seconds
2269	CTL_TURB_SETBACK_TRIP_DELAY	Input	Control			Delay	RE		Turbine Setback signal delay	Seconds
2270	CTL_TURB_RUNBACK_DELAY	Input	Control			Delay	RE		Turbine Runback delay	Seconds
2271	CTL_MISC_DELAYS	Input	Control			Delay	RE	10	Space for other control system delays	Seconds
2272	USER_COMMON	Segment					RE	1024	User global common variables	Segment
2273	SCRAM_DELAY	Input	CORE	RCS			RE		Total scram delay time after trip. This USER input is intended to be the delay time from the onset of a reactor trip signal until the scram breakers open. It may be different for each scenario, depending upon which trip function actuates. For safety analysis, it is usually set to the Tech. Spec. max. time. Normally, it does not include the UV trip coil delay. This is usually included in the scram reactivity vs. time table, which starts after SCRAM_DELAY has elapsed. Note that some plant controller decks have lags established for the pressure, temperature, and level sensors. For these plants, it is important for the USER to know how these lags figure into the overall calculation of the scram delay time so that the lags are not "double counted" when entering a value for SCRAM_DELAY.	Seconds
2274	MSLH_NO_MOISTURE_CARRY	Input	MSL	SG			RE		1 => No moisture carryover. This input variable = 1 forces CENTS to allow only steam to exit the SG outlet nozzle, regardless of the two-phase level in the SG. This allows compliance with regulatory guidelines for conservative estimations of SG blowdown during an MSLB event.	Dimensionless
2275	SGT_INIT_OPTION	Input	SG				RE		0 => Adjust area. 1 => Find SG press. During initialization of CENTS with a basedeck and set of initial conditions, two options are available for setting the SG steam dome pressure. If the USER knows exactly the desired pressure for the given scenario, then SGT_INIT_OPTION = 0 is chosen. In this case, the code will adjust the tube heat transfer area to allow the proper RCS to SG heat balance necessary to attain the desired pressure. Normally, the variable is set to 1, which allows CENTS to calculate the SG pressure which provides the best steady state heat balance for the given initial conditions. The SG tube heat transfer areas, in this case, remain at their base deck value.	Dimensionless
2276	INTERPOLATION_ERROR_OPTION	Input					RE		If 1 => Error stop after each interpolation out-of-table-range error, in order to avoid the danger of extrapolation. If 0, => Extrapolation will proceed with no message.	Dimensionless
2277	SGS_DEBUG_SGSINI	Input	SG				RE		1 => Debug print on in subroutine SGSINI. 0 => No debug print.	Dimensionless

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2278	SGS_DEBUG_SGHEAT	Input	SG				RE		1 => Debug print on in subroutine SGHEAT. 0 => No debug print.	Dimensionless
2279	CTL_CORE_POWERA	Output	CORE				RE		Core power. This CENTS calculated output (in Mwt) is the essentially equivalent to CTL_CORE_POWER (in BTU/sec) or CTL_CORE_POWER_FRACTION (in fraction of POW_USER_POWZ, which is design 100% power).	Megawatts
2280	SGS_AREA_DOWNCOMER	Input	SG				RE	4	Area of downcomer for bubble rise calculation. This calculated input is normally chosen to be an average area, or total volume/total height.	Ft^2
2281	SGS_ALPHA_DOWNCOMER	Output	SG				RE	4	Steam generator downcomer steam volume fractions.	Dimensionless
2282	SGS_VEL31_MULT	Input	SG				RE	4	Downcomer multiplier on Wilson velocity. Normally set to 1.0 except for special testing or tuning to known plant conditions or other codes.	Dimensionless
2283	SGS_STEAM_VEL31	Output	SG				RE	4	Steam velocity downcomer to steam dome.	Ft/sec
2284	RCS_BALANCE	Partition	RCS				RE	54	RCS mass and energy balance	Partition
2285	RCS_NODAL_EXT_FLOWS	Output	RCS				RE	50	Sum of the external flows to each node. Reference 1, Section 7.6.3.	Lbm/sec
2286	RCS_NET_EXT_FLOW	Output	RCS				RE		Sum of all external RCS flows - includes PRZR. This output parameter is the SUM(RCS_NODAL_EXT_FLOW(I)). Reference 1, Section 7.6.3.	Lbm/sec
2287	RCS_NET_HEAT_RATE	Output	RCS				RE		Sum of all heat flows to RCS. Reference 1, Section 7.6.3.	Btu/sec
2288	RCS_TOTAL_MASS	Output	RCS				RE		Sum of all RCS nodal fluid masses - inc PRZR. Reference 1, Section 7.6.3.	Lbm
2289	RCS_TOTAL_ENERGY	Output	RCS				RE		Sum of all RCS node total energy in the fluid system. Reference 1, Section 7.6.3.	Btu
2290	IODINE_TOTALS_PARTITION	Partition					RE	10	Variables to check iodine release model	Partition
2291	RCS_TOTAL_IODINE	Output	RCS				RE		Total iodine in RCS nodes	Curies
2292	SGS_TOTAL_IODINE	Output	RCS				RE		Total iodine in stm Generators & header	Curies
2293	RCS_IOD_REL_TOT	Output	RCS				RE		Total of core release & external flows	Curies
2294	RCS_IOD_REL_RATE	Output	RCS				RE		Net rate of core release and ext flows	Microcurie/sec
2295	CTL_SUMMARY_DATA	Partition					RE	150	Case summary data	Partition
2296	CTL_MAX_POWER_FRAC	Output	CORE	RCS			RE		Maximum power fraction during run. Reference 1, Section 7.6.3.	Fraction
2297	CTL_MAX_POWER_TIME	Output	CORE	RCS			RE		Time of maximum power during run. Reference 1, Section 7.6.3.	Seconds
2298	CTL_MAX_HEAT_FLUX_FRAC	Output	CORE	RCS			RE		Maximum heat flux during run. Reference 1, Section 7.6.3.	Fraction
2299	CTL_MAX_HEAT_FLUX_TIME	Output	CORE	RCS			RE		Time of maximum heat flux during run. Reference 1, Section 7.6.3.	Seconds
2300	CTL_MAX_PRZR_PRESS	Output	PZR	RCS			RE		Maximum Pressurizer Pressure during run. Reference 1, Section 7.6.3.	Psia
2301	CTL_MAX_PRZR_PRESS_TIME	Output	PZR	RCS			RE		Time of maximum Pressurizer Pressure during run. Reference 1, Section 7.6.3.	Seconds
2302	CTL_MIN_PRZR_PRESS	Output	PZR	RCS			RE		Minimum Pressurizer Pressure during run. Reference 1, Section 7.6.3.	Psia
2303	CTL_MIN_PRZR_PRESS_TIME	Output	PZR	RCS			RE		Time of minimum Pressurizer Pressure during run. Reference 1, Section 7.6.3.	Seconds
2304	CTL_MAX_RCS_PRESS	Output	RCS				RE		Maximum RCS Pressure during run. Reference 1, Section 7.6.3.	Psia

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2305	CTL_MAX_RCS_PRESS_TIME	Output	RCS				RE		Time of maximum RCS Press during run. Reference 1, Section 7.6.3.	Seconds
2306	CTL_MIN_RCS_PRESS	Output	RCS				RE		Minimum RCS Pressure during run. Reference 1, Section 7.6.3.	Psia
2307	CTL_MIN_RCS_PRESS_TIME	Output	RCS				RE		Time of Minimum RCS Press during run. Reference 1, Section 7.6.3.	Seconds
2308	CTL_MAX_SG_PRESS	Output	SG				RE	4	Maximum SG Pressure during run. Reference 1, Section 7.6.3.	Psia
2309	CTL_MAX_SG_PRESS_TIME	Output	SG				RE	4	Time of maximum SG Press during run. Reference 1, Section 7.6.3.	Seconds
2310	CTL_MIN_SG_PRESS	Output	SG				RE	4	Minimum SG Pressure during run. Reference 1, Section 7.6.3.	Psia
2311	CTL_MIN_SG_PRESS_TIME	Output	SG				RE	4	Time of minimum SG Press during run. Reference 1, Section 7.6.3.	Seconds
2312	CTL_INTEG_PFLOW_NONMOM	Output	RCS				RE	50	Integrated flow though all leak paths. Reference 1, Section 7.6.3.	Lbm
2313	CTL_INTEG_SGS_VALVES	Output	SG				RE	50	Integrated flow though secondary paths. Reference 1, Section 7.6.3.	Lbm
2314	CTL_INTEG_MSLB_IN_FLOW	Output	MSL				RE	8	Integrated flow MSLB inside containment. Reference 1, Section 7.6.3.	Lbm
2315	CTL_INTEG_MSLB_OUT_FLOW	Output	MSL				RE		Integrated flow MSLB outside containment. Reference 1, Section 7.6.3.	Lbm
2316	CTL_INITIAL_CORE_FLOW	Output	CORE	RCS			RE		Initial core flow. Reference 1, Section 7.6.3.	Lbm/sec
2317	CTL_CORE_FLOW_FRAC	Output	CORE	RCS			RE		Normalized core flow - frac of initial. Reference 1, Section 7.6.3.	Fraction
2318	CTL_HEAT_FLUX_FRAC	Output	CORE	RCS			RE		Core average heat flux fraction. Reference 1, Section 7.6.3.	Fraction
2319	CTL_CETOP_MIN_DNBR	Output	RCS	Core			RE		CETOP Minimum DNBR for the entire case run. Reference 1, Section 7.6.3 and Appendix F.	Fraction
2320	CTL_CETOP_MIN_DNBR_TIME	Output	RCS	Core			RE		Time of CETOP Minimum DNBR. Reference 1, Section 7.6.3 and Appendix F.	Seconds
2321	CETOP_LINK	Partition					RE	50	Partition to store CETOP link data. Reference1 , Appendix F.	Partition
2322	CETOP_OUT	Partition					RE	19	CETOP standard output. Reference 1 , Appendix F.	Partition
2323	CETOP_OUT_CASE	Output	RCS	Core			RE		CETOP out: Case number. Reference 1 , Appendix F.	Fraction
2324	CETOP_OUT_QDBL	Output	RCS	Core			RE		CETOP out: Heat flux. Reference 1 , Appendix F.	MegBtu/hr-ft^2
2325	CETOP_OUT_POLR	Output	RCS	Core			RE		CETOP out: Power operating limit. Reference 1 , Appendix F.	Fraction
2326	CETOP_OUT_TIN	Output	RCS	Core			RE		CETOP out: Inlet temperature. Reference 1 , Appendix F.	Degree F
2327	CETOP_OUT_PIN	Output	RCS	Core			RE		CETOP out: Pressure. Reference 1 , Appendix F.	Psia
2328	CETOP_OUT_GAVG	Output	RCS	Core			RE		CETOP out: Core average mass velocity. Reference1 , Appendix F.	10e6 lb/hr-ft2
2329	CETOP_OUT_ASI	Output	RCS	Core			RE		CETOP out: Axial shape index. Reference1 , Appendix F.	Ratio
2330	CETOP_OUT_NRAD	Output	RCS	Core			RE		CETOP out: Peripheral Axial shape index. Reference1 , Appendix F.	Fraction
2331	CETOP_OUT_P1MAX	Output	RCS	Core			RE		CETOP out: Max radial avg peaking factor. Reference1 , Appendix F.	Fraction
2332	CETOP_OUT_DNB-N	Output	RCS	Core			RE		CETOP out: Min DNBR at final iteration. Reference1 , Appendix F.	Fraction
2333	CETOP_OUT_X-N	Output	RCS	Core			RE		CETOP out: Quality at final iteration. Reference1 , Appendix F.	Fraction
2334	CETOP_OUT_DNB-1	Output	RCS	Core			RE		CETOP out: Min DNBR at first iteration. Reference1 , Appendix F.	Fraction
2335	CETOP_OUT_X-1	Output	RCS	Core			RE		CETOP out: Quality at first iteration. Reference1 , Appendix F.	Fraction
2336	CETOP_OUT_QUIX	Output	RCS	Core			RE		CETOP out: QUIX file case number. Reference1 , Appendix F.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2337	CETOP_OUT_ITER	Output	RCS	Core			RE		CETOP out: Number of iterations. Reference1 , Appendix F.	Fraction
2338	CETOP_OUT_IEND	Output	RCS	Core			RE		CETOP out: Iter code: 1 => DNBR converged. Reference1 , Appendix F.	Fraction
2339	CETOP_OUT_ATR	Output	RCS	Core			RE		CETOP out: Average enthalpy transport coefficient. Reference1 , Appendix F.	Composite Units
2340	CETOP_OUT_HCH	Output	RCS	Core			RE		CETOP out: Min DNBR hot channel number. Reference1 , Appendix F.	Pointer
2341	CETOP_OUT_MNOD	Output	RCS	Core			RE		CETOP out: Min DNBR node location. Reference1 , Appendix F.	Pointer
2342	CETOP_IN	Partition					RE	7	CETOP Inputs from CENTS. Reference1 , Appendix F.	Partition
2343	CETOP_IN_TIME	Output	RCS	Core			RE		CETOP in: CENTS simulation time. CETOP_IN_TIME is equal to the CENTS variable TIME, and replaces CETOP vector #93. Reference1 , Appendix F.	Seconds
2344	CETOP_IN_FLOW_FRAC	Output	RCS	Core			RE		CETOP in: Normalized core flow. CETOP_IN_FLOW_FRAC is equal to the CENTS variable CTL_CORE_FLOW_FRAC, which is defined as the ratio of the current core inlet mass flow to the initial core inlet mass flow. The CETOP mass flow specified by CETOP vector #1 is multiplied by this factor. Reference1 , Appendix F.	Fraction
2345	CETOP_IN_INLET_TEMP	Output	RCS	Core			RE		CETOP in: Core inlet temperature. CETOP_IN_INLET_TEMP is equal to the CENTS variable CHT_TEMP_COOL(1). This value replaces CETOP vector #3. Reference1 , Appendix F.	Degree F
2346	CETOP_IN_CORE_PRESSURE	Output	RCS	Core			RE		CETOP in: Core pressure. CETOP_IN_CORE_PRESSURE is equal to the CENTS variable PRESS(NODE_CORE). This value replaces CETOP input vector #4. Reference1 , Appendix F.	Psia
2347	CETOP_IN_HEAT_FLUX_FRAC	Output	RCS	Core			RE		CETOP in: Heat flux fraction. CETOP_IN_HEAT_FLUX_FRAC is equal to the CENTS variable CTL_HEAT_FLUX_FRAC, defined as the ratio of the current core average heat flux to the heat flux at full power. The CETOP heat flux specified in CETOP vectors 2 and 102 are multiplied by this factor. Reference1 , Appendix F.	Fraction
2348	CETOP_IN_FR_USER_MULT	Input	RCS	Core			RE		CETOP in: User input Fr multiplier. CETOP_IN_FR_USER_MULT is a user specified multiplier on the CETOP Fr given by CETOP input vector # 58. The base radial peak used by CETOP is specified in the CETOP input file by the variable A(58). When the CETOP link is active, this peak is adjusted by two multiplicative factors. The first factor is CETOP_IN_FR_USER_MULT. The user sets this multiplier (possibly with the RAMP command) to account for radial effects such as the increase in Fr due to a dropped CEA. This variable should normally be set to 1.0. The second factor is CETOP_IN_FR_TEMP_MULT. Reference1 , Appendix F.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2349	CETOP_IN_FR_TEMP_MULT	Output	RCS	Core			RE		CETOP in: FR temperature multiplier. CETOP_IN_FR_TEMP_MULT is one of two multipliers on the CETOP Fr given by CETOP input vector #58. This factor accounts for the increase in core peaking due to changes in core inlet temperature. The variable CETOP_IN_FR_TEMP_MULT is calculated by CENTS based on current path temperatures by the formula CETOP_IN_FR_TEMP_MULT = 1.0 + CETOP_FR_DERIV * | CETOP_FR_DEL_TEMP | The other multiplier is CETOP_IN_FR_USER_MULT. Reference1 , Appendix F.	Fraction
2350	CETOP_LINK_CONTROL	Partition	RCS	Core			RE	7	CETOP link variables and options. Reference1 , Appendix F.	Partition
2351	CETOP_PRESS_OPT	Input	RCS	Core			LO		CETOP link: Constant pressure option. CETOP_PRESS_OPT is a flag to use constant pressure in the DNBR calculation. The default is False, so that CETOP is passed the current value of core pressure. When CETOP_PRESS_OPT is set to true, the data base variable CETOP_IN_CORE_PRESSURE must be set by the user. Reference1 , Appendix F.	True False
2352	CETOP_FR_DERIV	Input	RCS	Core			RE		CETOP link: User input derivative of Fr with respect to temperature. See CETOP_IN_FR_TEMP_MULT. The variable CETOP_FR_DERIV is specified by the user. A typical value is 0.005 /degF. To disable the Fr temperature correction, set CETOP_IN_FR_DERIV to 0.0 so that CETOP_IN_FR_TEMP_MULT will always be 1.0. Reference1 , Appendix F.	1/Del-DegF
2353	CETOP_FR_PATH1	Input	RCS	Core			IN		CETOP link: Path number for CETOP_FR_TEMP1. Reference1 , Appendix F.	Pointer
2354	CETOP_FR_PATH2	Input	RCS	Core			IN		CETOP link: Path number for CETOP_FR_TEMP12. Reference1 , Appendix F.	Pointer
2355	CETOP_FR_TEMP1	I/O	RCS	Core			RE		CETOP link: Temp1 for DT calculation. If CETOP_FR_PATH1 > 0: Temperature in that path, set be CENTS. If CETOP_FR_PATH1 ≤ 0: Constant temperature, assigned by user. This enables the user to calculate the temperature correction based on the difference of a path temperature and a reference value. See CETOP_FR_DEL_TEMP and CETOP_IN_FR_TEMP_MULT. Reference1 , Appendix F.	Degree F
2356	CETOP_FR_TEMP2	I/O	RCS	Core			RE		CETOP link: Temp2 for DT calculation. If CETOP_FR_PATH2 > 0: Temperature in that path, set be CENTS. If CETOP_FR_PATH2 ≤ 0: Constant temperature, assigned by user. This enables the user to calculate the temperature correction based on the difference of a path temperature and a reference value. See CETOP_FR_DEL_TEMP and CETOP_IN_FR_TEMP_MULT. Reference1 , Appendix F.	Degree F

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2357	CETOP_FR_DEL_TEMP	Output	RCS	Core			RE		CETOP link: Temp Diff for Fr correction. The variable CETOP_FR_DEL_TEMP used in the Fr temperature correction is an inlet temperature difference which is calculated as the difference of CETOP_FR_TEMP1 and CETOP_FR_TEMP2. The two temperatures are set by CENTS to the temperature of any CENTS paths based on the value of the pointers CETOP_FR_PATH1 and CETOP_FR_PATH2. If the value of one or both of the pointers is 0, the corresponding temperature is not updated by CENTS and must be set by the user. This enables the user to calculate the temperature correction based on the difference of a path temperature and a reference value. Reference1 , Appendix F.	Degree F
2358	VATTENFALL_MISCELLANEOUS	Partition					RE	200	Partition for Vattenfall use	Partition
2359	INIT_DEBUG_OUTPUT	Input					RE		1 => Debug print on in the INITIALization routine. 0 => No debug print.	Dimensionless
2367	CDCONT_COMMON	Partition					RE	50	Container array for Cooldown Controllers	Partition
2368	DBG_SGTR_PARTITION	Output	RCS				RE	36	SGTR Debug Variables	Partition
2369	DBG_SGTR_FLOW1	Output	RCS				RE	4	Debug Variable SGTR Flow side 1	Lbm/sec
2370	DBG_SGTR_FLOW2	Output	RCS				RE	4	Debug Variable SGTR Flow side 2	Lbm/sec
2371	DBG_SGTR_FLOW_SLOT	Output	RCS				RE	4	Debug Variable SGTR Slot flow	Lbm/sec
2372	DBG_SGTR_PRESS_PRI1	Output	RCS				RE	4	Debug Variable SGTR Primary pressure side 1	Psia
2373	DBG_SGTR_PRESS_PRI2	Output	RCS				RE	4	Debug Variable SGTR Primary pressure side 2	Psia
2374	DBG_SGTR_PRESS_SG	Output	RCS				RE	4	Debug Variable SGTR Secondary pressure	Psia
2375	DBG_SGTR_PRESS_ITER	Output	RCS				RE	4	Debug Variable SGTR Slot pressure	Psia
2376	DBG_SGTR_SVOL_TUBE1	Output	RCS				RE	4	Debug Variable SGTR Tube 1 specific volume	ft^3/lbm
2377	DBG_SGTR_SVOL_TUBE2	Output	RCS				RE	4	Debug Variable SGTR Tube 2 specific volume	ft^3/lbm
2378	FWS_COMMON	Segment	FW				RE	20000	Feedwater System model segment	Segment
2379	FWS_FDPATH	Partition	FW				RE	1600	FWS model flow path partition	Partition
2380	FWS_DPEL	Input	FW			Plant Design	RE	50	FWS model flow path elevation gain, external path. Reference1 , Section 5.5, 6.7 and 7.3.4.	Feet
2381	FWS_CV	Input	FW			Plant Design	RE	50	FWS model flow path flow coefficient Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2382	FWS_RESL	Input/init	FW			Plant Design	RE	50	FWS model flow path flow resistance. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2383	FWS_RHOFD	Output	FW			T/H State	RE	50	FWS model flow path density. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/Ft^3
2384	FWS_PEXT	Output	FW			T/H State	RE	50	FWS model flow path external pressure. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psia
2385	FWS_WMAS	Output	FW			T/H State	RE	50	FWS model flow path mass flow rate. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/sec
2386	FWS_W0	Output	FW			T/H State	RE		FWS model flow path volumetric flow. Reference1 , Section 5.5, 6.7 and 7.3.4.	Gal/min
2387	FWS_W	Output	FW			T/H State	RE	50	FWS model flow path volumetric flow. Reference1 , Section 5.5, 6.7 and 7.3.4.	Gal/min

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2388	FWS_HPATH	Output	FW			T/H State	RE	50	FWS model flow path flow enthalpy. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2389	FWS_QCURR	Output	FW				RE	50	FWS model flow path heat transfer. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/sec
2390	FWS_RESV	Output	FW				RE	50	FWS model flow path valve flow resistance. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2391	FWS_RES	Output	FW				RE	50	FWS model flow path total resistance. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2392	FWS_HEXT	Output	FW			T/H State	RE	50	FWS model flow path ext node enthalpy. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2393	FWS_RHOEXT	Output	FW			T/H State	RE	50	FWS model flow path ext node density. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/Ft^3
2394	FWS_RP	Output	FW				RE	50	FWS model flow path pump resistance. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2395	FWS_PS	Output	FW				RE	50	FWS model flow path pump head. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psid
2396	FWS_SUMP	Output	FW				RE	50	FWS model flow path pressure error. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psid
2397	FWS_GPMCOR	Output	FW				RE	50	FWS model flow path density correction. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2398	FWS_NDIN	Input	FW			Model Design	IN	50	FWS model flow path input node ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2399	FWS_NDOUT	Input	FW			Model Design	IN	50	FWS model flow path output node ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2400	FWS_NDEXT	Input	FW			Model Design	IN	50	FWS model flow path external node ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2401	FWS_NCPUMP	Input	FW			Model Design	IN	50	FWS model flow path pump ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2402	FWS_ICPUMP	Output	FW				IN	50	FWS model flow path pump status. Reference1 , Section 5.5, 6.7 and 7.3.4.	Flag
2403	FWS_ICK	Input	FW			Model Design	IN	50	FWS model flow path check valve flag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2404	FWS_IMF	Output	FW				IN	50	FWS model flow path calculation flag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2405	FWS_POSISO	I/O	FW				RE	50	FWS model path isolation valve position. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2406	FWS_CV_AFLO	Output / Init	FW				RE	50	FWS model path check valve flow area. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2407	FWS_CV_RESMN	Input/Init	FW				RE	50	FWS model path check valve flow resistance. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2408	FWS_CV_DPMIN	Input/Init	FW				RE	50	FWS model path check valve minimum DP. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psid
2409	FWS_NFLO	Input	FW			Model Design	IN		FWS model network number of paths. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2410	FWS_KEY	Output	FW				IN		FWS model any fw pumps on flag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Flag
2411	FWS_FDNODE	Partition	FW				RE	400	FWS model node partition	Partition
2412	FWS_PEXTN	Input	FW			T/H State	RE	20	FWS model external node pressure. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psia
2413	FWS_HEXTN	Input	FW			T/H State	RE	20	FWS model external node enthalpy. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2414	FWS_P0	Output	FW			T/H State	RE		FWS model node pressure. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psia
2415	FWS_P	Output / Init	FW			T/H State	RE	30	FWS model node pressure. Reference1 , Section 5.5, 6.7 and 7.3.4.	Psia
2416	FWS_HNODE	Output / Init	FW			T/H State	RE	30	FWS model node enthalpy. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2417	FWS_RHONOD	Output	FW			T/H State	RE	30	FWS model node density. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/Ft^3
2418	FWS_WEXTF	I/O	FW			T/H State	RE	30	FWS model node ext flow. Positive out of node. Typically used to represent leakage flow out of system. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/sec
2419	FWS_HEXTF	I/O	FW			T/H State	RE	30	FWS model node external flow enthalpy = node enthalpy for leakage flow leaving a node. . Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2420	FWS_AEXTF	Input	FW			T/H State	RE	30	FWS model node external flow leakage area used to calculate the leakage flow rate given node pressure and leakage flow path external node pressure below. . Reference1 , Section 5.5, 6.7 and 7.3.4.	Ft^2
2421	FWS_PEXTF	I/O	FW			T/H State	RE	30	FWS model node external leakage flow back pressure used to calculate leakage flow. . Reference1 , Section 5.5, 6.7 and 7.3.4.	Psia
2422	FWS_WSUM	Output	FW				RE	30	FWS model node flow error. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/sec
2423	FWS_IMN	Output	FW				IN	30	FWS model node network masking flag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2424	FWS_NNOD	Input	FW			Model Design	IN		FWS model network number of nodes. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2425	FWS_NEXTN	Input	FW			Model Design	IN		FWS model network number of extnodes. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2426	FWS_NPSGMFW	Input	FW	SG		Model Design	IN	4	FWS model SG main fw path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2427	FWS_NPSGECO	Input	FW	SG		Model Design	IN	4	FWS model SG economizer fw path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2428	FWS_NPSGAFW	Input	FW	SG	AFW	Model Design	IN	4	FWS model SG emergency/aux fw path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2429	FWS_NPFWLB	Input	FW			Model Design	IN	4	FWS model MFWLB path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2430	FWS_AFWLB	Output	FW				RE	4	FWS model MFWLB flow area (local)	Ft^2
2432	FWS_NSG	Output	FW				IN		FWS model number of SG (local)	Pointer

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Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2433	FWS_FDVALV	Partition	FW				RE	1000	FWS model valve partition	Partition
2434	FWS_STROKE	I/O	FW				RE	30	FWS model valve demand (per cent)	Percent
2435	FWS_POSIT	Output	FW				RE	30	FWS model valve position. Reference1 , Section 5.5, 6.7 and 7.3.4.	Percent
2436	FWS_CVV	Output	FW				RE	30	FWS model valve flow coefficient. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2437	FWS_TOPN	Input	FW			Component Design	RE	30	FWS model valve stroke open time. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2438	FWS_TCLOS	Input	FW			Component Design	RE	30	FWS model valve stroke close time. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2439	FWS_TLAG	Input	FW			Component Design	RE	30	FWS model valve actuator lag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2440	FWS_CVP	Input	FW			Component Design	RE	200	FWS model valve CV vs Position. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2441	FWS_STP	Input	FW			Component Design	RE	200	FWS model valve position vs CV. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2442	FWS_NPATH	Input	FW			Model Design	IN	30	FWS model valve path location ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2443	FWS_NTABLE	Input	FW			Model Design	IN	30	FWS model valve CV table ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2444	FWS_NPTV	Input	FW				IN	10	FWS model valve CV table no of pts. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2445	FWS_INDEXF	Output	FW				IN	30	FWS model valve CV table index. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2446	FWS_NVMFV	Input	FW			Model Design	IN	4	FWS model Main Feed Valve ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2447	FWS_NVBFV	Input	FW			Model Design	IN	4	FWS model Bypass Feed Valve ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2448	FWS_NVAL	Input	FW			Model Design	IN		FWS model number of valves. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2449	FWS_NHDV	Input	FW			Model Design	IN		FWS model number of Heater Drain valves. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2450	FWS_NVHDV	Input	FW			Model Design	IN	3	FWS model heater drain valve ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2451	FWS_NAFWVT	Input	FW	AFW		Model Design	IN		FWS model total number of AFW valves. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2452	FWS_NVAFW1	Input	FW	AFW		Model Design	IN		FWS model AFW valve 1 ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2453	FWS_NTABFV	Input	FW			Model Design	IN		FWS model number of fw valve tables. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2454	FWS_FDPUMP	Partition	FW				RE	1200	FWS model pump partition	Partition
2455	FWS_SPDMD	I/O	FW				RE	20	FWS model pump speed demand. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2456	FWS_SPEED	Output	FW				RE	20	FWS model pump speed. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimensions	Definition	Units
2457	FWS_TAUON	Input	FW			Component Design	RE	20	FWS model pump speed lag (increasing) . Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2458	FWS_TAUOFF	Input	FW			Component Design	RE	20	FWS model pump speed lag (decreasing) . Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2459	FWS_HT	Input	FW			Component Design	RE	200	FWS model pump head vs flow tables. Reference1 , Section 5.5, 6.7 and 7.3.4.	Feet
2460	FWS_WT	Input	FW			Component Design	RE	200	FWS model pump flow vs head tables. Reference1 , Section 5.5, 6.7 and 7.3.4.	Gal/min
2461	FWS_BTABLE	Input/init	FW			Component Design	RE	200	FWS model pump BTABLE vs flow. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2462	FWS_ATABLE	Input/init	FW			Component Design	RE	200	FWS model pump ATABLE vs flow. Reference1 , Section 5.5, 6.7 and 7.3.4.	Composite Units
2463	FWS_NPMPTH	Input	FW			Model Design	IN	20	FWS model pump path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2464	FWS_NTABP	Input	FW				IN	20	FWS model pump perf table ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2465	FWS_NPTP	Input	FW				IN	10	FWS model pump table no of pts . Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2466	FWS_NPMPMFW	Input	FW			Model Design	IN	4	FWS model pump MFP ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2467	FWS_NPMPEFW	Input	FW			Model Design	IN	4	FWS model pump AFW/EFW pump ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2468	FWS_NPTHMFP	Input/init	FW			Model Design	IN	4	FWS model pump MFP path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2469	FWS_NPUM	Input	FW			Model Design	IN		FWS model number of pumps. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2470	FWS_NTABFP	Input	FW			Model Design	IN		FWS model number of fw pump tables. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2471	FWS_NMFWP	Input	FW			Model Design	IN		FWS model number of mfw pumps. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2472	FWS_NEFWP	Input	FW			Model Design	IN		FWS model number of efw pumps. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2473	FWS_FDHEAT	Partition	FW				RE	500	FWS model fw heater partition	Partition
2474	FWS_TPWR	Output	FW				RE		FWS model turbine power. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2475	FWS_TQLAG	Input	FW			Component Design	RE	9	FWS model fw heater heat xfer tau. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2476	FWS_HTRHOV	Input	FW			Component Design	RE	9	FWS model fw heater thermal mass. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm
2477	FWS_PWRTBL	Input	FW			Component Design	RE	90	FWS model fw heater turb pwr vs Q. Reference1 , Section 5.5, 6.7 and 7.3.4.	Percent
2478	FWS_QPTBL	Input	FW			Component Design	RE	90	FWS model fw heater Q vs turb pwr. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/sec

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2479	FWS_HTRHMX	Input	FW			Component Design	RE	90	FWS model fw heater max enthalpy. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2480	FWS_TPOWR	Input	FW			Plant Design	RE	10	FWS model fw Htr Drn turb pwr table. Reference1 , Section 5.5, 6.7 and 7.3.4.	Percent
2481	FWS_TWHDP	Input	FW			Plant Design	RE	10	FWS model fw Htr Drn flow vs turb pwr. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/sec
2482	FWS_TENHDP	Input	FW			Plant Design	RE	10	FWS model fw Htr Drn enth vs turb pwr. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2483	FWS_MAXTAU	Input	FW			Component Design	RE	9	FWS model fw heater max tau. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2484	FWS_FDPOS0	Output	FW				IN	9	FWS model fw heater table index. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2485	FWS_HFWBIAS	Input	FW				RE		FWS model fw enth bias to tune fw enth. Reference1 , Section 5.5, 6.7 and 7.3.4.	Btu/lbm
2486	FWS_NPHEAT	Input	FW			Model Design	IN	9	FWS model fw heater path location ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2487	FWS_NHTBL	Input	FW			Model Design	IN	9	FWS model fw heater table no of pts. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2488	FWS_NHT	Input	FW			Model Design	IN		FWS model number of fw heaters. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2489	FWS_NHDPTBL	Input	FW			Model Design	IN		FWS model fw htr drn table no of pts. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2490	FWS_FDMODL	Partition	FW				RE	288	FWS model fw model misc controls	Partition
2491	FWS_NRCIRC	Input	FW			Model Design	IN		FWS model no of recirc flow cntrls. Reference1 , Section 5.5, 6.7 and 7.3.4.	Counts
2492	FWS_FWRCPB	Input	FW			Controller Setpoint	RE	20	FWS model pump recirc control PB. Reference1 , Section 5.5, 6.7 and 7.3.4.	Percent
2493	FWS_FWRCRE	Input	FW			Controller Setpoint	RE	20	FWS model pump recirc control reset. Reference1 , Section 5.5, 6.7 and 7.3.4.	Seconds
2494	FWS_FWRCSP	Input	FW			Controller Setpoint	RE	20	FWS model pump recirc control setpt. Reference1 , Section 5.5, 6.7 and 7.3.4.	Gal/min
2495	FWS_FWRCIR	Input	FW			Controller Setpoint	RE	20	FWS model pump recirc cntrl instr range. Reference1 , Section 5.5, 6.7 and 7.3.4.	Gallons
2496	FWS_FWRCOUT	Output	FW			Controller State	RE	20	FWS model pump recirc control output. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2497	FWS_FWRCINT	Output	FW			Controller State	RE	20	FWS model pump recirc control integral. Reference1 , Section 5.5, 6.7 and 7.3.4.	Fraction
2498	FWS_NPTHRC	Input	FW			Model Design	IN	20	FWS model pump recirc cntrl path ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2499	FWS_NVALRC	Input	FW			Model Design	IN	20	FWS model pump recirc cntrl valve ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2500	FWS_NPMPRC	Input	FW			Model Design	IN	20	FWS model pump recirc cntrl pump ID. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2501	FWS_IAUTORC	Input/Init	FW			Flag	IN	20	FWS model pump recirc cntrl auto flag. Reference1 , Section 5.5, 6.7 and 7.3.4.	Pointer
2505	FWS_DCL_MASS	Output	FW			T/H State	RE	4	FWS model downcomer line mass. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm
2506	FWS_ECL_MASS	Output	FW			T/H State	RE	4	FWS model economizer line mass. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm
2507	AFWS_FLOW	I/O	FW	AFW		T/H State	RE	4	Auxiliary feedwater flow rate. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm/sec
2508	FWS_LINE_MASSES	Output	FW			T/H State	RE	4, 2	FWS steady state feed line mass. Reference1 , Section 5.5, 6.7 and 7.3.4.	Lbm
2509	FWS_FDSYST	Partition	FW				RE	10000	FWS model fw system eqn partition. Reference1 , Section 5.5, 6.7 and 7.3.4.	Partition
2510	NONCOND_COMMON	Segment					RE	9000	Species and noncondensibles transport	Segment
2511	RCS_SPECIES_CONSTANTS	Partition					RE	61	Species Constants Partition	Partition
2512	NUM_SOLUTES	Input	RCS				IN		Number of dissolved solute species exclusive of non-condensibles(NC), where Solutes (SO)+NC <= 20. This parameter sets the expected count for other partition variables. Reference 1, Sections 4.15, 5.8.	Counts
2513	HALF_LIFE_SOLUTES	Input	RCS				RE	20	Radioactive decay half lives of dissolved species. For stables solutes, the value for this variable is set to 0.0 sec. Nitrogen-16 carries a short half life which should be set for proper tracking of N-16. Reference 1, Sections 4.15, 5.8.	Seconds
2514	CONC_RATIO_STM_LIQ	Input	RCS				RE	20	Measure of each solute's relative solubilities in liquid & steam. Concentration ratio stm,liq = Cstm,max/(Cstm,max+Cliq,max) [0.0,1.0] Reference 1, Sections 4.15, 5.8.	Fraction
2515	CONC_MAX	Input	RCS				RE	20	Maximum concentration of each species in solution (LBM/LB,PPM,...) Reference 1, Sections 4.15, 5.8.	Composite Units
2516	ID_TYPE_SPECIES	Partition					IN	20	Identifying pointers for the species.	Partition
2517	ID_TYPE_SOLUTE	Partition					IN	15	Identifying pointers for the solutes. Reference 1, Sections 4.15, 7.2.7.	Pointer
2518	ID_TYPE_BORON	Input	RCS				IN		Identifying pointer for boron. Reference 1, Sections 4.15, 7.2.7.	Pointer
2519	ID_TYPE_N16	Input	RCS				IN		Identifying pointer for N-16. Reference 1, Sections 4.15, 7.2.7.	Pointer
2520	ID_TYPE_IODINE	Input	RCS				IN		Identifying pointer for iodine. Reference 1, Sections 4.15, 7.2.7.	Pointer
2521	ID_TYPE_XENON	Input	RCS				IN		Identifying pointer for xenon. Reference 1, Sections 4.15, 7.2.7.	Pointer
2522	ID_TYPE_PART	Input	RCS				IN		Identifying pointer for particulates. Reference 1, Sections 4.15, 7.2.7.	Pointer
2523	ID_TYPE_NONC	Partition					IN	5	Identifying pointers for the nonconds. Reference 1, Sections 4.15, 7.2.7.	Pointer
2524	ID_TYPE_HYD	Input	RCS				IN		Identifying pointer for hydrogen. Reference 1, Sections 4.12, 7.2.7.	Pointer
2525	ID_TYPE_NIT	Input	RCS				IN		Identifying pointer for nitrogen. Reference 1, Sections 4.12, 7.2.7.	Pointer
2526	ID_TYPE_AIR	Input	RCS				IN		Identifying pointer for air. Reference 1, Sections 4.12, 7.2.7.	Pointer
2527	RCS_NONCOND_CONSTANTS	Partition					RE	65	Noncondensibles constants Partition	Partition

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2528	NUM_NONC	Input	RCS				IN		No. of non-condensible species, NC <= 5 Reference 1, Sections 4.12, 7.2.7.	Counts
2529	NONC_K_DISSOLVE	Input	RCS				RE	5	NC gas dissolution coefficient, for each species, lb/sec-ft2-delconc. If the concentration of the NC within the liquid in the node is less than saturated , then separated gas may dissolve. The rate of dissolution is directly proportional the dissolution coefficient, stm-liq surface area, concentration of dissolved nc and the specific volumes of the stm & liq. Reference 1, Sections 4.12, 4.15.	Composite Units
2530	NONC_MW	Input	RCS				RE	5	Molecular weights of non-condensible. Reference 1, Section 4.12.	Composite Units
2531	CORE_N16_MULT	Input	RCS	Core			RE		Production constant for N-16. The generation rate of N-16 = POW_USER_QC (fission power fraction) * CORE_N16_MULT. Reference 1, Sections 4.15, 5.8, 7.2.7.	µC / power-fraction
2532	COND_NONC_FRAC	Input	RCS				RE	2	Condensation efficiency in the presence of non-condensible gases. When the node's gas fraction QUAL_NONC_SEP_TOT is at COND_NONC_FRAC(1) or below, condensation of steam can occur at full efficiency. When the node's gas fraction is at COND_NONC_FRAC(2) or above, the condensation efficiency is zero, and no steam condensation can occur. Between these points, the condensation efficiency is interpolated. Reference 1, Section 4.12.	Fraction
2533	COND_NONC_DEG_MULT	Input	RCS				RE	50	Condensation degradation with non-condensibles. Reference 1, Section 4.12.	Dimensionless
2534	RCS_PRZR_SPR_GAS_ENTR	Input	RCS				RE		Constant for gas entrainment in pzr spray. The rate of entrainment = rcs_przr_spr_gas_entr * p_flow_spray * gas quality in the pzr stm space. Reference 1, Section 4.12.	Dimensionless
2535	RCS_SPECIES_NODES	Partition					RE	2300	Node species state	Partition
2536	MASS_NONC_DIS	Output	RCS				RE	50, 5	Nodal mass of each dissolved non-condensibles. Reference 1, Section 4.12, 4.15, 7.2.7.	Lbm
2537	MASS_NONC_DIS_TOT	Output	RCS				RE	50	Nodal mass of Total dissolved non-condensibles. Reference 1, Section 4.12, 4.15, 7.2.7.	Lbm
2538	RCS_CONC_SOLUTE	Output	RCS				RE	50, 20	Node concentrations of all dissolved solute species. Rcs_conc_solute(l) = solute (k) mass / mass_tot(l). Reference 1, Section 4.15, 7.2.7.	Composite Units
2539	RCS_CUM_SOLU	Output	RCS				RE	50, 20	Node solute accumulation rate: production+net flow+dissolution rate. Reference 1, Section 4.12, 4.15.	Composite Units
2540	RCS_NONCOND_NODES	Partition					RE	1450	Node noncondensables state	Partition
2541	MASS_NONC_SEP	Output	RCS				RE	50, 5	Mass of each non-condensible in the steam/gas space of each node. Reference 1, Section 4.12, 7.2.7.	Lbm
2542	MASS_NONC_SEP_TOT	Output	RCS				RE	50	Total mass of all non-condensibles in the steam/gas space of each node. Reference 1, Section 4.12, 7.2.7.	Lbm
2543	QUAL_NONC_SEP	Output	RCS				RE	50, 5	Quality of each non-condensible in the nodal steam/gas space. Xg(l,k) = mass_nonc_sep(l,k)/(mass_stm(l)+ mass_nonc_sep_tot(l)). Reference 1, Section 4.12.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2544	QUAL_NONC_SEP_TOT	Output	RCS				RE	50	Quality of all non-condensibles in nodal steam/gas space, or the sum of all the qual_non_sep(l,k). Reference 1, Section 4.12.	Fraction
2545	RCS_CUM_NONC	Output	RCS				RE	50, 5	Per node, each non-condensible accumulation rate: net flow in + separation of dissolved gas from the liquid to the steam space. Reference 1, Section 4.12, 4.15.	Lbm/sec
2546	COND_NONC	Output	RCS				RE	50	Node rates of non-condensible dissolution. Reference 1, Section 4.12, 4,15.	Lbm/sec
2547	PPRES_NONC	Output	RCS				RE	50, 5	Partial pressures of each non-condensible in each node. Calculated using the ideal gas law: Ppres_nonc(k) = R*Mass_nonc_sep(k)/nonc_mw(k) *(Temp_nonc+459.7)/Pvol_nonc_tot. Reference 1, Section 4.12.	Psia
2548	PPRES_NONC_TOT	Output	RCS				RE	50	Sum of partial pressures of all the non-condensibles in the steam space of each node (i.e. the sum of ppres_nonc). This variable is limited to a 10 psi/sec rate of increase for numerical stability. Reference 1, Section 4.12.	Psia
2549	PPRES_STM	Output	RCS				RE	50	Node steam partial pressures. Reference 1, Section 4.12.	Psia
2550	PVOL_NONC_TOT	Output	RCS				RE	50	Total volume of separated non-condensible gas. This equates to the steam/nc or "free" space in each node. Reference 1, Section 4.12.	Ft^3
2551	TEMP_NONC	Output	RCS				RE	50	Temperature of non-condensible in each node. If no steam space is present in a given node, then the liquid temperature is used. It is assumed that the temperature of the non-condensibles is the same as the steam temperature. Reference 1, Section 4.12.	Degree F
2552	PRESS_STM_LAST	Output	RCS				RE	50	Last Nodal Pressure - does not include gas	Psia
2553	PTEMP_STM_SAT	Output	RCS				RE	50	Steam saturation temperature at its partial pressure. Related variables are TEMP_STM & TEMP_SAT. Reference 1, Section 4.12.	Degree F
2554	RCS_SPECIES_PATHS	Partition					RE	3000	Path species state	Partition
2555	P_CONC_SOLU	Output	RCS				RE	150, 20	Path concentrations of each dissolved species, inclusive of internal, external, leak, etc. paths. Reference 1, Section 4.15, 5.8, 7.2.7.	Composite Units
2556	RCS_NONCOND_PATHS	Partition					RE	1080	Path noncondensables state	Partition
2557	P_FLOW_NONC	Partition					RE	150	Path flows of all separated non-condensibles.	Lbm/sec
2558	P_FLOW_NONC_MOM	Output	RCS				RE	100	Mom path flows of all separated non-condensibles. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2559	P_FLOW_NONC_NONM	Output	RCS				RE	50	Non-mom path flows of all separated non-condensibles. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2560	P_FRAC_NONC	Output	RCS				RE	150, 5	Path concentrations of each of the separated non-condensibles in each flow path (momentum and nonmomentum). Reference 1, Section 4.12, 7.2.7.	Fraction
2561	P_FRAC_NONC_TOT	Output	RCS				RE	150	Path concentrations of the sum of separated non-condensibles in each flow path (momentum and nonmomentum). It is the sum of p_frac_nonc for each path. Reference 1, Section 4.12.	Fraction

Table G.1: Dictionary Listing

Index No.	Long Variable Name	Input / Output	System	System Alt. 1	System Alt. 2	Variable's Function	Type	Dimen-sions	Definition	Units
2562	MASS_NONC_SEP_RCS	Output	RCS				RE		Total mass of all non-condensibles in the steam/gas space of the RCS. This equals the sum of mass_nonc_sep_tot(l). Reference 1, Section 4.12, 7.2.7.	Lbm
2563	FLOW_DP_MAX_ERR	Output	RCS				RE		Max error of predicted pressure relative to calculated pressure	Psid
2564	FLOW_DP_NODE_MAX_ERR	Output	RCS				IN		Node at which maximum error FLOW_DP_MAX occurred.	Pointer
2565	FLOW_DP_PRINT_NODE	Input	RCS				IN		Print DP data for this node number (for debug)	Pointer
2566	MASS_NONC_RCS	Output	RCS				RE		RCS non-condensible total mass (separated & dissolved), sum of all species and all nodes. Reference 1, Section 4.12, 4.15.	Lbm
2567	RCS_PRZR_Q_EFF	Input	PZR	RCS			RE		Pressurizer condensation efficiency when non-condensibles are present. Reference 1, Section 4.12.	Fraction
2568	RCS_PRZR_Q_COND	Output	PZR	RCS			RE		Pressurizer condensation heat transfer. Reference 1, Section 4.12.	Btu/sec
2569	MASS_NONC_DIS_RCS	Output	RCS				RE		Total mass of dissolved non-condensibles in all RCS nodes combined. Reference 1, Section 4.12, 4.15, 7.2.7.	Lbm
2571	CORE_RELE_SOLU	Output	RCS				RE	20	Solute release rate in core (fuel failure). Reference 1, Section 4.12, 4.15, 5.8.	Composite Units
2572	RCS_NONCOND_INTERF	Partition					RE	38	Noncondensible interfaces partition	Partition
2573	P_FLOW_AUXSP_NONC	Output	RCS				RE	5	Auxiliary spray non-condensibles flow, for each species. This should equal the concentration of non-condensibles in the charging lines * the aux. spray flow rate in lbm/sec. Reference 1, Section 4.12.	Lbm/sec
2574	SIS_RCS_NONC	Input Partition					RE	6, 5	Noncondensables inflow via SI lines. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2575	SIS1_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, CL 1. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2576	SIS2_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, CL 2. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2577	SIS3_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, CL 3. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2578	SIS4_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, CL 4. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2579	SIS5_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, HL 1. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2580	SIS6_RCS_NONC	Input	RCS				RE	5	Each non-condensibles inflow via SI line, HL 2. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2581	GS_VES_NONC	Input	RCS				RE		Non-condensibles inflow to vessel via Gas System. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2582	GS_PRZR_NONC	Input	RCS				RE		Non-condensibles inflow to pressurizer via Gas System. Reference 1, Section 4.12, 7.2.7.	Lbm/sec
2583	GS_SPECIES	Input	RCS				IN		Species of Gas System gas (from ID_TYPE_SPECIES) that is entering the RCS via any of the inputs SISn_RCS_NONC, GS_VES_NONC or GS_PRZR_NONC. Reference 1, Section 4.12, 7.2.7.	Pointer

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1	CHR	CHR_COMMON	CH	336	Character variables for snapshot ID	Segment
2	. PLABEL	PLANT_DATA_LABEL	CH		Plant data title character variables	Partition
3	. . PFILE	PLANT_DATA_FILE_NAME	CH		Plant data file description	Character
4	. . PTITLE	PLANT_DATA_TITLE	CH		Plant data file title	Character
5	. . PTIME	PLANT_DATA_TIME	CH		Plant data file time stamp	Character
6	. . PDATE	PLANT_DATA_DATE	CH		Plant data file date stamp	Character
7	. . SLABEL	SNAPSHOT_LABEL	CH		Snapshot file character variables	Partition
8	. . . SFILE	SNAPSHOT_FILE_NAME	CH		Snapshot file description	Character
9	. . . STITLE	SNAPSHOT_TITLE	CH		Snapshot file title	Character
10	. . . STIME	SNAPSHOT_TIME	CH		Snapshot file time stamp	Character
11	. . . SDATE	SNAPSHOT_DATE	CH		Snapshot file date stamp	Character
12	. . . CTLT	CTL_TITLE	CH	1000	Titles of controllers	Character
13	PLT	PLT_DATA	RE	25000	Restore-only plant data	Segment
14	. PLT01	UNUSED_VAR_PLT01	RE	15	Unused Partition	Dimensionless
15	. . DUMMY1	CORE_RAD_OUT_DUMMY	RE	3	Unused Variable	Dimensionless
16	. . TNMAXL	CHT_NUM_LINPROP	IN		Unused Variable	Dimensionless
17	. . TNPROP	CHT_TIME_STP_NUM	IN		Unused Variable	Dimensionless
18	. DRCS	PLT_RCS	RE	2350	Restore-only RCS plant data	Partition
19	. . DRDESN	PLT_RCS_DESIGN	IN	10	RCS design features	Partition
20	. . . NUMSG	NUM_SG	IN		Number of steam generators	Counts
21	. . . DRTYPE	PLT_RCS_TYPE	IN		Unused Variable	Dimensionless
22	. . . DNPROP	NUM_PROP_HEATERS	IN		Number of proportional heaters	Counts
23	. . . DNBACK	NUM_BACK_HEATERS	IN		Number of backup heaters	Counts
24	. . . DNCHGS	NUM_CHGS_PUMPS	IN		Number of charging pumps	Counts
25	. . . DNSPRA	RCS_NUM_MSPRAYVLVS	IN		Number of przr main spray valves	Counts
26	. . . DNPORV	RCS_NUM_PORVS	IN		Number of przr PORVs	Counts
27	. . . DNPRSV	RCS_NUM_SAFETYVLVS	IN		Number of przr safety valves	Counts
28	. . . DMODIN	MOD_INIT	LO		Plant data initialization cue	True False
29	. . . DMDINV	MOD_INITV	LO		Plant data initialization cue - data	True False
30	. . DNODE	PLT_RCS_NODE	RE	900	Restore-only RCS plant node data	Partition
31	. . . NODENO	PLT_RCS_NODALIZATION	IN	50	RCS nodalization data	Partition
32	. . . . NODETO	RCS_NODE_TOTALS	IN	6	RCS total number of nodes per group	Partition
33	. . . . . NUMNOD	NUM_NODES	IN		Total number of nodes (50 max)	Counts
34	. . . . . NNODSE	NUM_NODES_SEC	IN		Number of sectionalized nodes (1 max)	Counts
35	. . . . . NNODSG	NUM_SG_NODES	IN		Number of SG nodes (2 per SG, 16 max)	Counts
36	. . . . . NNODHL	NUM_HL_NODES	IN		RCS number of hot leg nodes	Counts
37	. . . . . NNODSL	NUM_SL_NODES	IN		RCS number of suction leg nodes	Counts
38	. . . . . NNODCL	NUM_CL_NODES	IN		RCS number of cold leg nodes	Counts
39	. . . . NODENU	RCS_NODE_NUMBERS	IN	30	RCS node numbers	Partition
40	. . . . . NODEHL	RCS_NODE_HL	IN	4	RCS hot leg nodes	Partition
41	. . . . . NHL1	NODE_HL1	IN		Hot leg 1 node number	Pointer
42	. . . . . NHL2	NODE_HL2	IN		Hot leg 2 node number	Pointer
43	. . . . . NHL3	NODE_HL3	IN		Hot leg 3 node number	Pointer
44	. . . . . NHL4	NODE_HL4	IN		Hot leg 4 node number	Pointer
45	. . . . . NODESG	NODE_SG	IN	16	Array of SG node numbers	Pointer
46	. . . . . NSG1H	NODE_SG1H	IN		SG tube hot side node number,loop 1	Pointer
47	. . . . . NSG1C	NODE_SG1C	IN		SG tube cold side node number, loop 1	Pointer
48	. . . . . NSG2H	NODE_SG2H	IN		SG tube hot side node number, loop 2	Pointer
49	. . . . . NSG2C	NODE_SG2C	IN		SG tube cold side node number, loop 2	Pointer
50	. . . . . NSG3H	NODE_SG3H	IN		SG tube hot side node number,loop 3	Pointer
51	. . . . . NSG3C	NODE_SG3C	IN		SG tube cold side node number, loop 3	Pointer
52	. . . . . NSG4H	NODE_SG4H	IN		SG tube hot side node number, loop 4	Pointer
53	. . . . . NSG4C	NODE_SG4C	IN		SG tube cold side node number, loop 4	Pointer
54	. . . . . NODECL	NODE_CL	IN	4	Array of cold leg node numbers	Pointer
55	. . . . . NCL1	NODE_CL1	IN		Cold leg node number, loop 1	Pointer
56	. . . . . NCL2	NODE_CL2	IN		Cold leg node number, loop 2	Pointer
57	. . . . . NCL3	NODE_CL3	IN		Cold leg node number, loop 3	Pointer
58	. . . . . NCL4	NODE_CL4	IN		Cold leg node number, loop 4	Pointer
59	. . . . . NODESL	RCS_NODE_SL	IN	4	RCS suction leg node numbers	Partition
60	. . . . . NSG1P	NODE_SG1P	IN		SG outl plen. and suct. leg node loop 1	Pointer
61	. . . . . NSG2P	NODE_SG2P	IN		SG outl plen. and suct. leg node loop 2	Pointer
62	. . . . . NSG3P	NODE_SG3P	IN		SG outl plen. and suct. leg node loop 3	Pointer
63	. . . . . NSG4P	NODE_SG4P	IN		SG outl plen. and suct. leg node loop 4	Pointer
64	. . . . . NODEOT	RCS_NODE_OTHERS	IN	10	RCS remaining nodes	Partition
65	. . . . . NCORE	NODE_CORE	IN		Core node number	Pointer
66	. . . . . NPRZR	NODE_PRZR	IN		Pressurizer node number	Pointer
67	. . . . . NUHEAD	NODE_UHEAD	IN		Upper head node number	Pointer
68	. . . . . NANNUL	NODE_ANNUL	IN		Annulus node number	Pointer
69	. . . . . NCEASH	NODE_CEASH	IN		CEA shroud node number	Pointer
70	. . . NODGEO	RCS_NODE_GEOMETRY	RE	250	RCS node geometry variables	Partition
71	. . . . NODEA	NODE_AREA	RE	50	Node cross sectional area	Ft^2
72	. . . . NZTOT	NODE_HEIGHT	RE	50	Node height	Feet
73	. . . . NELBOT	N_BOT	RE	50	Node bottom elevation	Feet

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
74	. . . . NGEOM	N_GEOM	IN	50	Node geometry indicator	Pointer
75	. . . . NOSECT	N_SECTIONS	IN	50	Sections in node (node 1 max 22, rest 1)	Counts
76	. . . NODETH	RCS_NODE_TH_VARS	RE	500	RCS node thermo-hydraulic constants	Partition
77	. . . . NXLIQ	N_HEAT_XFER_LIQ	RE	50	Node wall-to-liq overall heat tr. coeffs	Btu/sec-degF
78	. . . . NXSTM	N_HEAT_XFER_STM	RE	50	Node wall-to-stm overall heat tr. coeffs	Btu/sec-degF
79	. . . . NXCON	N_HEAT_XFER_CONT	RE	50	Node wall-to-cont overall heat tr coeffs	Btu/sec-degF
80	. . . . NXBOT	N_HEAT_XFER_BOT	RE	50	Node bottom wall-to-fluid ht coef	Btu/secft^2degF
81	. . . . NWLMXC	N_HEAT_CAP	RE	50	Node wall heat capacity	Btu/degF
82	. . . . NXBOIL	N_XFER_BOIL	RE	50	Node boiling condensation coef	Btu/sec-degF
83	. . . . NXINJ	N_XFER_INJ	RE	50	Node liquid injection condensation mult	Dimensionless
84	. . . . NXSPOF	XFER_SURF_POFF	RE	50	Node surface condensation coef(pump off)	Btu/secft^2degF
85	. . . . NXSPON	XFER_SURF_PON	RE	50	Node surface condensation coef(pump on)	Btu/secft^2degF
86	. . . . NAMULT	AREA_INJ_MULT	RE	50	Interfacial condensation area mult	Dimensionless
87	. . . NSECT	RCS_NODE_SECTIONALIZED	RE	100	RCS sectionalized nodes variables	Partition
88	. . . . NUMSEG	RCS_PRZR_NSECT	IN		Number of area sections in przr	Counts
89	. . . . APZR	RCS_PRZR_ASECT	RE	3	Przr cross-sectional areas	Ft^2
90	. . . . HPZR	RCS_PRZR_HSECT	RE	3	Przr section heights	Feet
91	. . . . NUMANN	RCS_ANNUL_NSECT	IN		Number of sections in annulus low plen	Counts
92	. . . . AANN	RCS_ANNUL_ASECT	RE	3	Annulus cross-sectional areas	Ft^2
93	. . . . ZANN	RCS_ANNUL_HSECT	RE	3	Annulus section heights	Feet
94	. . . . ASECVA	N_AREA_SECT	RE	1,22	Cross sect area of section(node,section)	Ft^2
95	. . . . ZSECVA	N_HEIGHT_SECT	RE	1,22	Height of section (node,section)	Feet
96	. . DPATH	PLT_RCS_PATH	RE	1400	Restore-only flow path RCS plant data	Partition
97	. . . PATHNO	RCS_PATHS_NODALIZATION	IN	60	RCS paths nodalization variables	Partition
98	. . . . PATHTO	RCS_PATHS_TOTALS	IN	25	RCS total paths	Partition
99	. . . . . PNMOM	NUM_PATHS_MOM	IN		Number of momentum paths	Counts
100	. . . . . PNEXT	NUM_PATHS_EXT	IN		Number of external flow paths (25 max)	Counts
101	. . . . . PNLEAK	NUM_PATHS_LEAK	IN		Number of leak flow paths (17 max)	Counts
102	. . . . . PNINT	NUM_PATHS_INT	IN		Number of internal flow paths (8 max)	Counts
103	. . . . . PNPATH	NUM_PATHS	IN		Total number of flow paths	Counts
104	. . . . . PNSB	NUM_SML_BRK	IN		Number of SB leak flow paths (4 max)	Counts
105	. . . . . PNHL	NUM_PATHS_HL	IN		Number of hot leg flow paths (4 max)	Counts
106	. . . . . PNCL	NUM_PATHS_CL	IN		Number of cold leg flow paths (8 max)	Counts
107	. . . . . PNNONM	NUM_PATHS_NONM	IN		RCS number of non-momentum paths	Counts
108	. . . . . PNCHGS	RCS_NUMIN_CHGS	IN		Number of RCS-CHGS connections	Counts
109	. . . . . PNLET	RCS_NUMOUT_LDNS	IN		Number of RCS-letdown connections	Counts
110	. . . . . PNDRN	RCS_NUMOUT_RCWDRAINS	IN		Number of RCS-RCW drain connections	Counts
111	. . . . . PNSDC	RCS_NUMOUT_SDC	IN		Number of RCS-SDC connections (1 max)	Counts
112	. . . . . PNSIS	RCS_NUMIN_SIS	IN		Number of RCS-SIS connections	Counts
113	. . . . . PNRCP	RCS_NUMMAX_RCP	IN		Maximum number of RCP paths	Counts
114	. . . . . PNCHGM	RCS_NUMMAX_CHGSIN	IN		Max. number of CHGS conn. to RCS	Counts
115	. . . . . PNLETM	RCS_NUMMAX_LDNSOUT	IN		Max. numb. of ldns connect. to RCS	Counts
116	. . . . . PNDRNM	RCS_NUMMAX_DRAINSOUT	IN		Max. numb. of drains to RCW from RCS	Counts
117	. . . . . PNSDCM	RCS_NUMMAX_SDCOUT	IN		Max. numb. of SDC connect to RCS (out)	Counts
118	. . . . . PNSISM	RCS_NUMMAX_SISIN	IN		Max. numb. of SIS connect. to RCS (in)	Counts
119	. . . . . PNMOMM	RCS_NUMMAX_MOM	IN		Maximum number of momentum paths	Counts
120	. . . . PATHNU	RCS_PATHS_NUMBERS	IN	35	RCS path numbers	Partition
121	. . . . . PSURGE	PATH_SURGE	IN		Surge line path number	Pointer
122	. . . . . PANCOR	PATH_ANNUL_CORE	IN		Annulus-to-inner vessel path number	Pointer
123	. . . . . PCORUH	PATH_CORE_UHEAD	IN		Upper head-to-inner vessel path number	Pointer
124	. . . . . PSPRAY	PATH_SPRAY	IN		Pressurizer spray path number	Pointer
125	. . . . . PLBLOC	PATH_LB_LOCA	IN		Large break LOCA path number (mal 038)	Pointer
126	. . . . . PPUMP	PATH_PUMP	IN	4	RCP paths array (11a, 11b, 12a, 12b)	Pointer
127	. . . . . PATHHL	PATH_HL	IN	8	Inner vessel-to-hot leg path array	Pointer
128	. . . . . PATHCL	PATH_CL	IN	8	Array of cold leg path nos.: 11a,b,12a,b	Pointer
129	. . . . . PATHSG	PATH_SG	IN	4	Top of SG tube bundle path number	Pointer
130	. . . . . PUCEA	PATH_UCEA	IN		CEA to upper head path number	Pointer
131	. . . PATHG	RCS_PATHS_GEOMETRY	RE	1300	RCS paths geometry variables	Partition
132	. . . . PINLET	P_NODE_INLET	IN	150	Path inlet node number (all paths)	Pointer
133	. . . . . PIMOM	RCS_P_NODE_INLET_MOM	IN	100	Path inlet number (momentum)	Pointer
134	. . . . . PINMOM	RCS_P_NODE_INLET_NONM	IN	50	Path inlet number (non momentum)	Pointer
135	. . . . . PIEXT	RCS_PATHEXT_PNODEIN	IN	25	External paths inlet node	Pointer
136	. . . . . PIRCP	RCS_RCPLEAK_PNODEIN	IN	4	RCP leak inlet node	Pointer
137	. . . . . PICHGS	RCS_CHGS_PNODEIN	IN	4	Charging inlet node	Pointer
138	. . . . . PILET	RCS_LDNS_PNODEIN	IN	4	RCS- letdown inlet node	Pointer
139	. . . . . PIDRN	RCS_RCW_PNODEIN	IN	1	RCS RCW drains inlet node	Pointer
140	. . . . . PISDC	RCS_SDC_PNODEIN	IN	2	RCS shutdown cooling inlet node	Pointer
141	. . . . . PISIS	RCS_SIS_PNODEIN	IN	8	RCS safety injection inlet node	Pointer
142	. . . . . PIGAS	RCS_GAS_PNODEIN	IN	2	RCS gas injection inlet node	Pointer
143	. . . . . PILEAK	RCS_PATHLEAK_PNODEIN	IN	17	Leak paths inlet node	Pointer
144	. . . . . PISGTR	RCS_SGTR_PNODEIN	IN	8	RCS SG tube rupture inlet node	Pointer
145	. . . . . PISB	RCS_SBLOCA_PNODEIN	IN	4	RCS small break LOCA inlet node	Pointer
146	. . . . . PIRODE	RCS_RODEJ_PNODEIN	IN		RCS rod ejection small break inlet node	Pointer
147	. . . . . PIORIN	RCS_ORING_PNODEIN	IN		RCS o-ring seal inlet node	Pointer

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
148	PILB	RCS_LBLOCA_PNODEIN	IN		RCS large break LOCA inlet node	Pointer
149	PINT	RCS_PATHINT_PNODEIN	IN	8	RCS internal paths inlet node	Pointer
150	PISPRA	RCS_SPRAY_PNODEIN	IN		RCS przr spray inlet node	Pointer
151	PIBLED	RCS_SPRAYBLEED_PNODEIN	IN	2	RCS przr spray bleed inlet node	Pointer
152	PIPZRR	RCS_PRZR_RELIEF_PNODEIN	IN		Przr relief valves inlet node	Pointer
153	PIUHR	RCS_UHEAD_RELIEF_PNODEIN	IN		Upper head relief valves inlet node	Pointer
154	PEXIT	P_NODE_EXIT	IN	100	Path exit node number (momentum paths)	Pointer
155	PEINIT	P_ELEV_INLET	RE	150	Path inlet elevation (at circle center)	Feet
156	PEMOM	RCS_P_ELEV_INLET_MOM	RE	100	Inlet elevation (mom. paths)	Feet
157	PENONM	RCS_P_ELEV_INLET_NONM	RE	50	Path inlet elevation (non momentum)	Feet
158	PEEXT	RCS_PATHEXT_PELEVIN	RE	25	External paths inlet elevation	Feet
159	PERCP	RCS_RCPLEAK_PELEVIN	RE	4	RCP leak inlet elevation	Feet
160	PECHGS	RCS_CHGS_PELEVIN	RE	4	Charging inlet elevation	Feet
161	PELET	RCS_LDNS_PELEVIN	RE	4	RCS- letdown inlet elevation	Feet
162	PEDRN	RCS_RCW_PELEVIN	RE	1	RCS RCW drains inlet elevation	Feet
163	PESDC	RCS_SDC_PELEVIN	RE	2	RCS shutdown cooling inlet elevation	Feet
164	PESIS	RCS_SIS_PELEVIN	RE	8	RCS safety injection inlet elevation	Feet
165	PEGAS	RCS_GAS_PELEVIN	RE	2	RCS gas injection inlet elevation	Feet
166	PELEAK	RCS_PATHLEAK_PELEVIN	RE	17	Leak paths inlet elevation	Feet
167	PESGTR	RCS_SGTR_PELEVIN	RE	8	RCS SG tube rupture inlet elevation	Feet
168	PESB	RCS_SBLOCA_PELEVIN	RE	4	RCS small break LOCA inlet elevation	Feet
169	PERODE	RCS_RODEJ_PELEVIN	RE		RCS rod ejection small break inlet eleva	Feet
170	PEORIN	RCS_ORING_PELEVIN	RE		RCS o-ring seal inlet elevation	Feet
171	PELB	RCS_LBLOCA_PELEVIN	RE		RCS large break LOCA inlet elevation	Feet
172	PEINT	RCS_PATHINT_PELEVIN	RE	8	RCS internal paths inlet elevation	Feet
173	PESPRA	RCS_SPRAY_PELEVIN	RE		RCS przr spray inlet elevation	Feet
174	PEBLED	RCS_SPRAYBLEED_PELEVIN	RE	2	RCS przr spray bleed inlet elevation	Feet
175	PEPZRR	RCS_PRZR_RELIEF_PELEVIN	RE		Przr relief valves inlet elevation	Feet
176	PEUHR	RCS_UHEAD_RELIEF_PELEVIN	RE		Upper head relief valves inlet elevation	Feet
177	PEEXIT	P_ELEV_EXIT	RE	100	Path exit elevation (at circle center)	Feet
178	PGEOM	P_GEOM	IN	100	Path end geom(0-3=pt,circ,u semi,l semi)	Pointer
179	PRADII	P_RADIUS	RE	100	Path radii at end(not related to p_area)	Feet
180	PTLOA	PATH_TLOA	RE	100	Combined inertia length/area (dMom/dt)	Composite Units
181	PKXPOS	PATH_KLOSS_POS	RE	100	Geometric forward k-factor	Dimensionless
182	PKXNEG	PATH_KLOSS_NEG	RE	100	Geometric reverse flow k-factor	Dimensionless
183	PAREA	P_AREA	RE	100	Path flow area	Ft^2
184	PLDIAM	PATH_LEN_DIAM	RE	100	Path length-to-diameter ratio	Dimensionless
185	PDIA	P_DIAM_HYD	RE	100	Path hydraulic diameter	Feet
186	DINVES	PLT_RCS_VES	RE	60	Restore-only inner vessel RCS plant data	Partition
187	DUPMIN	PRES_ATWS_MIN	RE		Atws min head seal leakage pressure	Psia
188	DUAMIN	P_AREA_ATWS_MIN	RE		Atws min head seal leak area	Ft^2
189	DUPMAX	PRES_ATWS_MAX	RE		Atws pressure for max head seal leak	Psia
190	DUAMAX	P_AREA_ATWS_MAX	RE		Atws area at max head seal leak	Ft^2
191	DUAROD	P_AREA_RODEJ	RE		CEA ejection leak area	Ft^2
192	ZOUTUP	N_TOP_UPLEN	RE		Top elev of UP part of inner vessel node	Feet
193	ZINUP	N_BOT_UPLEN	RE		Bottom elev of UP part of IV node	Feet
194	XPOSUP	KLOSS_UPLEN_POS	RE		UP geometric form loss coef, + flow	Dimensionless
195	XNEGUP	KLOSS_UPLEN_NEG	RE		UP geometric form loss coef, - flow	Dimensionless
196	CORBOT	CORE_BOT	RE		Active core bot elev (rel to node bot)	Feet
197	CORTOP	CORE_TOP	RE		Active core top elev (rel to node bot)	Feet
198	FLA	AREA_CORE	RE		Active core flow area	Ft^2
199	DIHACE	HA_CEA_CORE	RE		CEA to IV wall heat trans coef (hA)	Btu/sec-degF
200	PUPCEA	PATH_CEA_LOW	IN		Inlet path, UP to CEA guide tubes	Pointer
201	PCEAUH	PATH_CEA_UP	IN		Exit path, CEA to UH	Pointer
202	DINCEA	NUM_CEAS	IN		Number of CEAs (65 max)	Counts
203	DIHCEA	CEAS_DIST	RE		Traveling distance of CEAs	Feet
204	DIEXBO	EXCORE_BOT	RE		Excore detector elev, bottom (est)	Feet
205	DIEXTO	EXCORE_TOP	RE		Excore detector elev, top (est)	Feet
206	DIEXMP	MAP_EXCORE	IN	10	Excore detector - RCS model mapping	Pointer
207	DIFBY	RTRV_BYPASS	RE		Fraction of vessel flow bypassing core	Fraction
208	DIFTLT	RCS_KWEIGHT_HTILT	RE	4,4	Coeff. for cold leg to hot leg mixing	Fraction
209	DIHAUI	HA_UHEAD_CORE	RE		Upper head to IV heat transfer coef (hA)	Btu/sec-degF
210	DPRZR	PLT_RCS_PRZR	RE	40	Restore-only pressurizer RCS plant data	Partition
211	DHNUM	NUM_HEATERS	IN		Total number przr heater banks (6 max)	Counts
212	DHBURN	BURNOUT_HEATER	RE	6	Heater burnout (set large remove limit)	Btu
213	DWABLD	AREA_BLEED_MIN	RE		Przr spray bleed line min area	Ft^2
214	DHHCAP	HCAP_HEATER	RE	6	Heater gross heat capacity	Btu/degF
215	DHHA	XFER_HEATER	RE	6	Heater overall heat transfer coef	Btu/sec-degF
216	DHOHMS	RESI_HEATER	RE	6	Heater electrical resistance	Ohms
217	DHLTOP	TOP_HEATERS	RE		Top elev of przr heaters	Feet
218	DHVMAX	VOLT_HEATER_MAX	RE		Maximum przr heaters bus voltage	Volts
219	DPLRTD	LEVL_PRZR_RTD	RE		Level of przr rtd	Feet
220	DPLRBO	LEVL_REF_BOT	RE		Bottom level of przr reference leg	Feet
221	DPLRTO	LEVL_REF_TOP	RE		Top level of przr reference leg	Feet

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
222 . .	DVLREL	LEVL_RELIEF	RE		Level of relief valve noz (rel to bot)	Feet
223 . .	DVGPOR	DESIGN_FLOW_PORV	RE		PORV design flow rate	Lbm/sec
224 . .	DVGPS1	DESIGN_FLOW_SAFETY1	RE		Safety valve 1 design flow	Lbm/sec
225 . .	DVGPS2	DESIGN_FLOW_SAFETY2	RE		Safety valve 2 design flow	Lbm/sec
226 .	DQTANK	PLT_RCS_QT	RE	10	Restore-only quench tank RCS plant data	Partition
227 . .	DQPN2	PRES_N2	RE		QT nitrogen supply pressure	Psia
228 . .	DQVOL	VOLU_QT	RE		QT total volume	Ft^3
229 . .	DQHT	HEIGHT_QT	RE		QT height assuming con circ cross sect	Feet
230 . .	DQMASS	MASS_QT_MAX	RE		QT maximum mass of water	Lbm
231 . .	DQPRUP	QT_RUPTURE_SPOINT	RE		Q.T. rupture disk setpoint pressure	Psia
232 .	DRCP	PLT_RCS_RCP	RE	450	Restore-only main coolant pump plant dat	Partition
233 . .	DRNUM	NUM_PUMPS	IN		Number of main coolant pumps (4 max)	Counts
234 . .	DRFRAC	FRAC_TABL	RE	11	Ind var inter for RCP homologous curves	Dimensionless
235 . .	BAN	BAN	RE	11	RCP torq homolog curve (normal +f,+s)	Dimensionless
236 . .	BVN	BVN	RE	11	RCP torq homolog curve (normal +f,+s)	Dimensionless
237 . .	BAD	BAD	RE	11	RCP torq homolog curve (eng diss -f,+s)	Dimensionless
238 . .	BVD	BVD	RE	11	RCP torq homolog curve (eng diss -f,+s)	Dimensionless
239 . .	BAT	BAT	RE	11	RCP torq homolog curve (turbine -f,-s)	Dimensionless
240 . .	BVT	BVT	RE	11	RCP torq homolog curve (turbine -f,-s)	Dimensionless
241 . .	BAR	BAR	RE	11	RCP torq homolog curve (abnormal +f,-s)	Dimensionless
242 . .	BVR	BVR	RE	11	RCP torq homolog curve (abnormal +f,-s)	Dimensionless
243 . .	HAN	HAN	RE	11	RCP head homolog curve (normal +f,+s)	Dimensionless
244 . .	HVN	HVN	RE	11	RCP head homolog curve (normal +f,+s)	Dimensionless
245 . .	HAD	HAD	RE	11	RCP head homolog curve (eng diss -f,+s)	Dimensionless
246 . .	HVD	HVD	RE	11	RCP head homolog curve (eng diss -f,+s)	Dimensionless
247 . .	HAT	HAT	RE	11	RCP head homolog curve (turbine -f,-s)	Dimensionless
248 . .	HVT	HVT	RE	11	RCP head homolog curve (turbine -f,-s)	Dimensionless
249 . .	HAR	HAR	RE	11	RCP head homolog curve (abnormal +f,-s)	Dimensionless
250 . .	HVR	HVR	RE	11	RCP head homolog curve (abnormal +f,-s)	Dimensionless
251 . .	HANC	HANC	RE	11	RCP diffr head homolog (normal +f,+s)	Dimensionless
252 . .	HVNC	HVNC	RE	11	RCP diffr head homolog (normal +f,+s)	Dimensionless
253 . .	HADC	HADC	RE	11	RCP diffr head homolog (eng diss -f,+s)	Dimensionless
254 . .	HVDC	HVDC	RE	11	RCP diffr head homolog (eng diss -f,+s)	Dimensionless
255 . .	HATC	HATC	RE	11	RCP diffr head homolog (turbine -f,-s)	Dimensionless
256 . .	HVTC	HVTC	RE	11	RCP diffr head homolog (turbine -f,-s)	Dimensionless
257 . .	HARC	HARC	RE	11	RCP diffr head homolog (abnormal +f,-s)	Dimensionless
258 . .	HVRC	HVRC	RE	11	RCP diffr head homolog (abnormal +f,-s)	Dimensionless
259 . .	HVOID	FRAC_HD_TABL	RE	11	RCP head degradation void frac (ind var)	Dimensionless
260 . .	HMUL	HD_DEG_TABL	RE	11	RCP head degradation multiplier	Dimensionless
261 . .	RRSPDR	RATED_PUMP_SPEED	RE	4	Rated pump speed	Shaft RPM
262 . .	RRVFLO	RATED_VOL_FLOW	RE	4	Rated pump volumetric flow	Ft^3/sec
263 . .	RRDD	RATED_PUMP_DENS	RE	4	Rated pump density	Lbm/ft^3
264 . .	RRPHD	RATED_PUMP_HD	RE	4	Rated pump head	Feet
265 . .	RRPHT	RATED_PUMP_TORQ	RE	4	Rated pump torque	Ft-lbf
266 . .	RRSYNC	RATED_PUMP_SYNCH	RE	4	Pump synch speed at rated frequency	Shaft RPM
267 . .	DRNPOL	NUM_POLES	IN		Number of poles per pump	Counts
268 . .	TTWIFR	WIND_TORQ_MULT	RE		Windage/friction torque constant	Ft-lbf
269 . .	DRVBUS	RATED_BUS_VOLT	RE		Rated bus voltage (for input units conv)	Volts
270 . .	DRTNUM	NPTS_TAB	IN		Number of points in motor tables	Counts
271 . .	DRSLIP	SLIP_TAB	RE	22	Electrical slip	Dimensionless
272 . .	DRTORQ	TORQ_TAB	RE	22	Electrical torque multiplier	Dimensionless
273 . .	DRDTDW	DTDW_TAB	RE	22	Unused Variable	Dimensionless
274 . .	DRCURR	CURRENT_TAB	RE	22	Electrical current multiplier	Dimensionless
275 . .	DRPLEK	PRESS_LDN	RE		Letdown line pressure (for RCP leaks)	Psia
276 . .	DRVRAT	RCP_VOLT_RATED	RE		RCP rated voltage	Volts
277 . .	DRFRAT	RCP_FREQ_RATED	RE		RCP rated frequency	Hertz
278 .	DCONST	RCS_CONST	RE	200	RCS tunable constants	Partition
279 . .	DPCONS	RCS_CONST_PRZR	RE	15	RCS pressurizer tunable constants	Partition
280 . . .	DPWMUL	PRZR_SPRAY_MULT	RE		Mult. on przr. spray (excluding aux.)	Dimensionless
281 . . .	DPHMUL	PRZR_HEATER_MULT	RE		Multiplier on total pressurizer heat	Dimensionless
282 . . .	DPPMUL	PRZR_PORV_MULT	RE		Multiplier on PORV relief flow rates	Dimensionless
283 . . .	DPSMUL	PRZR_SAFETY_MULT	RE		Multiplier on safety valve flow rates	Dimensionless
284 . . .	DPVMUL	PRZR_VENT_MULT	RE		Multiplier on przr. vent valve flows	Dimensionless
285 . . .	DPRTAU	PRZR_RELIEF_RTD_TAU	RE		First order lag constant - relief RTDs	Seconds
286 . . .	DPQMUL	PRZR_QT_MULT	RE		Mult. on control flow from QT to przr	Dimensionless
287 . . .	DPFMUL	RCS_PRZR_FLASH_MULT	RE		Multiplier for przr flashing calc.	Dimensionless
288 . . .	DPFLSH	RCS_DM_FLASH_PRZR	RE		Flashing rate przr sat region	Lbm/sec
289 . . .	DPLSAT	RCS_LEVL_SAT_PRZR	RE		Pressurizer sat level (u. bound)	Feet
290 . . .	DPDMAX	RCS_DFLASH_MAX_PRZR	RE		Max del flash in przr per step	Lbm/sec
291 . . .	DVKUP	VLV_PRZR_KLOSS_UP	RE		Loss coeff, przr to przr-relief-valves	Composite Units
292 . . .	DVKDWN	VLV_PRZR_KLOSS_DOWN	RE		Loss coeff, przr-relief-valves to Q.T.	Composite Units
293 . .	DUCONS	RCS_CONST_UHEAD	RE	10	RCS upper head tunable constants	Partition
294 . . .	DUKCOR	RTRV_KLOSS_CORE	RE		Core pressure drop factor for buoyancy	Dimensionless
295 . . .	DUVMUL	RTRV_VENT_MULT	RE		Multiplier on head vent valve flows	Dimensionless

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
296 . . .	DUPMUL	RTRV_HEAD_SEAL_MULT	RE		Multiplier on head seal pressure	Dimensionless
297 . . .	DURMUL	RCS_Q_CEA_CORE_MULT	RE		Multiplier heat transfer CEA-core	Dimensionless
298 . . .	DUAMUL	RCS_UHEAD_RING_SEAL_MULT	RE		Multiplier uppper head ring seal area	Dimensionless
299 . . .	DIIMIX	RTRV_MIX_INLET	RE	2	Core-in mixg fctr: (1)lowflow, (2)high	Fraction
300 . . .	DIOMIX	RTRV_MIX_OUTLET	RE	2	Core-out mixg fctr: (1)lowflow, (2)high	Fraction
301 . . .	DUKCEA	RCS_CEAIN_KTERM	RE		CEA in k factor multiplier	Dimensionless
302 . .	DRCONS	RCS_CONST_PUMPS	RE	13	RCS coolant pump tunable constants	Partition
303 . . .	PPINER	RCP_MOM_INERTIA	RE	4	Coolant pump rotor/flywheel interia	Lbf*ft2
304 . . .	DRQMUL	RCP_HEAT_MULT	RE		Coolant pump heat rate multiplier	Dimensionless
305 . . .	DRISPL	RCP_MOM_INERTIA_SPLIT	RE		Frac mom-inr to motor when sheared shaft	Fraction
306 . . .	DRVNOR	RCP_VIBR_NORM	RE		Unused Variable	Dimensionless
307 . . .	DRVMAX	RCP_VIBR_MAX	RE		Unused Variable	Dimensionless
308 . . .	DRVTIM	RCP_VIBR_TIME	RE		Unused Variable	Dimensionless
309 . . .	DRVSPD	RCP_SPEED_DERIV_SHAKE	RE		Unused Variable	Dimensionless
310 . .	DLOOPC	RCS_CONST_LOOP	RE	4	Tunable constants for RCS loop varbl.	Partition
311 . . .	DCONMU	RCS_CONT_HEAT_MULT	RE		Multiplier on cont. heat xfer rates	Dimensionless
312 . . .	DSGTRM	RCS_SGTR_FLOWMULT	RE		SG tube rupt. flow multiplier	Dimensionless
313 . .	DQCONS	RCS_CONST_QT	RE	6	RCS quench tank addressable constants	Partition
314 . . .	DQNMUL	QT_N2_MULT	RE		Multiplier on nitrogen supply flow	Dimensionless
315 . . .	DQGMUL	QT_GWS_MULT	RE		Multiplier on nitrogen flow to gws	Dimensionless
316 . . .	DQVMUL	QT_VENT_MULT	RE		Multiplier on quench tank vent flow	Dimensionless
317 . . .	DQSFRC	QT_FLOW_FRAC	RE		Fract. surge flow to QT to rupt. disk	Fraction
318 . .	DGENC	RCS_CONST_GENERAL	RE	133	General RCS addressable constants	Partition
319 . . .	DNIDPE	RCS_ITER_DP	RE		Equil. pressure search convergence band	Psia
320 . . .	DNIDPN	RCS_ITER_DP_NE	RE		Non-eq pres search conv band on pressure	Psia
321 . . .	DNIDHN	RCS_ITER_DH_NE	RE		Non-eq pres search conv band on enthalpy	Btu/lbm
322 . . .	DNDMUL	RCS_DROP_COND_MULT	RE	50	Multiplier droplet condensation (node	Dimensionless
323 .	DPKMUL	RCS_KLOSS_MULT	RE	100	Geometric losses multipliers	Dimensionless
324 .	DNSMUL	RCS_COND_SURF_MULT	RE	50	Surface condensation multiplier	Dimensionless
325 .	DLCONS	RCS_CONST_LEAKS	RE	5	Constants for leak tables and correla	Partition
326 . .	DLSPMU	RCS_SUPERCRIT_FLOW_MULT	RE		Multiplier supercritical mass flux	Dimensionless
327 . .	DLSBMU	RCS_SUBCRIT_FLOW_MULT	RE		Multiplier leak tables (subcrit. cond	Dimensionless
328 . .	DGPMA	CONV_GPM_AREA	RE	3	Gal/min-to-area (nom cond): 1-3=SL,HL,PR	Composite Units
329 .	DVAREA	PLT_RCS_VLVAREA	RE	25	RCS valve areas	Ft^2
330 . .	DVAVNT	PLT_VLVAREA_UHEAD_CONT	RE		Area of vent valve from u-head to cont	Ft^2
331 . .	DVAUHQ	PLT_VLVAREA_UHEAD_QT	RE	2	Area vents valves u-head to q-tank	Ft^2
332 . .	DVAPOR	PLT_VLVAREA_PRZR_PORV	RE	4	Area przr PORVs	Ft^2
333 . .	DVAPSV	PLT_VLVAREA_PRZR_SAFETY	RE	4	Area przr safety valves	Ft^2
334 . .	DVAMOV	PLT_VLVAREA_PRZR_MOV	RE	4	Area przr movs (in series with PORVs)	Ft^2
335 . .	DVAPCO	PLT_VLVAREA_PRZR_CONT	RE		Area vent przr to containment	Ft^2
336 . .	DVAPQT	PLT_VLVAREA_PRZR_QT	RE	2	Area vents przr to q-tank (in series)	Ft^2
337 . .	DVAMSP	PLT_VLVAREA_PRZR_MSPRAY	RE	2	Area main spray control valves	Ft^2
338 . .	DVAQTG	PLT_VLVAREA_QT_GWS	RE		Quench tank to gws vent valve area	Ft^2
339 . .	DVAQTC	PLT_VLVAREA_QT_CONT	RE		Quench tank to contain. vent vlv area	Ft^2
340 . .	DVANC	PLT_VLVAREA_QT_NSUPPLY	RE		Valve area nitrogen supply to contain	Ft^2
341 .	DM504	RCS_MORE_VARIABLES_504_RO	RE	41	RCS more variables spin 413 to 504 RO	Partition
342 . .	DPSDE	RCS_PRZR_DH_SPRAY_EQ	RE		Przr spray del-enth for equil.	Btu/lbm
343 . .	DPSEQ	RCS_PRZR_SPRAY_EQ	LO		Przr spray del-enth equil flag	True False
344 . .	DPHDT	RCS_PRZR_DT_SUBH	RE		Przr del-temp boil heaters on	Del-DegF
345 . .	DPTDT	RCS_PRZR_TAU_DTSUB	RE		Przr time constant del-temp subc.	Seconds
346 . .	DPDGMX	RCS_DWSOLID_SDC	RE		Fast time max SDC del flow przr solid	Lbm/sec
347 . .	DPLRIG	RCS_PRZR_VENT_RIG	LO		Przr vent rig flag T=in,F=out	True False
348 . .	DULRIG	RCS_UHEAD_VENT_RIG	LO		Uhead vent rig flag T=in,F=out	True False
349 . .	DUFRIG	RCS_UHEAD_VENT_RIG_FRAC	RE		Frac. nucl. uhead vent rig	Fraction
350 . .	DPFRIG	RCS_PRZR_VENT_RIG_FRAC	RE		Frac. nucl. przr vent rig	Fraction
351 . .	DPLBOL	RCS_PRZR_L_BOIL	RE	2	Boiling degradation parameters	Feet
352 . .	DSDP	RCS_SG_DP_ADD	RE		Tuning add. inst. SG. delp	Psig
353 . .	DSDP12	RCS_SG1112_DP_ADD	RE		Tuning add. instrum. SG. delp	Psig
354 . .	DSDPW	RCS_SG_DP_W_MULT	RE		Multiplier SG delp (coarse, 1 phase)	Dimensionless
355 . .	DSDPW1	RCS_SG1112_DP_W_MULT	RE		Mult. SG delp (detail. 1 phase)	Dimensionless
356 . .	DPCRFL	RCS_CRIT_FLOW_CHECK	LO		Mom. paths crit. flow check	True False
357 . .	DRCMUL	RCP_CAVIT_SGDP_MULT	RE		Unused Variable	Dimensionless
358 . .	DRCMIN	RCP_CAVIT_SGDP_FRAC_MIN	RE		Unused Variable	Dimensionless
359 . .	DPTMSP	RCS_PRZR_MSPRAY_TAU	RE		Main spray flow time constant	Seconds
360 . .	DPM034	RCS_PRES_COARSE_MAL034	RE		Press. for switch to coarse nodalzn	Psia
361 . .	DVTMAX	RCS_PRZR_VLVH_MAX_TAU	RE		Przr rel vlvs heat tran. max time cons	Seconds
362 . .	DRFRUB	RCP_FR_SP_RUB_RATCH	RE		RCP frac speed pawls rub on ratchet	Fraction
363 . .	DRTRUB	RCP_TORQ_RUB_RATCH	RE		RCP torque pawls rub on ratchet	Composite Units
364 . .	DPHAXW	RCS_PRZR_HAX_WALL	RE		Przr walls axial overall htcoff.	Btu/sec-degF
365 . .	DPLSBO	RCS_PRZR_LVLDT_SUBC	RE	2	Przr level values for boil (subc.)	Feet
366 . .	DUORFL	RCS_P_ORING_FAIL	RE		Press. for vessel O-ring failure	Psia
367 . .	DRFREF	RCP_FLOW_REF	RE		Unused Variable	Dimensionless
368 . .	DRAREF	RCP_ADMI_FLOWCORR_MULT	RE		Unused Variable	Dimensionless
369 . .	DRDAMP	RCP_DELAMPS	RE		Unused Variable	Dimensionless

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
370 . .	DUFAST	RCS_DHEAT_FASTT_UHEAD_FRAC	RE		Frac. const. for uhead fastt heat	Fraction
371 . .	DRVMUL	RCP_CAVIT_VIBR_MULT	RE		Unused Variable	Dimensionless
372 . .	DRLMUL	RCP_CAVIT_LOAD_MULT	RE		Unused Variable	Dimensionless
373 . .	DEDGDT	RCS_DWSTP_SIT	RE		SIT del flow per step (loop solid)	Lbm/sec
374 . .	DPTREV	RCS_PRZR_VLV_REVH_TAU	RE		Przr rel. vlvs rev heat tr. time const	Seconds
375 . .	DPPHMU	RCS_PHTR_RLD_MULT	RE		Przr prop heater rld mult.	Dimensionless
376 . .	DPBHMU	RCS_BHTR_RLD_MULT	RE		Przr backup heaters rld mult.	Dimensionless
377 . .	DPVVMU	RCS_PRZR_VLV_LVIB_MULT	RE		Przr relief vlvs.vibrat mult (slug flow	Dimensionless
378 . .	DLBCLC	RCS_K_TEMPCL_LOCA	RE	3	LB LOCA CL2b temp constants	Composite Units
379 .	DSGS	PLT_SGS	RE	850	Steam generator data constants	Partition
380 . .	DSGSIN	PLT_SGS_INTERNAL	RE	230	SG data constants - SG internals	Partition
381 . . .	DSGDES	SG_DESIGN	IN	4	Type of steam generator design (=1,2)	Pointer
382 . . .	ASPTBL	ASP_TBL	RE	15,2	Table: c. s. area of evaporator region	Ft^2
383	ASPTB1	ASP_TBL_DSGN1	RE	15	Table: CS area of evap region, design 1	Ft^2
384	ASPTB2	ASP_TBL_DSGN2	RE	15	Table: CS area of evap region, design 2	Ft^2
385 . . .	HSPTBL	HSP_TBL	RE	15,2	Table: height in evaporator region	Feet
386	HSPTB1	HSP_TBL_DSGN1	RE	15	Table: height in evap region, design 1	Feet
387	HSPTB2	HSP_TBL_DSGN2	RE	15	Table: height in evap region, design 2	Feet
388 . . .	VSTTBL	VST_TBL	RE	15,2	Table: volume in evaporator region	Ft^3
389	VSTTB1	VST_TBL_DSGN1	RE	15	Table: volume in evap region, design 1	Ft^3
390	VSTTB2	VST_TBL_DSGN2	RE	15	Table: volume in evap region, design 2	Ft^3
391 . . .	TBL2NU	TBL2_NUM	IN	2	No. of entries in evaporator geom. table	Counts
392 . . .	HT3TBL	HT3_TBL	RE	15,2	Table: height in SG downcomer	Feet
393	HT3TB1	HT3_TBL_DSGN1	RE	15	Table: height in downcomer, design 1	Feet
394	HT3TB2	HT3_TBL_DSGN2	RE	15	Table: height in downcomer, design 2	Feet
395 . . .	V3TBL	V3_TBL	RE	15,2	Table: volume in SG downcomer	Ft^3
396	V3TB1	V3_TBL_DSGN1	RE	15	Table: volume in downcomer, design 1	Ft^3
397	V3TB2	V3_TBL_DSGN2	RE	15	Table: volume in downcomer, design 2	Ft^3
398 . . .	TBL3NU	TBL3_NUM	IN	2	No. of entries in downcomer geom. table	Counts
399 . . .	ASEPSG	ASEP_SG	RE	4	Stm separation area at can deck, 100% ss	Ft^2
400 . . .	EVAPSS	EVAP_SS_ALPHA	RE	4	SG evaporator void fraction at 100% s.s.	Fraction
401 . . .	SPACE	SPACE	RE	4	Unused space	Unused
402 . . .	PERIM	PERIM	RE	2	Perimeter of tube shroud in lower SG	Feet
403 . . .	SFCONI	SF_CONC_IO	RE		Stripping factr for SG iodine nuc. conc.	Dimensionless
404 . . .	SGU12	SG_U12	RE		Heat trans. coeff. between regions 1 & 2	Btu/secft^2degF
405 . . .	SGU23	SG_U23	RE		H.t. coeff. regions 2 & 3; also 2/4, 3/4	Btu/secft^2degF
406 . . .	SGV2AC	SG_V2_ACTIVE	RE	2	Volume in region 2 to cover tubes	Ft^3
407 . . .	SGV4MX	SG_V4_MAX	RE	2	Volume of SG economizer region	Ft^3
408 . . .	SGV5MX	SG_V5_MAX	RE	2	Volume of quenching pool above can deck	Ft^3
409 . . .	TAURC1	TAURC1	RE		Time constant on recirculation flow W23	Seconds
410 . . .	TAUIO	TAU_IO	RE		Decay const for iodine nuclide conc.	Seconds
411 . . .	TAUPT	TAU_PT	RE		Decay const for particulate nuclide conc	Seconds
412 . . .	TAUXE	TAU_XE	RE		Decay const for xenon nuclide conc.	Seconds
413 . . .	VOLSGS	VOLSGS	RE	2	SG volume to main steam isolation valve	Ft^3
414 . . .	HT4MAX	SG_HT4_MAX	RE	2	Height of SG economizer region	Feet
415 . . .	W32FLC	W32_FLOW_COEFF	RE	4	Dcomer to tube bundle flow coeff, 100%ss	Ft/s*SQRT(lbm)
416 . . .	DSREFL	SG_REF_LEGS	RE	18	SG level measurement taps	Partition
417	DSNREF	SG_REF_NUM	IN	2	Number of level instrum. reference legs	Counts
418	DSBREF	SG_REF_BOT	RE	2,3	Lower tap ht abov tbsheet (design, leg#)	Feet
419	DSTREF	SG_REF_TOP	RE	2,3	Upper tap ht abov tbsheet (design, leg#)	Feet
420	DSTDN	TAU_REFLG_DN	RE	2	Time const., lvl instr ref leg cooldown	Seconds
421	DSTUP	TAU_REFLG_UP	RE	2	Time const., lvl instr ref leg heat-up	Seconds
422 . . .	DSATUB	SG_TUBE_AREA	RE	2	SG tube internal flow area, one tube	Ft^2
423 . . .	DSETUS	ELEV_TUBE_SHEET	RE	4	Tubesheet elevation above common refrnce	Feet
424 . . .	DSECON	SG_ECONOMIZER	LO		SG economizer: T=exist, F=none	True False
425 . .	DSHEAT	PLT_SGS_HEAT	RE	70	SG data constants - SG heat transfer	Partition
426 . . .	DSAFLO	ATUBES_MAX_CS	RE	2	Primary flow area through tubes	Ft^2
427 . . .	DSAHT	ATUBES_MAX_HT	RE	2	SG tubes heat tsfr area, evaporator only	Ft^2
428 . . .	QSG100	QSG100	RE	4	Tube heat trans to each SG at 100% power	Btu/sec
429 . . .	QSGTBL	QSG_TBL	RE	20	Rosenow heat flux vs dT table, B/hr-ft2	Composite Units
430 . . .	TMPTBL	TMP_TBL	RE	20	Delta temp for Rosenow heat flux table	Del-degF
431 . . .	RTUBES	RTUBES	RE	2	Thermal resistance of SG tubes, 1/units	Secft^2degF/Btu
432 . . .	SGMTCP	SGMTCP	RE	2	Total heat capacity of tubes	Btu/degF
433 . . .	DSDHYD	SGT_HYD_DIAM	RE	2	Hydraulic diam of SG tubes primary flow	Feet
434 . . .	DSHWAL	SG_HCONV	RE		Convective htc outside SG wall	Btu/secft^2degF
435 . . .	DSRWAL	SG_RWALL	RE	2	Thermal resistance of SG wall, 1/units	Secft^2degF/Btu
436 . . .	DSAWAL	WALL_AREA	RE	2	SG surface area for heat loss to cont.	Ft^2
437 . . .	DSMCPW	WALL_MCP	RE	2	SG wall heat capacity	Btu/degF
438 . . .	DSAEHT	ATUBES_MAXEC_HT	RE	2	SG tubes heat tsfr area, economizer only	Ft^2
439 . .	DMSLH	PLT_SGS_MSLH	RE	240	SG data constants - steamline & header	Partition
440 . . .	ASLMAX	ASL_MAX	RE	2,2	Steamline flow area (design,line)	Ft^2
441 . . .	DMHAWI	HA_WALLI_MSLH	RE		Inside MSLH wall heat transfer hA	Btu/sec-degF
442 . . .	DMHAWO	HA_WALLO_MSLH	RE		Outside MSLH wall heat transfer hA	Btu/sec-degF
443 . . .	DMMCPW	MCP_WALL_MSLH	RE		Total heat cap of MSLH pipe wall	Btu/degF

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
444	. . . DMSLIC	SLI_FLOW_COEFF	RE	8	Flow coeff, stm nozzle to MSIV, at 100%	Composite Units
445	. . . DMSLOC	SLO_FLOW_COEFF	RE	8	Flow coeff, MSIV to header, at 100%	Composite Units
446	. . . DMSLC	UNUSED_FLOW_COEFF	RE	8	Unused array	Unused
447	. . . VEL100	VEL100	RE	8	Steamline velocity at 100% flow	Ft/sec
448	. . . DMVOL	VOL_MSLH	RE		Header and SL vol from MSIV to turb stop	Ft^3
449	. . . DMAREA	MSLB_AREA	RE		Standard area for main steamline breaks	Ft^2
450	. . . DIAMAX	MSLH_MSIV_AMAX	RE	2,2	MSIV full-open flow area (design,line)	Ft^2
451	. . . DMABY	MSLH_MSIV_BYPASS_AMAX	RE	2,2	MSIBV full-open flow area (design,line)	Ft^2
452	. . . DMVAMX	MSLH_VALVE_AMAX	RE	50	Steamline ext valves fullopen flow areas	Ft^2
453	. . . DMVIN	MSLH_VALVE_INLET	IN	50	Steamline ext valves upstream region	Pointer
454	. . . DMVEX	MSLH_VALVE_EXIT	IN	50	Steamline ext valves downstream regions	Pointer
455	. . . DMVNUM	MSLH_VALVE_NUM	IN		# of stmline ext valvs <50-NUM_SG*NUM_SL	Counts
456	. . . DMPATM	P_ATMOSPHERE	RE		Atmospheric pressure	Psia
457	. . . DMTATM	MSLH_TATM	RE		Atmospheric temperature at MSLH	Degree F
458	. . . DMCHKV	SLI_CHECK_VALVE	LO	2,2	Steamline check valve: Y/N (design,line)	True False
459	. . . DMDPI1	SLI_DP100	RE	8	Press drop, stm nozzle to MSIV, at 100%	Psid
460	. . . DMDPO1	SLO_DP100	RE	8	Press drop, MSIV to header, at 100%	Psid
461	. . . ASLMIN	ASL_MIN	RE	2,2	Stln restrictor min area upst(dsgn,line)	Ft^2
462	. . . NUMSL	NUM_SL	IN		Number of steamlines per steam generator	Counts
463	. . DFWS	PLT_SGS_FWS	RE	225	SG data constants - main & aux feedwater	Partition
464	. . . FWCOEF	FW_COEFF	RE	4	FW coeff at 100%. used for #pumps=0 only	Composite Units
465	. . . DFG100	FWS_FLOW100	RE	4	Feedwater flow at 100% power, each SG	Lbm/sec
466	. . . WFW100	WFW100	RE		Feedwater flow at 100% power, all SGs.	Lbm/sec
467	. . . DFAFWB	FWLB_AREA	RE		Standard area for feedwater line breaks	Ft^2
468	. . . HTNOZF	FWS_NOZ_HEIGHT	RE	2,3	Feedwater nozzle heights	Partition
469	. . . . HTNOZ	HTNOZ	RE	2	Height of downcomer feedwater nozzle	Feet
470	. . . . HTNOZE	HTNOZ_ECON	RE	2	Height of economizer feedwater nozzle	Feet
471	. . . . HTNOZA	HTNOZ_EFW	RE	2	Height of aux. feedwater nozzle	Feet
472	. . . DFNPMP	NUM_FWS_PUMPS	IN		Number of feedwater pumps (max 4)	Counts
473	. . . DFNJUN	NUM_FWS_JUNCTIONS	IN		No. of feedwater flow junctions (max 4)	Counts
474	. . . DFPJUN	FWS_PUMP_JUNCTION	IN	4	ID# of junction feeding from Nth pump	Pointer
475	. . . DFLJUN	FWS_LINE_JUNCTION	IN	4,2	ID #s of junctions feeding FW lines	Pointer
476	. . . . DFJUN	FWS_JUNCTION	IN	4	ID# of junction feeding to nth DCFW line	Pointer
477	. . . . DFEJUN	FWS_ECON_JUNCTION	IN	4	ID# of junction feeding to nth ECFW line	Pointer
478	. . . DFGTAB	FWS_PUMP_FLOW_TABLE	RE	15	Flows for FW pump flow/head/speed tables	Gal/min
479	. . . DFHTAB	FWS_PUMP_HEAD_TABLE	RE	15,8	Heads for FW pump flow/head/speed tables	Feet
480	. . . DFSTAB	FWS_PUMP_SPEED_TABLE	RE	8	Speeds for FW pump flow/head/speed table	Shaft RPM
481	. . . DFGNUM	FWS_PUMP_FLOW_NPOINTS	IN		No. of flow entries in FW pump tables	Counts
482	. . . DFSNUM	FWS_PUMP_SPEED_NPOINTS	IN		No. of speed entries in FW pump tables	Counts
483	. . . DFCPMP	FWS_PUMP_COEFF	RE	4	Flow coeff, pump discharge to junction	Composite Units
484	. . . DFCVAL	FWS_VALVE_COEFFS	RE	4,2	Flow coeffs, junction to valve discharge	Composite Units
485	. . . . DFCVL	FWS_VALVE_COEFF	RE	4	Flow coeff,jct to dcomer valve discharge	Composite Units
486	. . . . DFCEVL	FWS_ECON_VALVE_COEFF	RE	4	Flow coeff,jct to econzr valve discharge	Composite Units
487	. . . DFCLIN	FWS_LINE_COEFFS	RE	4,2	Flow coeffs, valve discharge to SG	Composite Units
488	. . . . DFCLN	FWS_LINE_COEFF	RE	4	Flow coeff, valve discharge to downcomer	Composite Units
489	. . . . DFCELN	FWS_ECON_LINE_COEFF	RE	4	Flow coeff, valve discharge to econmizer	Composite Units
490	. . . DFVLIN	FWS_LINE_VOLUMES	RE	4,2	FW line volumes downstream of valves	Ft^3
491	. . . . DFVLN	FWS_VOL	RE	4	FW line volume after downcomer valve	Ft^3
492	. . . . DFVELN	FWS_ECON_VOL	RE	4	FW line volume after economizer valve	Ft^3
493	. . . DFDLIN	FWS_LINE_DIAMS	RE	2,2	FW line diameters	Feet
494	. . . . DFDLN	FWS_DIAM	RE	2	FW line diameter after downcomer valve	Feet
495	. . . . DFDELN	FWS_ECON_DIAM	RE	2	FW line diameter after economizer valve	Feet
496	. . . DANPMP	NUM_AFW_PUMPS	IN		Number of AFW pumps (max 4)	Counts
497	. . DSGDB	PLT_SGS_SGBD	RE	30	SG data constants - SG blowdown system	Partition
498	. . . DBATNK	SGBD_ACROSS	RE		Cross section area of SGBD tank	Ft^2
499	. . . DBHAWI	HA_WALLI_SGBD	RE		Inside SGBD tank heat transfer hA	Btu/sec-degF
500	. . . DBHAWO	HA_WALLO_SGBD	RE		Outside SGBD tank heat transfer hA	Btu/sec-degF
501	. . . DBMCPW	MCP_WALL_SGBD	RE		Total heat cap of SGBD tank wall	Btu/degF
502	. . . DBVTNK	SGBD_VOL	RE		SGBD tank volume	Ft^3
503	. . . DBCOEF	SGBD_SG_COEFF	RE	8	Flow coeffs, blowdown nozzles to tank	Partition
504	. . . . DBSCUR	SGBD_SURF_COEFF	RE	4	Flow coeffs, surface blowdown nozzles	Composite Units
505	. . . . DBCBOT	SGBD_BOT_COEFF	RE	4	Flow coeffs, bottom blowdown nozzles	Composite Units
506	. . . DBHNOZ	SGBD_SG_HTNOZ	RE	4	Hts of SG blowdown nozzles above tubesht	Partition
507	. . . . DBHSUR	SGBD_SURF_HTNOZ	RE	2	Height of SG surface blowdown nozzle	Feet
508	. . . . DBHBOT	SGBD_BOT_HTNOZ	RE	2	Height of SG bottom blowdown nozzle	Feet
509	. . . DBHOUT	SGBD_OUT_HTNOZ	RE	2	Hts above bottom, 2 BD tank outlet nozls	Feet
510	. . . DBCOUT	SGBD_OUT_COEFF	RE	2	Flow coeffs, 2 BD tank outlet nozzles	Composite Units
511	. . . DBAMAX	SGBD_RELIEF_AMAX	RE		Bd tank relief valve full-open flow area	Ft^2
512	. . DM2SLH	PLT_SGS_MSLH2	RE	40	SG data constants - new header model	Partition
513	. . . DM2SLO	NUM_MSLH	IN		Number of MSLH nodes (1 or 2)	Counts
514	. . . DM2AFR	MSLH_AFRSL	RE	8	Stmln restrictor min flowarea dnstrm	Ft^2
515	. . . DM2FKB	MSLH_FKBRK	RE	8	Stmln K factor from SG to MSLB	Composite Units
516	. . . DM2AC1	MSLH_ACROSS	RE		Stm header cross tie flowarea	Ft^2
517	. . . DM2AC2	MSLH_ACROSST	RE		Stm header cross tie flowarea w turbine	Ft^2

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
518	. . . DM2KC1	MSLH_FKCROSS	RE		Stm header cross tie flow resist	Composite Units
519	. . . DM2KC2	MSLH_FKCROSST	RE		Stm header cross tie flow resist w turb	Composite Units
520	. DCTL	PLT_CTL	RE	20700	Control module variables	Partition
521	. . DCNCON	CTL_CONTROLLER_NUMBERS	IN	150	Controller numbers	Partition
522	. . . DCACON	CTL_AFWS_CONTROLLERS	IN	4	AFWS flow controller number	Pointer
523	. . . DCRCON	CTL_CEA_CONTROLLER	IN		Control rod reactivity controller number	Pointer
524	. . . DCCCON	CTL_CHGS_CONTROLLERS	IN	4	Charging pump controller numbers	Pointer
525	. . . DCFCON	CTL_FWS_CONTROLLERS	IN	4	Main feedwater flow controller numbers	Pointer
526	. . . DCFECN	CTL_FWS_ECON_CONTROLLERS	IN	4	Economizer FW valve controller numbers	Pointer
527	. . . DCFPMP	CTL_FWS_PUMP_CONTROLLERS	IN	4	Main FW pumps speed controller numbers	Pointer
528	. . . DCFCOT	CTL_FWS_TRIP_CONTROLLER	IN		Main feedwater trip controller number	Pointer
529	. . . DCHCON	CTL_HEATER_CONTROLLERS	IN	2	PZr heater controller numbers: prop,back	Pointer
530	. . . DCLCON	CTL_LETDOWN_CONTROLLERS	IN	4	Letdown flow controller numbers	Pointer
531	. . . DCICON	CTL_MSIV_CONTROLLERS	IN	8	MSI valve controller numbers	Pointer
532	. . . DCICOT	CTL_MSIS_TRIP_CONTROLLER	IN		MSI signal controller number	Pointer
533	. . . DCMCON	CTL_MSLH_CONTROLLERS	IN	50	MSLH valve controller numbers	Pointer
534	. . . DCVPOR	CTL_PORV_CONTROLLERS	IN	4	Pressurizer PORV controller numbers	Pointer
535	. . . DCVPSV	CTL_PSV_CONTROLLERS	IN	4	Pressurizer safety valves controller #s	Pointer
536	. . . DCTCON	CTL_RPS_CONTROLLERS	IN	20	RPS channel controller numbers	Pointer
537	. . . DCECOT	CTL_SIAS_TRIP_CONTROLLER	IN		SIAS trip controller number	Pointer
538	. . . DCWCON	CTL_SPRAY_CONTROLLERS	IN	2	Przr spray controller numbers	Pointer
539	. . . DCTACO	CTL_T_AVG_CONTROLLER	IN		Controller number for loop avg temp	Pointer
540	. . . DCTRCO	CTL_T_REF_CONTROLLER	IN		Controller number for demand ref temp	Pointer
541	. . . DCGCOT	CTL_TURB_TRIP_CONTROLLERS	IN	2	Turb. trip controller nos. (trip/close)	Pointer
542	. . . DCTCOT	CTL_CORE_TRIP_CONTROLLER	IN		Core trip controller number	Pointer
543	. . . DCKCUT	CTL_POWER_CUTBACK_CONTROLLER	IN		Reactor power cutback controller number	Pointer
544	. . . DCGSET	CTL_TURB_SETBACK_CONTROLLER	IN		Turbine setback controller number	Pointer
545	. . . DCGRUN	CTL_TURB_RUNBACK_CONTROLLER	IN		Turbine runback controller number	Pointer
546	. . . DCPCOE	CTL_PRZR_LVL_ERR_CONTROLLER	IN		Przr level error calc. controller number	Pointer
547	. . . DCPCOP	CTL_PRZR_PROG_LVL_CONTROLLER	IN		Przr program level controller number	Pointer
548	. . . DCFBCN	CTL_FWS_BYPS_CONTROLLERS	IN	4	FWS Bypass valve controller number	Pointer
549	. . . DCFICN	CTL_FWS_ISOL_CONTROLLERS	IN	4	FWS isol. valve controller number	Pointer
550	. . . DCAVCN	CTL_AFWS_VALVE_CONTROLLERS	IN	14	AFWS valve controller number	Pointer
551	. . DCDNUM	CTL_ATM_DUMP_NUM	IN		Number of MSLH atm. dump valves	Counts
552	. . DCDPAT	CTL_ATM_DUMP_PATH	IN	10	Path number for MSLH atm. dump valve	Pointer
553	. . DCTANU	CTL_TAV_NUM	IN		Number of tubine admission valves	Counts
554	. . DCTAPA	CTL_TAV_PATH	IN	5	Path number for turbine admission valve	Pointer
555	. . DCBNUM	CTL_TURB_BYPASS_NUM	IN		Number of turbine bypass valves	Counts
556	. . DCBPAT	CTL_TURB_BYPASS_PATH	IN	5	Path number for turbine bypass valve	Pointer
557	. . DBADD	DBADD	IN	100	Index of state variables in common	Pointer
558	. . DBCOM	DBCOM	IN	100	Cue to common containing state variables	Pointer
559	. . ELEMS	ELEMS	IN	1000	No. of elements per controller	Counts
560	. . ELIN	ELIN	RE	10000	Inputs to controller elements	Pointer
561	. . ELTYPE	ELTYPE	IN	3000	Controller element type cues	Pointer
562	. . GROUPS	GROUPS	IN		Number of controllers	Counts
563	. . NOTAB	NOTAB	IN	100	No. of entries in user function table	Counts
564	. . PTTAB	PTTAB	IN	100	Pointer to start of user function table	Pointer
565	. . SEQNCE	SEQNCE	IN	1000	Order of exectuion of controllers	Pointer
566	. . XTAB	XTAB	RE	2000	Ind. variable values for user function	Undefined
567	. . YTAB	YTAB	RE	2000	Dep. variable values for user function	Undefined
568	. . UNUSED	UNUSED	RE		Unused Variable	Dimensionless
569	. . DCINIT	CTL_INIT	LO		Control system initialization cue	True False
570	. . INPED	INPED	LO		Control system structure display cue	True False
571	. . INEDSQ	INPED_SEQNCE	LO		INPED display order: T=seqnce, F=input	True False
572	. . INEDPG	INPED_PAGE	IN		Lines/page in inped output. 0=no paging	Counts
573	. . CTLDBG	CTL_DBG	LO	1002	Controller debug edit cues	True False
574	. . DCCONS	CTL_CONSTS	RE	10	Useful constants	Partition
575	. . . DCZERO	CTL_ZERO	RE		Floating point zero (0.0)	Dimensionless
576	. . . DCHALF	CTL_HALF	RE		Floating point one-half (0.5)	Dimensionless
577	. . . DCONE	CTL_ONE	RE		Floating point one (1.0)	Dimensionless
578	. . . DCMONE	CTL_M_ONE	RE		Floating point minus-one (-1.0)	Dimensionless
579	. . DCLIMS	CTL_LIMITS	IN	10	Dimensioned limits of the control system	Partition
580	. . . ELMAX	ELMAX	IN		Maximum total number of elements	Counts
581	. . . LSTMAX	LSTMAX	IN		Maximum total number of last-values	Counts
582	. . . INMAX	INMAX	IN		Max total number of controller inputs	Counts
583	. . . GRPMAX	GRPMAX	IN		Maximum number of controller groups	Counts
584	. . . CTLMAX	CTLMAX	IN		Dimension of CTL_CONTROLLER_NUMBERS	Counts
585	. . . TABMAX	TABMAX	IN		Maximum number of user-defined functions	Counts
586	. . . FCTMAX	FCTMAX	IN		Max tot no. of user-defined func entries	Counts
587	. . DCWARN	CTL_WARN	IN		Warnings display: 0/1/2=none/once/always	Pointer
588	. . INEDFL	INPED_FILE	LO		Inped output target: T=file, F=console	True False
589	CHT	CHT_COMMON	RE	1500	Core heat transfer segment	Segment
590	. CHTINP	CHT_INPUTS	RE	50	Core heat transfer model data constants	Partition
591	. . DTNRAD	CHT_NREGIONS_RAD	IN		Number of radial regions in h.t. mesh	Counts

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
592	. . DTROUT	CORE_RAD_OUT	RE	10	Outer radii of radial regs, C.H.T. mesh	Feet
593	. . MATTYP	MATTYP	IN	10	Rad reg material (1/2/3=Fuel/Clad/Gap)	Counts
594	. . DTH2	CORE_HYD_DIA	RE		Core hydraulic diameter	Feet
595	. . DTDENS	FUEL_DENSITY	RE		Density of uranium fuel	Lbm/ft^3
596	. . DTAHT	CORE_HT_AREA	RE		Core heat transfer area, clad/coolant	Ft^2
597	. . TCFMUL	CHT_COND_FUEL_MULT	RE		Multiplier fuel conductivity	Dimensionless
598	. . TCGAP	CHT_GAP_HCAP	RE		Fuel-clad gap thermal heat capacity	Btu/ft^3-degF
599	. . TPSPCR	CHT_PRESS_SUPERCRIT	RE		Pressure for supercrit DNB calculation	Psia
600	. . TCHFMU	CHT_CHF_MULT	RE		Multiplier on calculated crit heat flux	Dimensionless
601	. . TCLEV	CHT_CONST_LEV	RE		Constant for level calculation	Fraction
602	. . TGAPIN	TGAPIN	RE		Fuel gap conductance for all axial nodes	Btu/hr-ft2-degF
603	. . TFHTGN	CHT_FRAC_HT_GEN	RE	11	Heat generated in fuel,gap,clad,coolnt	Fraction
604	. . DTNZ	CHT_NNOD_BO	IN		Number of core nodes max 20	Counts
605	. . . CHTNUM	CHT_NUM_NODE	IN		Number of core nodes max 20	Counts
606	. . DTNFC	CHT_NNOD_FC	IN		Not used	Dimensionless
607	. CHTPRP	CHT_PROPERTIES	RE	25	CHT steam and liquid properties	Partition
608	. . TESATP	CHT_ENTH_SAT_LIQ_M1	RE		Saturated liq enthalpy - prev time step	Btu/lbm
609	. . TESATL	CHT_ENTH_SAT_LIQ	RE		Saturated liquid enthalpy	Btu/lbm
610	. . TESATS	CHT_ENTH_SAT_STM	RE		Saturated steam enthapy	Btu/lbm
611	. . TSSATL	CHT_SVOL_SAT_LIQ	RE		Saturated liquid specific volume	Ft^3/lbm
612	. . TSSATS	CHT_SVOL_SAT_STM	RE		Saturated steam specific volume	Ft^3/lbm
613	. . TTSAT	CHT_TEMP_SAT	RE		Saturation temperature	Degree F
614	. . TDHFDP	CHT_DHF_DP	RE		Sat liq enth derivative wrt press	Composite Units
615	. . TDHGDP	CHT_DHG_DP	RE		Sat stm enth derivative wrt press	Composite Units
616	. . TDTDPS	CHT_DTSAT_DP	RE		Sat temp derivative wrt press	Composite Units
617	. . TDTDHS	CHT_DTSAT_DH	RE		Sat temp derivative wrt enthalpy	Composite Units
618	. . TDVLDP	CHT_DVSATL_DP	RE		Sat liq spec vol derivative wrt press	Composite Units
619	. . TDVGDP	CHT_DVSATG_DP	RE		Sat stm spec vol derivative wrt press	Composite Units
620	. . TDVLDH	CHT_DVSATL_DH	RE		Sat liq spec vol derivative wrt enthalpy	Composite Units
621	. . TDVGDH	CHT_DVSATG_DH	RE		Sat stm spec vol derivative wrt enthalpy	Composite Units
622	. . TUWAT	CHT_VISCOS_WAT	RE		Water viscosity	Lbm/ft-sec
623	. . TUSTM	CHT_VISCOS_STM	RE		Steam viscosity	Lbm/ft-sec
624	. . TUSATS	CHT_VISCOS_SAT_STM	RE		Saturated steam viscosity	Lbm/ft-sec
625	. . TKWAT	CHT_COND_WAT	RE		Water thermal conductivity	Btu/sec-ft-degF
626	. . TKSTM	CHT_COND_STM	RE		Steam thermal conductivity	Btu/sec-ft-degF
627	. . TKSATS	CHT_COND_SAT_STM	RE		Saturated steam thermal conductivity	Btu/sec-ft-degF
628	. . TPRWAT	CHT_PRAN_WAT	RE		Water Prandtl number	Dimensionless
629	. . TPRSTM	CHT_PRAN_STM	RE		Steam Prandtl number	Dimensionless
630	. . TPRSTS	CHT_PRAN_SAT_STM	RE		Saturated steam Prandtl number	Dimensionless
631	. . TCWAT	CHT_SPEC_HT_WAT	RE		Water specific heat	Btu/lbm-degF
632	. . TCSATS	CHT_SPEC_HT_SAT_STM	RE		Saturated steam specific heat	Btu/lbm-degF
633	. CHTSTT	CHT_STATE	RE	25	CHT Core average state parameters	Partition
634	. . TLBOIL	CHT_BOILING	LO		Flag for heat trans mode T,F=boil,fc	True False
635	. . TQCRIT	CHT_FLUX_CRIT	RE		Critical heat flux	Btu/sec-ft^2
636	. . TTERMT	CHT_TERM	RE		Transition boiling term	Composite Units
637	. . TTERM2	CHT_TERM2	RE		Departure from nucleate boiling term	Composite Units
638	. . TTCRIT	CHT_TEMP_CRIT	RE		Critical temperature	Degree F
639	. . THNB	CHT_HTCOF_NB	RE		Nucleate boiling heat transfer coef.	Btu/secft^2degF
640	. . THSUB	CHT_HTCOF_SUB	RE		Heat transfer coef. to subcooled liq.	Btu/secft^2degF
641	. . TFLASH	CHT_FLASH_RATE_LAST	RE		Flashing rate last time step	Lbm/sec
642	. . TLMIXL	CHT_LEVL_MIX_LAST	RE		Mixture level last time step	Feet
643	. . TQAVE	CHT_AVG_HEAT_FLUX	RE		Core-wide average heat flux	MegBtu/hr-ft^2
644	. . TTFUEL	CHT_TEMP_FUEL_AV	RE		Average temperature of fuel	Degree F
645	. CHTAXL	CHT_AXIAL_OUTPUT	RE	475	CHT Axially dependant outputs	Partition
646	. . CHTAXF	CHT_AXIAL_DATA_FC	RE	175	CHT Axially dependant outputs - FC	Partition
647	. . . TXFC	CHT_QUAL	RE	20	Node coolant quality - fc mode only	Fraction
648	. . . TTCROS	CHT_TEMP_CROSS	RE	20	Crossover temperature	Degree F
649	. . . THFB	CHT_HTCOF_FB	RE	20	Film boiling heat transfer coef.	Btu/secft^2degF
650	. . . TQDNB	CHT_FLX_DNB	RE	20	Critical heat flux - forced conv. mode	Btu/sec-ft^2
651	. . . TTNBFC	CHT_TEMP_NB_FC	RE	20	Critical temp. - forced conv. mode	Degree F
652	. . CHTAXB	CHT_AXIAL_DATA_BO	RE	250	CHT Axially dependant outputs - BO	Partition
653	. . . TGSTMB	CHT_FLOW_STM_BO	RE	20	Steam flow rate - pool boiling mode.	Lbm/sec
654	. . . TKGAP	CHT_GAP_COND	RE	20	Fuel-clad gap thermal cond.	Btu/sec-ft-degF
655	. . . TQZRWA	CHT_HT_GEN_ZR_WAT	RE	20	Heat rate of Zr-water reaction	Btu/sec
656	. . . TIHT	CHT_IHT	IN	20	Cue for ht. transfer regime by node	Dimensionless
657	. . . TCSTM	CHT_SPEC_HT_STM	RE	20	Steam sp. heat st last prop. calc.	Btu/lbm-degF
658	. . . THSTM	CHT_HTCOF_ST	RE	20	Heat transfer coef. to steam	Btu/secft^2degF
659	. . . TFLUX	CHT_HT_FLUX	RE	20	Heat flux into moderator	Btu/sec-ft^2
660	. . . TTSURF	CHT_TEMP_SURF	RE	20	Node temp. at clad-moderator interface	Degree F
661	. . . TQAXIL	CFTH_RCSAXIAL_Q	RE	20	Total power in core axial section	Btu/sec
662	. . . TQLIQ	CHT_HEAT_LIQ	RE	20	Rod heat transfer to liquid	Btu/sec
663	. . . TQSTM	CHT_HEAT_STM	RE	20	Rod heat transfer to steam	Btu/sec
664	. . CHTAXA	CHT_AXIAL_DATA_ALL	RE	50	CHT Axially dependant outputs - FC&BO	Partition
665	. . . TECOOL	CHT_ENTH_COOL	RE	21	Coolant enthalpy at bottom of section	Btu/lbm

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
666	. . . TTCOOL	CHT_TEMP_COOL	RE	21	Coolant temperature at bottom of section	Degree F
667	. TRADEX	CHT_ROD_RADIAL	RE	600	Radial rod model variables	Partition
668	. . TTROD	CHT_TEMP_ROD	RE	10,20	Temperature. distribution in fuel rod	Degree F
669	. . TKROD	CHT_COND_ROD	RE	10,20	Fuel rod thermal conductivity	Btu/sec-ft-degF
670	. . TCROD	CHT_HT_CAP_ROD	RE	10,20	Fuel rod heat capacity	Btu/ft^3-degF
671	. CHTSEO	CHT_SECTIONS_OUTPUT	RE	41	CHT Axially Sections Mass and Enthalpy	Partition
672	. . MCORES	CHT_M_CORE_SECT	RE	20	Mass in core sections: Steam+Liquid	Lbm
673	. . HCORE	CHT_H_CORE_SECT	RE	20	Average enthalpy in core sections	Btu/lbm
674	. . CTHHOP	CHT_USE_NEW_ENTHALPY_OPTION	RE		1.0 => Use new(Ver 02250) CHT Enth Calc	Dimensionless
675	POW	POWER_COMMON	RE	1700	Segment for core power variables	Segment
676	. KUSER	POW_USER_COMMON	RE	80	Variables for user control of power	Partition
677	. . KUSERI	POW_USER_INP	RE	60	User control input variables	Partition
678	. . . POW01	UNUSED_VAR_POW01	RE	12	Unused Variable	Dimensionless
679	. . . KLUPOW	POW_USER_IFUPOW	LO		User option for using power table	True False
680	. . . KWPOWZ	POW_USER_POWZ	RE		Initial steady-state power	Megawatts
681	. . . KNPOWT	POW_USER_NPOWT	IN		No. of pairs in power vs time table	Counts
682	. . . KFPOWT	POW_USER_POWT	RE	20	Power values for power vs time table	Fraction
683	. . . KTPOWT	POW_USER_TPOWT	RE	20	Time values for power vs time table	Seconds
684	. . KUSERS	POW_USER_STATE	RE	10	User power state variables	Partition
685	. . . KFQC	POW_USER_QC	RE		Final kinetics fission power fraction	Fraction
686	. . . KFQCD	POW_USER_QCD	RE		Final decay power	Fraction
687	. KKIN	POW_KIN_COMMON	RE	630	Power kinetics variables	Partition
688	. . KKINI	POW_KIN_INP	RE	580	Kinetics input variables	Partition
689	. . . KALPHA	POW_KIN_ALPHA	RE	11	Fission products disintegration energies	Fraction
690	. . . KDLAM	POW_KIN_DLAM	RE	11	Decay constants for fission products	1/seconds
691	. . . KBETA	POW_KIN_BETA	RE	6	Delayed neutron fractions	Fraction
692	. . . KPLAM	POW_KIN_PLAM	RE	6	Decay constants for delayed neutrons	1/seconds
693	. . . KBBAR	POW_KIN_BBAR	RE		Total delayed neutrons fraction	Fraction
694	. . . KBBARR	POW_KIN_BBARR	RE		Delayed neutron effectiveness	Fraction
695	. . . KDKBOZ	POW_KIN_DKCONZ	RE		Reference boric acid reactivity	Reactivity
696	. . . KDKMTZ	POW_KIN_DKCTMZ	RE		Reference moderator temp reactivity	Reactivity
697	. . . KDKMDZ	POW_KIN_DKDENZ	RE		Reference moderator density reactivity	Reactivity
698	. . . KDKFTZ	POW_KIN_DKTMPZ	RE		Reference Doppler reactivity	Reactivity
699	. . . KDKINZ	POW_KIN_DKINSZ	RE		Reference ctrl rod insertion reactivity	Reactivity
700	. . . KLMOD	POW_KIN_MODDK	LO		Option: mod bor acid & temp reactivities	True False
701	. . . KNBO	POW_KIN_NDKCON	IN		No. pairs, react vs bor acid conc table	Counts
702	. . . KNMT	POW_KIN_NDKCTM	IN		No. pairs, react vs moder temp table	Counts
703	. . . KNMD	POW_KIN_NDKDEN	IN		No. pairs, react vs moder density table	Counts
704	. . . KNFT	POW_KIN_NDKTMP	IN		No. pairs, Dopplr reac vs fueltemp table	Counts
705	. . . KNQDK	POW_KIN_NQDK	IN		No. pairs, reactivity vs time table	Counts
706	. . . KSIGD2	POW_KIN_SIGD2	RE		Total fission (1.0 - sum POW_KIN_ALPHA)	Fraction
707	. . . KSTARL	POW_KIN_STARL	RE		Prompt neutron lifetime	Seconds
708	. . . KTSS	POW_KIN_TSS	RE		Maximum kinetics time step	Seconds
709	. . . KDKBO	POW_KIN_DKCON	RE	30	Boric acid reacts, for bar vs conc table	Reactivity
710	. . . KTBO	POW_KIN_TDKCON	RE	30	Concentration for bar vs conc table	Parts/million
711	. . . KDKMT	POW_KIN_DKCTM	RE	30	Mod temp react. for mtr vs temp table	Reactivity
712	. . . KTMT	POW_KIN_TDKCTM	RE	30	Temperature for mtr vs temp table	Degree F
713	. . . KDKMD	POW_KIN_DKDEN	RE	30	Mod dens react. for mdr vs density table	Reactivity
714	. . . KTMD	POW_KIN_TDKDEN	RE	30	Mod dens. for mdr vs density table	Lbm/ft^3
715	. . . KDKFT	POW_KIN_DKTMP	RE	30	React. for dopplr react vs fuel temp tbl	Reactivity
716	. . . KTFT	POW_KIN_TDKTMP	RE	30	Fuel temp for Dop react vs fuel temp tbl	Degree F
717	. . . KQDK	POW_KIN_QDK	RE	30	Reactivity for react vs time table	Reactivity
718	. . . KTQDK	POW_KIN_TQDK	RE	30	Time for react vs time table	Seconds
719	. . . KTFUEL	POW_KIN_T	RE		Average core fuel temperature	Degree F
720	. . . KDCORE	POW_KIN_DENCOR	RE		Core average moderator density	Lbm/ft^3
721	. . . KDKIN	POW_KIN_DKINS	RE	100	Reactivity for react vs CEA pos table	Reactivity
722	. . . KTDKIN	POW_KIN_TDKINS	RE	100	Pos (steps) for react vs CEA pos table	Counts
723	. . . KNDKIN	POW_KIN_NDKINS	IN		No. pairs in worth-vs position table	Counts
724	. . . KTUPOW	POW_IFUPOW_TIM	RE		Time elapsed since switch to user-power	Seconds
725	. . . KDKCT	POW_KIN_CUTBACK	RE	10	Reactivity for RPC react insertion table	Reactivity
726	. . . KTCT	POW_KIN_TCUTBACK	RE	10	Times for RPC reactivity insertion table	Seconds
727	. . . KNCT	POW_KIN_NCUTBACK	IN		No. points in RPC react insertion table	Counts
728	. . . KDSRC	POW_KIN_SOURCE	RE		Kinetics source term - fraction of FP	Fraction
729	. . . KDKSUB	POW_KIN_DK_INIT	RE		Initial subcriticality	Reactivity
730	. . KKINO	POW_KIN_OUT	RE	10	Kinetics output variables	Partition
731	. . . KDKTOT	POW_KIN_DKT	RE		Total reactivity	Reactivity
732	. . . KDKUSR	POW_KIN_DK	RE		User-specified reactiv. (e.g. stuck rod)	Reactivity
733	. . . KDKBOR	POW_KIN_DKBOR	RE		Boric acid reactivity	Reactivity
734	. . . KDKMOD	POW_KIN_DKMOD	RE		Core moderator density reactivity	Reactivity
735	. . . KDKDOP	POW_KIN_DKDOP	RE		Fuel temp Doppler reactivity	Reactivity
736	. . . KDKTMD	POW_KIN_DKTMD	RE		Moderator temperature reactivity	Reactivity
737	. . . KDKROD	POW_KIN_DKROD	RE		Control rods reactivity	Reactivity
738	. . . KDKSCR	POW_KIN_DKSCRAM	RE		Scram rods reactivity	Reactivity
739	. . . KDKCUT	POW_KIN_DKCUT	RE		Reactor power cutback reactivity	Reactivity

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
740	. . . KDKHER	POW_KIN_DKHERMC	RE		Hermite 3-D credit reactivity	Reactivity
741	. . KKINS	POW_KIN_STATE	RE	25	Kinetics state variables	Partition
742	. . . KCHI2	POW_KIN_CHI2	RE	11	Norm concentration for fission products	Fraction
743	. . . KEX2	POW_KIN_EX2	RE	6	Norm concentration for delayed neutrons	Fraction
744	. . . KQD2	POW_KIN_QD2	RE		Current kinetics decay heat fraction	Fraction
745	. . . KQF2	POW_KIN_QF2	RE		Current prompt power fraction	Fraction
746	. . . KEN2	POW_KIN_EN2	RE		Temporary prompt power fraction	Fraction
747	. . . KFTRIP	POW_CORE_TRIP_FRACTION	RE		Core power fraction at time of trip	Fraction
748	. KDKHT	POW_DKHT_COMMON	RE	100	Partition for decay heat variables	Partition
749	. . KDKHTI	POW_DKHT_INP	RE	85	Partition for decay heat inputs	Partition
750	. . . KTDHC	POW_DKHT_TIMDHT	RE	40	Time for ans decay heat vs time table	Seconds
751	. . . KFDHC	POW_DKHT_ANSDHC	RE	40	Decay heat frac for decay ht vs time tbl	Fraction
752	. . . KNDHC	POW_DKHT_NDHC	IN		No. of pairs in decay heat vs time table	Counts
753	. . . KFDHC0	POW_DKHT_DHCBEG	RE		Power fraction for switch to decay heat	Fraction
754	. . . KFDHCM	POW_DKHT_DHCFCT	RE		Multiplier on tabular decay heat	Dimensionless
755	. . KDKHTS	POW_DKHT_STATE	RE	5	Partition for decay heat output	Partition
756	. . . KFLGDK	POW_DKHT_IFDHC	LO		Signal: switched to decay heat	True False
757	. . . KTIMDH	POW_DKHT_TIMDHC	RE		Time of switch to decay heat	Seconds
758	. . . KFQCDT	POW_USER_QCD_LOOKUP	RE		Decay power from table	Fraction
759	. . KZRH2	POW_ZRH2O_COMMON	RE	8	Zirconium oxidation variables	Partition
760	. . . KZRH2I	POW_ZRH2O_INP	RE	5	Zr-H2O input variables	Partition
761	. . . . KNYZIR	POW_ZRH2O_NYZIR	LO		Option: calculate zirc-oxidation	True False
762	. . . . KFZBJ	POW_ZRH2O_FZBJ	RE		Multiplier on Baker-Just generated heat	Dimensionless
763	. . . . KZRH2S	POW_ZRH2O_STATE	RE	1	Zr-H2O state variables	Partition
764	. . . . . KH2M	POW_ZRH2O_H2M	RE		Hydrogen release rate due to Zr-H2O	Lbm/sec
765	. KINCON	POW_INITIAL_CONDITIONS	RE	20	Power initial conditions	Partition
766	. . KFRAIN	KFRAIN	RE		New initial core power fraction	Fraction
767	. KHER3D	POW_KIN_HERMITE_INPUT	RE	380	Hermite-torq 3D fb reactivity input	Partition
768	. . KPRHER	POW_KIN_HERMITE_PARAM	RE	30	Hermite-torq 3D fb reactivity param	Partition
769	. . . KTDHER	POW_KIN_HERM_TD	RE		Time delay for Hermite 3D feedback	Seconds
770	. . . KMLHER	POW_KIN_HERM_MULT	RE		Fraction of Hermite 3D feedback taken	Fraction
771	. . . KTLTMN	POW_KIN_TEMP_TILT_MIN	RE		Minimum temperature tilt	Degree F
772	. . . KPTWMN	POW_KIN_POWTOFLOW_MIN	RE		Minimum power to flow ratio (3D fb)	Dimensionless
773	. . . KWFRMN	POW_KIN_FLOWFRAC_MIN	RE		Minimum flow fraction (3D feedback)	Fraction
774	. . . KTLTMX	POW_KIN_TEMP_TILT_MAX	RE		Maximum temperature tilt (3D feedback)	Degree F
775	. . . KPTWMX	POW_KIN_POWTOFLOW_MAX	RE		Maximum power to flow ratio (3D fb)	Dimensionless
776	. . . KPHER	POW_KIN_HERM_POW_REF	RE		Power for normalization (3D feedback)	Megawatts
777	. . . KWHER	POW_KIN_HERM_FLOW_REF	RE		Flow for normalization (3D feedback)	Lbm/sec
778	. . . KNWFR	POW_KIN_HERM_N_FLOWFR	IN		Number of flow fractions (3D feedback)	Counts
779	. . . KWFHET	POW_KIN_CORE_W_FRACTAB	RE	8	Core frac flow for Hermite 3D feedback	Fraction
780	. . KRHER	POW_KIN_HERM_CREDITTAB	RE	350	Hermite react table trivariant (3D fb)	Partition
781	. KMHER	POW_KIN_MIXING_INPUT	RE	10	Hermite-torq 3D fb mixing input	Partition
782	. . KCONSC	POW_KIN_MIX_CON_COLD	RE	4	Cold side mixing weight factors (3D fb)	Fraction
783	. . KCONSH	POW_KIN_MIX_CON_HOT	RE	4	Hot side mixing weight factors (3D fb)	Fraction
784	. . KWEDGE	POW_KIN_EDGE_WEIGHT	RE		Edge temperature geom weight (3D fb)	Fraction
785	. . KFDH	POW_KIN_DH_FACTOR	RE		Core enthalpy rise fraction (3D fb)	Fraction
786	. KOPFB	POW_KIN_FEEDBACK_OPTIONS	RE	15	Core reactivity feedback options	Partition
787	. . KOPROD	POW_KIN_SCRAM_ROD_OPTION	LO		Scram control rod reactivity option	Active Inactive
788	. . KOPREG	POW_KIN_REG_ROD_OPTION	LO		Regulating rod reactivity option	Active Inactive
789	. . KOPCUT	POW_KIN_CUT_ROD_OPTION	LO		Cutback control rod reactivity option	Active Inactive
790	. . KOPDOP	POW_KIN_DOPPLER_FB_OPTION	LO		Doppler reactivity option	Active Inactive
791	. . KOPBOR	POW_KIN_BORON_FB_OPTION	LO		Moderator boric acid reactivity option	Active Inactive
792	. . KOPMOD	POW_KIN_MOD_TEMP_FB_OPTION	LO		Moderator temp reactivity option	Active Inactive
793	. . KOPDEN	POW_KIN_MOD_DENSITY_FB_OPTION	LO		Moderator density reactivity option	Active Inactive
794	. . KFLDEN	POW_KIN_MOD_DENSITY_OPTION	LO		Option flag - cold edge mod density fb	True False
795	. . KOPHER	POW_KIN_HERM_CREDIT_OPTION	LO		Hermite 3D fb reactivity - option flag	Active Inactive
796	. CORE3D	POW_EXCORE_OUT	RE	74	Variables for excore detectors	Partition
797	. . XDISP	POW_EXCORE_DISP	RE	25	Excore readings - used for display only	Partition
798	. . . XPOWRD	EXCORE_POWERD	RE	8	Tot excore power readings (display)	Fraction
799	. . . XPOWER	EXCORE_POWER	RE	4	Tot excore power readings (display)	Fraction
800	. . . XOFFST	EXCORE_OFFSET	RE	4	Excore axial offsets (display)	Dimensionless
801	. . . XPWRAV	EXCORE_POWER_AV	RE		Average excore power (display)	Fraction
802	. . . XOFFAV	EXCORE_OFFSET_AV	RE		Average excore axial offset (display)	Dimensionless
803	. . . XTCONS	EXCORE_TAU	RE		Time const for excore response (display)	Seconds
804	. . KXDISP	POW_EXCORE_DATA	RE	25	Excore readings: used by controls & RPS	Partition
805	. . . KXPOWD	POW_EXCORE_POWERD	RE	8	Total excore power readings	Fraction
806	. . . KXPOWR	POW_EXCORE_POWER	RE	4	Total excore power readings	Fraction
807	. . . KXOFFS	POW_EXCORE_OFFSET	RE	4	Excore axial offsets	Dimensionless
808	. . . KXPWAV	POW_EXCORE_POWER_AV	RE		Average excore power	Fraction
809	. . . KXOFFA	POW_EXCORE_OFFSET_AV	RE		Average excore axial offset	Dimensionless
810	. . . KXTAU	POW_EXCORE_TAU	RE		Time const for excore response	Seconds
811	. . KXCALB	POW_EXCORE_CALIB	RE	10	Calibration constants for excores	Partition
812	. . . KXTUNE	POW_EXCORE_TUNE	RE		Calibration tuning constant for excores	Dimensionless
813	. . . KXGAIN	POW_EXCORE_GAIN	RE		Decalibration gain for excores	Lbm/ft^3

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
814	. . . KXSVR	POW_EXCORE_SVR	RE		Reference downcomer spec-vol for excores	Ft^3/lbm
815	. POWAX	POW_AXIAL_DATA	RE	250	Power calculation - core axial variables	Partition
816	. . KFAXIL	POW_USER_QAXL	RE	20	Axial power shape	Dimensionless
817	. . KIZX	POW_ZRH2O_IZX	LO	20	Indicator: non-reacted clad is present	True False
818	. . KPCZR	POW_ZRH2O_PCZR	RE	20	Percent zirconium reacted	Percent
819	. . KZX	POW_ZRH2O_ZX	RE	20	Thickness of reacted cladding	Feet
820	. . KQZRH2	POW_ZRH2O_QZRH2O	RE	20	Zr-H2O heat generation flux	Btu/sec-ft^2
821	. . KSHPIN	KSHAPIN	RE	50	Initial power shape (normalized to one)	Fraction
822	. . ZSHPIN	ZSHAPIN	RE	50	Fraction of core height for KSHAPIN	Fraction
823	. . SHPOPT	AXPD_INPUT_OPT	IN		AXPD Input option: 0=node avg 1=end node	Dimensionless
824	. . NUMSHP	AXPD_NUM_POINTS	IN		Number of points in AXPD (SHPOPT=1 only)	Dimensionless
825	. . PRISHP	AXPD_PRINT_NORMALIZATION	IN		1=> Debug print initial AXPD normalize	Dimensionless
826	RCS	RCS_COMMON	RE	12000	RCS global common variables	Segment
827	. RMODEL	MODEL_OFF	LO	10	Turns off models	Partition
828	. . RMORCP	MOD_OFF_RCP	LO		Turns off RCP model	True False
829	. . RMOOIL	MOD_OFF_RCPOIL	LO		Turns off RCPOIL model	True False
830	. . RMOCHT	MOD_OFF_CHT	LO		Turns off CHT model	True False
831	. . RMORCS	MOD_OFF_RCS	LO		Turns off RCS model	True False
832	. . RMOQT	MOD_OFF_QT	LO		Turns off QT model	True False
833	. . RMOPOW	MOD_OFF_POWER	LO		Turns off POWER model	True False
834	. RINTER	RCS_INTERNAL	RE	8400	RCS internal variables	Partition
835	. . RNODEV	RCS_NODE_VARIABLES	RE	3100	Node variables	Partition
836	. . . RPNODE	RCS_NODE_PRESSURES	RE	100	Node pressure arrays	Partition
837	. . . . RPRESP	PRES_PRED	RE	50	Predicted node pressures	Psia
838	. . . . RPRESS	PRESS	RE	50	Node pressures	Psia
839	. . . RENNOD	RCS_NODE_ENERGIES	RE	100	Node energy arrays	Partition
840	. . . . RENTOT	ENGY_TOT	RE	50	Node total energies	Btu
841	. . . . RENSTM	ENGY_STM	RE	50	Node steam energies	Btu
842	. . . RMNODE	RCS_NODE_MASSES	RE	200	Node mass arrays	Partition
843	. . . . RMTOT	MASS_TOT	RE	50	Node total masses	Lbm
844	. . . . RMLIQ	MASS_LIQ	RE	50	Node liquid masses	Lbm
845	. . . . RMSTM	MASS_STM	RE	50	Node steam masses	Lbm
846	. . . . RMBUB	MASS_BUB	RE	50	Mass of entrained bubbles	Lbm
847	. . . RENODE	RCS_NODE_ENTHALPIES	RE	300	Node enthalpy arrays	Partition
848	. . . . RETOT	ENTH_TOT	RE	50	Node average enthalpies	Btu/lbm
849	. . . . RELIQ	ENTH_LIQ	RE	50	Node liquid enthalpies	Btu/lbm
850	. . . . RESTM	ENTH_STM	RE	50	Node steam enthalpies	Btu/lbm
851	. . . . REMIX	ENTH_MIX	RE	50	Node two-phase mixture enthalpies	Btu/lbm
852	. . . . RELIQS	ENTH_LIQ_SAT	RE	50	Node saturated liquid enthalpies	Btu/lbm
853	. . . . RESRMS	ENTH_STM_SAT	RE	50	Node saturated steam enthalpies	Btu/lbm
854	. . . RSNODE	RCS_NODE_SPEC_VOLUME	RE	250	Node specific volume arrays	Partition
855	. . . . RSTOT	SVOL_TOT	RE	50	Node average specific volumes	Ft^3/lbm
856	. . . . RSLIQ	SVOL_LIQ	RE	50	Node liquid specific volumes	Ft^3/lbm
857	. . . . RSSTM	SVOL_STM	RE	50	Node steam specific volumes	Ft^3/lbm
858	. . . . RSLIQS	SVOL_LIQ_SAT	RE	50	Node saturated liquid specific volumes	Ft^3/lbm
859	. . . . RSSTMS	SVOL_STM_SAT	RE	50	Node saturated steam specific volumes	Ft^3/lbm
860	. . . RTNODE	RCS_NODE_TEMPERATURE	RE	350	Node temperature arrays	Partition
861	. . . . TRTOT	TEMP_TOT	RE	50	Node average temperatures	Degree F
862	. . . . RTLIQ	TEMP_LIQ	RE	50	Node liquid temperatures	Degree F
863	. . . . RTSTM	TEMP_STM	RE	50	Node steam temperatures	Degree F
864	. . . . RTSAT	TEMP_SAT	RE	50	Node saturation temperatures	Degree F
865	. . . . RTWALL	TEMP_WALL	RE	50	Node wall temperatures	Degree F
866	. . . . RTSUBC	SUBC_LIQ	RE	50	Node liquid subcooling	Del-DegF
867	. . . . RTCONT	TEMP_CONT	RE	50	Node containment temperatures	Degree F
868	. . . RQNODE	RCS_NODE_HEAT_RATES	RE	350	Node heat rate arrays	Partition
869	. . . . RQWALL	HEAT_WALL	RE	50	Node wall to coolant heat rates	Btu/sec
870	. . . . RQCONT	HEAT_CONT	RE	50	Node wall to containment heat rates	Btu/sec
871	. . . . RQEXT	HEAT_EXT	RE	50	Node external heat rates	Btu/sec
872	. . . . RQTOT	HEAT_TOT	RE	50	Node total heat rates	Btu/sec
873	. . . . RQSTM	HEAT_STM	RE	50	Node wall-to-steam heat rates	Btu/sec
874	. . . . RQLIQ	HEAT_LIQ	RE	50	Node wall-to-liquid heat rates	Btu/sec
875	. . . . RQCOND	HEAT_COND	RE	50	Node condensation heat rates	Btu/sec
876	. . . RLNODE	RCS_NODE_LEVELS	RE	100	Node coolant level arrays	Partition
877	. . . . RLMIX	LEVL_MIX	RE	50	Node two-phase mixture levels	Feet
878	. . . . RLLIQ	LEVL_LIQ	RE	50	Subcooled (or collapsed) liquid level	Feet
879	. . . RXNODE	RCS_NODE_STEAM_FRAC	RE	150	Node steam fraction arrays	Partition
880	. . . . RXTOT	QUAL_TOT	RE	50	Node steam mass fractions (qualities)	Fraction
881	. . . . RXMIX	QUAL_MIX	RE	50	Two-phase mix mass fractions (qualities)	Fraction
882	. . . . RVOIDF	VOID_FRAC	RE	50	Node void fractions	Fraction
883	. . . RDNODE	RCS_NODE_DERIVATIVES	RE	650	Derivative arrays	Partition
884	. . . . RDPDMT	DPDM_TOT	RE	50	Pressure derivatives, on total mass	Composite Units
885	. . . . RDPDML	DPDM_LIQ	RE	50	Pressure derivatives, on liquid mass	Composite Units
886	. . . . RDPDMS	DPDM_STM	RE	50	Pressure derivatives, on steam mass	Composite Units
887	. . . . RDPDUT	DPDU_TOT	RE	50	Pressure derivatives, on total energy	Composite Units

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
888	. . . . RDPDUS	DPDU_STM	RE	50	Pressure derivative on steam	Composite Units
889	. . . . RDHDU	DHDU	RE	50	Enthalpy derivatives, on internal energy	Composite Units
890	. . . . RDHDM	DHDM	RE	50	Enthalpy derivatives, on total mass	Composite Units
891	. . . . RDVDPT	DVDP_TOT	RE	50	Pressure derivative on total spec volume	Composite Units
892	. . . . RDVDHT	DVDH_TOT	RE	50	Enthalpy derivative on total spec volume	Composite Units
893	. . . . RDHFDP	DHF_DP	RE	50	Pres. derivative of sat. liquid enthalpy	Composite Units
894	. . . . RDHGDP	DHG_DP	RE	50	Pres. derivative of sat. steam enthalpy	Composite Units
895	. . . . RDVHDP	DVF_DP	RE	50	Pres. deriv. of sat. liquid spec. volume	Composite Units
896	. . . . RDVGDP	DVG_DP	RE	50	Pres. deriv. of sat. steam spec. volume	Composite Units
897	. . . RBNODE	RCS_NODE_BUBBLES	RE	100	Node bubble release arrays	Partition
898	. . . . RBRELE	RELE_BUB	RE	50	Node bubble release rates	Lbm/sec
899	. . . . RBDRFT	DRFT_BUB	RE	50	Node bubble drift velocities	Feet
900	. . . RCNODE	RCS_NODE_CONDENSATION	RE	250	Steam to liquid condensation variables	Partition
901	. . . . RCTOT	COND_TOT	RE	50	Total steam condensation rate in node	Lbm/sec
902	. . . . RCBOIL	COND_BOIL	RE	50	Condensation rate due to vaporization	Lbm/sec
903	. . . . RCSURF	COND_SURF	RE	50	Liquid-steam surface condensation rate	Lbm/sec
904	. . . . RCINJ	COND_INJ	RE	50	Condensation rate due to incoming liquid	Lbm/sec
905	. . . . RCBUB	COND_BUB	RE	50	Condensation rate of entrained bubbles	Lbm/sec
906	. . . RNENOD	RCS_NODE_STATES	RE	150	Non-equilibrium and heterogeneity flags	Partition
907	. . . . RNECAN	NE_CANDIDATE	IN	50	Non-equilibrium state possible in node	Pointer
908	. . . . RNESTA	NON_EQ_STATE	IN	50	Non-equilibrium state now in existence	Pointer
909	. . . . RHETRO	N_HETERO	LO	50	Flag indicating node is heterogeneous	True False
910	. . . VOLMIX	VOL_MIX	RE	50	Volume of two-phase mixture in node	Ft^3
911	. . RSECT	RCS_SECT_NODE_VARIABLES	RE	71	RCS sectionalized node variables	Partition
912	. . . RIBUBM	RCS_MBUB_SS	RE		SS bubble mass sect. node	Lbm
913	. . . RIDBUB	RCS_RELE_PRIME	RE		Deriv. of bub. release rate	Composite Units
914	. . . RIVTOP	RCS_VOID_TOP	RE		SS surf. void fraction	Fraction
915	. . . RIVTRN	RCS_VOID_TRAN	RE		Trans. surf. void fraction	Fraction
916	. . . RIBCOR	RCS_TRANS_CORR	RE		Transient bub. rel. correction	Dimensionless
917	. . . RIXMIX	QUAL_MIX_SECT	RE	1,22	Array of section two-phase mix qualities	Fraction
918	. . . RIMBUB	MASS_BUB_SECT	RE	1,22	Array of section bubble masses	Lbm
919	. . . RISLIP	SLIP_SECT	RE	1,22	Array of section slip ratios	Fraction
920	. . RPATHV	RCS_PATH_VARIABLES	RE	2750	Path variables	Partition
921	. . . RGPATH	RCS_PATH_FLOW_RATES	RE	250	Path flow rate arrays	Partition
922	. . . . RPFLOW	P_FLOW	RE	150	Path mass flow rates	Lbm/sec
923	. . . . . RGMOM	RCS_P_FLOW_MOM	RE	100	Momentum paths mass flow rate	Lbm/sec
924	. . . . . RGNONM	RCS_P_FLOW_NONM	RE	50	Non momentum paths mass flow rate	Lbm/sec
925	. . . . . RGEXT	RCS_PATHEXT_FLOW	RE	25	External paths mass flow rate	Lbm/sec
926	. . . . . RGRCP	RCS_RCPLEAK_FLOW	RE	4	RCP leak mass flow	Lbm/sec
927	. . . . . RGCHGS	RCS_CHGS_FLOW	RE	4	Charging mass flow	Lbm/sec
928	. . . . . RGLET	RCS_LDNS_FLOW	RE	4	RCS- letdown mass flow	Lbm/sec
929	. . . . . RGDRN	RCS_RCW_FLOW	RE	1	RCS RCW drains flow	Lbm/sec
930	. . . . . RGSDC	RCS_SDC_FLOW	RE	2	RCS shutdown cooling flow	Lbm/sec
931	. . . . . RGSIS	RCS_SIS_FLOW	RE	8	RCS safety injection flow	Lbm/sec
932	. . . . . RGLEAK	RCS_PATHLEAK_FLOW	RE	17	Leak paths mass flow rate	Lbm/sec
933	. . . . . RGSGTR	RCS_SGTR_FLOW	RE	8	RCS SG tube rupture flow	Lbm/sec
934	. . . . . RGSB	RCS_SBLOCA_FLOW	RE	4	RCS small break LOCA flow	Lbm/sec
935	. . . . . RGRODE	RCS_RODEJ_FLOW	RE		RCS rod ejection small break flow	Lbm/sec
936	. . . . . RGORNG	RCS_ORING_FLOW	RE		RCS O-ring seal flow	Lbm/sec
937	. . . . . RGLB	RCS_LBLOCA_FLOW	RE		RCS large break LOCA flow	Lbm/sec
938	. . . . . RGINT	RCS_PATHINT_FLOW	RE	8	RCS internal paths mass flow rate	Lbm/sec
939	. . . . . RGSPRA	RCS_SPRAY_FLOW	RE		RCS przr spray flow	Lbm/sec
940	. . . . . RGBLED	RCS_SPRAYBLEED_FLOW	RE	2	RCS przr spray bleed flow	Lbm/sec
941	. . . . . RGPZRR	RCS_PRZR_RELIEF_FLOW	RE		Przr relief valves flow	Lbm/sec
942	. . . . . RGUHR	RCS_UHEAD_RELIEF_FLOW	RE		Upper head relief valves flow	Lbm/sec
943	. . . . PFLOWC	P_FLOW_CRIT	RE	100	Path critical flow rates	Lbm/sec
944	. . . RPATH	RCS_PATH_ENTHALPIES	RE	400	Path flow enthalpies	Partition
945	. . . . RPENTH	P_ENTH	RE	150	Path average enthalpies	Btu/lbm
946	. . . . . REMOM	RCS_P_ENTH_MOM	RE	100	Momentum paths enthalpy	Btu/lbm
947	. . . . . RENONM	RCS_P_ENTH_NONM	RE	50	Non momentum paths enthalpy	Btu/lbm
948	. . . . . REEXT	RCS_PATHEXT_ENTH	RE	25	External paths enth	Btu/lbm
949	. . . . . RERCP	RCS_RCPLEAK_ENTH	RE	4	RCP leak enth	Btu/lbm
950	. . . . . RECHGS	RCS_CHGS_ENTH	RE	4	Charging enth	Btu/lbm
951	. . . . . RELET	RCS_LDNS_ENTH	RE	4	RCS- letdown enth	Btu/lbm
952	. . . . . REDRN	RCS_RCW_ENTH	RE	1	RCS RCW drains enth	Btu/lbm
953	. . . . . RESDC	RCS_SDC_ENTH	RE	2	RCS shutdown cooling enth	Btu/lbm
954	. . . . . RESIS	RCS_SIS_ENTH	RE	8	RCS safety injection enth	Btu/lbm
955	. . . . . RELEAK	RCS_PATHLEAK_ENTH	RE	17	Leak paths enth	Btu/lbm
956	. . . . . RESGTR	RCS_SGTR_ENTH	RE	8	RCS SG tube rupture enth	Btu/lbm
957	. . . . . RESB	RCS_SBLOCA_ENTH	RE	4	RCS small break LOCA enth	Btu/lbm
958	. . . . . RERODE	RCS_RODEJ_ENTH	RE		RCS rod ejection small break enth	Btu/lbm
959	. . . . . REORNG	RCS_ORING_ENTH	RE		RCS o-ring seal enth	Btu/lbm
960	. . . . . RELB	RCS_LBLOCA_ENTH	RE		RCS large break LOCA enth	Btu/lbm
961	. . . . . REINT	RCS_PATHINT_ENTH	RE	8	RCS internal paths enth	Btu/lbm

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
962	RESPRA	RCS_SPRAY_ENTH	RE		RCS przr spray enth	Btu/lbm
963	REBLED	RCS_SPRAYBLEED_ENTH	RE	2	RCS przr spray bleed enth	Btu/lbm
964	REPZRR	RCS_PRZR_RELIEF_ENTH	RE		Przr relief valves enth	Btu/lbm
965	REUHR	RCS_UHEAD_RELIEF_ENTH	RE		Upper head relief valves enth	Btu/lbm
966	RPLIQ	P_ENTH_LIQ	RE	100	Path liquid enthalpies	Btu/lbm
967	RPSTM	P_ENTH_STM	RE	100	Path steam enthalpies	Btu/lbm
968	RPSVOL	P_SVOL	RE	100	Path average specific volumes	Ft^3/lbm
969	RXPATH	RCS_PATH_QUALITIES	RE	500	Path flow qualities	Partition
970	RPQUAL	P_QUAL	RE	150	Path average steam fractions (quality)	Fraction
971	RXMOM	RCS_P_QUAL_MOM	RE	100	Momentum paths quality	Fraction
972	RXNMOM	RCS_P_QUAL_NONM	RE	50	Non momentum paths quality	Fraction
973	RXEXT	RCS_PATHEXT_QUAL	RE	25	External paths quality	Fraction
974	RXRCP	RCS_RCPLEAK_QUAL	RE	4	RCP leak quality	Fraction
975	RXCHGS	RCS_CHGS_QUAL	RE	4	Charging quality	Fraction
976	RXLET	RCS_LDNS_QUAL	RE	4	RCS- letdown quality	Fraction
977	RXDRN	RCS_RCW_QUAL	RE	1	RCS RCW drains qual	Fraction
978	RXSDC	RCS_SDC_QUAL	RE	2	RCS shutdown cooling qual	Fraction
979	RXSIS	RCS_SIS_QUAL	RE	8	RCS safety injection qual	Fraction
980	RXLEAK	RCS_PATHLEAK_QUAL	RE	17	Leak paths quality	Fraction
981	RXSGTR	RCS_SGTR_QUAL	RE	8	RCS SG tube rupture qual	Fraction
982	RXSB	RCS_SBLOCA_QUAL	RE	4	RCS small break LOCA qual	Fraction
983	RXRODE	RCS_RODEJ_QUAL	RE		RCS rod ejection small break qual	Fraction
984	RXORNG	RCS_ORING_QUAL	RE		RCS O-ring seal qual	Fraction
985	RXLB	RCS_LBLOCA_QUAL	RE		RCS large break LOCA qual	Fraction
986	RXINT	RCS_PATHINT_QUAL	RE	8	RCS internal paths quality	Fraction
987	RXSPRA	RCS_SPRAY_QUAL	RE		RCS przr spray qual	Fraction
988	RXBLED	RCS_SPRAYBLEED_QUAL	RE	2	RCS przr spray bleed qual	Fraction
989	RXPZRR	RCS_PRZR_RELIEF_QUAL	RE		Przr relief valves qual	Fraction
990	RXUHR	RCS_UHEAD_RELIEF_QUAL	RE		Upper head relief valves qual	Fraction
991	RPVOID	P_VOID	RE	100	Path average steam void fractions	Fraction
992	PSTMUP	P_STM_UP	RE	150	Frac of fluid from upstream steam region	Fraction
993	RFMOM	RCS_P_STM_UP_MOM	RE	100	Steam frac from steam region (mom path	Fraction
994	RFNONM	RCS_P_STM_UP_NONM	RE	50	Steam frac from steam reg. (non mom.)	Fraction
995	RFEXT	RCS_PATHEXT_STM_UP	RE	25	External paths stm quality	Fraction
996	RFRCP	RCS_RCPLEAK_STM_UP	RE	4	RCP leak stm quali	Fraction
997	RFCHGS	RCS_CHGS_STM_UP	RE	4	Charging stm quali	Fraction
998	RFLET	RCS_LDNS_STM_UP	RE	4	RCS- letdown stm quali	Fraction
999	RFDRN	RCS_RCW_STM_UP	RE	1	RCS RCW drains stm quali	Fraction
1000	RFSDC	RCS_SDC_STM_UP	RE	2	RCS shutdown cooling stm quali	Fraction
1001	RFSIS	RCS_SIS_STM_UP	RE	8	RCS safety injection stm quali	Fraction
1002	RFLEAK	RCS_PATHLEAK_STM_UP	RE	17	Leak paths stm quali	Fraction
1003	RFSGTR	RCS_SGTR_STM_UP	RE	8	RCS SG tube rupture stm quali	Fraction
1004	RFSB	RCS_SBLOCA_STM_UP	RE	4	RCS small break LOCA stm quali	Fraction
1005	RFRODE	RCS_RODEJ_STM_UP	RE		RCS rod ejection small break stm quali	Fraction
1006	RFORNG	RCS_ORING_STM_UP	RE		RCS o-ring seal stm quali	Fraction
1007	RFLB	RCS_LBLOCA_STM_UP	RE		RCS large break LOCA stm quali	Fraction
1008	RFINT	RCS_PATHINT_STM_UP	RE	8	RCS internal paths stm quali	Fraction
1009	RFSPRA	RCS_SPRAY_STM_UP	RE		RCS przr spray stm quali	Fraction
1010	RFBLED	RCS_SPRAYBLEED_STM_UP	RE	2	RCS przr spray bleed stm quali	Fraction
1011	RFPZRR	RCS_PRZR_RELIEF_STM_UP	RE		Przr relief valves stm quali	Fraction
1012	RFUHR	RCS_UHEAD_RELIEF_STM_UP	RE		Upper head relief valves stm quali	Fraction
1013	RSTDN	P_STM_DOWN	RE	100	Frac of fluid to downstream steam region	Fraction
1014	RDPPAT	RCS_PATH_PRESS_DROPS	RE	900	Path flow pressure drops	Partition
1015	RDPMOM	DP_MOM	RE	100	Momentum pressure drop	Psid
1016	RDPFRC	DP_FRIC	RE	100	Friction pressure drop	Psid
1017	RDPELE	DP_ELEV	RE	100	Elevation pressure drop	Psid
1018	RDPLOS	DP_LOSS	RE	100	Form loss pressure drop	Psid
1019	RDPHED	DP_HEAD	RE	100	Head pressure drop	Psid
1020	RDPEXT	DP_EXT	RE	100	Externally driven pressure drop	Psid
1021	RDPTOT	DP_TOT	RE	100	Total pressure drop	Psid
1022	RDPACT	DP_ACTUAL	RE	100	Actual pressure drop (adjacent nodes)	Psid
1023	RDOCHK	DP_CHECK	RE	100	Pressure drop check (DP_ACTUAL-DP_TOTAL)	Psid
1024	RPDER	RCS_PATH_DERIVATIVES	RE	200	Path momentum terms	Partition
1025	RESUBK	ESUBK	RE	100	Path momentum time derivative	Composite Units
1026	RFSUBK	FSUBK	RE	100	Derivative of esubk by flow rate	Composite Units
1027	RPUPDN	RCS_PATH_UPDOWN	RE	400	Path flow direction dependent arrays	Partition
1028	PATHUP	P_NODE_UP	IN	100	Node currently upstream of path	Pointer
1029	PATHDN	P_NODE_DOWN	IN	100	Node currently downstream of path	Pointer
1030	RELUP	P_ELEV_UP	RE	100	Elevation of currently upstream end	Feet
1031	RELDN	P_ELEV_DOWN	RE	100	Elevation of currently downstream end	Feet
1032	RCSSG	RCS_STEAM_GENERATOR	RE	16	Steam generator variables	Partition
1033	HEATSG	HEAT_SG	RE	8	Steam generator heat transfer rates	Btu/sec
1034	RCSRCP	RCS_PUMPS	RE	20	Main coolant pump variables	Partition
1035	RRSPED	SPEED_PUMP	RE	4	Main coolant pump speeds	Shaft RPM

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1036 . . .	RRHEAT	HEAT_PUMP	RE	4	Main coolant pump heat rates	Btu/sec
1037 . . .	RRTORQ	TORQ_PUMP	RE	4	Unused Variable	Dimensionless
1038 . . .	RRHEAD	HEAD_PUMP	RE	4	Main coolant pump heads	Feet
1039 . . .	RRDP	DP_PUMP	RE	4	Main coolant pump pressure rises	Psid
1040 . .	RCSCOR	RCS_CORE	RE	80	Reactor core variables	Partition
1041 . . .	RKQ	HEAT_CORE	RE		Total core-to-coolant heat transfer rate	Btu/sec
1042 . . .	RKGIN	FLOW_CORE_IN	RE		Core inlet flow rate (totl minus bypass)	Lbm/sec
1043 . . .	RKBORN	BORON_CORE	RE		Core average boron concentration	Parts/million
1044 . . .	RILLIQ	LEVL_LIQ_VESSEL	RE		Collapsed liquid level in vessel	Feet
1045 . . .	RILMIX	LEVL_MIX_VESSEL	RE		Two-phase mixture level in vessel	Feet
1046 . . .	RKLMIX	LEVL_MIX_CORE	RE		Two-phase mixture level in core	Feet
1047 . . .	RKSANN	SVOL_DOWNCOMER	RE	2,10	Downcomer sp. vols. at excore detectors	Ft^3/lbm
1048 . . .	RKBOUY	BOUYANCY_CORE	RE		Core coolant bouyancy ratio	Fraction
1049 . . .	RKDPUH	DP_LOSS_UPLEN	RE		Pressure loss in vessel upper plennum	Psid
1050 . . .	RKQCEA	RCS_Q_CEA_CORE	RE		Heat transfer rate CEA to core node	Btu/sec
1051 . . .	RKEDIS	ENTH_QUAD_CORE	RE	4	Core inlet radial enthalpy distribution	Btu/lbm
1052 . . .	RKETLT	RCS_DELH_HLTILT	RE	4	Hot leg inlet delta enthalpy tilt	Btu/lbm
1053 . . .	RKQUH	RCS_Q_UHEAD_CORE	RE		Heat transfer rate u-head to core node	Btu/sec
1054 . .	RCSPZR	RCS_PRESSURIZER	RE	80	Pressurizer variables	Partition
1055 . . .	RHVOLT	VOLT_HEATER	RE	6	Pressurizer heater effective voltages	Volts
1056 . . .	RHADMI	ADMI_HEATER	RE	6	Pressurizer heater admittances	Mho admittance
1057 . . .	RHQELE	HEAT_ELEC	RE	6	Przr. heater electrical heat rates	Btu/sec
1058 . . .	RHENGY	ENGY_HEATER	RE	6	Pressurizer heater stored heats	Btu
1059 . . .	RHTEMP	TEMP_HEATER	RE	6	Pressurizer heater temperature	Degree F
1060 . . .	RHQHTR	HEAT_HEATER	RE	6	Pressurizer heater-to-coolant heat rates	Btu/sec
1061 . . .	RHQPZR	HEAT_PRZR	RE		Total pressurizer heater heat rate	Btu/sec
1062 . . .	RPDPLV	LEVL_PRZR_DP	RE		Pressure drop for level instrument	Feet
1063 . . .	RPTREF	TEMP_PRZR_REF	RE		Pressurizer reference leg temperature	Degree F
1064 . . .	RPTSRG	TEMP_PRZR_SURGE	RE		Surge line temperature	Degree F
1065 . . .	RPTRTD	TEMP_PRZR_RTD	RE		Pressurizer rtd temperature	Degree F
1066 . . .	RWGPAT	P_FLOW_SPRAY	RE		Pressuizer spray total flow rate	Lbm/sec
1067 . . .	RWEPAT	P_ENTH_SPRAY	RE		Pressurizer spray enthalpy	Btu/lbm
1068 . . .	RWBPAT	P_BORON_SPRAY	RE		Pressurizer spray boron concentration	Parts/million
1069 . . .	RWGAUX	P_FLOW_AUX_SPRAY	RE		Auxiliary spray flow rate	Lbm/sec
1070 . . .	RWEAUX	P_ENTH_AUX_SPRAY	RE		Auxiliary spray flow enthalpy	Btu/lbm
1071 . . .	RWBAUX	P_BORON_AUX_SPRAY	RE		Auxiliary spray flow boron concentration	Parts/million
1072 . . .	RWGBLD	P_FLOW_BLEED	RE	4	Spray bleed flows from cold legs	Lbm/sec
1073 . . .	RVGREL	P_FLOW_RELIEF	RE		Total pressurizer relief flow rate	Lbm/sec
1074 . . .	RVEREL	P_ENTH_RELIEF	RE		Pressurizer relief flow enthalpy	Btu/lbm
1075 . . .	RVSREL	P_SVOL_RELIEF	RE		Pressurizer relief flow specific volume	Ft^3/lbm
1076 . . .	RVVRLE	VIBR_VALVE_RELIEF	RE	4	Array of relief valve vibration signals	Volts
1077 . . .	RVTREL	TEMP_VALVE_RELIEF	RE	3	Array of relief valve exit temperatures	Degree F
1078 . . .	RPNCON	P_NONC_PRZR_CONT	RE		Non-cond flow przr to cont	Lbm/sec
1079 . . .	RPNQT	P_NONC_PRZR_QT	RE		Non-cond flow przr to quench tank	Lbm/sec
1080 . . .	RPGSQT	P_FLOW_PRZR_QT	RE		Pressurizer surge to QT flow rate	Lbm/sec
1081 . . .	RPGQT2	RCS_P_FLOW_PRZR_QT2	RE		PORVs and safeties flow przr to Q.T.	Lbm/sec
1082 . . .	RPPLOC	RCS_PRZR_PRES	RE		Pressurizer pressure (local variable)	Psia
1083 . . .	RWEBLD	P_ENTH_BLEED	RE	4	Spray bleed enthalpies from cold legs	Btu/lbm
1084 . . .	RVPUP	VLV_PRZR_PRES_UP	RE		Upstream pressure at przr relief valves	Psia
1085 . . .	RVPDN	VLV_PRZR_PRES_DOWN	RE		Downstream pressr at przr relief valves	Psia
1086 . .	RCSUH	RCS_UPPER_HEAD	RE	25	Reactor vessel upper head variables	Partition
1087 . . .	RUGQT	P_FLOW_UHEAD_QT	RE		Upper head to quench tank flow rate	Lbm/sec
1088 . . .	RUEQT	P_ENTH_UHEAD_QT	RE		Upper head to quench tank flow enthalpy	Btu/lbm
1089 . . .	RUGCON	P_FLOW_UHEAD_CONT	RE		Upper head to containment vent flow rate	Lbm/sec
1090 . . .	RUECON	P_ENTH_UHEAD_CONT	RE		Upper head to containment vent enthalpy	Btu/lbm
1091 . . .	RUETOP	ENTH_UHEAD_TOP	RE		Enthalpy in top of upper head	Btu/lbm
1092 . . .	RUSTOP	SVOL_UHEAD_TOP	RE		Specific volume at top of upper head	Ft^3/lbm
1093 . . .	RUMNON	MASS_NON_UHEAD	RE		Non-condensbl gas mass in upper head	Lbm
1094 . . .	RUVNON	VOLU_NON_UHEAD	RE		nu Non-condens gas volume in upper head	Ft^3
1095 . . .	RUPNON	DP_NON_UHEAD	RE		nu Upper head non-cond gas partial press	Psia
1096 . . .	RUNDIL	NONC_DILU_RATE	RE		Dilution of noncondensible u.h. bubble	Lbm/sec
1097 . . .	RUNCON	P_NONC_UHEAD_CONT	RE		Non-cond flow from upper head to contmt	Lbm/sec
1098 . . .	RUNQT	P_NONC_UHEAD_QT	RE		Non-cond flow from upper head to quench	Lbm/sec
1099 . . .	RUPLOC	RCS_UHEAD_PRES	RE		Upper head pressure (local variable)	Psia
1100 . . .	RCKMUL	RCS_CEA_MULT	RE	2	CEA paths k factor multipliers	Dimensionless
1101 . . .	RCLCEA	RCS_CEA_AV	RE		CEA average position	Feet
1102 . .	RCSQT	RCS_QUENCH_TANK	RE	20	Quench tank variables	Partition
1103 . . .	RQPRES	PRES_QT	RE		Quench tank pressure	Psia
1104 . . .	RQENTH	ENTH_QT	RE		Quench tank enthalpy	Btu/lbm
1105 . . .	RQENGY	ENGY_QT	RE		Quench tank liquid energy	Btu
1106 . . .	RQLEVL	LEVL_QT	RE		Quench tank liquid level	Feet
1107 . . .	RQMWAT	MASS_WAT_QT	RE		Mass of water in quench tank	Lbm
1108 . . .	RQMGAS	MASS_GAS_QT	RE		Mass of nitrogen in quench tank	Lbm
1109	RQTEMP	TEMP_QT	RE		Quench tank temperature	Degree F

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1110 . . .	RQTSUR	TEMP_QT_SURGE	RE		Quench tank in-surge temperature	Degree F
1111 . . .	RQLRUP	RUPTURE_QT	LO		Rupture disk ruptured when .TRUE.	True False
1112 . . .	RQSOLU	CONC_SOLU_QT	RE	5	Solute concs in Q.T.: B,H,I,Cs,Xe	Composite Units
1113 . . .	RQNCON	P_NONC_QT_CONT	RE		Quench tank to cont vent non-cond flow	Lbm/sec
1114 . .	RCSGLO	RCS_GLOBAL_AVERAGE	RE	18	Global variables (excludes pressurizer)	Partition
1115 . . .	RGPRES	PRES_GLOB	RE		Global pressure	Psia
1116 . . .	RGMASS	MASS_GLOB	RE		Global mass (excludes pressurizer)	Lbm
1117 . . .	RGENTH	ENTH_GLOB	RE		Global specific enthalpy	Btu/lbm
1118 . . .	RGENGY	ENGY_GLOB	RE		Global internal energy	Btu
1119 . . .	RGSENG	SENG_GLOB	RE		Global specific internal energy	Btu/lbm
1120 . . .	RGSVOL	SVOL_GLOB	RE		Global specific volume	Ft^3/lbm
1121 . . .	RGQUAL	QUAL_GLOB	RE		Global quality	Fraction
1122 . . .	RGELQS	ENTH_LIQ_SAT_GLOB	RE		Global saturated liquid enthalpy	Btu/lbm
1123 . . .	RGESTS	ENTH_STM_SAT_GLOB	RE		Global saturated steam enthalpy	Btu/lbm
1124 . . .	RGSLQS	SVOL_LIQ_SAT_GLOB	RE		Global saturated liquid spec volume	Ft^3/lbm
1125 . . .	RGSSTS	SVOL_STM_SAT_GLOB	RE		Global saturated steam spec volume	Ft^3/lbm
1126 . . .	RGTSAT	TEMP_SAT_GLOB	RE		Global saturation temperature	Degree F
1127 . . .	RGDP	DP_GLOB	RE		Change in global press. during last step	Psid
1128 . .	RCSSOL	RCS_SOLUTE	RE	1030	Coolant solute variables	Partition
1129 . . .	RPSOL	RCS_P_SOLU	RE	50,5	Non mom. paths solute concentrations	Composite Units
1130	RPBOR	RCS_P_BORON	RE	50	Non mom. paths boron concentration	Parts/million
1131	RPHYD	RCS_P_HYD	RE	50	Non mom. paths hydrogen	Lbm/lbm
1132	RPIOD	RCS_P_IOD	RE	50	Non mom. paths iodine	Microcurie/lbm
1133	RPPART	RCS_P_PART	RE	50	Non mom. paths particulates	Microcurie/lbm
1134	RPXEN	RCS_P_XEN	RE	50	Non mom. paths xenon	Microcurie/lbm
1135 . . .	RWAHYD	RCS_P_HYD_AUX_SPRAY	RE		Aux spray hydrogen concentr.	Lbm/lbm
1136 . . .	RWAIO	RCS_P_IOD_AUX_SPRAY	RE		Aux spray iodine concentr.	Microcurie/lbm
1137 . . .	RWAPT	RCS_P_PART_AUX_SPRAY	RE		Aux spray particulate concentr.	Microcurie/lbm
1138 . . .	RWAXE	RCS_P_XEN_AUX_SPRAY	RE		Aux spray xenon concentr.	Microcurie/lbm
1139 . . .	RNREL	RCS_RELE_NONC	RE		Hydrogen release rate to u-head	Lbm/sec
1140 . . .	RNSOL	RCS_CONC_SOLU	RE	50,5	Node solution concentrations	Composite Units
1141	RNBOR	RCS_CONC_BORON	RE	50	Node boron concentrations	Parts/million
1142	RNHYD	RCS_CONC_HYD	RE	50	Node hydrogen concentrations	Lbm/lbm
1143	RNIOD	RCS_CONC_IOD	RE	50	Node iodine concentrations	Microcurie/lbm
1144	RNPART	RCS_CONC_PART	RE	50	Node particulates concentrations	Microcurie/lbm
1145	RNXEN	RCS_CONC_XEN	RE	50	Node xenon concentrations	Microcurie/lbm
1146 . . .	RSREL	RCS_RELE_SOLU	RE	50,5	Node solute accumulation rates	Composite Units
1147 . . .	RKSREL	RCS_RELE_SOLU_CORE	RE	5	Core solute releases. 1-5:Bo,Hy,Io,Ce,Xe	Composite Units
1148	RKBREL	CORE_BORON_REL	RE		Core boron release (=0.0: unused)	Composite Units
1149	RKHREL	CORE_HYD_REL	RE		Core hydrogen release	Lbm/sec
1150	RKIREL	CORE_IOD_REL	RE		Core iodine release	Microcurie/sec
1151	RKPREL	CORE_PART_REL	RE		Core particulate (cesium) release	Microcurie/sec
1152	RKXREL	CORE_XEN_REL	RE		Core xenon release	Microcurie/sec
1153 . . .	RDSPAR	RCS_DOSE_VARIABLES	RE	20	Dose Model variables	Partition
1154	RDMIIO	RCS_DOSE_INIT_IOD	RE		Dose Model Initial RCS Iodine Conc.	Microcurie/lbm
1155	RDMFSH	RCS_DOSE_FLASH	RE		Dose model flashing factor flag	Dimensionless
1156	RDMBF	RCS_DOSE_BF	RE		Dose model breathing factor	FT^3/sec
1157	RDMCF	RCS_DOSE_CF	RE		Dose model conversion factor	Rem/Curie
1158	RDMXQ2	RCS_DOSE_XOQ2	RE		Dose model 2Hr site dispersion factor	sec/FT^3
1159	RDMXQ8	RCS_DOSE_XOQ8	RE		Dose model 8hr site dispersion factor	sec/FT^3
1160	RDMCLR	RCS_DOSE_CONT_LEAK	RE		Dose Model Containment Leak Rate	Frac./day
1161	RDMCDF	RCS_DOSE_COND_DF	RE		Dose Model Turb & cond Decon Factor	Dimensionless
1162	RDMTCU	RCS_DOSE_TOT_CURIE	RE		Dose Model Total Curies Iodine Released	Curies
1163	RDM2HR	RCS_DOSE_2HR	RE		Dose Model Total 2 Hour DOSE Accum.	REM
1164	RDM8HR	RCS_DOSE_8HR	RE		Dose Model Total 8 Hour DOSE Accum.	REM
1165 . .	RPASTV	RCS_PAST_VALUES	RE	651	Retained variables from last execution	Partition
1166 . . .	RLENST	ENGY_STM_LAST	RE	50	Node steam energy at last time step	Btu
1167 . . .	RLENTO	ENGY_TOT_LAST	RE	50	Node total energy at last time step	Btu
1168 . . .	RLMLIQ	MASS_LIQ_LAST	RE	50	Node mass of liquid at last time step	Lbm
1169 . . .	RLMSTM	MASS_STM_LAST	RE	50	Node mass of steam at last time step	Lbm
1170 . . .	RLMBUB	MASS_BUB_LAST	RE	50	Node mass of bubbles at last time step	Lbm
1171 . . .	RLMTOT	MASS_TOT_LAST	RE	50	Node total mass at last time step	Lbm
1172 . . .	RLPRES	PRES_LAST	RE	50	Node pressures from last execution	Psia
1173 . . .	RLELIQ	ENTH_LIQ_LAST	RE	50	Node liquid enthalpies from last exec.	Btu/lbm
1174 . . .	RLESTM	ENTH_STM_LAST	RE	50	Node steam enthalpies from last exec.	Btu/lbm
1175 . . .	RLELQS	ENTH_LIQ_SAT_LAST	RE	50	Saturated liquid enthalpy, last step	Btu/lbm
1176 . . .	RLFLOW	P_FLOW_LAST	RE	150	Path flow rates at last time step	Lbm/sec
1177 . . .	RLKFLS	RCS_CORE_FLASH_LAST	RE		Core flashing rate at last execution	Lbm/sec
1178 . .	RCSSTA	RCS_STATUS	RE	156	Variables associated with RCS abort	Partition
1179 . . .	RLIERR	FATAL_INPUT_ERROR	LO		RCS model abort on input data error(s)	True False
1180 . . .	RLOERR	FATAL_OUTPUT_ERROR	LO		RCS model abort on calculation error(s)	True False
1181 . . .	RLHOMO	RCS_HOMOGENEOUS	LO		Forces all nodes to be homogeneous	True False
1182 . . .	RLEQUI	RCS_EQUILIBRIUM	LO		Deactivates RCS non-equilibrium calc.	True False
1183 . . .	RMBUBP	MASS_BUB_PRED	RE	50	Predicted bubble masses for path props.	Lbm

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1184	. . . RLLBMP	RCS_LOCA_MAPPING	LO		Enables LOCA super-node mapping each	True False
1185	. . . RPITER	RCS_SEARCH_ITER	IN	50	Number of iterations in pressure search	Counts
1186	. . . RPTYPE	RCS_SEARCH_TYPE	IN	50	Pressure search used	Pointer
1187	. . . RKASUR	CORE_SURF_AREA_LAST	RE		Vessel flow area at two-phase boundary	Ft^2
1188	. . RCSVLV	RCS_VALVES	RE	25	Variables associated with RCS valves	Partition
1189	. . . RVAREA	RCS_VLV_AREA	RE	25	RCS valve areas	Ft^2
1190	. . . . RUAVLV	AREA_VALVE_UHEAD	RE	3	Array of upper head vent valve areas	Ft^2
1191	. . . . RPAVLV	AREA_VALVE_PRZR	RE	15	Array of presssurizer relief valve areas	Ft^2
1192	. . . . RWAVLV	AREA_VALVE_SPRAY	RE	2	Array of presssurizer spray bleed valves	Ft^2
1193	. . . . RQAVLV	AREA_VALVE_QT	RE	3	Array of quench tank valve areas	Ft^2
1194	. . RCSMAL	RCS_MALFUNCTION	RE	20	Malfunction flags and variables	Partition
1195	. . . RLRODE	FLAG_RODEJ	LO		Rod ejection malfuntion in effect	True False
1196	. . . RLLB	FLAG_LOCA	LO		Large break LOCA in effect	True False
1197	. . . RLBLOW	LOCA_BLOWDOWN	LO		Blowdown part of LOCA in progress	True False
1198	. . . RALEAK	P_AREA_LEAK	RE	17	Leak flow path areas	Ft^2
1199	. . RPVLV	RCS_PRZR_FLOW_VALVES	RE	10	Pressurizer valves flow	Partition
1200	. . . RPGPOR	RCS_P_FLOW_PORV	RE	4	PORVs mass flow rate	Lbm/sec
1201	. . . RPGSAF	RCS_P_FLOW_SAFETY	RE	4	Przr safety valves mass flow rate	Lbm/sec
1202	. . . RPGCON	P_FLOW_PRZR_CONT	RE		Przr to containment vent flow rate	Lbm/sec
1203	. . . RPGQT1	RCS_P_FLOW_PRZR_QT1	RE		Przr to quench tank vent flow rate	Lbm/sec
1204	. . RCPCOM	RCP_COMMON	RE	100	Coolant pump model global common	Partition
1205	. . . RCPINT	RCP_INTERNAL	RE	88	Pump model internal variables	Partition
1206	. . . . RCPELE	RCP_ELECTRIC	RE	28	Coolant pump motor electrical variables	Partition
1207	. . . . . RRVOLT	RCP_VOLT	RE	4	Pump motor input voltages	Volts
1208	. . . . . RRFREQ	RCP_FREQ	RE	4	Pump motor electrical frequencies	Hertz
1209	. . . . . RRADRE	RCP_ADMI_RE	RE	4	Unused Variable	Dimensionless
1210	. . . . . RRADIM	RCP_ADMI_IM	RE	4	Unused Variable	Dimensionless
1211	. . . . . RRSLIP	RCP_SLIP	RE	4	Coolant pump motor slip	Fraction
1212	. . . . . RRPF	RCP_PF	RE	4	Unused Variable	Dimensionless
1213	. . . . RCPMEC	RCP_MECHANICAL	RE	40	Coolant pump mechanical variables	Partition
1214	. . . . . RRTHYD	RCP_TORQ_HYD	RE	4	Coolant pump hydraulic torques	Ft-lbf
1215	. . . . . RRTELE	RCP_TORQ_ELEC	RE	4	Coolant pump electrical torques	Ft-lbf
1216	. . . . . RRTFRI	RCP_TORQ_FRIC	RE	4	Coolant pump friction torques	Ft-lbf
1217	. . . . . RRQRCP	RCP_HEAT	RE	4	Coolant pump fluid heat rates	Btu/sec
1218	. . . . . RRVIBR	RCP_VIBR	RE	4	Coolant pump vibrations	G's vibration
1219	. . . . . RRSPMP	RCP_SPEED_PUMP	RE	4	Coolant pump impeller speed	Radians/second
1220	. . . . . RRSMOT	RCP_SPEED_MOTOR	RE	4	Coolant pump motor speed	Radians/second
1221	. . . . . RRAVIB	RCP_VIBR_AMP	RE	4	Pump vibration amplitude at rated speed	G's vibration
1222	. . . . . RRDSPD	RCP_SPEED_DERIV	RE	4	Coolant pump speed derivatives	Composite Units
1223	. . . . RCPMAL	RCP_MALFUNCTION	RE	12	Coolant pump malfunction variables	Partition
1224	. . . . . RRBREK	RCP_BREAK	LO	4	Unused Variable	True False
1225	. . . . . RRHIVI	RCP_HI_VIB	LO	4	Unused Variable	True False
1226	. . . . . RRLOCK	RCP_LOCKED	LO	4	Logical indicating pump shaft locked	True False
1227	. . . . RCPLEK	RCP_RCS_LEAK	RE	4	RCP seals leak partition	Partition
1228	. . . . . RRLEAK	RCP_SEALS_LEAK	RE	4	RCP seals leakage rated cond.	Gal/min
1229	. RCSOPT	RCS_OPTIMIZATION	RE	820	RCS optimization partition	Partition
1230	. . RPNCAL	RCS_NSTEP_CALCULATIONS	RE	160	Partition vars updated every n steps	Partition
1231	. . . RPITRP	RCS_ICOUNT_MUKPR_P	IN		Counter mu-k-Pr calculations	Counts
1232	. . . RPNTRP	RCS_NUM_MUKPR_P	IN		Number steps for mu-k-Pr calc.	Counts
1233	. . . RPVISC	RCS_P_VISCOS	RE	100	Path liquid viscosity	Lbm/ft-sec
1234	. . RPCOND	RCS_P_CONDUCT	RE	100	Path liquid conductivity	Btu/sec-ft-degF
1235	. . RPPRAN	RCS_P_PRANDTL	RE	100	Path liquid Prandtl number	Dimensionless
1236	. . RPICRT	RCS_ICOUNT_FLOWLIM_P	IN		Counter for critical flow calculations	Counts
1237	. . RPNCRT	RCS_NUM_FLOWLIM_P	IN		Number steps for crit. flow calc.	Counts
1238	. . RMORA	RCS_MORE_VARIABLES_A	RE	153	RCS_more variables A	Partition
1239	. . . RMOR1	RCS_MORE_VARIABLES_I	RE	20	RCS more variables partition I	Partition
1240	. . . . RPEMIN	RCS_MIN_EXT_ENTH	RE		nu External paths min. enth. bound	Btu/lbm
1241	. . . . RPEMAX	RCS_MAX_EXT_ENTH	RE		nu External paths max. enth. bound	Btu/lbm
1242	. . . . RPQCMU	RCS_PRZR_CONT_HEAT_MULT	RE		Mult. wall heat przr to cont.	Dimensionless
1243	. . . . RTHSMU	CHT_H_SUPER_MULT	RE		Supercrit. heat coeff. mult.	Dimensionless
1244	. . . . RTFRAC	CHT_HEAT_FRAC	RE		Total core heat transfer to coolant	Fraction
1245	. . . . RLSPIK	RCS_P_SPIKE_OUTPUT	LO		nu Flag for press spike output message	True False
1246	. . . . RFLHET	RCS_FTIME_HEATER	LO		nu Heaters fast time control	True False
1247	. . . . RHTIME	RCS_DELT_HEATER	RE		nu Heaters time step	Seconds
1248	. . . . RTTMSC	CHT_TIME_SCALE	RE		CHT time scale	Dimensionless
1249	. . . . RTDEL	CHT_DELT	RE		CHT standard time step	Seconds
1250	. . . . RTFDEL	CHT_FDELT	RE		nu CHT fast time delt	Seconds
1251	. . . . RFLCHT	CHT_FTIME	LO		CHT fast time flag	True False
1252	. . . . RTDELT	CHT_DELTA_T	RE		CHT time step	Seconds
1253	. . . . RFLSPR	RCS_FTIME_SPRAYS	LO		nu Sprays fast time flag	True False
1254	. . . . RPTFLS	RCS_PRZR_FLASH_TAU	RE		Time constant for przr flashing	Fraction
1255	. . . . RUQCMU	RCS_UHEAD_CONT_HEAT_MULT	RE		Multiplr on uppr head heat loss to cont.	Dimensionless
1256	. . . . RCRMOD	RCS_CRIT_MODEL	IN		Liq/2-phs choked flow model: 0=HEM, 1=HF	Pointer
1257	. . . RMOR2	RCS_MORE_VARIABLES_II	RE	28	RCS more variables partition II	Partition

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1258	RWEFF	RCS_SPRAY_EFF	RE		Spray efficiency	Fraction
1259	RWEFFM	RCS_SPRAY_EFF_MULT	RE		Spray efficiency multiplier	Dimensionless
1260	RWLEFF	RCS_L_EFF_SPR	RE	2	Levels for spray effic. calc.	Feet
1261	RTTSRG	RCS_T_SURGE_TAU	RE		Time constant surge temp.	Dimensionless
1262	RELVLB	RCS_MAL038	RE		Local variable malf. 38 (LBLOCA)	Percent
1263	REDTLB	RCS_DTFOPEN_LB	RE		Delta t for full open of LBLOCA	Seconds
1264	REFLB	RCS_FRAC_SIT_12B	RE		Fraction SIT CL12b to RCS (LB only)	Fraction
1265	REGLB	RCS_W_SIT_CONT	RE		CL 12b SIT flow to containm (LB only)	Lbm/sec
1266	REELB	RCS_H_SIT_CONT	RE		CL12b SIT enthalpy to contain (LB onl)	Btu/lbm
1267	RTTMAX	CHT_TERM_MAX	RE		Max. term for transition boiling	Dimensionless
1268	RTESRG	RCS_H_SURGE_TAU	RE		Time constant surge line enth.	Dimensionless
1269	RFLSDC	RCS_FTIME_SDC	LO		Flag shutd. cool fast time contr.	True False
1270	RCHGMX	RCS_MAX_CHGS	RE		RCS bound on charging flow	Lbm/sec
1271	RSITMX	RCS_MAX_SIT	RE		RCS bound on SIT flow	Lbm/sec
1272	RLETMX	RCS_MAX_LDNS	RE		RCS bound on letdown flow	Lbm/sec
1273	RDRNMX	RCS_MAX_WDRAIN	RE		RCS bound on drain flows	Lbm/sec
1274	RSDCMX	RCS_MAX_WSDC	RE		RCS bound on SDC flow	Lbm/sec
1275	REXBMX	RCS_MAX_BC_EXT	RE		RCS bound on ext. boron conc.	Parts/million
1276	RFLBUB	RCS_FTIME_BUB	LO		nu Flag fast time bub. rel.	True False
1277	RWDELH	RCS_SPRAY_DELH_DEG	RE		Del enthalpy for spray degrad.	Btu/lbm
1278	RWEFF1	RCS_SPRAY_EFF1	RE		Spray eff. term (flash red.)	Fraction
1279	RWLPRS	RCS_SPRAY_PRES_DEG	LO		Sprays press dep. degrad.	True False
1280	RWEFF2	RCS_SPRAY_EFF2	RE		Sprays press. dep eff. frac	Fraction
1281	RPLLOP	RCS_PRZR_LOWP_COND_LOG	LO		Przr low press. cond. logic	True False
1282	RNEXMN	RCS_QUAL_MIN_NE	RE		Min. quality for non eq. calc.	Fraction
1283	RPLCOF	RCS_PRZR_L_COND_OFF	RE		Level cut-off przr. surf. cond.	Feet
1284	RWPDEG	RCS_SPRAY_PDEG_TERM	RE		Spray degrad. press. term	Dimensionless
1285	RMOR3	RCS_MORE_VARIABLES_III	RE	6	RCS more variables III post 406A.	Partition
1286	RPCORS	RCS_HIGHP_COARSE_NODES	RE		High press switch to coarse nodes(atws	Psia
1287	RSDPMU	RCS_SG_DP_MULT	RE		RCS SG del press mult.(coarse nodes)	Dimensionless
1288	RPHWMU	RCS_PRZR_HWALLF_MULT	RE		Mult. for przr cond on wall hcoff	Dimensionless
1289	RPCWAL	RCS_PRZR_COND_WALL	RE		Przr condensation on wall	Lbm/sec
1290	RMOR3A	RCS_MORE_VARIABLES_IIIA	RE	5	RCS more variables IIIA	Partition
1291	RPHLMU	RCS_PRZR_HLIQ_MULT	RE		Przr wall htcof to liq. mult.	Dimensionless
1292	RFLPZR	RCS_FTIME_PRZR	LO		Przr fast time flag (condens.)	True False
1293	RPTAUR	RCS_PRZR_TREF_TAU	RE	2	Przr ref. leg time constants	Seconds
1294	RKHRMX	RCS_CORE_HYD_REL_MAX	RE		Maximum core hyd. rel (single ph.)	Lbm/sec
1295	RMOR3B	RCS_MORE_VARIABLES_IIIB	RE	4	RCS more variables IIIA	Partition
1296	RHVBSP	RCS_VOLT_HTR_BUS	RE	2	Voltage przr prop heater buses	Volts
1297	RPLREF	RCS_PRZR_LEVEL	RE		RCS przr level (inch from ref.leg bot.	Inches
1298	RMOR4	RCS_MORE_VARIABLES_IV	RE	10	RCS more variables IV	Partition
1299	RPDTBL	RCS_PRZR_DT_BOIL	RE		Przr. delt temp for boiling	Del-DegF
1300	RPDTSB	RCS_PRZR_DT_SUBC	RE		Przr. delt temp for flash.	Del-DegF
1301	RRADMU	RCP_ADMI_MULT	RE		Unused Variable	Dimensionless
1302	RRDSLO	RCP_DELSPEED_LOCKED	RE		RCP locked rotor del-speed (rad/sec)	Radians/second
1303	RRCFRC	RCP_FRIC_COEFF	RE		RCP windage and frict. coeff.	Composite Units
1304	RPPMOD	RCS_P_ELEV_MOD_SURGE	RE		nu Press. for surge lin mod. elev test.	Psia
1305	RDHFMN	RCS_DHF_MIN	RE		Subcooling del. enthalpy (low press.)	Btu/lbm
1306	RPDPMD	RCS_DP_ELEV_SURGE	RE		nu Surge line modified dp	Psig
1307	RITDPL	RCS_ITER_DPL	RE		Dp for converg. low press.(equil.)	Psig
1308	RELTST	RCS_SDCSIT_CONSIST_TEST	LO		Flag to test SDC-SIT consist.	True False
1309	RMOR5	RCS_MORE_VARIABLES_V	RE	8	RCS more variables V	Partition
1310	RDWSDC	RCS_DW_SDC	RE		SDC- SIT delta flow	Lbm/sec
1311	RDWSTP	RCS_DWSTP_SDC	RE		Del flow / step SDC-SIT test	Lbm/sec
1312	RRSTAR	RCP_RCP_START	RE	4	Unused Variable	Dimensionless
1313	RPMSTM	RCS_PRZR_MASS_STM	RE		Przr steam mass	Lbm
1314	RPMAIR	RCS_PRZR_MASS_AIR	RE		Przr air mass	Lbm
1315	RMOR6	RCS_MORE_VARIABLES_VI	RE	14	RCS more variables VI	Partition
1316	REINIT	RCS_REINITIALIZE	LO		Control variable for reinitialization	True False
1317	RPPINT	RCS_INIT_P	RE		Przr pressure (reinitialization)	Psia
1318	RPLINT	RCS_INIT_LEVEL_PRZR	RE		Przr level reinitialization	Inches
1319	RPLAIR	RCS_INIT_AIR_PRZR	LO		Reinit. with air in przr control	True False
1320	RPGVCN	RCS_W_PRZR_CONT	RE		Mass flow przr to contain	Lbm/sec
1321	RPGVQT	RCS_W_PRZR_QT	RE		Mass flow przr to quench tank (valves)	Lbm/sec
1322	RPXREL	RCS_PRZR_QUAL_RELIEF	RE		Przr relief quality	Fraction
1323	RPTINT	RCS_INIT_T_PRZR	RE		Przr liquid temp (reinitializ.)	Degree F
1324	RLTINT	RCS_INIT_T_LOOP	RE		Loop temperature (reinitializ.)	Degree F
1325	RSDCGF	RCS_DRAINS_SDC	RE		Drains from SDC line (fast time only)	Lbm/sec
1326	RSDCGM	RCS_MAX_DRAIN_SDC	RE		SDC drain flow bound (fast t.)	Lbm/sec
1327	RPFAIR	RCS_PRZR_FRAC_AIR	RE		Air mass fraction in przr.	Fraction
1328	RKHSTM	RCS_PRZR_KH_STM	RE		K for p degrad. of hcof stm.	Dimensionless
1329	RKPSTM	RCS_PRZR_KP_STM	RE		P for p degrad. of hcof stm.	Psia
1330	RM504	RCS_MORE_VARIABLES_504_SR	RE	58	RCS more variables spin 413 to 504 SR	Partition
1331	RRFCAV	RCP_CAVIT_SGDP_FRAC	RE		Unused Variable	Dimensionless

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1332	RPTSB	RCS_PRZR_DT_SUB_BOIL	RE		Przr del-temp for boiling	Del-DegF
1333	RRVOID	RCS_RCP_VOIDF	RE	4	RCP void fraction	Fraction
1334	RRDTTP	RCP_DT_LAST_TRIP	RE	4	Delt since RCP trip (0 RCP running)	Seconds
1335	RRSTOP	RCP_STOPPED	LO	4	Unused Variable	True False
1336	RRTRIP	RCP_TRIPPED	LO	4	Unused Variable	True False
1337	RPCSUR	RCS_PRZR_COND_SURF	RE		Przr cond. on liq. surface	Lbm/sec
1338	RPLLAS	RCS_PRZR_LEVL_LAST	RE		Przr. level last step	Feet
1339	RPTWAL	RCS_PRZR_T_WALL	RE	2	Przr walls temp. 1:liq, 2: stm	Degree F
1340	RPQCON	RCS_PRZR_Q_CONT	RE	2	Przr walls heat to containment	Btu/sec
1341	RPQAXW	RCS_PRZR_QAX_WALL	RE		Przr walls axial heat transf.	Btu/sec
1342	RPDTSS	RCS_PRZR_DT_SUBSS	RE		Przr. ss subcooling to start boil.	Del-DegF
1343	RUPORG	RCS_P_ORING	RE		Inner O-ring region pressure	Psia
1344	RULORG	RCS_ORING_FAIL	LO		Vessel O-ring failure flag	True False
1345	RRADFC	RCP_ADMI_FLOWCORR	RE	4	Unused Variable	Dimensionless
1346	RRAMPS	RCP_AMPS	RE	4	Unused Variable	Dimensionless
1347	RRSVOL	RCS_RCP_SVOL	RE	4	RCS RCP specific volume	Ft^3/lbm
1348	RRLCAV	RCS_RCP_CAVITAT	LO	4	Unused Variable	True False
1349	REGSIT	RCS_W_SIT	RE	4	Safety injection tank flow	Lbm/sec
1350	REDGST	RCS_DW_SIT	RE	4	SIT delta flow	Lbm/sec
1351	RTC12B	RCS_TEMP_CL12B	RE		CL2b temperature	Degree F
1352	RQPJ4	QT_J4_P	RE		Quench tank press down of	Psia
1353	RRLTHI	RCP_TBEARING_HIGH	LO	4	Unused Variable	True False
1354 . .	RFAIL	RCS_FAILURE_STATUS	LO	3	RCS failure status partition	Partition
1355 . . .	RNEVER	RCS_NEVER_STOP_AUTO	LO		RCS never stop (bomb) control option	True False
1356 . . .	RSFAIL	RCS_STEP_FAILURE	LO		RCS step failure flag	True False
1357 . . .	RSRECV	RCS_STEP_RECOVERY	LO		RCS step recovery flag	True False
1358 . .	RTIMEC	RCS_TIME_CONTROL	RE	45	Time control partition	Partition
1359 . . .	RTIMSC	RCS_TIME_SCALE	RE		Time scale for RCS	Dimensionless
1360 . . .	RDEL	RCS_DELT	RE		Master delt for RCS	Seconds
1361 . . .	RFDELT	RCS_FDELT	RE		Fast time delt for RCS	Seconds
1362 . . .	RDELTA	RCS_DELTA_T	RE		RCS integration delta t	Seconds
1363 . . .	RDELWL	RCS_DELT_WALL	RE		Walls integration delta t	Seconds
1364 . . .	RFLWAL	RCS_FTIME_WALL	LO		Walls fast time control	True False
1365 . . .	RFLCOL	RCS_FTIME_HEAT	LO		Heat to coolant fast time control	True False
1366 . . .	RFLNON	RCS_FTIME_PATHS	LO		Non mom. paths fast time control	True False
1367 . . .	RFQHT	RCS_HEAT_FASTT	RE	30	Fast time heat transfer	Btu/sec
1368 . . .	RFLCVC	RCS_FTIME_CVCS	LO		CVCS paths fast time control	True False
1369 . . .	RFLSIT	RCS_FTIME_SIT	LO		SIT-shutd-cool fast time control	True False
1370 . . .	RFDQHT	RCS_DHEAT_FASTT	RE		Net delta heat fast time	Btu/sec
1371 . . .	RFDQMX	RCS_DHEAT_MAX_FASTT	RE		Max. net delt heat fast time	Btu/sec
1372 . . .	RFSDQS	RCS_DHEAT_STEP_FASTT	RE		Max del heat per step fast time	Btu/sec
1373 . .	RCSLB	RCS_LARGE_BREAK	RE	30	RCS large break variables	Partition
1374 . . .	RLBEL	P_ENTH_LIQ_LB	RE		Large break leak liquid enthalpy	Btu/lbm
1375 . . .	RLBES	P_ENTH_STM_LB	RE		Large break leak steam enthalpy	Btu/lbm
1376 . . .	RLBVFR	P_VOID_LB	RE		Large break leak void fraction	Fraction
1377 . . .	RLBS	P_SVOL_LB	RE		Large break leak specific volume	Ft^3/lbm
1378 . . .	RLBALS	RCS_AREA_LB_LAST	RE		Large break last step break area	Ft^2
1379 . . .	RLBLDR	RCS_LB_SGDRAIN	LO		Large break SG drain flag	True False
1380 . . .	RLBDPL	RCS_DP_LEAK_LAST_LB	RE		Last step leak delta press (large brk)	Psig
1381 . . .	RLBQMX	RCS_HEAT_SG_MAX_LB	RE		Max SG heat rate (steam, large break)	Btu/sec
1382 . . .	RLBLDP	RCS_FLAG_DP_LEAK_LB	LO		LB LOCA leak flag	True False
1383 . . .	RLBDTS	RCS_DELTEM_SG_LB	RE	4	Delta temperature SG primary - tube	Del-DegF
1384 . . .	RSHAOV	RCS_HA_PRIM	RE	4	SG overall heat trans. coeff (prim)	Btu/sec-degF
1385 . . .	RSTPRE	RCS_TEMP_SG_PRE	RE	4	SG predicted temperature	Degree F
1386 . . .	TSTLST	RCS_TEMP_SG_LAST	RE	4	Last step temp for SG heat transfer	Degree F
1387 . . .	RLBCOS	RCS_FLAG_COARSE_NODES	LO		RCS coarse nodalization flag	True False
1388 . . .	RLBRCS	RCS_LB_LOCA_FIRST	LO		Flag first time coarse nodal (RCS)	True False
1389 . . .	RCSLBL	RCS_RCSLB_FIRST	LO		Flag first time coarse nodal (RCSLB)	True False
1390 . .	ROUTPT	RCS_MOD_OUTPUTS	RE	60	RCS model global common outputs	Partition
1391 . . .	ROPUMP	RCS_MOD_OUTPUTS_INSTRUM	RE	4	RCS model outputs for instruments	Partition
1392	RR1DP	RCSL_PMP1_DP	RE		Main coolant pump 1A pressure rise	Psid
1393	RR2DP	RCSL_PMP2_DP	RE		Main coolant pump 1B pressure rise	Psid
1394	RR3DP	RCSL_PMP3_DP	RE		Main coolant pump 2A pressure rise	Psid
1395	RR4DP	RCSL_PMP4_DP	RE		Main coolant pump 2B pressure rise	Psid
1396 . . .	ROCORE	RCS_MOD_OUTPUTS_CORE	RE	3	RCS outputs to 1-D core	Partition
1397	RKTAV	CHT_TCOOL_AV	RE		Core coolant average temperature	Degree F
1398	RKSAV	CHT_SVOLCOOL_AV	RE		Core coolant average spec. vol.	Ft^3/lbm
1399	RRBORL	RCS_BORON_CORE	RE		Core node boron concentration	Parts/million
1400 . . .	ROCHT	RCS_MOD_OUTPUTS_CHT	RE	53	RCS modified outputs to CHT	Partition
1401	RTPRES	RCS_CHT_PRESS	RE		RCS core pressure	Psia
1402	RTELIQ	RCS_CHT_ENTHLIQ	RE		RCS core liquid enthalpy	Btu/lbm
1403	RTESTM	RCS_CHT_ENTHSTM	RE		RCS core steam enthalpy	Btu/lbm
1404	RTQUAL	RCS_CHT_QUAL	RE		RCS core quality	Fraction
1405	RTGIN	RCS_CHT_FLOWIN	RE		RCS core inlet flow (total minus bypass)	Lbm/sec

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1406	RTEIN	RCS_CHT_ENTHIN	RE		RCS core inlet enthalpy	Btu/lbm
1407	RTXIN	RCS_CHT_QUALIN	RE		RCS core inlet quality	Fraction
1408	RTLMIX	RCS_CHT_LEVMIX	RE		RCS core mixture level	Feet
1409	RTLSAT	RCS_CHT_LEVSAT	RE		RCS core saturation level	Feet
1410	RTQWAL	RCS_CHT_QWALL	RE		RCS lower plenum wall heat	Btu/sec
1411	RTTWAL	RCS_CHT_TWALL	RE		RCS lower plenum wall temperature	Degree F
1412	RTMLIQ	RCS_CHT_MASSLIQ	RE		RCS lower plenum liquid mass	Lbm
1413	RTMBUB	RCS_CHT_MASSBUB	RE	22	RCS bubble mass in core sections	Lbm
1414 .	RINPUT	RCS_MOD_INPUTS	RE	205	RCS modified inputs	Partition
1415 . .	RINBOP	RCS_MOD_INPUTS_BOP	RE	50	RCS modified inputs bop systems	Partition
1416 . . .	RCFLOW	CHGS_RCS_FLOW	RE	4	Charging system flows (RCS connections	Lbm/sec
1417 . . .	RCENTH	CHGS_RCS_ENTH	RE		Charging system enthalpy (RCS connect.	Btu/lbm
1418 . . .	RCBORN	CHGS_RCS_BORON	RE		Charging system boron conc.(RCS connec	Parts/million
1419 . . .	RCHYD	CHGS_RCS_HYD	RE		Charging system hydrog. conc.(RCS conn	Lbm/lbm
1420 . . .	RCIOD	CHGS_RCS_IOD	RE		Charging system iodine conc (RCS conn.	Microcurie/lbm
1421 . . .	RCPART	CHGS_RCS_PART	RE		Charging sys particulate conc (RCS conn.	Microcurie/lbm
1422 . . .	RCXEN	CHGS_RCS_XEN	RE		Charging system xenon conc.(RCS connec	Microcurie/lbm
1423 . . .	RGASPR	CHGS_ASPRAY_FLOW	RE		Charging aux. spray flow	Lbm/sec
1424 . . .	RLETG	LDNS_RCS_FLOW	RE	4	Letdown system flow (RCS connections)	Lbm/sec
1425 . . .	RDRNG	RCW_RCS_FLOW	RE	1	Drain flow to waste syst (RCS connect.	Lbm/sec
1426 . . .	RSDCG	SDC_RCS_FLOW	RE	2	Shutdown cooling out flow (RCS connec.	Lbm/sec
1427 . . .	RSISG	SIS_RCS_FLOW	RE	8	SIS flows (RCS connections)	Lbm/sec
1428 . . .	RSISE	SIS_RCS_ENTH	RE	8	SIS enthalpy (RCS connections)	Btu/lbm
1429 . . .	RSISB	SIS_RCS_BORON	RE	8	SIS boron concentration (RCS connectio	Parts/million
1430 . . .	RSITG	SI_TANK_FLOW	RE	4	Safety injection tank flow	Lbm/sec
1431 . .	RIVLVC	RCS_MOD_INPUTS_VLVCONTR	RE	30	RCS mod inputs from valve controllers	Partition
1432 . . .	RVPOS	VLV_RCS_POS	RE	24	RCS valve positions (fraction)	Fraction
1433	RVFUHC	VLV_UHEAD_CONT	RE		Upper head to contain valve pos.	Fraction
1434	RVFUHQ	VLV_UHEAD_QT	RE	2	Upper head to quench tank valve pos.	Fraction
1435	RVFPOR	VLV_PRZR_PORV	RE	4	Przr PORV position	Fraction
1436	RVFSAF	VLV_PRZR_SAFETY	RE	4	Przr safety valves position	Fraction
1437	RVFMOV	VLV_PRZR_MOV	RE	4	Przr mov position(in series with PORVs	Fraction
1438	RVFPC	VLV_PRZR_CONT	RE		Vent valve przr to containment	Fraction
1439	RVFPQT	VLV_PRZR_QT	RE	2	Przr to quench tank vent vlvs(in serie	Fraction
1440	RVFSPR	VLV_PRZR_MSPRAY	RE	2	Main spray control valves	Fraction
1441	RVFQTG	VLV_QT_GWS	RE		Quench tank to gws vent vlv. position	Fraction
1442	RVFQTC	VLV_QT_CONT	RE		Quench tank to contain. vent vlv pos.	Fraction
1443	RVFQTN	VLV_QT_NSUPPLY	RE		Nitrogen supply to QTank valve pos.	Fraction
1444 . . .	RVFSIG	VLV_RCS_SIG	RE	6	RCS valve signals	Partition
1445	RVSSPR	VLV_PRZR_MSPRAY_SIG	RE	2	Przr main spray valve signal	Fraction
1446	RVSPOR	VLV_PRZR_PORV_SIG	RE	4	Przr pressure relief valve signal	Fraction
1447 . .	RIVOLT	RCS_MOD_INPUTS_VOLTCONTR	RE	20	RCS mod inputs voltage controllers	Partition
1448 . . .	RHFVLT	PRSI_HEATER_VOLT_FRAC	RE	6	Przr heaters voltage (fraction)	Fraction
1449 . . .	RRFVLT	RCPI_VOLT_FRAC	RE	4	RCP voltage (fraction)	Fraction
1450 . . .	RHVBUS	RCS_HEATER_VOLT_BUS	RE	6	Heater bus voltages	Volts
1451 . . .	RRFFRQ	RCPI_FREQ_FRAC	RE	4	RCP electric motor frequency (frac.)	Fraction
1452 . .	RIMAL	RCS_MOD_INPUTS_MALFUNCTIONS	RE	52	RCS_modified malfunctions	Partition
1453 . . .	RMSB	MAL_SB_LOCA	RE	4	Small break LOCA areas	Ft^2
1454 . . .	RMLB	MAL_LB_LOCA	RE		Large break LOCA area	Ft^2
1455 . . .	RMSGTR	MAL_SGTR	RE	4	SG tube rupture leaks (numb of tubes)	Pointer
1456 . . .	DUM001	DUM001	RE	4	Dummy variable	Unused
1457 . . .	RMRODE	MAL_ROD_EJECT	RE		Rod ejection plus CEDM rupture (fract)	Fraction
1458 . . .	RMVALV	MAL_RCS_VALVE	RE	25	RCS valves malfunction	Partition
1459	RMVUHC	MAL_VLV_UHEAD_CONT	RE		Upper head to contain valve pos. (malf)	Fraction
1460	RMVUHQ	MAL_VLV_UHEAD_QT	RE	2	Upper head to quench tank valve pos. (ma	Fraction
1461	RMVPOR	MAL_VLV_PRZR_PORV	RE	4	Przr PORV pos. (malf)	Fraction
1462	RMVSAF	MAL_VLV_PRZR_SAFETY	RE	4	Przr safety valves pos. (malf)	Fraction
1463	RMVMOV	MAL_VLV_PRZR_MOV	RE	4	Przr mov pos (malf)	Fraction
1464	RMVPCR	MAL_VLV_PRZR_CONT	RE		Vent valve przr to containment (malf)	Fraction
1465	RMVPQT	MAL_VLV_PRZR_QT	RE	2	Przr to quench tank vent vlvs(malf)	Fraction
1466	RMVSPR	MAL_VLV_PRZR_MSPRAY	RE	2	Main spray control valves (malf)	Fraction
1467	RMVQTG	MAL_VLV_QT_GWS	RE		Q tank to gws vent vlv. pos. (malf)	Fraction
1468	RMVQTC	MAL_VLV_QT_CONT	RE		Q tank to contain. vent vlv pos. (malf)	Fraction
1469	RMVQTN	MAL_VLV_QT_NSUPPLY	RE		Nitrogen supply to QTank valve pos. (mal	Fraction
1470 . . .	RMRSHB	MAL_RCP_SHAFTBREAK	LO	4	RCP shaft break malfunction	True False
1471 . . .	RMRLOC	MAL_RCP_LOCKED	LO	4	RCP locked rotor malfunction	True False
1472 . . .	RMRVIB	MAL_RCP_HIVIB	LO	4	Unused Variable	True False
1473 . . .	RMROD	MAL_ROD_CORE	IN		Rod number to eject (+) or drop (-)	Pointer
1474 . .	RICONT	RCS_MOD_INPUTS_CONT	RE	2	RCS modified inputs from containment	Partition
1475 . . .	RPCONT	CONT_PRES	RE		Containment pressure	Psia
1476 . .	RIQT	QT_MOD_INPUTS	RE	5	Quench tank modified inputs	Partition
1477 . . .	RQGDMW	DMW_QT_FLOW	RE		Demineralized water flow to quench tan	Lbm/sec
1478 . . .	RQEDMW	DMW_QT_ENTH	RE		Demineralized water enthalpy	Btu/lbm
1479 . . .	RQGRCW	RCW_QT_FLOW	RE		Mass flow QT to RCW	Lbm/sec

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1480 . . .	RQPGWS	GWS_QT_PRES	RE		GWS pressure	Psia
1481 . . .	RQGGWS	GWS_QT_FLOW	RE		Gas flow quench tank to GWS	Lbm/sec
1482 . .	RIPZRR	RCS_INPUTS_PRZR_RELIEF	RE	33	Przr relief valves discharge model	Partition
1483 . . .	RVXPZR	VLV_PRZR_QUAL_DF	RE		Opt 2/3 below this quality only, above=1	Fraction
1484 . . .	RVOPZR	VLV_PRZR_FLOW_OPTION	IN		Opt 0-3: crit,crit/bern,bern/cd(dt),f(p)	Pointer
1485 . . .	RVNPZR	VLV_PRZR_NPOINTS_TAB	IN		No. of points in discharge table	Counts
1486 . . .	RVGPZR	VLV_PRZR_FLOW_TABLE	RE	15	Discharge table: dependent variable	Undefined
1487 . . .	RVPPZR	VLV_PRZR_PROP_TABLE	RE	15	Discharge table: independent variable	Undefined
1488 .	RINCON	RCS_INITIAL_CONDITIONS	RE	15	RCS initial conditions	Partition
1489 . .	RPINIT	RPINIT	RE		New initial pressurizer pressure	Psia
1490 . .	RLINIT	RLINIT	RE		New initial pressurizer level	Feet
1491 . .	RWINIT	RWINIT	RE		New initial total loop flow rate	Lbm/sec
1492 . .	RTCLIN	RTCLIN	RE		New initial cold leg temperature	Degree F
1493 . .	RBINIT	RBINIT	RE		New initial boron concentration	Parts/million
1494 . .	RKPUMP	RKPUMP	RE	4	Pump head multiplier	Fraction
1495 . .	RSINIT	RSINIT	RE		Pump initial speed	Shaft RPM
1496 .	SGQPAR	SG_TUBE_SECTIONS	RE	1051	Partition for SG tube model	Partition
1497 . .	SGQNSE	NUM_SG_SECT	IN	16	Number of sections in SG node (request)	Counts
1498 . .	SGQNNS	RCS_SG_NSECT	IN	16	Number of sections in SG node (dynamic)	Counts
1499 . .	SGQDH	RCS_SG_SECT_DH	RE		Tolerance for SG node satn hysteresis	Btu/lbm
1500 . .	SGQDW	RCS_SG_SECT_DW	RE		Tolerance for SG node flow hysteresis	Lbm/sec
1501 . .	SGQLH	RCS_SG_SECT_LH	LO	16	State of SG node saturation hysteresis	True False
1502 . .	SGQLW	RCS_SG_SECT_LW	LO	16	State of SG node flow hysteresis	True False
1503 . .	SGQSET	RCS_SG_SECT_TEMP	RE	20,8	Pri temperatures of tube sections	Degree F
1504 . .	SGQQP	RCS_SG_SECT_QP	RE	20,8	Pri heat rates of tube sections	Btu/sec
1505 . .	SGQQS	RCS_SG_SECT_QS	RE	20,8	Sec heat rates of tube sections	Btu/sec
1506 . .	SGQTTB	RCS_SG_SECT_TTUBE	RE	20,8	Tube temperatures of tube sections	Degree F
1507 . .	SGQPR	RCS_SG_SECT_PRESS	RE	20,8	Pri pressures of tube sections	Psia
1508 . .	SGQNSS	SGS_NSECT	IN	8	Number of sections in each SG side	Counts
1509 . .	SGQOPT	RCS_SG_SECT_TOPT	IN		Tube section primary T: 0=Exit, 1=LMTD	Pointer
1510 . .	SGQSEH	RCS_SG_SECT_ENTH	RE	11,16	Section-bottom enthalpies (section,node)	Btu/lbm
1511 .	SGTRP	SGTR_DATA	RE	28	Data for SGTR Model	Partition
1512 . .	SGTLEN	SGTR_TUBE_LENGTH	RE	8	SGTR tube length. 2 values/SG	Feet
1513 . .	SGTRK	SGTR_TUBE_ENTRANCE_K	RE	8	SGTR Entrance K fact-use 0.5-2 values/SG	Dimensionless
1514 . .	SGTHT	SGTR_BREAK_ELEV	RE	4	SGTR Elev above tube sheet - 1 value/SG	Feet
1515 . .	SGTSLT	SGTR_SLOT_BREAK_OPT	LO	4	SGTR Calculate slot break flow	True False
1516 . .	SGTSAR	SGTR_SLOT_BREAK_AREA	RE	4	SGTR Slot area for Slot break option	Ft^2
1517 .	SBPDAT	SB_LOCA_PIPE_DATA	RE	20	Data for SBLOCA pipe loss model	Partition
1518 . .	SBPAR	SB_PIPE_AREA	RE	4	SBLOCA pipe flow area	Ft^2
1519 . .	SBPLOD	SB_PIPE_LOD	RE	4	SBLOCA pipe length/diameter	Dimensionless
1520 . .	SBPKG	SB_PIPE_KGEOM	RE	4	SB pipe geom k-factor, excl entrance	Dimensionless
1521 . .	SBPKE	SB_PIPE_KENT	RE	4	SBLOCA pipe entrance loss k-factor	Dimensionless
1522 . .	SBPDZ	SB_DELTA_ELEV	RE	4	SB break elev above RCS connection	Feet
1523 .	CVDAT	CVCS_DATA	RE	50	CVCS model data	Partition
1524 . .	LDPDAT	LDN_PIPE_DATA	RE	20	Input data for letdown line loss model	Partition
1525 . . .	LDPAR	LDN_PIPE_AREA	RE	2	Ldn line flow area (pre,post RHX)	Ft^2
1526 . . .	LDPLOD	LDN_PIPE_LOD	RE	2	Ldn line length/diameter (pre,post RHX)	Dimensionless
1527 . . .	LDPKG	LDN_PIPE_KGEOM	RE	2	Ldn line Kg, excl entry (pre,post RHX)	Dimensionless
1528 . . .	LDPKE	LDN_PIPE_KENT	RE	2	Ldn line entry loss k-factor (@RCS,RHX)	Dimensionless
1529 . . .	LDPDZ	LDN_PIPE_DELTA_ELEV	RE	2	Ldn line elevation rise (pre,post RHX)	Feet
1530 . . .	RMLDNB	MAL_LDN_BREAK	RE		Ldn line break area (<0:pre, >0:postRHX)	Ft^2
1531 . .	CVRHX	CVCS_RHX_DATA	RE	30	CVCS model calculated data	Partition
1532 . . .	CVRHTL	CVCS_RHX_TLDN	RE	2	Letdown temperature at RHEX inlet/exit	Degree F
1533 . . .	CVRHTC	CVCS_RHX_TCH	RE	2	Charging temperature at RHEX inlet/exit	Degree F
1534 . . .	CVRHHL	CVCS_RHX_HLDN	RE	2	Letdown enthalpy at RHEX inlet/exit	Btu/lbm
1535 . . .	CVRHHC	CVCS_RHX_HCH	RE	2	Charging enthalpy at RHEX inlet/exit	Btu/lbm
1536 . . .	CVRHWL	CVCS_RHX_WLDN	RE		Letdown mass flow rate	Lbm/sec
1537 . . .	CVRHWC	CVCS_RHX_WCH	RE		Charging mass flow rate	Lbm/sec
1538 . . .	CVRHQ	CVCS_RHX_HEAT	RE		Regenerative heat exchanger heat load	Btu/sec
1539 . . .	LDRCH	LDN_RCS_ENTH	RE	4	Enthalpy at letdown line RCS connections	Btu/lbm
1540 . . .	LDRCP	LDN_RCS_PRES	RE	4	Pressure at letdown line RCS connections	Psia
1541	SGS	SGS_COMMON	RE	1536	SG secondary global common variables	Segment
1542 .	SGSINT	SGS_INTERNAL	RE	400	SG secondary internal variables	Partition
1543 . .	SBOTP	SGS_BOT_P	RE	4	Fluid pressure at SG tube sheet	Psia
1544 . .	SCIO1	SGS_CON_IO1	RE	4	SG steam node iodine concentration	Microcurie/lbm
1545 . .	SCIO2	SGS_CON_IO2	RE	4	SG evaporator node iodine concentration	Microcurie/lbm
1546 . .	SCPT1	SGS_CON_PT1	RE	4	SG steam node particulates concentration	Microcurie/lbm
1547 . .	SCPT2	SGS_CON_PT2	RE	4	SG evaporator node partic. concentration	Microcurie/lbm
1548 . .	SCXE1	SGS_CON_XE1	RE	4	SG steam node xenon concentration	Microcurie/lbm
1549 . .	SCEX2	SGS_CON_XE2	RE	4	SG evaporator node xenon concentration	Microcurie/lbm
1550 . .	SCBOR1	SGS_CON_BORON1	RE	4	SG steam node boron concentration	Parts/million
1551 . .	SCBOR2	SGS_CON_BORON2	RE	4	SG evaporator node boron concentration	Parts/million
1552 . .	SDELTV	SGS_DELTV	RE	4	Multiplier on steam velocity	Dimensionless
1553 . .	SDP	SGS_DP	RE	3,4	Level instrum. delta press (refleg, sg)	Psid

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1554 . .	SDVDP	SGS_DVDP	RE	4	Slope of volume(pressure) curve	Composite Units
1555 . .	SENTH1	SGS_ENTH1	RE	4	SG steam node average specific enthalpy	Btu/lbm
1556 . .	SENTH2	SGS_ENTH2	RE	4	SG evaporator node average sp. enthalpy	Btu/lbm
1557 . .	SENTH3	SGS_ENTH3	RE	4	SG downcomer node average sp. enthalpy	Btu/lbm
1558 . .	SENTH4	SGS_ENTH4	RE	4	SG economizer node average sp. enthalpy	Btu/lbm
1559 . .	SENTH5	SGS_ENTH5	RE	4	SG quench-pool node average sp. enthalpy	Btu/lbm
1560 . .	SGSE1	SGS_E1	RE	4	SG steam node total energy	Btu
1561 . .	SGSE2	SGS_E2	RE	4	SG evaporator node total energy	Btu
1562 . .	SGSE3	SGS_E3	RE	4	SG downcomer node total energy	Btu
1563 . .	SGSE4	SGS_E4	RE	4	SG economizer node total energy	Btu
1564 . .	SGSE5	SGS_E5	RE	4	SG quench-pool node total energy	Btu
1565 . .	SGSHF	SGS_HF	RE	4	SG saturated liquid specific enthalpy	Btu/lbm
1566 . .	SGSHG	SGS_HG	RE	4	SG saturated steam specific enthalpy	Btu/lbm
1567 . .	SHLEVL	SGS_HLEVEL	RE	4	SG coolant level	Feet
1568 . .	SGSHT2	SGS_HT2	RE	4	SG evaporator coolant level	Feet
1569 . .	SGSHT3	SGS_HT3	RE	4	SG downcomer coolant level	Feet
1570 . .	SGSHT1	SGS_HTI	RE	4,3	Instrumnt-measured water levels (SG,leg)	Feet
1571 . .	SGSM1	SGS_M1	RE	4	SG steam node total mass	Lbm
1572 . .	SGSM2	SGS_M2	RE	4	SG evaporator node total mass	Lbm
1573 . .	SGSM3	SGS_M3	RE	4	SG downcomer node total mass	Lbm
1574 . .	SGSM4	SGS_M4	RE	4	SG economizer node total mass	Lbm
1575 . .	SGSM5	SGS_M5	RE	4	SG quench-pool node total mass	Lbm
1576 . .	SGSP	SGS_P	RE	4	SG steam node pressure	Psia
1577 . .	SRECIR	SGS_RECIRC	RE	4	SG evaporator to downcomer flow ratio	Dimensionless
1578 . .	SRHO1	SGS_RHO1	RE	4	SG steam node density	Lbm/ft^3
1579 . .	SRHO2	SGS_RHO2	RE	4	SG evaporator node density	Lbm/ft^3
1580 . .	SRHO3	SGS_RHO3	RE	4	SG downcomer node density	Lbm/ft^3
1581 . .	SRHO4	SGS_RHO4	RE	4	SG economizer node density	Lbm/ft^3
1582 . .	SRHO5	SGS_RHO5	RE	4	SG quench-pool node density	Lbm/ft^3
1583 . .	SGSSV1	SGS_SV1	RE	4	SG steam node average specific volume	Ft^3/lbm
1584 . .	SGSSV2	SGS_SV2	RE	4	SG evaporator node average spec. volume	Ft^3/lbm
1585 . .	SGSSV3	SGS_SV3	RE	4	SG downcomer node average spec. volume	Ft^3/lbm
1586 . .	SGSSV4	SGS_SV4	RE	4	SG economizer node average spec. volume	Ft^3/lbm
1587 . .	SGSSV5	SGS_SV5	RE	4	SG quench-pool node average spec. volume	Ft^3/lbm
1588 . .	STREFL	SGS_TREFLG	RE	4	SG reference leg water temperature	Degree F
1589 . .	STWALL	SGS_TWALL	RE	4	SG wall metal temperature	Degree F
1590 . .	SGST1	SGS_T1	RE	4	SG steam node temperature	Degree F
1591 . .	SGST2	SGS_T2	RE	4	SG evaporator node temperature	Degree F
1592 . .	SGST3	SGS_T3	RE	4	SG downcomer node temperature	Degree F
1593 . .	SGST4	SGS_T4	RE	4	SG economizer node temperature	Degree F
1594 . .	SGST5	SGS_T5	RE	4	SG quench-pool node temperature	Degree F
1595 . .	SUSTM	SGS_USTM	RE	4	Steam velocity leaving separators	Ft/sec
1596 . .	SGSVF	SGS_VF	RE	4	SG saturated liquid specific volume	Ft^3/lbm
1597 . .	SGSVF2	SGS_VF2	RE	4	SG evaporator node liquid spec. volume	Ft^3/lbm
1598 . .	SGSVF3	SGS_VF3	RE	4	SG downcomer node liquid specific volume	Ft^3/lbm
1599 . .	SGSVF4	SGS_VF4	RE	4	SG economizer node liq specific volume	Ft^3/lbm
1600 . .	SGSVF5	SGS_VF5	RE	4	SG quench-pool node liq specific volume	Ft^3/lbm
1601 . .	SGSVG	SGS_VG	RE	4	SG saturated steam specific volume	Ft^3/lbm
1602 . .	SGSV1	SGS_V1	RE	4	SG steam node total volume	Ft^3
1603 . .	SGSV2	SGS_V2	RE	4	SG evaporator node total volume	Ft^3
1604 . .	SGSV3	SGS_V3	RE	4	SG downcomer node total volume	Ft^3
1605 . .	SGSV4	SGS_V4	RE	4	SG economizer node total volume	Ft^3
1606 . .	SGSV5	SGS_V5	RE	4	SG quench-pool node total volume	Ft^3
1607 . .	SGSWF1	SGS_WF1	RE	4	SG steam node liquid mass	Lbm
1608 . .	SGSWF2	SGS_WF2	RE	4	SG evaporator node liquid mass	Lbm
1609 . .	SGSWF3	SGS_WF3	RE	4	SG downcomer node liquid mass	Lbm
1610 . .	SGSWF4	SGS_WF4	RE	4	SG economizer node liquid mass	Lbm
1611 . .	SGSWF5	SGS_WF5	RE	4	SG quench-pool node liquid mass	Lbm
1612 . .	SGSWG1	SGS_WG1	RE	4	SG steam node steam mass	Lbm
1613 . .	SGSWG2	SGS_WG2	RE	4	SG evaporator node steam mass	Lbm
1614 . .	SGSWG3	SGS_WG3	RE	4	SG downcomer node steam mass	Lbm
1615 . .	SGSWG4	SGS_WG4	RE	4	SG economizer node steam mass	Lbm
1616 . .	SGSWG5	SGS_WG5	RE	4	SG quench-pool node steam mass	Lbm
1617 . .	SGSW13	SGS_W13	RE	4	Stm node to dcomer condensation flowrate	Lbm/sec
1618 . .	SGSW21	SGS_W21	RE	4	SG evaporator to steam node flow rate	Lbm/sec
1619 . .	SGSW23	SGS_W23	RE	4	Evaporator to downcomer circulation flow	Lbm/sec
1620 . .	SGSW31	SGS_W31	RE	4	Dcomer to steam node vapzation flow rate	Lbm/sec
1621 . .	SGSW32	SGS_W32	RE	4	SG downcomer to evaporator flow rate	Lbm/sec
1622 . .	SGSW51	SGS_W51	RE	4	Quench-pool to dome vaprzation flow rate	Lbm/sec
1623 . .	SGSW25	SGS_W25	RE	4	Evap to quenchpool circulation flow rate	Lbm/sec
1624 . .	SGSW53	SGS_W53	RE	4	Quench-pool to downcomer flow rate	Lbm/sec
1625 . .	SGSW42	SGS_W42	RE	4	SG economizer to evaporator flow rate	Lbm/sec
1626 . .	SWOUT	SGS_WOUTSG	RE	8	SG steam outlet nozzle flow	Lbm/sec
1627 . .	SGSX1	SGS_X1	RE	4	SG steam node quality	Fraction

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1628	. . SGSX2	SGS_X2	RE	4	SG evaporator node quality	Fraction
1629	. . SGSX3	SGS_X3	RE	4	SG downcomer node quality	Fraction
1630	. . SGSX4	SGS_X4	RE	4	SG economizer node quality	Fraction
1631	. . SGSX5	SGS_X5	RE	4	SG quench-pool node quality	Fraction
1632	. . SGCHOK	SGS_FLOW_CHOKED	LO	8	Flag: steam flow choked at restrictor	True False
1633	. SHEAT	SGS_HEAT	RE	60	SG heat transfer variables	Partition
1634	. . SQHOTR	SGT_RCS_QHOT	RE	4	SG hot side RCS-to-tube heat transfer	Btu/sec
1635	. . SQHOTS	SGT_SG_QHOT	RE	4	Hot side tube-to-secondary heat transfer	Btu/sec
1636	. . SQCLDR	SGT_RCS_QCOLD	RE	4	SG entire cold side RCS-to-tube heat tr.	Btu/sec
1637	. . SQCLDS	SGT_SG_QCOLD	RE	4	Entire cold side tube-to-secy heat trans	Btu/sec
1638	. . SQRECN	SGT_RCS_QECON	RE	4	SG economizer RCS-to-tube heat transfer	Btu/sec
1639	. . SQSECN	SGT_SG_QECON	RE	4	Economizer tube-to-secondary heat transf	Btu/sec
1640	. . STHOT	SGT_TEMP_HOT	RE	4	SG hot side tube metal temperature	Degree F
1641	. . STCOLD	SGT_TEMP_COLD	RE	4	SG cold side tube metal temp, evaporator	Degree F
1642	. . STECON	SGT_TEMP_ECON	RE	4	SG cold side tube metal temp, economizer	Degree F
1643	. . SQLOAD	SGS_HEAT_LOAD	RE		Total secondary side heat load	Btu/sec
1644	. . SQCONT	SGS_Q_CONT	RE	4	SG wall-to-containment heat rate	Btu/sec
1645	. . SQWAL1	SGS_Q_WALL1	RE	4	SG steam node steam-to-wall heat rate	Btu/sec
1646	. . SQWAL3	SGS_Q_WALL3	RE	4	SG downcomer node liq-to-wall heat rate	Btu/sec
1647	. MSLH	SGS_STEAMLINE	RE	390	SG steam line variables	Partition
1648	. . MNODE	MSLH_STATE	RE	40	Steamline header variables	Partition
1649	. . . MSLBO	MAL_MSLB_OUT	IN		Int:Stmline break in MSLH: 0=>no 1=>yes	Flag
1650	. . . MGSLBO	MSLB_OUT_FLOW	RE		Stmline break outside contment flowrate	Lbm/sec
1651	. . . MCIO	MSLH_CON_IO	RE		MSLH node iodine concentration	Microcurie/lbm
1652	. . . MCPT	MSLH_CON_PT	RE		MSLH node particulates concentration	Microcurie/lbm
1653	. . . MCXE	MSLH_CON_XE	RE		MSLH node xenon concentration	Microcurie/lbm
1654	. . . MDVDH	MSLH_DVDH	RE		MSLH node partial sp. vol with enthalpy	Composite Units
1655	. . . MDVDP	MSLH_DVDP	RE		MSLH node partial sp. vol. with pressure	Composite Units
1656	. . . MSLHH	MSLH_H	RE		MSLH node enthalpy	Btu/lbm
1657	. . . HSLHHF	MSLH_HF	RE		MSLH node saturated liquid enthalpy	Btu/lbm
1658	. . . MSLHHG	MSLH_HG	RE		MSLH node saturated steam enthalpy	Btu/lbm
1659	. . . MSLHM	MSLH_M	RE		MSLH node mass	Lbm
1660	. . . MSLHML	MSLH_ML	RE		MSLH node liquid mass	Lbm
1661	. . . MSLHP	MSLH_P	RE		MSLH node pressure	Psia
1662	. . . MSLHQ	MSLH_Q	RE		MSLH coolant-to-wall heat rate	Btu/sec
1663	. . . MQARM	MSLH_Q_ATM	RE		MSLH wall-to-atmosphere heat rate	Btu/sec
1664	. . . MSLHSV	MSLH_SV	RE		MSLH node specific volume	Ft^3/lbm
1665	. . . MSVF	MSLH_SVF	RE		MSLH node saturated liquid specific vol.	Ft^3/lbm
1666	. . . MSVG	MSLH_SVG	RE		MSLH node saturated steam specific vol.	Ft^3/lbm
1667	. . . MSLHT	MSLH_T	RE		MSLH node temperature	Degree F
1668	. . . MTWALL	MSLH_TWALL	RE		MSLH node pipe metal temperature	Degree F
1669	. . . MWIN	MSLH_WIN	RE	8	Steamline steam flow into the header	Lbm/sec
1670	. . . MSLHX	MSLH_X	RE		MSLH node quality	Fraction
1671	. . MSLIN	STEAMLINE_STATE	RE	350	Steamlines & stmline ext. valves	Partition
1672	. . . MSLBI	MAL_MSLB_IN	IN	8	SLB in stmln 0=No, 1-3=various locations	Pointer
1673	. . . MGSLBI	MSLB_IN_FLOW	RE	8	Steamline break inside contment flowrate	Lbm/sec
1674	. . . MHSL	MSLH_HSL	RE	8	SG steamline enthalpy	Btu/lbm
1675	. . . MPSL	MSLH_PSL	RE	8	SG steamline pressure	Psia
1676	. . . MTSL	MSLH_TSL	RE	8	SG steamline temperature	Degree F
1677	. . . MISL	MSLH_ISL	RE	8	SG steamline iodine concentrations	Microcurie/lbm
1678	. . . MCSL	MSLH_CSL	RE	8	SG steamline partic concentrations	Microcurie/lbm
1679	. . . MXSL	MSLH_XSL	RE	8	SG steamline xenon concentrations	Microcurie/lbm
1680	. . . MIPOS	MSLH_MSIV_POS	RE	8	MSIV fraction open	Fraction
1681	. . . MISIG	MSLH_MSIV_SIG	RE	8	MSIV signal	Fraction
1682	. . . MIBYPO	MSLH_MSIV_BYPASS_POS	RE	8	MSIV bypass fraction open	Fraction
1683	. . . MVPOS	MSLH_VALVE_POS	RE	50	Steamline external valves fraction open	Fraction
1684	. . . MVSIG	MSLH_VALVE_SIG	RE	50	Steamline external valves signal	Fraction
1685	. . . SLPFLO	SL_P_FLOW	RE	50	Steamline external valves flow rates	Lbm/sec
1686	. . . MAOUT	MSLH_AOUT	RE	9,4	Steamline ext. valves combined areas	Partition
1687	. . . . MAATM	MSLH_AOUT_ATM	RE	9	Ext valves flow area, stmlines-atmospher	Ft^2
1688	. . . . MACOND	MSLH_AOUT_COND	RE	9	Ext valves flow area, stmlines-condenser	Ft^2
1689	. . . . MACONT	MSLH_AOUT_CONT	RE	9	Ext valves flow area, stmlines-contnment	Ft^2
1690	. . . . MATURB	MSLH_AOUT_TURB	RE	9	Ext valves flow area, stmlines-turbine	Ft^2
1691	. . . MWOUT	MSLH_WOUT	RE	9,4	Steamline ext. valves combined flowrates	Partition
1692	. . . . MWATM	MSLH_WOUT_ATM	RE	9	Ext valves flow rate, stmlines-atmospher	Lbm/sec
1693	. . . . MWCOND	MSLH_WOUT_COND	RE	9	Ext valves flow rate, stmlines-condenser	Lbm/sec
1694	. . . . MWCONT	MSLH_WOUT_CONT	RE	9	Ext valves flow rate, stmlines-contnment	Lbm/sec
1695	. . . . MWTURB	MSLH_WOUT_TURB	RE	9	Ext valves flow rate, stmlines-turbine	Lbm/sec
1696	. . . MGOUT	MSLH_OUTFLOW	RE	5,4	Steamline outflow quantities, inc. break	Partition
1697	. . . . MGATM	MSLH_FLOW_ATM	RE		Total flow rate, steamline to atmosph	Lbm/sec
1698	. . . . MEATM	MSLH_ENTH_ATM	RE		Total flow enthpy, steamline to atmosph	Btu/lbm
1699	. . . . MIATM	MSLH_IO_ATM	RE		Tot flow iodine conc, stmline to atmosph	Microcurie/lbm
1700	. . . . MPATM	MSLH_PT_ATM	RE		Tot flow partic conc, stmline to atmosph	Microcurie/lbm
1701	. . . . MXATM	MSLH_XE_ATM	RE		Tot flow xenon conc, stmline to atmosph	Microcurie/lbm

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1702	MGCOND	MSLH_FLOW_COND	RE		Total flow rate, steamline to condnsr	Lbm/sec
1703	MECOND	MSLH_ENTH_COND	RE		Total flow enthpy, steamline to condnsr	Btu/lbm
1704	MICOND	MSLH_IO_COND	RE		Tot flow iodine conc, stmline to condnsr	Microcurie/lbm
1705	MPCOND	MSLH_PT_COND	RE		Tot flow partic conc, stmline to condnsr	Microcurie/lbm
1706	MXCOND	MSLH_XE_COND	RE		Tot flow xenon conc, stmline to condnsr	Microcurie/lbm
1707	MGCONT	MSLH_FLOW_CONT	RE		Total flow rate, steamline to contmnt	Lbm/sec
1708	MECONT	MSLH_ENTH_CONT	RE		Total flow enthpy, steamline to contmnt	Btu/lbm
1709	MICONT	MSLH_IO_CONT	RE		Tot flow iodine conc, stmline to contmnt	Microcurie/lbm
1710	MPCONT	MSLH_PT_CONT	RE		Tot flow partic conc, stmline to contmnt	Microcurie/lbm
1711	MXCONT	MSLH_XE_CONT	RE		Tot flow xenon conc, stmline to contmnt	Microcurie/lbm
1712	MGTUR	MSLH_FLOW_TURB	RE		Total flow rate, steamline to turbine	Lbm/sec
1713	METUR	MSLH_ENTH_TURB	RE		Total flow enthpy, steamline to turbine	Btu/lbm
1714	MITUR	MSLH_IO_TURB	RE		Tot flow iodine conc, stmline to turbine	Microcurie/lbm
1715	MPTUR	MSLH_PT_TURB	RE		Tot flow partic conc, stmline to turbine	Microcurie/lbm
1716	MXTUR	MSLH_XE_TURB	RE		Tot flow xenon conc, stmline to turbine	Microcurie/lbm
1717 . . .	NETIOU	MSLH_IO_INT_FLOW	RE	10	Integrated iodine flows	Partition
1718	ITOTAT	MSLH_IO_INT_ATM	RE		Integrated iodine flow to atmo	Curie
1719	ITOTCD	MSLH_IO_INT_COND	RE		Integrated iodine flow to cond (w/o DF)	Curie
1720	ITOTCT	MSLH_IO_INT_CONT	RE		Integrated iodine flow to cont	Curie
1721	ITOTTU	MSLH_IO_INT_TURB	RE		Integrated iodine flow to turb (w/o DF)	Curie
1722	IOCTLK	MSLH_IO_CONT_LEAK	RE		Iodine leak rate from containment	Microcurie/sec
1723	IOCTL	MSLH_IO_CONT_INT_LEAK	RE		Integrated iodine leak from containment	Curie
1724 . . .	MSCHOK	MSLH_FLOW_CHOKED	LO	8	Flag: flow choked between header & MSLB	True False
1725 .	SGSFWS	SGS_FWS	RE	180	SG feedwater system variables	Partition
1726 . .	FPPIN	FWS_PUMP_PIN	RE		Main FW pumps suction pressure, constant	Psia
1727 . .	FPPMP	FWS_PUMP_P	RE	4	Main feedwater pump discharge pressure	Psia
1728 . .	FPJUN	FWS_JUNCTION_P	RE	4	Main FW piping junction pressure	Psia
1729 . .	FPVALV	FWS_VALVE_PRESSURES	RE	4,2	Main FW valve discharge pressure	Psia
1730 . . .	FPVAL	FWS_VALVE_P	RE	4	FW downcomer valve discharge pressure	Psia
1731 . . .	FPEVAL	FWS_ECON_VALVE_P	RE	4	FW economizer valve discharge pressure	Psia
1732 . .	FSPMP	FWS_PUMP_SPEED	RE	4	Main feedwater pump speed	Shaft RPM
1733 . .	FHPMP	FWS_PUMP_HEAD	RE	4	Main feedwater pump head	Feet
1734 . .	FGPMP	FWS_PUMP_FLOW	RE	4	Main feedwater pump delivered flow	Gal/min
1735 . .	FGLINE	FWS_LINE_FLOWS	RE	4,2	Flow through main FW control valves	Lbm/sec
1736 . . .	FGLIN	FWS_FLOW	RE	4	Main FW flow rate at downcomer valves	Lbm/sec
1737 . . .	FGELIN	FWS_ECON_FLOW	RE	4	Main FW flow rate at economizer valves	Lbm/sec
1738 . .	FGTOT	FWS_FLOW_TOT	RE	4	Total MFW flow to SG thru dc & ec valves	Lbm/sec
1739 . .	FWSENT	FWS_ENTH	RE	4	Main feedwater flow spec. enthalpy	Btu/lbm
1740 . .	FELINE	FWS_LINE_ENTHALPIES	RE	4,2	Inventory enthalpies in main FW lines	Btu/lbm
1741 . . .	FELIN	FWS_LINE_H	RE	4	Downcomer feedwater line enthalpy	Btu/lbm
1742 . . .	FEELIN	FWS_ECON_LINE_H	RE	4	Economizer feedwater line enthalpy	Btu/lbm
1743 . .	FIOCON	FWS_CON_IO	RE	4	Main feedwater supply iodine concent.	Microcurie/lbm
1744 . .	FPTCON	FWS_CON_PT	RE	4	Main feedwater supply partic concent.	Microcurie/lbm
1745 . .	FXECON	FWS_CON_XE	RE	4	Main feedwater supply xenon concent.	Microcurie/lbm
1746 . .	FGNOZZ	FWS_NOZZLE_FLOW	RE	4,2	Main FW flow rates at SG feed nozzles	Lbm/sec
1747 . . .	FGNOZ	FWS_NOZ_FLOW	RE	4	Main FW flow rate at downcomer nozzle	Lbm/sec
1748 . . .	FGENOZ	FWS_ECON_NOZ_FLOW	RE	4	Main FW flow rate at economizer nozzle	Lbm/sec
1749 . .	FENOZZ	FWS_NOZZLE_ENTHALPY	RE	4,2	Main FW flow enthalpy at SG feed nozzles	Btu/lbm
1750 . . .	FENOZ	FWS_NOZ_ENTH	RE	4	Main FW flow enthalpy at downcomer nozzl	Btu/lbm
1751 . . .	FEENOZ	FWS_ECON_NOZ_ENTH	RE	4	Main FW flow enthalpy at economiZr nozzl	Btu/lbm
1752 . .	FXNOZZ	FWS_NOZZLE_QUALITY	RE	4,2	Main FW flow quality at SG feed nozzles	Fraction
1753 . . .	FXNOZ	FWS_NOZ_QUAL	RE	4	Main FW flow quality at downcomer nozzle	Fraction
1754 . . .	FXENOZ	FWS_ECON_NOZ_QUAL	RE	4	Main FW flow quality at economiZr nozzle	Fraction
1755 . .	FTNOZZ	FWS_NOZZLE_TEMP	RE	4,2	Main FW flow temp at SG feed nozzles	Degree F
1756 . . .	FTNOZ	FWS_NOZ_T	RE	4	Main FW flow temp at downcomer nozzle	Degree F
1757 . . .	FTENOZ	FWS_ECON_NOZ_T	RE	4	Main FW flow temp at economizer nozzle	Degree F
1758 . .	FWLBIN	FWLB_IN	RE	4,2	Cues for feedline break inside chk valve	Fraction
1759 . . .	FLBIN	MAL_FWLB_IN	RE	4	Feedline break inside chk valve, DC line	Fraction
1760 . . .	FLBEIN	MAL_FWLB_ECON_IN	RE	4	Feedline break inside chk valve, EC line	Fraction
1761 . .	FWLBOU	FWLB_OUT	RE	4,2	Cues for feedline brk outside chk valve	Fraction
1762 . . .	FLBOU	MAL_FWLB_OUT	RE	4	Feedline brk outside chk valve, DC line	Fraction
1763 . . .	FLBEOU	MAL_FWLB_ECON_OUT	RE	4	Feedline brk outside chk valve, EC line	Fraction
1764 . .	FWLBLO	FWLB_LOCATION	RE	4,2	Feedline break locations: 0=valve 1=nozz	Fraction
1765 . . .	FWLBF	FWLB_F	RE	4	Feedline break location, downcomer line	Fraction
1766 . . .	FWLBEF	FWLB_ECON_F	RE	4	Feedline break location, economizer line	Fraction
1767 . .	FWLBW	FWLB_W	RE	4,2	Feedline break flow rates	Lbm/sec
1768 . . .	FLBW	FWLB_FLOW	RE	4	Downcomer feedline break flow rate	Lbm/sec
1769 . . .	FLBEW	FWLB_ECON_FLOW	RE	4	Economizer feedline break flow rate	Lbm/sec
1770 . .	FWLBH	FWLB_H	RE	4,2	Feedline break flow enthalpies	Btu/lbm
1771 . . .	FLBH	FWLB_ENTH	RE	4	Downcomer feedline break flow enthalpy	Btu/lbm
1772 . . .	FLBEH	FWLB_ECON_ENTH	RE	4	Economizer feedline break flow enthalpy	Btu/lbm
1773 . .	FWLBX	FWLB_QUALITY	RE	4,2	Feedline break flow qualities	Fraction
1774 . . .	FLBX	FWLB_QUAL	RE	4	Downcomer feedline break flow quality	Fraction
1775 . . .	FLBEX	FWLB_ECON_QUAL	RE	4	Economizer feedline break flow quality	Fraction

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1776 . .	FWLBIO	FWLB_IODINE	RE	4,2	Feedline break flow iodine concentratins	Microcurie/lbm
1777 . . .	FLBIO	FWLB_IO	RE	4	Downcomer feedline brk flow iodine conc	Microcurie/lbm
1778 . . .	FLBEIO	FWLB_ECON_IO	RE	4	Economizer feedline brk flow iodine conc	Microcurie/lbm
1779 . .	FWLBPT	FWLB_PART	RE	4,2	Feedline break flow partic concentratins	Microcurie/lbm
1780 . . .	FLBPT	FWLB_PT	RE	4	Downcomer feedline brk flow partic conc	Microcurie/lbm
1781 . . .	FLBEPT	FWLB_ECON_PT	RE	4	Economizer feedline brk flow partic conc	Microcurie/lbm
1782 . .	FWLBXE	FWLB_XENON	RE	4,2	Feedline break flow xenon concentrns	Microcurie/lbm
1783 . . .	FLBXE	FWLB_XE	RE	4	Downcomer feedline brk flow xenon conc	Microcurie/lbm
1784 . . .	FLBEXE	FWLB_ECON_XE	RE	4	Economizer feedline brk flow xenon conc	Microcurie/lbm
1785 . .	SGNAFW	AFWS_NOZ_FLOW	RE	4	Auxiliary feedwater flow to separate noz	Lbm/sec
1786 . .	SEAFWS	AFWS_ENTH	RE	4	Auxiliary feedwater flow spec. enthalpy	Btu/lbm
1787 .	SGBD	SGS_SGBD	RE	100	SG blowdown system variables	Partition
1788 . .	SBITNK	SGBD_CON_IO	RE		SGBD tank iodine concentration	Microcurie/lbm
1789 . .	SBPTNK	SGBD_CON_PT	RE		SGBD tank particulates concentration	Microcurie/lbm
1790 . .	SBXTNK	SGBD_CON_XE	RE		SGBD tank xenon concentration	Microcurie/lbm
1791 . .	SBDVDH	SGBD_DVDH	RE		SGBD tank partial sp. vol with enthalpy	Composite Units
1792 . .	SBDVDP	SGBD_DVDP	RE		SGBD tank partial sp. vol. with pressure	Composite Units
1793 . .	SGBDH	SGBD_H	RE		SGBD tank specific enthalpy	Btu/lbm
1794 . .	SGBDHF	SGBD_HF	RE		SGBD tank saturated liquid enthalpy	Btu/lbm
1795 . .	SGBDHG	SGBD_HG	RE		SGBD tank saturated steam enthalpy	Btu/lbm
1796 . .	SGBDL	SGBD_L	RE		SGBD tank water level	Feet
1797 . .	SBBDM	SGBD_M	RE		SGBD tank total mass	Lbm
1798 . .	SGBDML	SGBD_ML	RE		SGBD tank liquid mass	Lbm
1799 . .	SGBDP	SGBD_P	RE		SGBD tank pressure	Psia
1800 . .	SGBDSV	SGBD_SV	RE		SGBD tank specific volume	Ft^3/lbm
1801 . .	SVSVF	SGBD_SVF	RE		SGBD tank sat. liquid specific volume	Ft^3/lbm
1802 . .	SBSVG	SGBD_SVG	RE		SGBD tank sat. steam specific volume	Ft^3/lbm
1803 . .	SGBDT	SGBD_T	RE		SGBD tank fluid temperature	Degree F
1804 . .	SBTWAL	SGBD_TWALL	RE		SGBD tank wall metal temperature	Degree F
1805 . .	SGBDX	SGBD_X	RE		SGBD tank quality	Fraction
1806 . .	SBVPOS	SGBD_SG_POS	RE	8	SG blowdown line valves	Partition
1807 . . .	SBVSUR	SGBD_SURF_POS	RE	4	Surface blowdown lines valve positions	Fraction
1808 . . .	SBVBOT	SGBD_BOT_POS	RE	4	Bottom blowdown lines valve positions	Fraction
1809 . .	SBG	SGBD_SG_FLOW	RE	8	SG blowdown line flow rates	Partition
1810 . . .	SBGSUR	SGBD_SURF_FLOW	RE	4	Surface blowdown line flow rates	Lbm/sec
1811 . . .	SBGBOT	SGBD_BOT_FLOW	RE	4	Bottom blowdown line flow rates	Lbm/sec
1812 . .	SBENTH	SGBD_SG_ENTH	RE	8	SG blowdown line flow enthalpies	Partition
1813 . . .	SBESUR	SGBD_SURF_ENTH	RE	4	Surface blowdown line flow enthalpies	Btu/lbm
1814 . . .	SBEBOT	SGBD_BOT_ENTH	RE	4	Bottom blowdown line flow enthalpies	Btu/lbm
1815 . .	SBIO	SGBD_SG_IO	RE	8	SG blowdown line flow iodine concs	Partition
1816 . . .	SBISUR	SGBD_SURF_IO	RE	4	Surface blowdown line flow iodine concs	Microcurie/lbm
1817 . . .	SBIBOT	SGBD_BOT_IO	RE	4	Bottom blowdown line flow iodine concs	Microcurie/lbm
1818 . .	SBPT	SGBD_SG_PT	RE	8	SG blowdown line flow partic concs	Partition
1819 . . .	SBPSUR	SGBD_SURF_PT	RE	4	Surface blowdown line flow partic concs	Microcurie/lbm
1820 . . .	SBPBOT	SGBD_BOT_PT	RE	4	Bottom blowdown line flow partic concs	Microcurie/lbm
1821 . .	SBXE	SGBD_SG_XE	RE	8	SG blowdown line flow xenon concs	Partition
1822 . . .	SBXSUR	SGBD_SURF_XE	RE	4	Surface blowdown line flow xenon concs	Microcurie/lbm
1823 . . .	SBXBOT	SGBD_BOT_XE	RE	4	Bottom blowdown line flow xenon concs	Microcurie/lbm
1824 . .	SBVSNK	SGBD_SINK_POS	RE	3	SGBD tank discharge line valves	Partition
1825 . . .	SBVOUT	SGBD_OUT_POS	RE	2	SGBD tank outlet lines valve positions	Fraction
1826 . . .	SBVREL	SGBD_RELIEF_POS	RE		SGBD tank relief line valve position	Fraction
1827 . .	SBGSNK	SGBD_SINK_FLOW	RE	3	SGBD tank discharge line flow rates	Partition
1828 . . .	SBGOUT	SGBD_OUT_FLOW	RE	2	SGBD tank outlet lines flow rates	Lbm/sec
1829 . . .	SBGREL	SGBD_RELIEF_FLOW	RE		SGBD tank relief line flow rate	Lbm/sec
1830 . .	SBESNK	SGBD_SINK_ENTH	RE	3	SGBD tank discharge line flow enthalpies	Partition
1831 . . .	SBEOUT	SGBD_OUT_ENTH	RE	2	SGBD tank outlet lines flow enthalpies	Btu/lbm
1832 . . .	SBEREL	SGBD_RELIEF_ENTH	RE		SGBD tank relief line flow enthalpy	Btu/lbm
1833 . .	SBISNK	SGBD_SINK_IO	RE	3	SGBD tank disch. line flow iodine concs	Partition
1834 . . .	SBIOUT	SGBD_OUT_IO	RE	2	SGBD tank outlet lines flow iodine concs	Microcurie/lbm
1835 . . .	SBIREL	SGBD_RELIEF_IO	RE		SGBD tank relief line flow iodine conc	Microcurie/lbm
1836 . .	SBPSNK	SGBD_SINK_PT	RE	3	SGBD tank disch. line flow partic concs	Partition
1837 . . .	SBPOUT	SGBD_OUT_PT	RE	2	SGBD tank outlet lines flow partic concs	Microcurie/lbm
1838 . . .	SBPREL	SGBD_RELIEF_PT	RE		SGBD tank relief line flow partic conc	Microcurie/lbm
1839 . .	SBXSNK	SGBD_SINK_XE	RE	3	SGBD tank disch. line flow xenon concs	Partition
1840 . . .	SBXOUT	SGBD_OUT_XE	RE	2	SGBD tank outlet lines flow xenon concs	Microcurie/lbm
1841 . . .	SBXREL	SGBD_RELIEF_XE	RE		SGBD tank relief line flow xenon conc	Microcurie/lbm
1842 . .	SBPRSN	SGBD_SINK_P	RE	3	SGBD tank disch. line dwnstrm pressures	Partition
1843 . . .	SBPROT	SGBD_OUT_P	RE	2	SGBD tank outlet lines dwnstrm pressures	Psia
1844 . . .	DBPRRL	SGBD_RELIEF_P	RE		SGBD tank relief line dwnstrm pressure	Psia
1845 . .	SBMODF	MOD_OFF_SGBD	LO		Turns off SGBD model	True False
1846 .	STUNE	SGS_TUNE	RE	50	SG adjustable constants	Partition
1847 . .	STCONT	CONT_SG_TEMP	RE	4	Containment temperature at SGS	Degree F
1848 . .	MFTMAX	MSLH_FTIME_MAX	RE		Maximum time step size for MSLH model	Seconds
1849 . .	MPRESC	P_CONDENSER	RE		Condenser pressure	Psia

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1850 . .	SASEPT	SGS_ASEP_TUNE	RE		SGS steam separator area tuning factor	Dimensionless
1851 . .	SGSM	SGS_DELTV_MAX	RE		Multiplier for maximum steam velocity	Dimensionless
1852 . .	SFK3T	SGS_FK3_TUNE	RE		SGS downcomer flow coeff. tuning factor	Dimensionless
1853 . .	SFTIME	SGS_FTIME	RE		SGS models fast-time step size	Seconds
1854 . .	SFPMAX	SGS_FTIME_PMAX	RE		Max pressure for fasttime w/ MSIV open	Psia
1855 . .	SLHASB	SGS_HASUB_OPTION	LO		Option for calculating subcooled region	True False
1856 . .	SPCONV	SGS_PCNVRG	RE		Pressure convergence criterion	Psia
1857 . .	SPMIN	SGS_PMIN	RE		Minimum secondary-side pressure	Psia
1858 . .	SDVREC	SGS_RECIRC_DELVOL	RE		Delta volume for adjusting recirc flow	Ft^3
1859 . .	SRECMN	SGS_RECIRC_MIN	RE		Minimum recirculation for crossflow	Dimensionless
1860 . .	SSEPMN	SGS_SEP_PMIN	RE		Minimum pressure for separation model	Psia
1861 . .	STRTUN	SGS_TAURC1_TUNE	RE		SGS recirc flow time const tuning factor	Dimensionless
1862 . .	STRMAX	SGS_TAURC2_MAX	RE		SGS downcomer flow max time constant	Seconds
1863 . .	STGMAX	SGS_TAU_WOUTSG	RE		Unused spare	Unused
1864 . .	SPERIM	SGS_UADROP_PERIM	RE		Perimeter of the feedring	Feet
1865 . .	SFDMIN	SGS_UADROP_WFDMIN	RE		Min feedflow below which condens eff = 1	Lbm/sec
1866 . .	SUSTMN	SGS_USTM_MIN	RE		Minimum steam separation velocity	Ft/sec
1867 . .	SVCONV	SGS_VCNVRG	RE		Volume convergence criterion	Fraction
1868 . .	SWFMIN	SGS_WFMIN	RE		Reg. 2 liq mass for single-region switch	Lbm
1869 . .	SX2RG1	SGS_X2_1	RE		Reg. 2 quality to re-establist reg. 1	Fraction
1870 . .	SCOLDT	SGT_HTCRTC	RE	4	SG cold side heat transfer tuning factor	Composite Units
1871 . .	SHOTT	SGT_HTCRTH	RE	4	SG hot side heat transfer tuning factor	Composite Units
1872 . .	SH2SUB	SGT_HTCSCW	RE		H.t. coeff if region 2 is subcooled	Btu/secft^2degF
1873 . .	SH2STM	SGT_HTCSTM	RE		H.t. coeff in region 2 if surface is stm	Btu/secft^2degF
1874 . .	SQMULT	SGT_Q_MULT	RE	4	Multiplier on SG tube heat transfer area	Dimensionless
1875 . .	MDPMIN	MSLH_DPMIN_MULT	RE		Min del-P for flow coeff, frac of DP100	Fraction
1876 . .	SVFREF	SGS_VF_REF	RE		Liquid sp.vol for level instrum calibr	Ft^3/lbm
1877 . .	SVGREF	SGS_VG_REF	RE		Steam sp.vol for level instrum calibr	Ft^3/lbm
1878 . .	SVLEGR	SGS_VLEG_REF	RE		Ref-leg spvol for level instrum calibr	Ft^3/lbm
1879 . .	SGTAU	SGS_TAU_FLOW	RE	2	Steamflow time const @ lo/hi valve rates	Seconds
1880 . .	SGXTAU	SGS_XTAU_FLOW	RE	2	Fractional valve rates for SGS_tau_flow	Fraction
1881 . .	SCRMOD	SGS_CRIT_MODEL	IN		Liq/2-phs choked flow model: 0=HEM, 1=HF	Pointer
1882 .	SMORE	SGS_MORE_VARIABLES	RE	120	SGS misc additional variables	Partition
1883 . .	SINCON	SGS_INITIAL_CONDITIONS	RE	15	SGS initial conditions	Partition
1884 . . .	SPINIT	SPINIT	RE		New initial steam generator pressure	Psia
1885 . . .	SLINIT	SLINIT	RE		New init SG sec side mixture level	Feet
1886 . . .	FHINIT	FHINIT	RE		New initial feed water enthalpy	Btu/lbm
1887 . . .	SKAMUL	SKAMUL	RE	4	SG tube area multiplier	Fraction
1888 . .	SADEG	SGS_TUBE_AREA_DEGRAD	RE	10	Secondary tube area degradation model	Partition
1889 . . .	SADGOP	SGS_TUBE_AREA_OPTION	LO		Option to degrade secondary tube area	True False
1890 . . .	SADFUL	SGS_MASS_FULL_TUBE_AREA	RE	4	Min mass for full sec tube area	Lbm
1891 . . .	SADZER	SGS_MASS_ZERO_TUBE_AREA	RE	4	Mass for zero secondary area	Lbm
1892 . .	FHTBL	FWS_ENTH_TABLE	RE	50	Table of main feedwater enthalpy vs load	Partition
1893 . . .	FHENTH	FWS_HTABLE_ENTH	RE	20	Table: MFW norm enthalpy, (h-H1)/(H2-H1)	Dimensionless
1894 . . .	FHLOAD	FWS_HTABLE_LOAD	RE	20	Table: turbine normalized load, W/Wrated	Dimensionless
1895 . . .	FHNUM	FWS_HTABLE_NUM	IN		Table: number of entries	Counts
1896 . .	SECON	SGS_ECON_VARS	RE	40	More vars for the SG economizer model	Partition
1897 . . .	STPINE	SGS_ECON_TPIN	RE	4	Economizer primary inlet temperature	Degree F
1898 . . .	STPOTE	SGS_ECON_TPOUT	RE	4	Economizer primary outlet temperature	Degree F
1899 . . .	STFINE	SGS_ECON_TFIN	RE	4	Economizer feedwater inlet temperature	Degree F
1900 . . .	STFOTE	SGS_ECON_TFOUT	RE	4	Economizer feedwater outlet temperature	Degree F
1901 . . .	SASUBE	SGS_ECON_ASUB	RE	4	Economizer area in subcooled heat trans	Ft^2
1902 . . .	STCAVE	SGS_ECON_TCAV	RE	4	SG cold side average primary temperature	Degree F
1903 . . .	SCNVRG	SGS_ECON_CNVRG	RE		Converg criterion for econ ht iteration	Dimensionless
1904 . . .	SFLIME	SGS_ECON_FLIM	RE		Min MFW flow to econ. Below: model off	Lbm/sec
1905 .	MNODE2	MSLH2_STATE	RE	40	Steamline header node 2 variables	Partition
1906 . .	M2CIO	MSLH2_CON_IO	RE		MSLH2 node iodine concentration	Microcurie/lbm
1907 . .	M2CPT	MSLH2_CON_PT	RE		MSLH2 node particulates concentration	Microcurie/lbm
1908 . .	M2CXE	MSLH2_CON_XE	RE		MSLH2 node xenon concentration	Microcurie/lbm
1909 . .	M2DVDH	MSLH2_DVDH	RE		MSLH2 node partial sp. vol with enthalpy	Composite Units
1910 . .	M2DVDP	MSLH2_DVDP	RE		MSLH2 node partial sp. vol. w pressure	Composite Units
1911 . .	M2SLHH	MSLH2_H	RE		MSLH2 node enthalpy	Btu/lbm
1912 . .	M2SLHF	MSLH2_HF	RE		MSLH2 node saturated liquid enthalpy	Btu/lbm
1913 . .	M2SLHG	MSLH2_HG	RE		MSLH2 node saturated steam enthalpy	Btu/lbm
1914 . .	M2SLM	MSLH2_M	RE		MSLH2 node mass	Lbm
1915 . .	M2SLML	MSLH2_ML	RE		MSLH2 node liquid mass	Lbm
1916 . .	M2SLP	MSLH2_P	RE		MSLH2 node pressure	Psia
1917 . .	M2SLQ	MSLH2_Q	RE		MSLH2 coolant-to-wall heat rate	Btu/sec
1918 . .	M2QARM	MSLH2_Q_ATM	RE		MSLH2 wall-to-atmosphere heat rate	Btu/sec
1919 . .	M2SLSV	MSLH2_SV	RE		MSLH2 node specific volume	Ft^3/lbm
1920 . .	M2SVF	MSLH2_SVF	RE		MSLH2 node saturated liquid spec. vol.	Ft^3/lbm
1921 . .	M2SVG	MSLH2_SVG	RE		MSLH2 node saturated steam specific vol.	Ft^3/lbm
1922 . .	M2SLT	MSLH2_T	RE		MSLH2 node temperature	Degree F
1923 . .	M2TWAL	MSLH2_TWALL	RE		MSLH2 node pipe metal temperature	Degree F

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1924	. . M2SLX	MSLH2_X	RE		MSLH2 node quality	Fraction
1925	CTL	CONTROL_COMMON	RE	5120	Control, protective, and bop systems	Segment
1926	. CTIME	CTL_TIME_STEP	RE		Time step delt available to controllers	Seconds
1927	. CTCONT	CTL_CORE_CONTROL	RE	110	Core control partition	Partition
1928	. . CTSET	CTL_CORE_SETPOINTS_FOR_TRIP	RE	45	Partition for RPS setpoints	Partition
1929	. . . CTPOHI	CTL_CORE_HI_POWER_FRAC_TRIP	RE		Hi power fraction scram setpoint	Fraction
1930	. . . CTSRHI	CTL_CORE_HI_POWER_SUR_TRIP	RE		High power SUR scram setpoint	Decades/min
1931	. . . CTPPLO	CTL_CORE_LOW_PRZR_PRES_TRIP	RE		Low przr pressure scram setpoint	Psia
1932	. . . CTPPHI	CTL_CORE_HI_PRZR_PRES_TRIP	RE		High przr pressure scram setpoint	Psia
1933	. . . CTLPHI	CTL_CORE_HI_PRZR_LEVEL_TRIP	RE		High przr level scram setpoint	Fraction
1934	. . . CTTMAR	CTL_CORE_OVER_TEMP_MRGN_TRIP	RE		Thermal margin setpts for over temp trip	Del-degF
1935	. . . CTWMAR	CTL_CORE_OVER_POWER_MRGN_TRIP	RE		Thermal margin setpts for over pwr trip	Del-degF
1936	. . . CTGRCS	CTL_CORE_RCSFLOW_FRAC_TRIP	RE		Low loop flow scram setpoint	Fraction
1937	. . . CTSIAS	CTL_CORE_SIAS_TRIP	RE		Scram due to SIAS	Fraction
1938	. . . CTPSGL	CTL_CORE_LOW_SG_PRES_TRIP	RE		Low SG pressure scram setpoint	Psia
1939	. . . CTLSGL	CTL_CORE_LOW_SG_LEVEL_TRIP	RE		Low SG level scram setpoint	Fraction
1940	. . . CTLSGH	CTL_CORE_HI_SG_LEVEL_TRIP	RE		High SG level scram setpoint	Fraction
1941	. . . CTGSGM	CTL_STEAM_FEED_MISMATCH_TRIP	RE		Steam-feed flow mismatch scram setpoint	Lbm/sec
1942	. . . CTDTUR	CTL_CORE_TURB_TRIP_DELAY	RE		Scram due to turb trip: time delay	Seconds
1943	. . . CTPCHI	CTL_CORE_HI_CONT_PRES_TRIP	RE		Hi cont. pressure scram setpoint	Psia
1944	. . . CTUSER	CTL_CORE_USER_DEFINED_TRIP	RE	10	Space for other scram setpoints	Undefined
1945	. . . CTGKSP	CTL_RCP_FLOW_STPOINT	RE	5	Low primary flow scram setpoints	Lbm/sec
1946	. . . CTSRBY	CTL_CORE_HI_POWER_SUR_BYPS	RE	2	Hi power SUR scram-inhibit setpoints	Fraction
1947	. . . CTPORA	CTL_CORE_POWER_RATIO	RE		Logrithmic rate of power change	Dimensionless
1948	. . . CTGSBY	CTL_STEAM_FEED_MISMATCH_BYPS	RE		Scram on flow mismatch: inhibit setpoint	Fraction
1949	. . . CTTUBY	CTL_CORE_TURB_TRIP_BYPS	RE		Scram on turbine trip: inhibit setptoint	Lbm/sec
1950	. . . CTUSBY	CTL_CORE_USER_DEFINED_BYPS	RE	10	Space for other scram inhibit setpoints	Undefined
1951	. . COVER	CTL_CORE_TRIP_OR	RE	25	Partition for scram overrides	Partition
1952	. . . COPOHI	CTL_CORE_HI_POWER_FRAC_TRIP_OR	RE		Hi power fraction scram override	Override Normal
1953	. . . COSRHI	CTL_CORE_HI_POWER_SUR_TRIP_OR	RE		High power SUR scram override	Override Normal
1954	. . . COPPLO	CTL_CORE_LOW_PRZR_PRES_TRIP_OR	RE		Low przr pressure scram override	Override Normal
1955	. . . COPPHI	CTL_CORE_HI_PRZR_PRES_TRIP_OR	RE		High przr pressure scram override	Override Normal
1956	. . . COLPHI	CTL_CORE_HI_PRZR_LEVEL_TRIP_OR	RE		High przr level scram overrides	Override Normal
1957	. . . COTMAR	CTL_CORE_OVER_TEMP_MRGN_TRIP_OR	RE		Over-temp thermal margin scram override	Override Normal
1958	. . . COWMAR	CTL_CORE_OVER_POWER_MRGN_TRIP_OR	RE		Over-power thermal margin scram override	Override Normal
1959	. . . COGRCS	CTL_CORE_RCSFLOW_FRAC_TRIP_OR	RE		Low loop flow scram override	Override Normal
1960	. . . COSIAS	CTL_CORE_SIAS_TRIP_OR	RE		Scram due to SIAS override	Override Normal
1961	. . . COPSGL	CTL_CORE_LOW_SG_PRES_TRIP_OR	RE		Low SG pressure scram override	Override Normal
1962	. . . COLSGL	CTL_CORE_LOW_SG_LEVEL_TRIP_OR	RE		Low SG level scram override	Override Normal
1963	. . . COLSGH	CTL_CORE_HI_SG_LEVEL_TRIP_OR	RE		High SG level scram override	Override Normal
1964	. . . COGSGM	CTL_STEAM_FEED_MISMATCH_TRIP_OR	RE		Steam-feed flow mismatch scram override	Override Normal
1965	. . . CODTUR	CTL_CORE_TURB_TRIP_DELAY_OR	RE		Scram due to turb trip: override	Override Normal
1966	. . . COPCHI	CTL_CORE_HI_CONT_PRES_TRIP_OR	RE		Hi cont. pressure scram override	Override Normal
1967	. . . COUSER	CTL_CORE_USER_DEFINED_TRIP_OR	RE	10	Space for other scram overrides	Override Normal
1968	. . CKTRPT	CTL_TIME_CORE_TRIP	RE		Time elapsed after scram	Seconds
1969	. . COREQ	CTL_CORE_POWER	RE		Core power	Btu/sec
1970	. . COREQT	CTL_QCORE_TRIP	RE		Core power at time of trip	Btu/sec
1971	. . CPOWFR	CTL_CORE_POWER_FRACTION	RE		Core power, fraction of rated	Fraction
1972	. . CPOWFL	CTL_CORE_POWER_FRAC_LAST	RE		Core power fraction, last step	Fraction
1973	. . CNRPS	CTL_NUM_RPS	IN		Number of RPS channels	Counts
1974	. . CKAUTO	CTL_CORE_CONTROL_AUTO	LO		Flag: automatic control of core	Auto Manual
1975	. . CKTRP	CTL_CORE_TRIP	LO		Core tripped flag	Trip Normal
1976	. . CKTRPS	CTL_CORE_TRIP_SIG	LO	25	Scram signals	Active Inactive
1977	. . CKTRPP	CTL_CORE_PTRIP	LO		Scram signal at last time step	True False
1978	. CCEA	CTL_CEA_COMMON	RE	20	Control-element assembly model	Partition
1979	. . CRSET	CTL_CEA_SETPOINTS	RE	6	Setpoints for reactor regulating system	Partition
1980	. . . CRTNO	CTL_CEA_TREF_NO	RE		Reference (avg) primary temp at no load	Degree F
1981	. . . CRTFUL	CTL_CEA_TREF_FULL	RE		Reference (avg) primary temp, full load	Degree F
1982	. . . CREXP	CTL_CEA_GAIN_EXP	RE		Exponent for nonlinear gain=demand**exp	Dimensionless
1983	. . . CRGAIN	CTL_CEA_TURBLD_GAIN	RE		Nonlinear gain for crr system	Dimensionless
1984	. . CRFPOS	CTL_CEAPOSITION_FRAC	RE		Fractional average rod position	Fraction
1985	. . CRMOTL	CTL_CEA_LAST_TIME	RE		CEA motion time	Seconds
1986	. . CRMAX	CTL_CEA_MAX	RE		Maximum CEA withdrawal position	Steps
1987	. . CRMIN	CTL_CEA_MIN	RE		Minimum CEA withdrawal position	Steps
1988	. . CRPOS	CTL_CEA_POS	RE		CEA withdrawal position	Steps
1989	. . CRSPD	CTL_CEA_SPEED	RE		CEA motion speed and direction	Steps/min
1990	. . CRSTEP	CTL_CEA_STEP	RE		Step size of control rod motion	Inches
1991	. . CAUTO	CTL_CEA_AUTO	LO		Flag: auto/manual CEA control	True False
1992	. . CRPERF	CTL_CEA_PERFECT	LO		Flag: CEA perfect controller	True False
1993	. . CRACCM	CTL_CEA_ACCUM	RE		CEA control accumulated signal	Steps
1994	. . CRSPDL	CTL_CEA_SPEED_LAST	RE		CEA speed and direction, last step	Steps/min
1995	. CCVCS	CTL_CVCS_COMMON	RE	85	Chemical & volume control system	Partition
1996	. . CPSET	CTL_PRZR_LEVEL_SETPOINTS	RE	9	Przr level setpoints	Partition
1997	. . . CPTEM	CTL_PRZR_PLEVEL_TEMP	RE	2	Przr level-program temperature setpoints	Degree F

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
1998 . . .	CPLEV	CTL_PRZR_PLEVEL	RE	2	Przr level-program level setpoints	Fraction
1999 . . .	CPSLIQ	CTL_PRZR_LIQ_SPVOL_REF	RE		Przr instrum. ref. liquid specific-vol	Ft^3/lbm
2000 . . .	CPSSTM	CTL_PRZR_STM_SPVOL_REF	RE		Przr instrum. ref. steam specific-vol	Ft^3/lbm
2001 . .	CLSET	CTL_LETDOWN_SETPOINTS	RE	6	Letdown control setpoints	Partition
2002 . . .	CLLSP	CTL_CVCS_LDN_ZSPOINT	RE	2	Letdown level control setpoints	Fraction
2003 . . .	CLGSP	CTL_CVCS_LDN_W_GPM	RE	2	Letdown flow setpoints	Gal/min
2004 . .	CCSET	CTL_CHARGING_SETPOINTS	RE	15	Charging pump control setpoints	Partition
2005 . . .	CCLSP1	CTL_CVCS_CH1_SPOINT	RE	2	Charging pump 1 control setpoints	Fraction
2006 . . .	CCLSP2	CTL_CVCS_CH2_SPOINT	RE	2	Charging pump 2 control setpoints	Fraction
2007 . . .	CCLSP3	CTL_CVCS_CH3_SPOINT	RE	2	Charging pump 3 control setpoints	Fraction
2008 . . .	CCLSP4	CTL_CVCS_CH4_SPOINT	RE	2	Charging pump 4 control setpoints	Fraction
2009 . . .	CCGRAT	CTL_CH_PUMP_W_RATED	RE	4	Charging pump rated flow	Gal/min
2010 . .	CPPROG	CTL_CVCS_CONTROL	RE	24	CVCS control variables	Partition
2011 . . .	CPLPRG	CTL_PRZR_PROG_LEVEL	RE		Pressurizer programmed level	Fraction
2012 . . .	CPLERR	CTL_PRZR_LEVEL_ERROR	RE		Pressurizer level error	Fraction
2013 . . .	CPLINS	CTL_PRZR_LEVEL_INST	RE		Przr instrumentation level reading	Feet
2014 . . .	CTAVG	CTL_T_AVG	RE		Average primary coolant temperature	Degree F
2015 . . .	CTREF	CTL_T_REF	RE		Demand reference temperature	Degree F
2016 . . .	CCFPMP	CTL_CH_PUMP_FRAC	RE	4	Charging pump fractional flow	Fraction
2017 . . .	CCAUTO	CTL_CH_PUMP_AUTO	LO	4	Flags: charging pumps automatic control	Auto Manual
2018 . . .	CCPMPO	CTL_CH_PUMP_ON	LO	4	Charging pumps on-off indicator	Active Inactive
2019 . . .	CLAUTO	CTL_LDN_AUTO	LO		Flag: letdown automatic control	Auto Manual
2020 . .	CCVALV	CTL_CVCS_RCS_VALVES	RE	10	CVCS-RCS valve connections	Partition
2021 . . .	CCFVAL	CTL_CHV_FRAC	RE	5	Fractional opening of charging valve	Fraction
2022 . . .	CCAVAL	CTL_CHV_RAREA	RE	5	Charging valve relative flow areas	Dimensionless
2023 . .	CXREG	CTL_CVCS_TH_VARIABLES	RE	15	CVCS thermal-hydraulic variables	Partition
2024 . . .	CXHA	CTL_HA_REG_HEAT_X	RE		Regen. heat exchanger overall ht coeff.	Btu/sec-degF
2025 . . .	CLFLOW	CTL_LDN_FLOW	RE		Letdown mass flow rate	Lbm/sec
2026 . . .	CLTEMP	CTL_LDN_T	RE	2	Letdown temperature at RHEX inlet/exit	Degree F
2027 . . .	CLENTH	CTL_LDN_H	RE	2	Letdown enthalpy at RHEX inlet/exit	Btu/lbm
2028 . . .	CLFRAC	CTL_LETDOWN_FRAC	RE	4	Letdown flow fraction	Fraction
2029 . . .	CCFLOW	CTL_CH_FLOW	RE		Total charging pumps delivery	Lbm/sec
2030 . . .	CCTEMP	CTL_CH_T	RE	2	Charging temperature at RHEX inlet/exit	Degree F
2031 . . .	CCENTH	CTL_CH_H	RE	2	Charging enthalpy at RHEX inlet/exit	Btu/lbm
2032 .	CHEATR	CTL_HEATERS_CONTROL	RE	18	Heaters control partition	Partition
2033 . .	CHSET	CTL_PRZR_HEATER_SETPOINTS	RE	10	Heater control setpoints	Partition
2034 . . .	CHLBSP	CTL_PRZR_BHLEVEL_SPOINT	RE	2	Przr heaters hi-level on/off setpoints	Fraction
2035 . . .	CHLOFF	CTL_LEVEL_HEATER_OFF	RE		Heaters low-level cutoff setpoint	Fraction
2036 . . .	CHPPOF	CTL_PRES_PHEATER_OFF	RE		Prop heaters high pressure setpoint	Psia
2037 . . .	CHPPON	CTL_PRES_PHEATER_ON	RE		Prop heaters low pressure setpoint	Psia
2038 . . .	CHPBOF	CTL_PRES_BHEATER_OFF	RE		Backup heaters high pressure setpoint	Psia
2039 . . .	CHPBON	CTL_PRES_BHEATER_ON	RE		Backup heaters low pressure setpoint	Psia
2040 . . .	CHPREF	CTL_PRZR_REF_PRES	RE		Reference p for przr pressure control	Psia
2041 . .	CHVPRP	CTL_VOLT_PROP	RE		Proportional heaters voltage	Volts
2042 . .	CHVBAK	CTL_VOLT_BACK	RE		Backup heaters voltage	Volts
2043 . .	CHVRAT	CTL_PRZR_HEATERS_VOLT	RE		Przr heaters rated voltage	Volts
2044 . .	CHAUTO	CTL_HEATERS_CONTROL_AUTO	LO		Flag: automatic ctrl of przr heaters	Auto Manual
2045 .	CSPRAY	CTL_PRZR_SPRAY_CONTROL	RE	5	Pressurizer main spray controls	Partition
2046 . .	CWSET	CTL_PRZR_SPRAY_SETPOINTS	RE	4	Przr spray control setpoints	Partition
2047 . . .	CWPON	CTL_PRZR_SPRAY_PRES_ON	RE		Przr spray ctrl high-press. on-setpoint	Psia
2048 . . .	CWPOFF	CTL_PRZR_SPRAY_PRES_OFF	RE		Przr spray ctrl low-press. off-setpoint	Psia
2049 . .	CWAUTO	CTL_PRZR_SPRAY_CONTROL_AUTO	LO		Flag: automatic control of przr spray	Auto Manual
2050 .	CVRELF	CTL_PRESSURIZER_RELIEF	RE	26	Przr PORV and SV control variables	Partition
2051 . .	CVSET	CTL_PRZR_RELIEF_SETPOINTS	RE	20	Przr relief and safety valve setpoints	Partition
2052 . . .	CVPSET	CTL_PORV_PSET	RE	4	PORV opening pressure setpoints	Psia
2053 . . .	CVOPEN	CTL_PSV_PSET_OPEN	RE	4	Przr safeties full-open setpoints	Psia
2054 . . .	CVCLOS	CTL_PSV_PSET_CLOSE	RE	4	Przr safeties full-closed setpoints	Psia
2055 . . .	CVBLDN	CTL_PSV_PSET_BLDN	RE	4	Przr safeties re-closing setpoints	Psia
2056 . .	CVAUTO	CTL_PORV_AUTO	LO	4	Flags: automatic control of PORVs	Auto Manual
2057 .	CECCS	CTL_SIS_COMMON	RE	200	Safety injection system	Partition
2058 . .	CESET	CTL_SIAS_SETPOINTS	RE	8	Safety injection syst setpoints	Partition
2059 . . .	CEPLO	CTL_SIAS_PRZR_PRES_LOW	RE		Low pressure setpoint for SIAS	Psia
2060 . . .	CEDPSL	CTL_SIAS_SL_SH_DP	RE		Steamline flow trip setpoint	Psid
2061 . . .	CEPCHI	CTL_SIAS_HI_CONT_PRES	RE		High containment press setpoint for SIAS	Psia
2062 . . .	CETAVL	CTL_SIAS_LOW_TAVG	RE		Low temperature setpoint for SIAS	Degree F
2063 . . .	CEPSLL	CTL_SIAS_LOW_SL_PRES	RE		Low steamline pressure setpoint for SIAS	Psia
2064 . .	CESIS	CTL_SIS_CONTROL	RE	150	Safety injection syst control variables	Partition
2065 . . .	CENHPS	CTL_HPSI_NPOINTS_TAB	IN		No. of pairs in HPSI flow vs press table	Counts
2066 . . .	CEGHPS	CTL_HPSI_FLOW_TABLE	RE	45	Flows for HPSI flow-vs-pressure table	Gal/min
2067 . . .	CEPHPS	CTL_HPSI_PRES_TABLE	RE	15	Back press for HPSI flow-vs-press table	Psia
2068 . . .	CEHNUM	CTL_HPSI_PUMP_NUM	IN		Number of operating HPSI pumps	Counts
2069 . . .	CESHPS	CTL_HPSI_SPLIT	RE	8	HPSI flow split to injection points	Fraction
2070 . . .	CENLPS	CTL_LPSI_NPOINTS_TAB	IN		No. of pairs in LPSI flow vs press table	Counts
2071 . . .	CEGLPS	CTL_LPSI_FLOW_TABLE	RE	45	Flows for LPSI flow-vs-pressure table	Gal/min

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2072 . . .	CEPLPS	CTL_LPSI_PRES_TABLE	RE	15	Back press for LPSI flow-vs-press table	Psia
2073 . . .	CELNUM	CTL_LPSI_PUMP_NUM	IN		Number of operating LPSI pumps	Counts
2074 . . .	CESLPS	CTL_LPSI_SPLIT	RE	8	LPSI flow split to injection points	Fraction
2075 . . .	CETRPT	CTL_SIAS_TIME	RE		Time elapsed since SIAS	Seconds
2076 . . .	CEDEL	CTL_SIS_DELAY	RE		SI pumps time delay after SIAS	Seconds
2077 . . .	CEAUTO	CTL_SIAS_CONTROL_AUTO	LO		Flag: automatic control of SIAS	Auto Manual
2078 . . .	CETRP	CTL_SIAS_TRIP	LO		Safety injection actuation signal	Active Inactive
2079 . . .	CETRPP	CTL_SIAS_PTRIP	LO		SI signal at last time step	True False
2080 . .	CEMISC	CTL_SIS_FLOW	RE	36	Safety injection system flow variables	Partition
2081 . . .	CEBHLP	CTL_SIS_HLPSI_BC	RE		HPSI/LPSI flow boron concentration	Parts/million
2082 . . .	CEHHLP	CTL_SIS_HLPSI_H	RE		HPSI/LPSI flow enthalpy	Btu/lbm
2083 . . .	CEBSIT	CTL_SIS_SIT_BC	RE		SI tank flow boron concentration	Parts/million
2084 . . .	CEHSIT	CTL_SIS_SIT_H	RE		SI tank flow enthalpy	Btu/lbm
2085 . . .	CENSIT	CTL_SIT_NUM	IN		Number of SI tanks	Counts
2086 . . .	CEELEV	CTL_SIT_ELEV_PRES	RE	4	SI tank elevation heads	Psid
2087 . . .	CEFLCO	CTL_SIT_FLOW_COEFF	RE	4	SI tank flow coefficients	Composite Units
2088 . . .	CECGAS	CTL_SIT_GAS_CONST	RE		SI tank gas constant	Dimensionless
2089 . . .	CEPSIT	CTL_SIT_GAS_PRES	RE	4	SI tank gas pressures	Psia
2090 . . .	CEVGAS	CTL_SIT_GAS_VOLUME	RE	4	SI tank gas volumes	Ft^3
2091 . . .	CEIVAL	CTL_SIT_ISO_VALVE	LO	4	SI tank isolation valves	Open Closed
2092 . . .	CESLIQ	CTL_SIT_LIQ_SPVOL	RE	4	SI tank liquid specific volumes	Ft^3/lbm
2093 . . .	CEVLIQ	CTL_SIT_LIQ_VOLUME	RE	4	SI tank liquid volumes	Ft^3
2094 . .	CSDCCN	CTL_SDC_CONTROL	RE	6	Shutdown Cooling control variables	Partition
2095 . . .	CSDCDH	CTL_SDC_DH	RE		Shutdown Cooling enthalpy drop	Btu/lbm
2096 . . .	CSDCHM	CTL_SDC_H_MIN	RE		Shutdown Cooling min. return enthalpy	Btu/lbm
2097 . . .	CSDCSP	CTL_SDC_SPLIT	RE	4	SDC flow split to injection points	Fraction
2098 .	CTURB	CTL_TURB_CONTROL	RE	14	Turbine controls	Partition
2099 . .	CGSET	CTL_TURB_SETPOINTS	RE	7	Turbine control setpoints	Partition
2100 . . .	CGTCLS	CTL_TURB_TRIP_VALVE_TIME	RE		TAV full-range closing time on turb trip	Seconds
2101 . . .	CGVTC	CTL_TURB_AOUT_TC	RE		Turb admission valve time constant	Seconds
2102 . . .	CGTRPT	CTL_TURB_TRIP_TIME	RE		Time elapsed since turbine trip	Seconds
2103 . . .	CGFDEM	CTL_TURB_DEMAND	RE		Turbine steam demand	Fraction
2104 . . .	CGGRAT	CTL_TURB_STEAM_RATED	RE		Rated turbine steam flow	Lbm/sec
2105 . .	CGCAUT	CTL_TURB_CONTROL_AUTO	LO		Flag: automatic turbine control	Auto Manual
2106 . .	CGLOAD	CTL_TURB_CONTROL_LOAD	LO		Flag to match st. demand with heat load	Auto Manual
2107 . .	CGTRP	CTL_TURB_TRIP	LO		Signal: turbine tripped	Trip Normal
2108 . .	CGTAUT	CTL_TURB_TRIP_AUTO	LO		Flag: automatic trip of turbine	Auto Manual
2109 . .	CGTRPP	CTL_TURB_PTRIP	LO		Turbine trip signal at last time step	True False
2110 .	CMSIS	CTL_MSIS_CONTROL	RE	14	Main steam isolation signal controls	Partition
2111 . .	CISET	CTL_MSIS_SETPOINTS	RE	10	MSIS control setpoints	Partition
2112 . . .	CIPSLO	CTL_MSIS_SG_PRES_TRIP	RE		Low SG pressure MSIS trip setpoint	Psia
2113 . . .	CIPCHI	CTL_MSIS_CONT_PRES_TRIP	RE		Containment pressure MSIS trip setpoint	Psia
2114 . . .	CIGSLO	CTL_MSIS_SG_SLFLOW_TRIP	RE	4	High steamline flow MSIS trip setpoint	Lbm/sec
2115 . .	CIAUTO	CTL_MSIS_CONTROL_AUTO	LO		Flag: MSIS automatic control	Auto Manual
2116 . .	CITRP	CTL_MSIS_TRIP	LO		Main steam isolation signal	Active Inactive
2117 .	CDUMP	CTL_ATM_DUMP_CONTROL	RE	6	Atmospheric dump valves controls	Partition
2118 . .	CDSET	CTL_ATM_DUMP_SETPOINTS	RE	4	Przr ADVs setpoints	Partition
2119 . . .	CDTSP	CTL_ATM_DUMP_SPOINT	RE	2	Atm. dump valves temperature setpoints	Psia
2120 . .	CDAUTO	CTL_ATM_DUMP_CONTROL_AUTO	LO		Flag: automatic ctrl of atm-dump valves	Auto Manual
2121 .	CBYPAS	CTL_TURB_BYPASS_CONTROL	RE	11	Turbine bypass controls	Partition
2122 . .	CBSET	CTL_TURB_BYPASS_SETPOINTS	RE	10	Turbine bypass valves setpoints	Partition
2123 . . .	CBPOPN	CTL_TURB_DUMP_OPEN	RE		Pressure to open bypass valves	Psia
2124 . . .	CBDELP	CTL_TURB_DUMP_DELP	RE		Press. range of turb bypass ctrl system	Psid
2125 . . .	CBQOPN	CTL_TURB_DUMP_QOPEN	RE		Quick-opening time for turb bypass valve	1/seconds
2126 . . .	CBNOPN	CTL_TURB_DUMP_NOPEN	RE		Normal-open time for turb bypass valve	1/seconds
2127 . . .	CBQCLS	CTL_TURB_DUMP_QCLOSE	RE		Quick-close time for turb bypass valve	1/seconds
2128 . . .	CBNCLS	CTL_TURB_DUMP_NCLOSE	RE		Normal-close time for turb bypass valve	1/seconds
2129 . . .	CBMODE	CTL_TURB_DUMP_MODE	RE		Bypass control mode: 0=p-temp, 1=s-pres	Pointer
2130 . .	CBAUTO	CTL_TURB_BYPASS_CONTROL_AUTO	LO		Flag: automatic turbine-bypass control	Auto Manual
2131 .	CSAFE	CTL_SG_SAFETIES	RE	120	SG safety valves control variables	Partition
2132 . .	CSSET	CTL_SG_SV_SETPOINTS	RE	120	SG external safety valve setpoints	Partition
2133 . . .	CSOPEN	CTL_SGSV_PSET_OPEN	RE	24	SG safeties design-open press. setpoints	Psia
2134 . . .	CSFULL	CTL_SGSV_PSET_FULL	RE	24	SG safeties full-open pressure setpoints	Psia
2135 . . .	CSCLOS	CTL_SGSV_PSET_CLOSE	RE	24	SG safeties closing pressure setpoints	Psia
2136 . . .	CSAOPN	CTL_SGSV_ASET_OPEN	RE	24	SG safeties design-open fraction	Fraction
2137 .	CFWS	CTL_FWS_CONTROL	RE	70	Feedwater system controls	Partition
2138 . .	CFSET	CTL_FWS_SETPOINTS	RE	15	FWS control setpoints	Partition
2139 . . .	CFLPRG	CTL_FWS_SG_LEVEL_LOAD	RE	2	SG level program load setpoints	Fraction
2140 . . .	CFLLO	CTL_FWS_SG_LEVEL_LOW	RE		Main feedwater lo-level control setpoint	Fraction
2141 . . .	CFLHI	CTL_FWS_SG_LEVEL_HIGH	RE		Main feedwater hi-level control setpoint	Fraction
2142 . . .	CFRAMP	CTL_FWS_TURB_TRIP_FRAC	RE		Main FW rampdown flow frac after trip	Fraction
2143 . . .	CFDELA	CTL_FWS_TURB_TRIP_DELAY	RE		Main FW rampdown time after turb trip	Seconds
2144 . . .	CFGMAX	CTL_FWS_MAX_FLOW	RE		Max feedwater flow to each SG	Lbm/sec
2145 . . .	CFSMUL	CTL_FWS_SPEED_MULT	RE	4	Multp on FW pump speed signl: =0 to trip	Dimensionless

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2146 . . .	CFTLO	CTL_FWS_TRIP_SP	RE		Feedwater trip setpoint	Undefined
2147 . .	CFENTH	CTL_FWS_H	RE	2	Steady state FW enth: 1 at CST, 2 at SGS	Btu/lbm
2148 . .	CFEMAX	CTL_FWS_H_MAX	RE		Maximum feedwater enthalpy	Btu/lbm
2149 . .	CFETC	CTL_FWS_H_TC	RE		Feedwater enthalpy time constant	Seconds
2150 . .	CFTRP	CTL_FWS_TRIP	LO		FWS trip signal	Active Inactive
2151 . .	CFAUT	CTL_FWS_AUTO	LO	14	Flags for automatic control of FW system	Partition
2152 . . .	CFAUTO	CTL_FWS_CONTROL_AUTO	LO		Master FW flag: T=separate, F=all manual	Auto Manual
2153 . . .	CFVAUT	CTL_FWS_VALVE_AUTO	LO	4	Flags: auto control of downcmr FW valves	Auto Manual
2154 . . .	CFEAUT	CTL_FWS_ECON_VALVE_AUTO	LO	4	Flags: auto control of econmzr FW valves	Auto Manual
2155 . . .	CFPAUT	CTL_FWS_PUMP_AUTO	LO	4	Flags: auto control of main FW pumps	Auto Manual
2156 . . .	CFTAUT	CTL_FWS_TRIP_AUTO	LO		Flag: automatic main feedwater trip	Auto Manual
2157 . .	CFVSIG	CTL_FWS_VALVE_SIG	RE	4,2	Main FW valve demand signals	Fraction
2158 . . .	CFVSI	CTL_FWS_SIG	RE	4	Main FW downcomer valve demand signal	Fraction
2159 . . .	CFVESI	CTL_FWS_ECON_SIG	RE	4	Main FW economizer valve demand signal	Fraction
2160 . .	CFVPOS	CTL_FWS_VALVE_POS	RE	4,2	Main FW valve positions	Fraction
2161 . . .	CFVPO	CTL_FWS_POS	RE	4	Main FW downcomer valve position	Fraction
2162 . . .	CFVEPO	CTL_FWS_ECON_POS	RE	4	Main FW economizer valve position	Fraction
2163 . .	CFSSIG	CTL_FWS_SPEED_SIG	RE	4	Main FW pumps speed demand signals	Fraction
2164 . .	CFSFRC	CTL_FWS_SPEED_FRAC	RE	4	Main FW pumps normalized speed, actual	Fraction
2165 . .	CFSMAX	CTL_FWS_SPEED_MAX	RE		Main FW pumps reference speed	Shaft RPM
2166 . .	CFVISO	CTL_FWS_ISO_POS	RE	4	Main FW isolation valve position	Fraction
2167 . .	CFVBYP	CTL_FWS_BYP_SIG	RE	4	Main FW Bypass valve demand signal	Fraction
2168 .	CAFWS	CTL_AFWS_CONTROL	RE	25	Aux feed system controls	Partition
2169 . .	CASET	CTL_AFWS_SETPOINTS	RE	20	AFWS control setpoints	Partition
2170 . . .	CALLO	CTL_AFWS_SG_LEVEL_LOW	RE	4	Low level setpoint for aux feed	Fraction
2171 . . .	CALHI	CTL_AFWS_SG_LEVEL_HIGH	RE	4	High level setpoint for aux feed	Fraction
2172 . . .	CAGMAX	CTL_AFWS_TOT_FLOW	RE		Total aux-feed flow capacity, all SGs	Lbm/sec
2173 . . .	CADPHI	CTL_AFWS_SGDP_HIGH	RE		SG press.-difference to cutout aux. feed	Psid
2174 . . .	CADELA	CTL_AFWS_DELAY	RE		AFW time delay after trip	Seconds
2175 . . .	CAFMUL	CTL_AFWS_FLOW_MULT	RE	4	Multiplier on aux feedwater flow rate	Dimensionless
2176 . . .	CATURB	CTL_AFWS_TURB_PUMP	RE		AFWS turb-driven pump switch: 0=off,1=ok	Pointer
2177 . . .	CAMOTR	CTL_AFWS_MOTOR_PUMP	RE		AFWS motor-drivn pump switch: 0=off,1=ok	Pointer
2178 . .	CAAUTO	CTL_AFWS_CONTROL_AUTO	LO		Flag: automatic control of aux feed	Auto Manual
2179 . .	CASSIG	CTL_AFWS_SPEED_SIG	RE	4	AFW pumps speed demand signals	Fraction
2180 .	CRPCS	CTL_RPCS_CONTROL	RE	15	Reactor power cutback system	Partition
2181 . .	CQSET	CTL_RPCS_SETPOINTS	RE	5	RPCS setpoints	Partition
2182 . .	CQAUTO	CTL_RPCS_CONTROL_AUTO	LO		Flag: automatic RPCS control	Auto Manual
2183 . .	CQTRP	CTL_RPCS_TRIP	LO		Signal: RPC engaged	Trip Normal
2184 . .	CQTRPP	CTL_RPCS_PTRIP	LO		RPC signal at last time step	Trip Normal
2185 . .	CQTRPT	CTL_RPCS_TRIP_TIME	RE		Time elapsed since RP cutback engaged	Seconds
2186 .	CGSCON	CTL_TURB_SETBACK_CONTROL	RE	20	Turbine setback and runback systems	Partition
2187 . .	CGSSET	CTL_TURB_SETBACK_SETPOINTS	RE	10	Turb setback & runback system setpoints	Undefined
2188 . .	CGSAUT	CTL_TURB_SETBACK_AUTO	LO		Flag: automatic turbine setback control	Auto Manual
2189 . .	CGRAUT	CTL_TURB_RUNBACK_AUTO	LO		Flag: automatic turbine runback control	Auto Manual
2190 . .	CGSTRP	CTL_TURB_SETBACK_TRIP	LO		Signal: turbine setback engaged	Trip Normal
2191 . .	CGRTRP	CTL_TURB_RUNBACK	LO		Signal: turbine runback engaged	True False
2192 .	CSETPT	CTL_MISC_SETPOINTS	RE	200	Miscellaneous user-defined setpoints	Undefined
2193 . .	SETT	CTL_SET_TEMP	RE	20	Miscellaneous temperature setpoints	Degree F
2194 . .	SETDT	CTL_SET_DELTEMP	RE	20	Miscellaneous delta-temp setpoints	Del-degF
2195 . .	SETDDT	CTL_SET_DELTEMPD	RE	20	Miscellaneous per-delta-temp setpoints	Per-degF
2196 . .	SETP	CTL_SET_PRES	RE	20	Miscellaneous pressure setpoints	Psia
2197 . .	SETDP	CTL_SET_PRESD	RE	20	Miscellaneous per-pressure setpoints	Per-psia
2198 . .	SETDM	CTL_SET_NODIM	RE	60	Miscellaneous dimensionless setpoints	Dimensionless
2199 . .	SETW	CTL_SET_FLOW	RE	10	Miscellaneous flowrate setpoints	Lbm/sec
2200 . .	SETWD	CTL_SET_FLOWD	RE	10	Miscellaneous per-flowrate setpoints	Sec/lbm
2201 . .	SETRT	CTL_SET_PERTIME	RE	20	Miscellaneous per-time setpoints	1/seconds
2202 .	CTIMCN	CTL_TIME_CONSTANTS	RE	150	Miscellan. user-defined time constants	Seconds
2203 .	COUT	CTL_OUTPUT	RE	16	Output control partition	Partition
2204 . .	COUTIN	CTL_OUTPUT_INTERVAL	IN		Output frequency for line output	Counts
2205 . .	COUTOP	CTL_OUTPUT_OPTION	IN		Line output option	Pointer
2206 . .	COUTCT	CTL_OUTPUT_COUNT	IN	4	Output counter: calls/line/graph/title	Counts
2207 . .	COUTTI	CTL_OUTPUT_NTITLE	IN		Line output title frequency	Counts
2208 . .	COUTGR	CTL_GRAPH_INTERVAL	IN		Output frequency for graphics output	Counts
2209 . .	COUTFI	CTL_GRAPH_FILE	IN		Suffix nn for graphics file graphnn.dat	Pointer
2210 . .	COUTLO	CTL_OUTPUT_LOOP	IN	2	Select loops for std output & graphics	Dimensionless
2211 . .	COUTCL	CTL_OUTPUT_OPCL	IN		Increment for 2nd cold leg in loop	Dimensionless
2212 . .	COUT3D	CTL_OUTPUT_3DMAP	LO		Flag to produce a 3-D power map	True False
2213 .	CSPAR2	CTL_SPARE2	RE	600	Not used	Unused
2214 .	CBLOCK	CTL_TIME_BLOCK	RE	10	Time step control information for CENTS	Partition
2215 . .	DELT	DELT	RE		Master time step variable	Seconds
2216 . .	FDELT	FDELT	RE		Fast DELT used for scaled time operation	Seconds
2217 . .	TBASE	TBASE	RE		Base time step (set to 1.0)	Seconds
2218 . .	TIME	TIME	RE		Simulation time	Seconds
2219 . .	TSCALE	TIME_SCALE	RE		Time scaling ratio >1 is faster than rt	Per unit

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2220	. . TSTOP	TSTOP	RE		Value of time at which to pause	Seconds
2221	. MODELQ	MODEL_QUEUE	RE	60	Model queue information	Partition
2222	. . TIMQUE	TIMQUE	RE	20	Model queue - fraction of timestep	Fraction
2223	. . MODQUE	MODQUE	IN	20	Model queue - model number called	Dimensionless
2224	. . FLGQUE	FLGQUE	LO	20	Model queue - on/off flag	Active Inactive
2225	. CINCON	CTL_INITIAL_CONDITIONS	RE	4	Flags for initial conditions	Partition
2226	. . CTLUN	CTL_UNUSED	RE		Not used	Unused
2227	. . CLCONT	CLCONT	LO		Flag for including control routines	True False
2228	. CSPARE	CTL_SPARE	RE	200	Spare space	Unused
2229	. INIFLG	INIT_FLAG	LO	10	Model initialization flag	Partition
2230	. . CEINIT	INIT_ALL	LO		Initialization of all routines	True False
2231	. . MODOFF	INIT_OFF_MODELS	LO	7	Off flags for initialization models	True False
2232	. . . RCSOFF	INIT_OFF_RCS	LO		Initialization of RCS: off flag	True False
2233	. . . CHTOFF	INIT_OFF_CHT	LO		Initialization of CHT: off flag	True False
2234	. . . POWOFF	INIT_OFF_POW	LO		Initialization of POW: off flag	True False
2235	. . . SGSOFF	INIT_OFF_SGS	LO		Initialization of SGS: off flag	True False
2236	. . . CONOFF	INIT_OFF_CON	LO		Initialization of CONT: off flag	True False
2237	. . CORINI	INIT_CORE	LO		Flag to initialize the 3-D core model	True False
2238	. . NINIT	INIT_ITER	IN		Number of initialization passes	Counts
2239	. CLEVEL	CTL_ILEVEL	RE	15	Instrument level readings for controls	Fraction
2240	. . CLEVSG	CTL_SG_ILEVEL	RE	4,3	SG level readings (SG, refleg)	Fraction
2241	. . CLEVP	CTL_PRZR_ILEVEL	RE		Pressurizer level reading	Fraction
2242	. MODERR	MODEL_ERROR	IN		User-accessible flag for model errors	Pointer
2243	. CONT	CTL_CONTROLLER	RE	3000	Control module variables	Partition
2244	. . ELLAST	ELLAST	RE	1000	Saved "last values" of control elements	Undefined
2245	. . GROUT	GROUT	RE	1000	Control group output signals	Undefined
2246	. . MALCTL	MAL_CTL	LO	1000	Control group malfunction cues	Malfunc Normal
2247	. CDELAY	CTL_DELAYS	RE	50	Partition for control system delays	Partition
2248	. . CDTRIP	CTL_CORE_TRIP_DELAYS	RE	30	Scram channel delays	Partition
2249	. . . CDPOHI	CTL_CORE_HI_POWER_FRAC_TRIP_DL	RE		Hi power fraction scram delay	Seconds
2250	. . . CDSRHI	CTL_CORE_HI_POWER_SUR_TRIP_DL	RE		High power SUR scram delay	Seconds
2251	. . . CDPPLO	CTL_CORE_LOW_PRZR_PRES_TRIP_DL	RE		Low przr pressure scram delay	Seconds
2252	. . . CDPPHI	CTL_CORE_HI_PRZR_PRES_TRIP_DL	RE		High przr pressure scram delay	Seconds
2253	. . . CDLPHI	CTL_CORE_HI_PRZR_LEVEL_TRIP_DL	RE		High przr level scram delays	Seconds
2254	. . . CDTMAR	CTL_CORE_OVER_TEMP_MRGN_TRIP_DL	RE		Over-temp thermal margin scram delay	Seconds
2255	. . . CDWMAR	CTL_CORE_OVER_POWER_MRGN_TRIP_DL	RE		Over-power thermal margin scram delay	Seconds
2256	. . . CDGRCS	CTL_CORE_RCSFLOW_FRAC_TRIP_DL	RE		Low loop flow scram delay	Seconds
2257	. . . CDSIAS	CTL_CORE_SIAS_TRIP_DL	RE		Scram due to SIAS delay	Seconds
2258	. . . CDPSGL	CTL_CORE_LOW_SG_PRES_TRIP_DL	RE		Low SG pressure scram delay	Seconds
2259	. . . CDLSGL	CTL_CORE_LOW_SG_LEVEL_TRIP_DL	RE		Low SG level scram delay	Seconds
2260	. . . CDLSGH	CTL_CORE_HI_SG_LEVEL_TRIP_DL	RE		High SG level scram delay	Seconds
2261	. . . CDGSGM	CTL_STEAM_FEED_MISMATCH_TRIP_DL	RE		Steam-feed flow mismatch scram delay	Seconds
2262	. . . CDPCHI	CTL_CORE_HI_CONT_PRES_TRIP_DL	RE		Hi containment pressure scram delay	Seconds
2263	. . . CDUSER	CTL_CORE_USER_DEFINED_TRIP_DL	RE	10	Space for other scram delays	Seconds
2264	. . CDMIST	CTL_MISC_TRIP_DELAYS	RE	20	Miscellaneous control system delays	Partition
2265	. . . CDGTRP	CTL_TURB_TRIP_DELAY	RE		Turbine trip signal delay	Seconds
2266	. . . CDITRP	CTL_MSIS_TRIP_DELAY	RE		Main steamline isolation signal delay	Seconds
2267	. . . CDFTRP	CTL_FWS_TRIP_DELAY	RE		Main feedwater trip signal delay	Seconds
2268	. . . CDQTRP	CTL_RPCS_TRIP_DELAY	RE		Reactor Power Cutback signal delay	Seconds
2269	. . . CDGSTR	CTL_TURB_SETBACK_TRIP_DELAY	RE		Turbine Setback signal delay	Seconds
2270	. . . CDGRTR	CTL_TURB_RUNBACK_DELAY	RE		Turbine Runback delay	Seconds
2271	. . . CDMISC	CTL_MISC_DELAYS	RE	10	Space for other control system delays	Seconds
2272	USR	USER_COMMON	RE	1024	User global common variables	Segment
2273	. SDELAY	SCRAM_DELAY	RE		Total scram delay time after trip	Seconds
2274	. MOISTC	MSLH_NO_MOISTURE_CARRY	RE		1 => No moisture carryover	Dimensionless
2275	. SGTIOP	SGT_INIT_OPTION	RE		0 => Adjust area. 1 => Find SG press	Dimensionless
2276	. WARNOP	INTERPOLATION_ERROR_OPTION	RE		1 => Warning after each interp error	Dimensionless
2277	. DBGSGI	SGS_DEBUG_SGSINI	RE		1 => Debug print on-subroutine SGSINI	Dimensionless
2278	. DBGSGH	SGS_DEBUG_SGHEAT	RE		1 => Debug print on-subroutine SGHEAT	Dimensionless
2279	. COREQA	CTL_CORE_POWERA	RE		0 Core power	Megawatts
2280	. SAREA3	SGS_AREA_DOWNCOMER	RE	4	Area of downcomer for bubble rise calc	Ft^2
2281	. ALPHA3	SGS_ALPHA_DOWNCOMER	RE	4	Downcomer steam volume fraction	Dimensionless
2282	. V3MULT	SGS_VEL31_MULT	RE	4	Downcomer multiplier on Wilson velocity	Dimensionless
2283	. SVEL31	SGS_STEAM_VEL31	RE	4	Steam velocity downcomer to steam dome	Ft/sec
2284	. RBAL	RCS_BALANCE	RE	54	RCS mass and energy balance	Partition
2285	. . RNODFL	RCS_NODAL_EXT_FLOWS	RE	50	Sum of the external flows to each node	Lbm/sec
2286	. . RTOTFL	RCS_NET_EXT_FLOW	RE		Sum of all RCS flows - includes PRZR	Lbm/sec
2287	. . RTOTHR	RCS_NET_HEAT_RATE	RE		Sum of all heat flows to RCS	Btu/sec
2288	. . RTOTM	RCS_TOTAL_MASS	RE		Sum of all RCS nodal masses - inc PRZR	Lbm
2289	. . RTOTE	RCS_TOTAL_ENERGY	RE		Sum of all RCS node total energy	Btu
2290	. ITOTP	IODINE_TOTALS_PARTITION	RE	10	Variables to check iodine release model	Partition
2291	. . RITOT	RCS_TOTAL_IODINE	RE		Total iodine in RCS nodes	Curies
2292	. . SITOT	SGS_TOTAL_IODINE	RE		Total iodine in stm Generators & header	Curies
2293	. . RIRELT	RCS_IOD_REL_TOT	RE		Total of core release & external flows	Curies

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2294 . .	RIRELR	RCS_IOD_REL_RATE	RE		Net rate of core release and ext flows	Microcurie/sec
2295 .	MINMAX	CTL_SUMMARY_DATA	RE	150	Case summary data	Partition
2296 . .	MXPOW	CTL_MAX_POWER_FRAC	RE		Maximum power fraction during run	Fraction
2297 . .	MXPOWT	CTL_MAX_POWER_TIME	RE		Time of maximum power during run	Seconds
2298 . .	MXHTFR	CTL_MAX_HEAT_FLUX_FRAC	RE		Maximum heat flux during run	Fraction
2299 . .	MXHTT	CTL_MAX_HEAT_FLUX_TIME	RE		Time of maximum heat flux during run	Seconds
2300 . .	MXPPR	CTL_MAX_PRZR_PRESS	RE		Maximum Pressurizer Pressure during run	Psia
2301 . .	MXPPRT	CTL_MAX_PRZR_PRESS_TIME	RE		Time of maximum Przr Press during run	Seconds
2302 . .	MNPPR	CTL_MIN_PRZR_PRESS	RE		Minimum Pressurizer Pressure during run	Psia
2303 . .	MNPPRT	CTL_MIN_PRZR_PRESS_TIME	RE		Time of minimum Przr Press during run	Seconds
2304 . .	MXRCSP	CTL_MAX_RCS_PRESS	RE		Maximum RCS Pressure during run	Psia
2305 . .	MXRPT	CTL_MAX_RCS_PRESS_TIME	RE		Time of maximum RCS Press during run	Seconds
2306 . .	MNRCSP	CTL_MIN_RCS_PRESS	RE		Minimum RCS Pressure during run	Psia
2307 . .	MNRPT	CTL_MIN_RCS_PRESS_TIME	RE		Time of Minimum RCS Press during run	Seconds
2308 . .	MXSGP	CTL_MAX_SG_PRESS	RE	4	Maximum SG Pressure during run	Psia
2309 . .	MXSGPT	CTL_MAX_SG_PRESS_TIME	RE	4	Time of maximum SG Press during run	Seconds
2310 . .	MNSGP	CTL_MIN_SG_PRESS	RE	4	Minimumm SG Pressure during run	Psia
2311 . .	MNSGPT	CTL_MIN_SG_PRESS_TIME	RE	4	Time of minimum SG Press during run	Seconds
2312 . .	INWRCS	CTL_INTEG_PFLOW_NONMOM	RE	50	Integrated flow though all leak paths	Lbm
2313 . .	INSGV	CTL_INTEG_SGS_VALVES	RE	50	Integrated flow though secondary paths	Lbm
2314 . .	INSLBO	CTL_INTEG_MSLB_IN_FLOW	RE	8	Integrated flow MSLB inside containment	Lbm
2315 . .	INSLBI	CTL_INTEG_MSLB_OUT_FLOW	RE		Integrated flow MSLB outside containment	Lbm
2316 . .	CORWO	CTL_INITIAL_CORE_FLOW	RE		Initial core flow	Lbm/sec
2317 . .	CORWFR	CTL_CORE_FLOW_FRAC	RE		Normalized core flow - frac of initial	Fraction
2318 . .	CORHFR	CTL_HEAT_FLUX_FRAC	RE		Core average heat flux fraction	Fraction
2319 . .	CTPMIN	CTL_CETOP_MIN_DNBR	RE		CETOP Minimum DNBR	Fraction
2320 . .	CTPMNT	CTL_CETOP_MIN_DNBR_TIME	RE		Time of CETOP Minimum DNBR	Seconds
2321 .	CETOPC	CETOP_LINK	RE	50	Partion to store CETOP link data	Partition
2322 . .	CTPOUT	CETOP_OUT	RE	19	CETOP standard output	Partition
2323 . . .	CTPO1	CETOP_OUT_CASE	RE		CETOP out: Case number	Fraction
2324 . . .	CTPO2	CETOP_OUT_QDBL	RE		CETOP out: Heat flux	MegBtu/hr-ft^2
2325 . . .	CTPO3	CETOP_OUT_POLR	RE		CETOP out: Power operating limit	Fraction
2326 . . .	CTPO4	CETOP_OUT_TIN	RE		CETOP out: Inlet temperature	Degree F
2327 . . .	CTPO5	CETOP_OUT_PIN	RE		CETOP out: Pressure	Psia
2328 . . .	CTPO6	CETOP_OUT_GAVG	RE		CETOP out: Core average mass velocity	10e6 lb/hr-ft2
2329 . . .	CTPO7	CETOP_OUT_ASI	RE		CETOP out: Axial shape index	Ratio
2330 . . .	CTPO8	CETOP_OUT_NRAD	RE		CETOP out: Peripheral Axial shape index	Fraction
2331 . . .	CTPO9	CETOP_OUT_P1MAX	RE		CETOP out: Max radial avg peaking factor	Fraction
2332 . . .	CTPO10	CETOP_OUT_DNB-N	RE		CETOP out: Min DNBR at final iteration	Fraction
2333 . . .	CTPO11	CETOP_OUT_X-N	RE		CETOP out: Quality at final iteration	Fraction
2334 . . .	CTPO12	CETOP_OUT_DNB-1	RE		CETOP out: Min DNBR at first iteration	Fraction
2335 . . .	CTPO13	CETOP_OUT_X-1	RE		CETOP out: Quality at first iteration	Fraction
2336 . . .	CTPO14	CETOP_OUT_QUIX	RE		CETOP out: QUIX file case number	Fraction
2337 . . .	CTPO15	CETOP_OUT_ITER	RE		CETOP out: Number of iterations	Fraction
2338 . . .	CTPO16	CETOP_OUT_IEND	RE		CETOP out: Iter code: 1 => DNBR conv'd	Fraction
2339 . . .	CTPO17	CETOP_OUT_ATR	RE		CETOP out: Avg enthalpy transport coeff	Composite Units
2340 . . .	CTPO18	CETOP_OUT_HCH	RE		CETOP out: Min DNBR hot channel number	Pointer
2341 . . .	CTPO19	CETOP_OUT_MNOD	RE		CETOP out: Min DNBR node location	Pointer
2342 . .	CTPINP	CETOP_IN	RE	7	CETOP Inputs from CENTS	Partition
2343 . . .	CTPI1	CETOP_IN_TIME	RE		CETOP in: CENTS simulation time	Seconds
2344 . . .	CTPI2	CETOP_IN_FLOW_FRAC	RE		CETOP in: Normalized core flow	Fraction
2345 . . .	CTPI3	CETOP_IN_INLET_TEMP	RE		CETOP in: Core inlet temperature	Degree F
2346 . . .	CTPI4	CETOP_IN_CORE_PRESSURE	RE		CETOP in: Core pressure	Psia
2347 . . .	CTPI5	CETOP_IN_HEAT_FLUX_FRAC	RE		CETOP in: Heat flux fraction	Fraction
2348 . . .	CTPI6	CETOP_IN_FR_USER_MULT	RE		CETOP in: User input Fr multiplier	Fraction
2349 . . .	CTPI7	CETOP_IN_FR_TEMP_MULT	RE		CETOP in: FR temperature multiplier	Fraction
2350 . .	CTPLNK	CETOP_LINK_CONTROL	RE	7	CETOP link variables and options	Partition
2351 . . .	CTPC1	CETOP_PRESS_OPT	LO		CETOP link: Constant pressure option	True False
2352 . . .	CTPC2	CETOP_FR_DERIV	RE		CETOP link: Fr vs temperature derivative	1/Del-DegF
2353 . . .	CTPC3	CETOP_FR_PATH1	IN		CETOP link: Path # for Temp1	Pointer
2354 . . .	CTPC4	CETOP_FR_PATH2	IN		CETOP link: Path # for Temp2	Pointer
2355 . . .	CTPC5	CETOP_FR_TEMP1	RE		CETOP link: Temp1 for DT calc	Degree F
2356 . . .	CTPC6	CETOP_FR_TEMP2	RE		CETOP link: Temp2 for DT calc	Degree F
2357 . . .	CTPC7	CETOP_FR_DEL_TEMP	RE		CETOP link: Temp Diff for Fr correction	Degree F
2358 .	VBMISC	VATTENFALL_MISCELLANEOUS	RE	200	Space for Vattenfall use	Partition
2359 .	INIOUT	INIT_DEBUG_OUTPUT	RE		1 => Debug print on-subroutine INITIAL	Dimensionless
2360 .	JUNK1	JUNK_PARTITION	RE	112	These variables are unused but in decks	Unused
2361 . .	SLFLC	SL_FLOW_COEFF	RE	8	Unused	Unused
2362 . .	DRATIO	RATIO_CONC_SOLU	RE	5	Conc ratio - unused for vdict rev15	Dimensionless
2363 . .	RAUSER	RCS_LINPROP_USER	LO		nu Linearization of props. user control	True False
2364 . .	RLNUP	RCS_NUM_LINPROP	IN		nu Max steps to update lin. props.	Counts
2365 . .	RSSCON	RCS_SS_CONTROL	LO		nu Flag t=RCSs called f= RCS called	True False
2366 . .	RSSUSE	RCS_SS_USER	LO		nu Control of RCSs or RCS (user)	True False
2367 .	CDCONT	CDCONT_COMMON	RE	50	Container array for Cooldown Controllers	Partition

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2368 .	SGTDBP	DBG_SGTR_PARTITION	RE	36	SGTR Debug Variables	Partition
2369 . .	SGTDB1	DBG_SGTR_FLOW1	RE	4	Debug Var SGTR Flow side 1	Lbm/sec
2370 . .	SGTDB2	DBG_SGTR_FLOW2	RE	4	Debug Var SGTR Flow side 2	Lbm/sec
2371 . .	SGTDB3	DBG_SGTR_FLOW_SLOT	RE	4	Debug Var SGTR Slot Flow	Lbm/sec
2372 . .	SGTDB4	DBG_SGTR_PRESS_PRI1	RE	4	Debug Var SGTR Primary press side 1	Psia
2373 . .	SGTDB5	DBG_SGTR_PRESS_PRI2	RE	4	Debug Var SGTR Primary press side 2	Psia
2374 . .	SGTDB6	DBG_SGTR_PRESS_SG	RE	4	Debug Var SGTR Secondary press	Psia
2375 . .	SGTDB7	DBG_SGTR_PRESS_ITER	RE	4	Debug Var SGTR Slot pressure	Psia
2376 . .	SGTDB8	DBG_SGTR_SVOL_TUBE1	RE	4	Debug Var SGTR Tube 1 Specific Volume	Ft^3/lbm
2377 . .	SGTDB9	DBG_SGTR_SVOL_TUBE2	RE	4	Debug Var SGTR Tube 2 Specific Volume	Ft^3/lbm
2378	FWSCOM	FWS_COMMON	RE	20000	Feedwater System model segment	Segment
2379 .	FDPATH	FWS_FDPATH	RE	1600	FWS model flow path partition	Partition
2380 . .	FDPEL	FWS_DPEL	RE	50	FWS model flow path elev gain ext path	Feet
2381 . .	FCV	FWS_CV	RE	50	FWS model flow path flow coeff.	Composite Units
2382 . .	FRESL	FWS_RESL	RE	50	FWS model flow path flow resistnce	Composite Units
2383 . .	FRHOFD	FWS_RHOFD	RE	50	FWS model flow path density	Lbm/Ft^3
2384 . .	FPEXT	FWS_PEXT	RE	50	FWS model flow path external pressure	Psia
2385 . .	FWMAS	FWS_WMAS	RE	50	FWS model flow path mass flow rate	Lbm/sec
2386 . .	FWSW0	FWS_W0	RE		FWS model flow path volumetric flow	Gal/min
2387 . .	FWSW	FWS_W	RE	50	FWS model flow path volumetric flow	Gal/min
2388 . .	FHPATH	FWS_HPATH	RE	50	FWS model flow path flow enthaly	Btu/lbm
2389 . .	FQCURR	FWS_QCURR	RE	50	FWS model flow path heat transfer	Btu/sec
2390 . .	FRESV	FWS_RESV	RE	50	FWS model flow path valve flow resist	Composite Units
2391 . .	FRES	FWS_RES	RE	50	FWS model flow path total resistance	Composite Units
2392 . .	FHEXT	FWS_HEXT	RE	50	FWS model flow path ext node enthalpy	Btu/lbm
2393 . .	FRHOEX	FWS_RHOEXT	RE	50	FWS model flow path ext node density	Lbm/Ft^3
2394 . .	FWSRP	FWS_RP	RE	50	FWS model flow path pump resistance	Composite Units
2395 . .	FWSPS	FWS_PS	RE	50	FWS model flow path pump head	Psid
2396 . .	FSUMP	FWS_SUMP	RE	50	FWS model flow path pressure error	Psid
2397 . .	FGPMCO	FWS_GPMCOR	RE	50	FWS model flow path density correction	Composite Units
2398 . .	FNDIN	FWS_NDIN	IN	50	FWS model flow path input node ID	Pointer
2399 . .	FNDOUT	FWS_NDOUT	IN	50	FWS model flow path output node ID	Pointer
2400 . .	FNDEXT	FWS_NDEXT	IN	50	FWS model flow path external node ID	Pointer
2401 . .	FNCPMP	FWS_NCPUMP	IN	50	FWS model flow path pump ID	Pointer
2402 . .	FICPMP	FWS_ICPUMP	IN	50	FWS model flow path pump status	Pointer
2403 . .	FWSICK	FWS_ICK	IN	50	FWS model flow path check valve flag	Pointer
2404 . .	FWSIMF	FWS_IMF	IN	50	FWS model flow path calculation flag	Pointer
2405 . .	FPOISO	FWS_POSISO	RE	50	FWS model path isolation valve pos	Fraction
2406 . .	FCVAFL	FWS_CV_AFLO	RE	50	FWS model path check valve flow area	Fraction
2407 . .	FCVRES	FWS_CV_RESMN	RE	50	FWS model path chk val flow resist.	Composite Units
2408 . .	FCVDPM	FWS_CV_DPMIN	RE	50	FWS model path chk val minimum DP	Psid
2409 . .	FNFLO	FWS_NFLO	IN		FWS model network number of paths	Counts
2410 . .	FWSKEY	FWS_KEY	IN		FWS model any fw pumps on flag	Pointer
2411 .	FDNODE	FWS_FDNODE	RE	400	FWS model node partition	Partition
2412 . .	FPEXTN	FWS_PEXTN	RE	20	FWS model external node pressure	Psia
2413 . .	FHEXTN	FWS_HEXTN	RE	20	FWS model external node enthalpy	Btu/lbm
2414 . .	FWSP0	FWS_P0	RE		FWS model node pressure	Psia
2415 . .	FWSP	FWS_P	RE	30	FWS model node pressure	Psia
2416 . .	FHNODE	FWS_HNODE	RE	30	FWS model node enthalpy	Btu/lbm
2417 . .	FRHOND	FWS_RHONOD	RE	30	FWS model node density	Lbm/Ft^3
2418 . .	FWEXTF	FWS_WEXTF	RE	30	FWS model node external leak flow out	Lbm/sec
2419 . .	FHEXTF	FWS_HEXTF	RE	30	FWS model node ext leak flow enthalpy	Btu/lbm
2420 . .	FAEXTF	FWS_AEXTF	RE	30	FWS model node ext leak flow area	Ft^2
2421 . .	FPEXTF	FWS_PEXTF	RE	30	FWS model node ext leak flow back press.	Psia
2422 . .	FWSUM	FWS_WSUM	RE	30	FWS model node flow error	Lbm/sec
2423 . .	FIMN	FWS_IMN	IN	30	FWS model node network masking flag	Pointer
2424 . .	FNNOD	FWS_NNOD	IN		FWS model network number of nodes	Counts
2425 . .	FNEXTN	FWS_NEXTN	IN		FWS model network number of ext. nodes	Counts
2426 . .	FNPSGM	FWS_NPSGMFW	IN	4	FWS model SG main fw path ID	Pointer
2427 . .	FNPSGE	FWS_NPSGECO	IN	4	FWS model SG economizer fw path ID	Pointer
2428 . .	FNPSGA	FWS_NPSGAFW	IN	4	FWS model SG emergency/aux fw path ID	Pointer
2429 . .	FNPFLB	FWS_NPFWLB	IN	4	FWS model MFWLB path ID	Pointer
2430 . .	FWAFLB	FWS_AFWLB	RE	4	FWS model MFWLB flow area (local)	Ft^2
2431 . .	FNPPRV	FWS_NPMFPRV	IN	4	FWS model (not used)	Pointer
2432 . .	FNSG	FWS_NSG	IN		FWS model number of SG (local)	Pointer
2433 .	FDVALV	FWS_FDVALV	RE	1000	FWS model valve partition	Partition
2434 . .	FSTROK	FWS_STROKE	RE	30	FWS model valve demand (per cent)	Percent
2435 . .	FPOSIT	FWS_POSIT	RE	30	FWS model valve position	Percent
2436 . .	FCVV	FWS_CVV	RE	30	FWS model valve flow coefficient	Composite Units
2437 . .	FTOPN	FWS_TOPN	RE	30	FWS model valve stroke open time	Seconds
2438 . .	FTCLOS	FWS_TCLOS	RE	30	FWS model valve stroke close time	Seconds
2439 . .	FTLAG	FWS_TLAG	RE	30	FWS model valve actuator lag	Seconds
2440 . .	FCVP	FWS_CVP	RE	200	FWS model valve CV vs Position	Composite Units
2441 . .	FSTP	FWS_STP	RE	200	FWS model valve position vs. CV	Fraction

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2442	FNPATH	FWS_NPATH	IN	30	FWS model valve path location ID	Pointer
2443	FNTABL	FWS_NTABLE	IN	30	FWS model valve CV table ID	Pointer
2444	FNPTV	FWS_NPTV	IN	10	FWS model valve CV table no. of pts.	Counts
2445	FINDXF	FWS_INDEXF	IN	30	FWS model valve CV table index	Pointer
2446	FNVMFV	FWS_NVMFV	IN	4	FWS model Main Feed Valve ID	Pointer
2447	FNVBFV	FWS_NVBFV	IN	4	FWS model Bypass Feed Valve ID	Pointer
2448	FNVAL	FWS_NVAL	IN		FWS model number of valves	Counts
2449	FNHDV	FWS_NHDV	IN		FWS model number of Htr Drn valves	Counts
2450	FNVHDV	FWS_NVHDV	IN	3	FWS model heater drain valve ID	Pointer
2451	FNAFVT	FWS_NAFWVT	IN		FWS model total number of AFW valves	Counts
2452	FNAFV1	FWS_NVAFW1	IN		FWS model AFW valve 1 ID	Pointer
2453	FNTAFV	FWS_NTABFV	IN		FWS model number of fw valve tables	Counts
2454	FDPUMP	FWS_FDPUMP	RE	1200	FWS model pump partition	Partition
2455	FSPDMD	FWS_SPDMD	RE	20	FWS model pump speed demand (frac)	Fraction
2456	FSPEED	FWS_SPEED	RE	20	FWS model pump speed (frac)	Fraction
2457	FTAUON	FWS_TAUON	RE	20	FWS model pump speed lag (increasing)	Seconds
2458	FTAUOF	FWS_TAUOFF	RE	20	FWS model pump speed lag (decreasing)	Seconds
2459	FWSHT	FWS_HT	RE	200	FWS model pump head vs flow tables	Feet
2460	FWSWT	FWS_WT	RE	200	FWS model pump flow vs head tables	Gal/min
2461	FBTABL	FWS_BTABLE	RE	200	FWS model pump BTABLE vs flow	Composite Units
2462	FATABL	FWS_ATABLE	RE	200	FWS model pump ATABLE vs flow	Composite Units
2463	FNPMTH	FWS_NPMPTH	IN	20	FWS model pump path ID	Pointer
2464	FNTABP	FWS_NTABP	IN	20	FWS model pump perf. table ID	Pointer
2465	FNPTP	FWS_NPTP	IN	10	FWS model pump table no. of pts.	Counts
2466	FNPMPM	FWS_NPMPMFW	IN	4	FWS model pump MFP ID	Pointer
2467	FNPMPE	FWS_NPMPEFW	IN	4	FWS model pump AFW/EFW pump ID	Pointer
2468	FNPTMP	FWS_NPTHMFP	IN	4	FWS model pump MFP path ID	Pointer
2469	FNPUM	FWS_NPUM	IN		FWS model number of pumps	Counts
2470	FNTBFP	FWS_NTABFP	IN		FWS model number of fw pump tables	Counts
2471	FNMFWP	FWS_NMFWP	IN		FWS model number of mfw pumps	Counts
2472	FNEFWP	FWS_NEFWP	IN		FWS model number of efw pumps	Counts
2473	FDHEAT	FWS_FDHEAT	RE	500	FWS model fw heater partition	Partition
2474	FTPWR	FWS_TPWR	RE		FWS model turbine power	Fraction
2475	FTQLAG	FWS_TQLAG	RE	9	FWS model fw heater heat xfer tau	Seconds
2476	FHTRHV	FWS_HTRHOV	RE	9	FWS model fw heater thermal mass	Lbm
2477	FPWRTB	FWS_PWRTBL	RE	90	FWS model fw heater turb pwr vs Q	Percent
2478	FQPTBL	FWS_QPTBL	RE	90	FWS model fw heater Q vs turb pwr	Btu/sec
2479	FHTHMX	FWS_HTRHMX	RE	90	FWS model fw heater max enthalpy	Btu/lbm
2480	FTPOWR	FWS_TPOWR	RE	10	FWS model fw Htr Drn turb pwr table	Percent
2481	FTWHDP	FWS_TWHDP	RE	10	FWS model fw Htr Drn flow vs turb pwr	Lbm/sec
2482	FTEHDP	FWS_TENHDP	RE	10	FWS model fw Htr Drn enth vs turb pwr	Btu/lbm
2483	FMAXTU	FWS_MAXTAU	RE	9	FWS model fw heater max tau	Seconds
2484	FFDPS0	FWS_FDPOS0	IN	9	FWS model fw heater table index	Pointer
2485	FHFWBI	FWS_HFWBIAS	RE		FWS model fw enth bias to tune fw enth	Btu/lbm
2486	FNPHET	FWS_NPHEAT	IN	9	FWS model fw heater path location ID	Pointer
2487	FNHTBL	FWS_NHTBL	IN	9	FWS model fw heater table no. of pts.	Counts
2488	FWSNHT	FWS_NHT	IN		FWS model number of fw heaters	Counts
2489	FNHDPT	FWS_NHDPTBL	IN		FWS model fw htr drn table no. of pts.	Counts
2490	FDMODL	FWS_FDMODL	RE	288	FWS model fw model misc controls	Partition
2491	FWSNRC	FWS_NRCIRC	IN		FWS model no. of recirc flow cntrls	Counts
2492	FWRCPB	FWS_FWRCPB	RE	20	FWS model pump recirc control PB	Percent
2493	FWRCRE	FWS_FWRCRE	RE	20	FWS model pump recirc control reset	Seconds
2494	FWRCSP	FWS_FWRCSP	RE	20	FWS model pump recirc control setpt	Gal/min
2495	FWRCIR	FWS_FWRCIR	RE	20	FWS model pump recirc cntrl instr range	Gallons
2496	FWRCOT	FWS_FWRCOUT	RE	20	FWS model pump recirc control output	Fraction
2497	FWRCIN	FWS_FWRCINT	RE	20	FWS model pump recirc control integral	Fraction
2498	FNPTRC	FWS_NPTHRC	IN	20	FWS model pump recirc cntrl path ID	Pointer
2499	FNVLRC	FWS_NVALRC	IN	20	FWS model pump recirc cntrl valve ID	Pointer
2500	FNPMRC	FWS_NPMPRC	IN	20	FWS model pump recirc cntrl pump ID	Pointer
2501	FIAURC	FWS_IAUTORC	IN	20	FWS model pump recirc cntrl auto flag	Pointer
2502	FTIMET	FWS_TIMET	RE	20	FWS model pump trip timer	Seconds
2503	FITRIP	FWS_IFTRIP	IN	20	FWS model pump current trip state	Pointer
2504	FITRPO	FWS_IFTRPO	IN	20	FWS model pump previous trip state	Pointer
2505	FDCLMS	FWS_DCL_MASSES	RE	4	FWS model downcomer line mass	Lbm
2506	FECLMS	FWS_ECL_MASSES	RE	4	FWS model economizer line mass	Lbm
2507	SGAFWS	AFWS_FLOW	RE	4	Auxiliary feedwater flow rate	Lbm/sec
2508	FWLMSS	FWS_LINE_MASSES	RE	4,2	FWS steady state feed line mass	Lbm
2509	FDSYST	FWS_FDSYST	RE	10000	FWS model fw system eqn partition	Partition
2510	NONC	NONCOND_COMMON	RE	9000	Species and noncondensibles transport	Segment
2511	NONC01	RCS_SPECIES_CONSTANTS	RE	61	Species Constants Partition	Partition
2512	NONC02	NUM_SOLUTES	IN		# dissolved solutes excl nc, SO+NC <= 20	Counts
2513	NONC03	HALF_LIFE_SOLUTES	RE	20	Decay half lives of dissolved species	Seconds
2514	CRATIO	CONC_RATIO_STM_LIQ	RE	20	Conc ratio st,liq: Cs/(Cs+Cl) [0.0,1.0]	Fraction
2515	NONC05	CONC_MAX	RE	20	Maximum conc of species (LBM/LB,PPM,...)	Composite Units

Table G.2: Variables Dictionary in Tree Structure

Index No.	Variable Name: Short	Long	Type	Dimensions	Definition	Units
2516	NONC06	ID_TYPE_SPECIES	IN	20	Identifying pointers for the species	Partition
2517	NONC07	ID_TYPE_SOLUTE	IN	15	Identifying pointers for the solutes	Pointer
2518	NONC08	ID_TYPE_BORON	IN		Identifying pointer for boron	Pointer
2519	NONC09	ID_TYPE_N16	IN		Identifying pointer for N-16	Pointer
2520	NONC10	ID_TYPE_IODINE	IN		Identifying pointer for iodine	Pointer
2521	NONC11	ID_TYPE_XENON	IN		Identifying pointer for xenon	Pointer
2522	NONC12	ID_TYPE_PART	IN		Identifying pointer for particulates	Pointer
2523	NONC13	ID_TYPE_NONC	IN	5	Identifying pointers for the nonconds	Pointer
2524	NONC14	ID_TYPE_HYD	IN		Identifying pointer for hydrogen	Pointer
2525	NONC15	ID_TYPE_NIT	IN		Identifying pointer for nitrogen	Pointer
2526	NON15A	ID_TYPE_AIR	IN		Identifying pointer for air	Pointer
2527	NONC16	RCS_NONCOND_CONSTANTS	RE	65	Noncondensibles constants Partition	Partition
2528	NONC17	NUM_NONC	IN		No. of noncondensible species, NC <= 5	Counts
2529	NONC18	NONC_K_DISSOLVE	RE	5	NC dissolution const, lb/sec-ft2-delconc	Composite Units
2530	NONC19	NONC_MW	RE	5	Molecular weights of non-condensibles	Composite Units
2531	NONC20	CORE_N16_MULT	RE		Production constant for N-16	Composite Units
2532	NONC21	COND_NONC_FRAC	RE	2	Noncond frac: 1=full cond, 2=no condens	Fraction
2533	NONC22	COND_NONC_DEG_MULT	RE	50	Condens degrad at initl inflow of n/cs	Dimensionless
2534	DPGASP	RCS_PRZR_SPR_GAS_ENTR	RE		Const for gas entrainment in sprays	Dimensionless
2535	NONC31	RCS_SPECIES_NODES	RE	2300	Node species state	Partition
2536	NONC32	MASS_NONC_DIS	RE	50,5	Nodal mass of dissolved noncondensibles	Lbm
2537	NONC33	MASS_NONC_DIS_TOT	RE	50	Nodal mass of dissolved noncondensibles	Lbm
2538	NONC35	RCS_CONC_SOLUTE	RE	50,20	Node concentrations of dissolved species	Composite Units
2539	NONC36	RCS_CUM_SOLU	RE	50,20	Node solute accum rate: prod+flow+disslv	Composite Units
2540	NONC37	RCS_NONCOND_NODES	RE	1450	Node noncondensibles state	Partition
2541	NONC38	MASS_NONC_SEP	RE	50,5	Mass of separ-noncond in node	Lbm
2542	NONC39	MASS_NONC_SEP_TOT	RE	50	Total mass of separ-noncond in node	Lbm
2543	NONC41	QUAL_NONC_SEP	RE	50,5	Quality of separ-noncond in nodal steam	Fraction
2544	NONC42	QUAL_NONC_SEP_TOT	RE	50	Quality of separ-noncond in nodal steam	Fraction
2545	NONC45	RCS_CUM_NONC	RE	50,5	Node separ-nonc accum rates: flow+bubble	Lbm/sec
2546	NONC46	COND_NONC	RE	50	Node rates of noncondensble dissolution	Lbm/sec
2547	NONC47	PPRES_NONC	RE	50,5	Partial pressures of separ-nonconds	Psia
2548	NONC48	PPRES_NONC_TOT	RE	50	Sum of partial pressures of sep-noncond	Psia
2549	NONC49	PPRES_STM	RE	50	Node steam partial pressures	Psia
2550	NONC51	PVOL_NONC_TOT	RE	50	Total volume of separated non-cond gas	Ft^3
2551	NONC52	TEMP_NONC	RE	50	Temperature of non-condensibles in node	Degree F
2552	PPSLST	PRESS_STM_LAST	RE	50	Last Nodal Pressure - does not inc gas	Psia
2553	NONC54	PTEMP_STM_SAT	RE	50	Steam saturation temp at the partial pr	Degree F
2554	NONC57	RCS_SPECIES_PATHS	RE	3000	Path species state	Partition
2555	NONC58	P_CONC_SOLU	RE	150,20	Path concentrations of dissolved species	Composite Units
2556	NONC59	RCS_NONCOND_PATHS	RE	1080	Path noncondensibles state	Partition
2557	NONC60	P_FLOW_NONC	RE	150	Path flows of all separ-nonconds	Lbm/sec
2558	NONC61	P_FLOW_NONC_MOM	RE	100	Mom path flows of all separ-nonconds	Lbm/sec
2559	NONC62	P_FLOW_NONC_NONM	RE	50	Non-mom path flows of all sep-nonconds	Lbm/sec
2560	NONC65	P_FRAC_NONC	RE	150,5	Path concentrations of separ-noncond	Fraction
2561	NONC66	P_FRAC_NONC_TOT	RE	150	Path concentrations of separ-noncond	Fraction
2562	NONC40	MASS_NONC_SEP_RCS	RE		Total mass of separ-nonconds in RCS	Lbm
2563	NONC50	FLOW_DP_MAX_ERR	RE		Max error predicted - calculated press	Psid
2564	NON50A	FLOW_DP_NODE_MAX_ERR	IN		Node of max error FLOW_DP_MAX	Pointer
2565	NON50B	FLOW_DP_PRINT_NODE	IN		Print DP data for this node (for debug)	Pointer
2566	RLMGAS	MASS_NONC_RCS	RE		RCS noncond tot mass (separ & dissolved)	Lbm
2567	PZQEFF	RCS_PRZR_Q_EFF	RE		Przr condens efficiency when n/c present	Fraction
2568	PZQCND	RCS_PRZR_Q_COND	RE		Przr condens heat transfer	Btu/sec
2569	NONC34	MASS_NONC_DIS_RCS	RE		Total mass of dissolved nonconds in RCS	Lbm
2570	NONC55	RCS_SPECIES_CORE	RE	20	Core node species	Partition
2571	NONC56	CORE_RELE_SOLU	RE	20	Solute release rate in core (production)	Composite Units
2572	NONC67	RCS_NONCOND_INTERF	RE	38	Noncondensible interfaces partition	Partition
2573	NONC68	P_FLOW_AUXSP_NONC	RE	5	Auxiliary spray noncondensibles flow	Lbm/sec
2574	NONCSI	SIS_RCS_NONC	RE	6,5	Noncond inflow via SI lines	Lbm/sec
2575	NONC72	SIS1_RCS_NONC	RE	5	Noncond inflow via SI line, CL 1	Lbm/sec
2576	NONC73	SIS2_RCS_NONC	RE	5	Noncond inflow via SI line, CL 2	Lbm/sec
2577	NONC74	SIS3_RCS_NONC	RE	5	Noncond inflow via SI line, CL 3	Lbm/sec
2578	NONC75	SIS4_RCS_NONC	RE	5	Noncond inflow via SI line, CL 4	Lbm/sec
2579	NONC76	SIS5_RCS_NONC	RE	5	Noncond inflow via SI line, HL 1	Lbm/sec
2580	NONC77	SIS6_RCS_NONC	RE	5	Noncond inflow via SI line, HL 2	Lbm/sec
2581	NONC78	GS_VES_NONC	RE		Noncond inflow to vessel via Gas System	Lbm/sec
2582	NONC79	GS_PRZR_NONC	RE		Noncond inflow to przr via Gas System	Lbm/sec
2583	NONC80	GS_SPECIES	IN		Species of Gas Sys gas (from ID_TYPE_SP	Pointer

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name	Index	Long Variable Name
1056	ADMI_HEATER	2345	CETOP_IN_INLET_TEMP
1786	AFWS_ENTH	2343	CETOP_IN_TIME
2507	AFWS_FLOW	2321	CETOP_LINK
1785	AFWS_NOZ_FLOW	2350	CETOP_LINK_CONTROL
213	AREA_BLEED_MIN	2322	CETOP_OUT
198	AREA_CORE	2329	CETOP_OUT_ASI
86	AREA_INJ_MULT	2339	CETOP_OUT_ATR
1191	AREA_VALVE_PRZR	2323	CETOP_OUT_CASE
1193	AREA_VALVE_QT	2334	CETOP_OUT_DNB-1
1192	AREA_VALVE_SPRAY	2332	CETOP_OUT_DNB-N
1190	AREA_VALVE_UHEAD	2328	CETOP_OUT_GAVG
399	ASEP_SG	2340	CETOP_OUT_HCH
440	ASL_MAX	2338	CETOP_OUT_IEND
461	ASL_MIN	2337	CETOP_OUT_ITER
382	ASP_TBL	2341	CETOP_OUT_MNOD
383	ASP_TBL_DSGN1	2330	CETOP_OUT_NRAD
384	ASP_TBL_DSGN2	2331	CETOP_OUT_P1MAX
426	ATUBES_MAX_CS	2327	CETOP_OUT_PIN
427	ATUBES_MAX_HT	2325	CETOP_OUT_POLR
438	ATUBES_MAXEC_HT	2324	CETOP_OUT_QDBL
823	AXPD_INPUT_OPT	2336	CETOP_OUT_QUIX
824	AXPD_NUM_POINTS	2326	CETOP_OUT_TIN
825	AXPD_PRINT_NORMALIZATION	2335	CETOP_OUT_X-1
237	BAD	2333	CETOP_OUT_X-N
235	BAN	2351	CETOP_PRESS_OPT
241	BAR	661	CFTH_RCSAXIAL_Q
239	BAT	1423	CHGS_ASPRAY_FLOW
1043	BORON_CORE	1418	CHGS_RCS_BORON
1048	BOUYANCY_CORE	1417	CHGS_RCS_ENTH
212	BURNOUT_HEATER	1416	CHGS_RCS_FLOW
238	BVD	1419	CHGS_RCS_HYD
236	BVN	1420	CHGS_RCS_IOD
242	BVR	1421	CHGS_RCS_PART
240	BVT	1422	CHGS_RCS_XEN
2367	CDCONT_COMMON	1	CHR_COMMON
203	CEAS_DIST	643	CHT_AVG_HEAT_FLUX
2357	CETOP_FR_DEL_TEMP	664	CHT_AXIAL_DATA_ALL
2352	CETOP_FR_DERIV	652	CHT_AXIAL_DATA_BO
2353	CETOP_FR_PATH1	646	CHT_AXIAL_DATA_FC
2354	CETOP_FR_PATH2	645	CHT_AXIAL_OUTPUT
2355	CETOP_FR_TEMP1	634	CHT_BOILING
2356	CETOP_FR_TEMP2	600	CHT_CHF_MULT
2342	CETOP_IN	589	CHT_COMMON
2346	CETOP_IN_CORE_PRESSURE	597	CHT_COND_FUEL_MULT
2344	CETOP_IN_FLOW_FRAC	669	CHT_COND_ROD
2349	CETOP_IN_FR_TEMP_MULT	627	CHT_COND_SAT_STM
2348	CETOP_IN_FR_USER_MULT	626	CHT_COND_STM
2347	CETOP_IN_HEAT_FLUX_FRAC	625	CHT_COND_WAT

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name
601	CHT_CONST_LEV
1249	CHT_DELT
1252	CHT_DELTA_T
614	CHT_DHF_DP
615	CHT_DHG_DP
617	CHT_DTSAT_DH
616	CHT_DTSAT_DP
621	CHT_DVSATG_DH
619	CHT_DVSATG_DP
620	CHT_DVSATL_DH
618	CHT_DVSATL_DP
665	CHT_ENTH_COOL
609	CHT_ENTH_SAT_LIQ
608	CHT_ENTH_SAT_LIQ_M1
610	CHT_ENTH_SAT_STM
1250	CHT_FDELT
641	CHT_FLASH_RATE_LAST
653	CHT_FLOW_STM_BO
635	CHT_FLUX_CRIT
650	CHT_FLX_DNB
603	CHT_FRAC_HT_GEN
1251	CHT_FTIME
654	CHT_GAP_COND
598	CHT_GAP_HCAP
673	CHT_H_CORE_SECT
1243	CHT_H_SUPER_MULT
1244	CHT_HEAT_FRAC
662	CHT_HEAT_LIQ
663	CHT_HEAT_STM
670	CHT_HT_CAP_ROD
659	CHT_HT_FLUX
655	CHT_HT_GEN_ZR_WAT
649	CHT_HTCOF_FB
639	CHT_HTCOF_NB
658	CHT_HTCOF_ST
640	CHT_HTCOF_SUB
656	CHT_IHT
590	CHT_INPUTS
642	CHT_LEVL_MIX_LAST
672	CHT_M_CORE_SECT
604	CHT_NNOD_BO
606	CHT_NNOD_FC
591	CHT_NREGIONS_RAD
16	CHT_NUM_LINPROP
605	CHT_NUM_NODE
630	CHT_PRAN_SAT_STM
629	CHT_PRAN_STM
628	CHT_PRAN_WAT

Index	Long Variable Name
599	CHT_PRESS_SUPERCRIT
607	CHT_PROPERTIES
647	CHT_QUAL
667	CHT_ROD_RADIAL
671	CHT_SECTIONS_OUTPUT
632	CHT_SPEC_HT_SAT_STM
657	CHT_SPEC_HT_STM
631	CHT_SPEC_HT_WAT
633	CHT_STATE
611	CHT_SVOL_SAT_LIQ
612	CHT_SVOL_SAT_STM
1398	CHT_SVOLCOOL_AV
1397	CHT_TCOOL_AV
666	CHT_TEMP_COOL
638	CHT_TEMP_CRIT
648	CHT_TEMP_CROSS
644	CHT_TEMP_FUEL_AV
651	CHT_TEMP_NB_FC
668	CHT_TEMP_ROD
613	CHT_TEMP_SAT
660	CHT_TEMP_SURF
636	CHT_TERM
1267	CHT_TERM_MAX
637	CHT_TERM2
1248	CHT_TIME_SCALE
17	CHT_TIME_STP_NUM
674	CHT_USE_NEW_ENTHALPY_OPTION
624	CHT_VISCOS_SAT_STM
623	CHT_VISCOS_STM
622	CHT_VISCOS_WAT
2227	CLCONT
2515	CONC_MAX
2514	CONC_RATIO_STM_LIQ
1112	CONC_SOLU_QT
902	COND_BOIL
905	COND_BUB
904	COND_INJ
2546	COND_NONC
2533	COND_NONC_DEG_MULT
2532	COND_NONC_FRAC
903	COND_SURF
901	COND_TOT
1475	CONT_PRES
1847	CONT_SG_TEMP
1925	CONTROL_COMMON
328	CONV_GPM_AREA
1148	CORE_BORON_REL
196	CORE_BOT

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Index	Long Variable Name
596	CORE_HT_AREA
594	CORE_HYD_DIA
1149	CORE_HYD_REL
1150	CORE_IOD_REL
2531	CORE_N16_MULT
1151	CORE_PART_REL
592	CORE_RAD_OUT
15	CORE_RAD_OUT_DUMMY
2571	CORE_RELE_SOLU
1187	CORE_SURF_AREA_LAST
197	CORE_TOP
1152	CORE_XEN_REL
2168	CTL_AFWS_CONTROL
2178	CTL_AFWS_CONTROL_AUTO
522	CTL_AFWS_CONTROLLERS
2174	CTL_AFWS_DELAY
2175	CTL_AFWS_FLOW_MULT
2177	CTL_AFWS_MOTOR_PUMP
2169	CTL_AFWS_SETPOINTS
2171	CTL_AFWS_SG_LEVEL_HIGH
2170	CTL_AFWS_SG_LEVEL_LOW
2173	CTL_AFWS_SGDP_HIGH
2179	CTL_AFWS_SPEED_SIG
2172	CTL_AFWS_TOT_FLOW
2176	CTL_AFWS_TURB_PUMP
550	CTL_AFWS_VALVE_CONTROLLERS
2117	CTL_ATM_DUMP_CONTROL
2120	CTL_ATM_DUMP_CONTROL_AUTO
551	CTL_ATM_DUMP_NUM
552	CTL_ATM_DUMP_PATH
2118	CTL_ATM_DUMP_SETPOINTS
2119	CTL_ATM_DUMP_SPOINT
1993	CTL_CEA_ACCUM
1991	CTL_CEA_AUTO
1978	CTL_CEA_COMMON
523	CTL_CEA_CONTROLLER
1982	CTL_CEA_GAIN_EXP
1985	CTL_CEA_LAST_TIME
1986	CTL_CEA_MAX
1987	CTL_CEA_MIN
1992	CTL_CEA_PERFECT
1988	CTL_CEA_POS
1979	CTL_CEA_SETPOINTS
1989	CTL_CEA_SPEED
1994	CTL_CEA_SPEED_LAST
1990	CTL_CEA_STEP
1981	CTL_CEA_TREF_FULL
1980	CTL_CEA_TREF_NO
1983	CTL_CEA_TURBLD_GAIN
1984	CTL_CEAPOSITION_FRAC
2319	CTL_CETOP_MIN_DNBR
2320	CTL_CETOP_MIN_DNBR_TIME
2029	CTL_CH_FLOW
2031	CTL_CH_H
2017	CTL_CH_PUMP_AUTO
2016	CTL_CH_PUMP_FRAC
2018	CTL_CH_PUMP_ON
2009	CTL_CH_PUMP_W_RATED
2030	CTL_CH_T
2004	CTL_CHARGING_SETPOINTS
524	CTL_CHGS_CONTROLLERS
2021	CTL_CHV_FRAC
2022	CTL_CHV_RAREA
574	CTL_CONSTS
2243	CTL_CONTROLLER
521	CTL_CONTROLLER_NUMBERS
1927	CTL_CORE_CONTROL
1974	CTL_CORE_CONTROL_AUTO
2317	CTL_CORE_FLOW_FRAC
1943	CTL_CORE_HI_CONT_PRES_TRIP
2262	CTL_CORE_HI_CONT_PRES_TRIP_DL
1966	CTL_CORE_HI_CONT_PRES_TRIP_OR
1929	CTL_CORE_HI_POWER_FRAC_TRIP
2249	CTL_CORE_HI_POWER_FRAC_TRIP_DL
1952	CTL_CORE_HI_POWER_FRAC_TRIP_OR
1946	CTL_CORE_HI_POWER_SUR_BYPS
1930	CTL_CORE_HI_POWER_SUR_TRIP
2250	CTL_CORE_HI_POWER_SUR_TRIP_DL
1953	CTL_CORE_HI_POWER_SUR_TRIP_OR
1933	CTL_CORE_HI_PRZR_LEVEL_TRIP
2253	CTL_CORE_HI_PRZR_LEVEL_TRIP_DL
1956	CTL_CORE_HI_PRZR_LEVEL_TRIP_OR
1932	CTL_CORE_HI_PRZR_PRES_TRIP
2252	CTL_CORE_HI_PRZR_PRES_TRIP_DL
1955	CTL_CORE_HI_PRZR_PRES_TRIP_OR
1940	CTL_CORE_HI_SG_LEVEL_TRIP
2260	CTL_CORE_HI_SG_LEVEL_TRIP_DL
1963	CTL_CORE_HI_SG_LEVEL_TRIP_OR
1931	CTL_CORE_LOW_PRZR_PRES_TRIP
2251	CTL_CORE_LOW_PRZR_PRES_TRIP_DL
1954	CTL_CORE_LOW_PRZR_PRES_TRIP_OR
1939	CTL_CORE_LOW_SG_LEVEL_TRIP
2259	CTL_CORE_LOW_SG_LEVEL_TRIP_DL
1962	CTL_CORE_LOW_SG_LEVEL_TRIP_OR
1938	CTL_CORE_LOW_SG_PRES_TRIP
2258	CTL_CORE_LOW_SG_PRES_TRIP_DL

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1961	CTL_CORE_LOW_SG_PRES_TRIP_OR
1935	CTL_CORE_OVER_POWER_MRGN_TRIP
2255	CTL_CORE_OVER_POWER_MRGN_TRIP_DL
1958	CTL_CORE_OVER_POWER_MRGN_TRIP_OR
1934	CTL_CORE_OVER_TEMP_MRGN_TRIP
2254	CTL_CORE_OVER_TEMP_MRGN_TRIP_DL
1957	CTL_CORE_OVER_TEMP_MRGN_TRIP_OR
1969	CTL_CORE_POWER
1972	CTL_CORE_POWER_FRAC_LAST
1971	CTL_CORE_POWER_FRACTION
1947	CTL_CORE_POWER_RATIO
2279	CTL_CORE_POWERA
1977	CTL_CORE_PTRIP
1936	CTL_CORE_RCSFLOW_FRAC_TRIP
2256	CTL_CORE_RCSFLOW_FRAC_TRIP_DL
1959	CTL_CORE_RCSFLOW_FRAC_TRIP_OR
1928	CTL_CORE_SETPOINTS_FOR_TRIP
1937	CTL_CORE_SIAS_TRIP
2257	CTL_CORE_SIAS_TRIP_DL
1960	CTL_CORE_SIAS_TRIP_OR
1975	CTL_CORE_TRIP
542	CTL_CORE_TRIP_CONTROLLER
2248	CTL_CORE_TRIP_DELAYS
1951	CTL_CORE_TRIP_OR
1976	CTL_CORE_TRIP_SIG
1949	CTL_CORE_TURB_TRIP_BYPS
1942	CTL_CORE_TURB_TRIP_DELAY
1965	CTL_CORE_TURB_TRIP_DELAY_OR
1950	CTL_CORE_USER_DEFINED_BYPS
1944	CTL_CORE_USER_DEFINED_TRIP
2263	CTL_CORE_USER_DEFINED_TRIP_DL
1967	CTL_CORE_USER_DEFINED_TRIP_OR
2005	CTL_CVCS_CH1_SPOINT
2006	CTL_CVCS_CH2_SPOINT
2007	CTL_CVCS_CH3_SPOINT
2008	CTL_CVCS_CH4_SPOINT
1995	CTL_CVCS_COMMON
2010	CTL_CVCS_CONTROL
2003	CTL_CVCS_LDN_W_GPM
2002	CTL_CVCS_LDN_ZSPOINT
2020	CTL_CVCS_RCS_VALVES
2023	CTL_CVCS_TH_VARIABLES
573	CTL_DBG
2247	CTL_DELAYS
2151	CTL_FWS_AUTO
2167	CTL_FWS_BYP_SIG
548	CTL_FWS_BYPS_CONTROLLERS
2137	CTL_FWS_CONTROL
2152	CTL_FWS_CONTROL_AUTO
525	CTL_FWS_CONTROLLERS
526	CTL_FWS_ECON_CONTROLLERS
2162	CTL_FWS_ECON_POS
2159	CTL_FWS_ECON_SIG
2154	CTL_FWS_ECON_VALVE_AUTO
2147	CTL_FWS_H
2148	CTL_FWS_H_MAX
2149	CTL_FWS_H_TC
2166	CTL_FWS_ISO_POS
549	CTL_FWS_ISOL_CONTROLLERS
2144	CTL_FWS_MAX_FLOW
2161	CTL_FWS_POS
2155	CTL_FWS_PUMP_AUTO
527	CTL_FWS_PUMP_CONTROLLERS
2138	CTL_FWS_SETPOINTS
2141	CTL_FWS_SG_LEVEL_HIGH
2139	CTL_FWS_SG_LEVEL_LOAD
2140	CTL_FWS_SG_LEVEL_LOW
2158	CTL_FWS_SIG
2164	CTL_FWS_SPEED_FRAC
2165	CTL_FWS_SPEED_MAX
2145	CTL_FWS_SPEED_MULT
2163	CTL_FWS_SPEED_SIG
2150	CTL_FWS_TRIP
2156	CTL_FWS_TRIP_AUTO
528	CTL_FWS_TRIP_CONTROLLER
2267	CTL_FWS_TRIP_DELAY
2146	CTL_FWS_TRIP_SP
2143	CTL_FWS_TURB_TRIP_DELAY
2142	CTL_FWS_TURB_TRIP_FRAC
2153	CTL_FWS_VALVE_AUTO
2160	CTL_FWS_VALVE_POS
2157	CTL_FWS_VALVE_SIG
2209	CTL_GRAPH_FILE
2208	CTL_GRAPH_INTERVAL
2024	CTL_HA_REG_HEAT_X
576	CTL_HALF
2318	CTL_HEAT_FLUX_FRAC
529	CTL_HEATER_CONTROLLERS
2032	CTL_HEATERS_CONTROL
2044	CTL_HEATERS_CONTROL_AUTO
2066	CTL_HPSI_FLOW_TABLE
2065	CTL_HPSI_NPOINTS_TAB
2067	CTL_HPSI_PRES_TABLE
2068	CTL_HPSI_PUMP_NUM
2069	CTL_HPSI_SPLIT
2239	CTL_ILEVEL

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Index	Long Variable Name
569	CTL_INIT
2225	CTL_INITIAL_CONDITIONS
2316	CTL_INITIAL_CORE_FLOW
2314	CTL_INTEG_MSLB_IN_FLOW
2315	CTL_INTEG_MSLB_OUT_FLOW
2312	CTL_INTEG_PFLOW_NONMOM
2313	CTL_INTEG_SGS_VALVES
2019	CTL_LDN_AUTO
2025	CTL_LDN_FLOW
2027	CTL_LDN_H
2026	CTL_LDN_T
530	CTL_LETDOWN_CONTROLLERS
2028	CTL_LETDOWN_FRAC
2001	CTL_LETDOWN_SETPOINTS
2035	CTL_LEVEL_HEATER_OFF
579	CTL_LIMITS
2071	CTL_LPSI_FLOW_TABLE
2070	CTL_LPSI_NPOINTS_TAB
2072	CTL_LPSI_PRES_TABLE
2073	CTL_LPSI_PUMP_NUM
2074	CTL_LPSI_SPLIT
578	CTL_M_ONE
2298	CTL_MAX_HEAT_FLUX_FRAC
2299	CTL_MAX_HEAT_FLUX_TIME
2296	CTL_MAX_POWER_FRAC
2297	CTL_MAX_POWER_TIME
2300	CTL_MAX_PRZR_PRESS
2301	CTL_MAX_PRZR_PRESS_TIME
2304	CTL_MAX_RCS_PRESS
2305	CTL_MAX_RCS_PRESS_TIME
2308	CTL_MAX_SG_PRESS
2309	CTL_MAX_SG_PRESS_TIME
2302	CTL_MIN_PRZR_PRESS
2303	CTL_MIN_PRZR_PRESS_TIME
2306	CTL_MIN_RCS_PRESS
2307	CTL_MIN_RCS_PRESS_TIME
2310	CTL_MIN_SG_PRESS
2311	CTL_MIN_SG_PRESS_TIME
2271	CTL_MISC_DELAYS
2192	CTL_MISC_SETPOINTS
2264	CTL_MISC_TRIP_DELAYS
2113	CTL_MSIS_CONT_PRES_TRIP
2110	CTL_MSIS_CONTROL
2115	CTL_MSIS_CONTROL_AUTO
2111	CTL_MSIS_SETPOINTS
2112	CTL_MSIS_SG_PRES_TRIP
2114	CTL_MSIS_SG_SLFLOW_TRIP
2116	CTL_MSIS_TRIP
532	CTL_MSIS_TRIP_CONTROLLER
2266	CTL_MSIS_TRIP_DELAY
531	CTL_MSIV_CONTROLLERS
533	CTL_MSLH_CONTROLLERS
1973	CTL_NUM_RPS
577	CTL_ONE
2203	CTL_OUTPUT
2212	CTL_OUTPUT_3DMAP
2206	CTL_OUTPUT_COUNT
2204	CTL_OUTPUT_INTERVAL
2210	CTL_OUTPUT_LOOP
2207	CTL_OUTPUT_NTITLE
2211	CTL_OUTPUT_OPCL
2205	CTL_OUTPUT_OPTION
2056	CTL_PORV_AUTO
534	CTL_PORV_CONTROLLERS
2052	CTL_PORV_PSET
543	CTL_POWER_CUTBACK_CONTROLLER
2038	CTL_PRES_BHEATER_OFF
2039	CTL_PRES_BHEATER_ON
2036	CTL_PRES_PHEATER_OFF
2037	CTL_PRES_PHEATER_ON
2050	CTL_PRESSURIZER_RELIEF
2034	CTL_PRZR_BHLEVEL_SPOINT
2033	CTL_PRZR_HEATER_SETPOINTS
2043	CTL_PRZR_HEATERS_VOLT
2241	CTL_PRZR_ILEVEL
2012	CTL_PRZR_LEVEL_ERROR
2013	CTL_PRZR_LEVEL_INST
1996	CTL_PRZR_LEVEL_SETPOINTS
1999	CTL_PRZR_LIQ_SPVOL_REF
546	CTL_PRZR_LVL_ERR_CONTROLLER
1998	CTL_PRZR_PLEVEL
1997	CTL_PRZR_PLEVEL_TEMP
2011	CTL_PRZR_PROG_LEVEL
547	CTL_PRZR_PROG_LVL_CONTROLLER
2040	CTL_PRZR_REF_PRES
2051	CTL_PRZR_RELIEF_SETPOINTS
2045	CTL_PRZR_SPRAY_CONTROL
2049	CTL_PRZR_SPRAY_CONTROL_AUTO
2048	CTL_PRZR_SPRAY_PRES_OFF
2047	CTL_PRZR_SPRAY_PRES_ON
2046	CTL_PRZR_SPRAY_SETPOINTS
2000	CTL_PRZR_STM_SPVOL_REF
535	CTL_PSV_CONTROLLERS
2055	CTL_PSV_PSET_BLDN
2054	CTL_PSV_PSET_CLOSE
2053	CTL_PSV_PSET_OPEN

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Index	Long Variable Name
1970	CTL_QCORE_TRIP
1945	CTL_RCP_FLOW_STPOINT
2180	CTL_RPCS_CONTROL
2182	CTL_RPCS_CONTROL_AUTO
2184	CTL_RPCS_PTRIP
2181	CTL_RPCS_SETPOINTS
2183	CTL_RPCS_TRIP
2268	CTL_RPCS_TRIP_DELAY
2185	CTL_RPCS_TRIP_TIME
536	CTL_RPS_CONTROLLERS
2094	CTL_SDC_CONTROL
2095	CTL_SDC_DH
2096	CTL_SDC_H_MIN
2097	CTL_SDC_SPLIT
2194	CTL_SET_DELTEMP
2195	CTL_SET_DELTEMPD
2199	CTL_SET_FLOW
2200	CTL_SET_FLOWD
2198	CTL_SET_NODIM
2201	CTL_SET_PERTIME
2196	CTL_SET_PRES
2197	CTL_SET_PRESD
2193	CTL_SET_TEMP
2240	CTL_SG_ILEVEL
2131	CTL_SG_SAFETIES
2132	CTL_SG_SV_SETPOINTS
2136	CTL_SGSV_ASET_OPEN
2135	CTL_SGSV_PSET_CLOSE
2134	CTL_SGSV_PSET_FULL
2133	CTL_SGSV_PSET_OPEN
2077	CTL_SIAS_CONTROL_AUTO
2061	CTL_SIAS_HI_CONT_PRES
2063	CTL_SIAS_LOW_SL_PRES
2062	CTL_SIAS_LOW_TAVG
2059	CTL_SIAS_PRZR_PRES_LOW
2079	CTL_SIAS_PTRIP
2058	CTL_SIAS_SETPOINTS
2060	CTL_SIAS_SL_SH_DP
2075	CTL_SIAS_TIME
2078	CTL_SIAS_TRIP
537	CTL_SIAS_TRIP_CONTROLLER
2057	CTL_SIS_COMMON
2064	CTL_SIS_CONTROL
2076	CTL_SIS_DELAY
2080	CTL_SIS_FLOW
2081	CTL_SIS_HLPSI_BC
2082	CTL_SIS_HLPSI_H
2083	CTL_SIS_SIT_BC
2084	CTL_SIS_SIT_H
2086	CTL_SIT_ELEV_PRES
2087	CTL_SIT_FLOW_COEFF
2088	CTL_SIT_GAS_CONST
2089	CTL_SIT_GAS_PRES
2090	CTL_SIT_GAS_VOLUME
2091	CTL_SIT_ISO_VALVE
2092	CTL_SIT_LIQ_SPVOL
2093	CTL_SIT_LIQ_VOLUME
2085	CTL_SIT_NUM
2228	CTL_SPARE
2213	CTL_SPARE2
538	CTL_SPRAY_CONTROLLERS
1948	CTL_STEAM_FEED_MISMATCH_BYPS
1941	CTL_STEAM_FEED_MISMATCH_TRIP
2261	CTL_STEAM_FEED_MISMATCH_TRIP_DL
1964	CTL_STEAM_FEED_MISMATCH_TRIP_OR
2295	CTL_SUMMARY_DATA
2014	CTL_T_AVG
539	CTL_T_AVG_CONTROLLER
2015	CTL_T_REF
540	CTL_T_REF_CONTROLLER
553	CTL_TAV_NUM
554	CTL_TAV_PATH
2214	CTL_TIME_BLOCK
2202	CTL_TIME_CONSTANTS
1968	CTL_TIME_CORE_TRIP
1926	CTL_TIME_STEP
12	CTL_TITLE
2101	CTL_TURB_AOUT_TC
2121	CTL_TURB_BYPASS_CONTROL
2130	CTL_TURB_BYPASS_CONTROL_AUTO
555	CTL_TURB_BYPASS_NUM
556	CTL_TURB_BYPASS_PATH
2122	CTL_TURB_BYPASS_SETPOINTS
2098	CTL_TURB_CONTROL
2105	CTL_TURB_CONTROL_AUTO
2106	CTL_TURB_CONTROL_LOAD
2103	CTL_TURB_DEMAND
2124	CTL_TURB_DUMP_DELP
2129	CTL_TURB_DUMP_MODE
2128	CTL_TURB_DUMP_NCLOSE
2126	CTL_TURB_DUMP_NOPEN
2123	CTL_TURB_DUMP_OPEN
2127	CTL_TURB_DUMP_QCLOSE
2125	CTL_TURB_DUMP_QOPEN
2109	CTL_TURB_PTRIP
2191	CTL_TURB_RUNBACK

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Index	Long Variable Name	Index	Long Variable Name
2189	CTL_TURB_RUNBACK_AUTO	225	DESIGN_FLOW_SAFETY2
545	CTL_TURB_RUNBACK_CONTROLLER	890	DHDM
2270	CTL_TURB_RUNBACK_DELAY	889	DHDU
2188	CTL_TURB_SETBACK_AUTO	893	DHF_DP
2186	CTL_TURB_SETBACK_CONTROL	894	DHG_DP
544	CTL_TURB_SETBACK_CONTROLLER	1478	DMW_QT_ENTH
2187	CTL_TURB_SETBACK_SETPOINTS	1477	DMW_QT_FLOW
2190	CTL_TURB_SETBACK_TRIP	1022	DP_ACTUAL
2269	CTL_TURB_SETBACK_TRIP_DELAY	1023	DP_CHECK
2099	CTL_TURB_SETPOINTS	1017	DP_ELEV
2104	CTL_TURB_STEAM_RATED	1020	DP_EXT
2107	CTL_TURB_TRIP	1016	DP_FRIC
2108	CTL_TURB_TRIP_AUTO	1127	DP_GLOB
541	CTL_TURB_TRIP_CONTROLLERS	1019	DP_HEAD
2265	CTL_TURB_TRIP_DELAY	1018	DP_LOSS
2102	CTL_TURB_TRIP_TIME	1049	DP_LOSS_UPLEN
2100	CTL_TURB_TRIP_VALVE_TIME	1015	DP_MOM
2226	CTL_UNUSED	1095	DP_NON_UHEAD
2042	CTL_VOLT_BACK	1039	DP_PUMP
2041	CTL_VOLT_PROP	1021	DP_TOT
587	CTL_WARN	885	DPDM_LIQ
575	CTL_ZERO	886	DPDM_STM
584	CTLMAX	884	DPDM_TOT
274	CURRENT_TAB	888	DPDU_STM
1523	CVCS_DATA	887	DPDU_TOT
1531	CVCS_RHX_DATA	899	DRFT_BUB
1535	CVCS_RHX_HCH	273	DTDW_TAB
1538	CVCS_RHX_HEAT	1456	DUM001
1534	CVCS_RHX_HLDN	892	DVDH_TOT
1533	CVCS_RHX_TCH	891	DVDP_TOT
1532	CVCS_RHX_TLDN	895	DVF_DP
1537	CVCS_RHX_WCH	896	DVG_DP
1536	CVCS_RHX_WLDN	559	ELEMS
557	DBADD	423	ELEV_TUBE_SHEET
558	DBCOM	560	ELIN
2371	DBG_SGTR_FLOW_SLOT	2244	ELLAST
2369	DBG_SGTR_FLOW1	580	ELMAX
2370	DBG_SGTR_FLOW2	561	ELTYPE
2368	DBG_SGTR_PARTITION	1118	ENGY_GLOB
2375	DBG_SGTR_PRESS_ITER	1058	ENGY_HEATER
2372	DBG_SGTR_PRESS_PRI1	1105	ENGY_QT
2373	DBG_SGTR_PRESS_PRI2	841	ENGY_STM
2374	DBG_SGTR_PRESS_SG	1166	ENGY_STM_LAST
2376	DBG_SGTR_SVOL_TUBE1	840	ENGY_TOT
2377	DBG_SGTR_SVOL_TUBE2	1167	ENGY_TOT_LAST
2215	DELT	1117	ENTH_GLOB
223	DESIGN_FLOW_PORV	849	ENTH_LIQ
224	DESIGN_FLOW_SAFETY1	1173	ENTH_LIQ_LAST

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Index	Long Variable Name	Index	Long Variable Name
852	ENTH_LIQ_SAT	1765	FWLB_F
1122	ENTH_LIQ_SAT_GLOB	1768	FWLB_FLOW
1175	ENTH_LIQ_SAT_LAST	1770	FWLB_H
851	ENTH_MIX	1758	FWLB_IN
1104	ENTH_QT	1777	FWLB_IO
1051	ENTH_QUAD_CORE	1776	FWLB_IODINE
850	ENTH_STM	1764	FWLB_LOCATION
1174	ENTH_STM_LAST	1761	FWLB_OUT
853	ENTH_STM_SAT	1779	FWLB_PART
1123	ENTH_STM_SAT_GLOB	1780	FWLB_PT
848	ENTH_TOT	1774	FWLB_QUAL
1091	ENTH_UHEAD_TOP	1773	FWLB_QUALITY
1025	ESUBK	1767	FWLB_W
400	EVAP_SS_ALPHA	1783	FWLB_XE
204	EXCORE_BOT	1782	FWLB_XENON
800	EXCORE_OFFSET	2420	FWS_AEXTF
802	EXCORE_OFFSET_AV	2430	FWS_AFWLB
799	EXCORE_POWER	2462	FWS_ATABLE
801	EXCORE_POWER_AV	2461	FWS_BTABLE
798	EXCORE_POWERD	2378	FWS_COMMON
803	EXCORE_TAU	1743	FWS_CON_IO
205	EXCORE_TOP	1744	FWS_CON_PT
1179	FATAL_INPUT_ERROR	1745	FWS_CON_XE
1180	FATAL_OUTPUT_ERROR	2381	FWS_CV
586	FCTMAX	2406	FWS_CV_AFLO
2216	FDELT	2408	FWS_CV_DPMIN
1886	FHINIT	2407	FWS_CV_RESMN
1196	FLAG_LOCA	2440	FWS_CVP
1195	FLAG_RODEJ	2436	FWS_CVV
2224	FLGQUE	2505	FWS_DCL_MASS
1042	FLOW_CORE_IN	494	FWS_DIAM
2563	FLOW_DP_MAX_ERR	2380	FWS_DPEL
2564	FLOW_DP_NODE_MAX_ERR	2506	FWS_ECL_MASS
2565	FLOW_DP_PRINT_NODE	495	FWS_ECON_DIAM
259	FRAC_HD_TABL	1737	FWS_ECON_FLOW
234	FRAC_TABL	477	FWS_ECON_JUNCTION
1026	FSUBK	489	FWS_ECON_LINE_COEFF
595	FUEL_DENSITY	1742	FWS_ECON_LINE_H
464	FW_COEFF	1751	FWS_ECON_NOZ_ENTH
467	FWLB_AREA	1748	FWS_ECON_NOZ_FLOW
1772	FWLB_ECON_ENTH	1754	FWS_ECON_NOZ_QUAL
1766	FWLB_ECON_F	1757	FWS_ECON_NOZ_T
1769	FWLB_ECON_FLOW	486	FWS_ECON_VALVE_COEFF
1778	FWLB_ECON_IO	1731	FWS_ECON_VALVE_P
1781	FWLB_ECON_PT	492	FWS_ECON_VOL
1775	FWLB_ECON_QUAL	1739	FWS_ENTH
1784	FWLB_ECON_XE	1892	FWS_ENTH_TABLE
1771	FWLB_ENTH	2473	FWS_FDHEAT

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Index	Long Variable Name
2490	FWS_FDMODL
2411	FWS_FDNODE
2379	FWS_FDPATH
2484	FWS_FDPOS0
2454	FWS_FDPUMP
2509	FWS_FDSYST
2433	FWS_FDVALV
1736	FWS_FLOW
1738	FWS_FLOW_TOT
465	FWS_FLOW100
2497	FWS_FWRCINT
2495	FWS_FWRCIR
2496	FWS_FWRCOUT
2492	FWS_FWRCPB
2493	FWS_FWRCRE
2494	FWS_FWRCSP
2397	FWS_GPMCOR
2392	FWS_HEXT
2419	FWS_HEXTF
2413	FWS_HEXTN
2485	FWS_HFWBIAS
2416	FWS_HNODE
2388	FWS_HPATH
2459	FWS_HT
1893	FWS_HTABLE_ENTH
1894	FWS_HTABLE_LOAD
1895	FWS_HTABLE_NUM
2479	FWS_HTRHMX
2476	FWS_HTRHOV
2501	FWS_IAUTORC
2403	FWS_ICK
2402	FWS_ICPUMP
2503	FWS_IFTRIP
2504	FWS_IFTRPO
2404	FWS_IMF
2423	FWS_IMN
2445	FWS_INDEXF
476	FWS_JUNCTION
1728	FWS_JUNCTION_P
2410	FWS_KEY
488	FWS_LINE_COEFF
487	FWS_LINE_COEFFS
493	FWS_LINE_DIAMS
1740	FWS_LINE_ENTHALPIES
1735	FWS_LINE_FLOWS
1741	FWS_LINE_H
475	FWS_LINE_JUNCTION
2508	FWS_LINE_MASSES
490	FWS_LINE_VOLUMES
2483	FWS_MAXTAU
2451	FWS_NAFWVT
2401	FWS_NCPUMP
2400	FWS_NDEXT
2398	FWS_NDIN
2399	FWS_NDOUT
2472	FWS_NEFWP
2425	FWS_NEXTN
2409	FWS_NFLO
2489	FWS_NHDPTBL
2449	FWS_NHDV
2488	FWS_NHT
2487	FWS_NHTBL
2471	FWS_NMFWP
2424	FWS_NNOD
1750	FWS_NOZ_ENTH
1747	FWS_NOZ_FLOW
468	FWS_NOZ_HEIGHT
1753	FWS_NOZ_QUAL
1756	FWS_NOZ_T
1749	FWS_NOZZLE_ENTHALPY
1746	FWS_NOZZLE_FLOW
1752	FWS_NOZZLE_QUALITY
1755	FWS_NOZZLE_TEMP
2442	FWS_NPATH
2429	FWS_NPFWLB
2486	FWS_NPHEAT
2431	FWS_NPMFPRV
2467	FWS_NPMPEFW
2466	FWS_NPMPMFW
2500	FWS_NPMPRC
2463	FWS_NPMPTH
2428	FWS_NPSGAFW
2427	FWS_NPSGECO
2426	FWS_NPSGMFW
2468	FWS_NPTHMFP
2498	FWS_NPTHRC
2465	FWS_NPTP
2444	FWS_NPTV
2469	FWS_NPUM
2491	FWS_NRCIRC
2432	FWS_NSG
2470	FWS_NTABFP
2453	FWS_NTABFV
2443	FWS_NTABLE
2464	FWS_NTABP
2452	FWS_NVAFW1

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Index	Long Variable Name	Index	Long Variable Name
2448	FWS_NVAL	2474	FWS_TPWR
2499	FWS_NVALRC	2475	FWS_TQLAG
2447	FWS_NVBFV	2481	FWS_TWHDP
2450	FWS_NVHDV	485	FWS_VALVE_COEFF
2446	FWS_NVMFV	484	FWS_VALVE_COEFFS
2415	FWS_P	1730	FWS_VALVE_P
2414	FWS_P0	1729	FWS_VALVE_PRESSURES
2384	FWS_PEXT	491	FWS_VOL
2421	FWS_PEXTF	2387	FWS_W
2412	FWS_PEXTN	2386	FWS_W0
2405	FWS_POSISO	2418	FWS_WEXTF
2435	FWS_POSIT	2385	FWS_WMAS
2395	FWS_PS	2422	FWS_WSUM
483	FWS_PUMP_COEFF	2460	FWS_WT
1734	FWS_PUMP_FLOW	562	GROUPS
481	FWS_PUMP_FLOW_NPOINTS	2245	GROUT
478	FWS_PUMP_FLOW_TABLE	583	GRPMAX
1733	FWS_PUMP_HEAD	2582	GS_PRZR_NONC
479	FWS_PUMP_HEAD_TABLE	2583	GS_SPECIES
474	FWS_PUMP_JUNCTION	2581	GS_VES_NONC
1727	FWS_PUMP_P	1481	GWS_QT_FLOW
1726	FWS_PUMP_PIN	1480	GWS_QT_PRES
1732	FWS_PUMP_SPEED	199	HA_CEA_CORE
482	FWS_PUMP_SPEED_NPOINTS	209	HA_UHEAD_CORE
480	FWS_PUMP_SPEED_TABLE	441	HA_WALLI_MSLH
2477	FWS_PWRTBL	499	HA_WALLI_SGBD
2389	FWS_QCURR	442	HA_WALLO_MSLH
2478	FWS_QPTBL	500	HA_WALLO_SGBD
2391	FWS_RES	245	HAD
2382	FWS_RESL	253	HADC
2390	FWS_RESV	2513	HALF_LIFE_SOLUTES
2393	FWS_RHOEXT	243	HAN
2383	FWS_RHOFD	251	HANC
2417	FWS_RHONOD	249	HAR
2394	FWS_RP	257	HARC
2455	FWS_SPDMD	247	HAT
2456	FWS_SPEED	255	HATC
2441	FWS_STP	214	HCAP_HEATER
2434	FWS_STROKE	260	HD_DEG_TABL
2396	FWS_SUMP	1038	HEAD_PUMP
2458	FWS_TAUOFF	875	HEAT_COND
2457	FWS_TAUON	870	HEAT_CONT
2438	FWS_TCLOS	1041	HEAT_CORE
2482	FWS_TENHDP	1057	HEAT_ELEC
2502	FWS_TIMET	871	HEAT_EXT
2439	FWS_TLAG	1060	HEAT_HEATER
2437	FWS_TOPN	874	HEAT_LIQ
2480	FWS_TPOWR	1061	HEAT_PRZR

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Index	Long Variable Name	Index	Long Variable Name
1036	HEAT_PUMP	572	INPED_PAGE
1033	HEAT_SG	571	INPED_SEQNCE
873	HEAT_STM	2276	INTERPOLATION_ERROR_OPTION
872	HEAT_TOT	2290	IODINE_TOTALS_PARTITION
869	HEAT_WALL	2360	JUNK_PARTITION
229	HEIGHT_QT	766	KFRAIN
385	HSP_TBL	195	KLOSS_UPLEN_NEG
386	HSP_TBL_DSGN1	194	KLOSS_UPLEN_POS
387	HSP_TBL_DSGN2	821	KSHAPIN
392	HT3_TBL	1525	LDN_PIPE_AREA
393	HT3_TBL_DSGN1	1524	LDN_PIPE_DATA
394	HT3_TBL_DSGN2	1529	LDN_PIPE_DELTA_ELEV
469	HTNOZ	1528	LDN_PIPE_KENT
470	HTNOZ_ECON	1527	LDN_PIPE_KGEOM
471	HTNOZ_EFW	1526	LDN_PIPE_LOD
246	HVD	1539	LDN_RCS_ENTH
254	HVDC	1540	LDN_RCS_PRES
244	HVN	1424	LDNS_RCS_FLOW
252	HVNC	878	LEVL_LIQ
250	HVR	1044	LEVL_LIQ_VESSEL
258	HVRC	877	LEVL_MIX
248	HVT	1046	LEVL_MIX_CORE
256	HVTC	1045	LEVL_MIX_VESSEL
2526	ID_TYPE_AIR	1062	LEVL_PRZR_DP
2518	ID_TYPE_BORON	219	LEVL_PRZR_RTD
2524	ID_TYPE_HYD	1106	LEVL_QT
2520	ID_TYPE_IODINE	220	LEVL_REF_BOT
2519	ID_TYPE_N16	221	LEVL_REF_TOP
2525	ID_TYPE_NIT	222	LEVL_RELIEF
2523	ID_TYPE_NONC	1197	LOCA_BLOWDOWN
2522	ID_TYPE_PART	581	LSTMAX
2517	ID_TYPE_SOLUTE	2246	MAL_CTL
2516	ID_TYPE_SPECIES	1760	MAL_FWLB_ECON_IN
2521	ID_TYPE_XENON	1763	MAL_FWLB_ECON_OUT
2230	INIT_ALL	1759	MAL_FWLB_IN
2237	INIT_CORE	1762	MAL_FWLB_OUT
2359	INIT_DEBUG_OUTPUT	1454	MAL_LB_LOCA
2229	INIT_FLAG	1530	MAL_LDN_BREAK
2238	INIT_ITER	1672	MAL_MSLB_IN
2233	INIT_OFF_CHT	1649	MAL_MSLB_OUT
2236	INIT_OFF_CON	1472	MAL_RCP_HIVIB
2231	INIT_OFF_MODELS	1471	MAL_RCP_LOCKED
2234	INIT_OFF_POW	1470	MAL_RCP_SHAFTBREAK
2232	INIT_OFF_RCS	1458	MAL_RCS_VALVE
2235	INIT_OFF_SGS	1473	MAL_ROD_CORE
582	INMAX	1457	MAL_ROD_EJECT
570	INPED	1453	MAL_SB_LOCA
588	INPED_FILE	1455	MAL_SGTR

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Index	Long Variable Name
1464	MAL_VLV_PRZR_CONT
1463	MAL_VLV_PRZR_MOV
1466	MAL_VLV_PRZR_MSPRAY
1461	MAL_VLV_PRZR_PORV
1465	MAL_VLV_PRZR_QT
1462	MAL_VLV_PRZR_SAFETY
1468	MAL_VLV_QT_CONT
1467	MAL_VLV_QT_GWS
1469	MAL_VLV_QT_NSUPPLY
1459	MAL_VLV_UHEAD_CONT
1460	MAL_VLV_UHEAD_QT
206	MAP_EXCORE
846	MASS_BUB
1170	MASS_BUB_LAST
1183	MASS_BUB_PRED
918	MASS_BUB_SECT
1108	MASS_GAS_QT
1116	MASS_GLOB
844	MASS_LIQ
1168	MASS_LIQ_LAST
1093	MASS_NON_UHEAD
2536	MASS_NONC_DIS
2569	MASS_NONC_DIS_RCS
2537	MASS_NONC_DIS_TOT
2566	MASS_NONC_RCS
2541	MASS_NONC_SEP
2562	MASS_NONC_SEP_RCS
2542	MASS_NONC_SEP_TOT
230	MASS_QT_MAX
845	MASS_STM
1169	MASS_STM_LAST
843	MASS_TOT
1171	MASS_TOT_LAST
1107	MASS_WAT_QT
593	MATTYP
443	MCP_WALL_MSLH
501	MCP_WALL_SGBD
28	MOD_INIT
29	MOD_INITV
830	MOD_OFF_CHT
833	MOD_OFF_POWER
832	MOD_OFF_QT
828	MOD_OFF_RCP
829	MOD_OFF_RCPOIL
831	MOD_OFF_RCS
1845	MOD_OFF_SGBD
2242	MODEL_ERROR
827	MODEL_OFF
2221	MODEL_QUEUE
2223	MODQUE
449	MSLB_AREA
1673	MSLB_IN_FLOW
1650	MSLB_OUT_FLOW
516	MSLH_ACROSS
517	MSLH_ACROSST
514	MSLH_AFRSL
1686	MSLH_AOUT
1687	MSLH_AOUT_ATM
1688	MSLH_AOUT_COND
1689	MSLH_AOUT_CONT
1690	MSLH_AOUT_TURB
1651	MSLH_CON_IO
1652	MSLH_CON_PT
1653	MSLH_CON_XE
1678	MSLH_CSL
1875	MSLH_DPMIN_MULT
1654	MSLH_DVDH
1655	MSLH_DVDP
1698	MSLH_ENTH_ATM
1703	MSLH_ENTH_COND
1708	MSLH_ENTH_CONT
1713	MSLH_ENTH_TURB
515	MSLH_FKBRK
518	MSLH_FKCROSS
519	MSLH_FKCROSST
1697	MSLH_FLOW_ATM
1724	MSLH_FLOW_CHOKED
1702	MSLH_FLOW_COND
1707	MSLH_FLOW_CONT
1712	MSLH_FLOW_TURB
1848	MSLH_FTIME_MAX
1656	MSLH_H
1657	MSLH_HF
1658	MSLH_HG
1674	MSLH_HSL
1699	MSLH_IO_ATM
1704	MSLH_IO_COND
1709	MSLH_IO_CONT
1723	MSLH_IO_CONT_INT_LEAK
1722	MSLH_IO_CONT_LEAK
1718	MSLH_IO_INT_ATM
1719	MSLH_IO_INT_COND
1720	MSLH_IO_INT_CONT
1717	MSLH_IO_INT_FLOW
1721	MSLH_IO_INT_TURB
1714	MSLH_IO_TURB

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Index	Long Variable Name	Index	Long Variable Name
1677	MSLH_ISL	1910	MSLH2_DVDP
1659	MSLH_M	1911	MSLH2_H
1660	MSLH_ML	1912	MSLH2_HF
450	MSLH_MSIV_AMAX	1913	MSLH2_HG
451	MSLH_MSIV_BYPASS_AMAX	1914	MSLH2_M
1682	MSLH_MSIV_BYPASS_POS	1915	MSLH2_ML
1680	MSLH_MSIV_POS	1916	MSLH2_P
1681	MSLH_MSIV_SIG	1917	MSLH2_Q
2274	MSLH_NO_MOISTURE_CARRY	1918	MSLH2_Q_ATM
1696	MSLH_OUTFLOW	1905	MSLH2_STATE
1661	MSLH_P	1919	MSLH2_SV
1675	MSLH_PSL	1920	MSLH2_SVF
1700	MSLH_PT_ATM	1921	MSLH2_SVG
1705	MSLH_PT_COND	1922	MSLH2_T
1710	MSLH_PT_CONT	1923	MSLH2_TWALL
1715	MSLH_PT_TURB	1924	MSLH2_X
1662	MSLH_Q	94	N_AREA_SECT
1663	MSLH_Q_ATM	73	N_BOT
1648	MSLH_STATE	193	N_BOT_UPLEN
1664	MSLH_SV	74	N_GEOM
1665	MSLH_SVF	81	N_HEAT_CAP
1666	MSLH_SVG	80	N_HEAT_XFER_BOT
1667	MSLH_T	79	N_HEAT_XFER_CONT
457	MSLH_TATM	77	N_HEAT_XFER_LIQ
1676	MSLH_TSL	78	N_HEAT_XFER_STM
1668	MSLH_TWALL	95	N_HEIGHT_SECT
452	MSLH_VALVE_AMAX	909	N_HETERO
454	MSLH_VALVE_EXIT	75	N_SECTIONS
453	MSLH_VALVE_INLET	192	N_TOP_UPLEN
455	MSLH_VALVE_NUM	82	N_XFER_BOIL
1683	MSLH_VALVE_POS	83	N_XFER_INJ
1684	MSLH_VALVE_SIG	907	NE_CANDIDATE
1669	MSLH_WIN	68	NODE_ANNUL
1691	MSLH_WOUT	71	NODE_AREA
1692	MSLH_WOUT_ATM	69	NODE_CEASH
1693	MSLH_WOUT_COND	54	NODE_CL
1694	MSLH_WOUT_CONT	55	NODE_CL1
1695	MSLH_WOUT_TURB	56	NODE_CL2
1670	MSLH_X	57	NODE_CL3
1701	MSLH_XE_ATM	58	NODE_CL4
1706	MSLH_XE_COND	65	NODE_CORE
1711	MSLH_XE_CONT	72	NODE_HEIGHT
1716	MSLH_XE_TURB	41	NODE_HL1
1679	MSLH_XSL	42	NODE_HL2
1906	MSLH2_CON_IO	43	NODE_HL3
1907	MSLH2_CON_PT	44	NODE_HL4
1908	MSLH2_CON_XE	66	NODE_PRZR
1909	MSLH2_DVDH	45	NODE_SG

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Index	Long Variable Name
47	NODE_SG1C
46	NODE_SG1H
60	NODE_SG1P
49	NODE_SG2C
48	NODE_SG2H
61	NODE_SG2P
51	NODE_SG3C
50	NODE_SG3H
62	NODE_SG3P
53	NODE_SG4C
52	NODE_SG4H
63	NODE_SG4P
67	NODE_UHEAD
908	NON_EQ_STATE
1096	NONC_DILU_RATE
2529	NONC_K_DISSOLVE
2530	NONC_MW
2510	NONCOND_COMMON
563	NOTAB
270	NPTS_TAB
496	NUM_AFW_PUMPS
23	NUM_BACK_HEATERS
202	NUM_CEAS
24	NUM_CHGS_PUMPS
38	NUM_CL_NODES
473	NUM_FWS_JUNCTIONS
472	NUM_FWS_PUMPS
211	NUM_HEATERS
36	NUM_HL_NODES
513	NUM_MSLH
33	NUM_NODES
34	NUM_NODES_SEC
2528	NUM_NONC
103	NUM_PATHS
106	NUM_PATHS_CL
100	NUM_PATHS_EXT
105	NUM_PATHS_HL
102	NUM_PATHS_INT
101	NUM_PATHS_LEAK
99	NUM_PATHS_MOM
107	NUM_PATHS_NONM
267	NUM_POLES
22	NUM_PROP_HEATERS
233	NUM_PUMPS
20	NUM_SG
35	NUM_SG_NODES
1497	NUM_SG_SECT
462	NUM_SL
37	NUM_SL_NODES
104	NUM_SML_BRK
2512	NUM_SOLUTES
183	P_AREA
190	P_AREA_ATWS_MAX
188	P_AREA_ATWS_MIN
1198	P_AREA_LEAK
191	P_AREA_RODEJ
456	P_ATMOSPHERE
1071	P_BORON_AUX_SPRAY
1068	P_BORON_SPRAY
2555	P_CONC_SOLU
1849	P_CONDENSER
185	P_DIAM_HYD
1031	P_ELEV_DOWN
177	P_ELEV_EXIT
155	P_ELEV_INLET
1030	P_ELEV_UP
945	P_ENTH
1070	P_ENTH_AUX_SPRAY
1083	P_ENTH_BLEED
966	P_ENTH_LIQ
1374	P_ENTH_LIQ_LB
1074	P_ENTH_RELIEF
1067	P_ENTH_SPRAY
967	P_ENTH_STM
1375	P_ENTH_STM_LB
1090	P_ENTH_UHEAD_CONT
1088	P_ENTH_UHEAD_QT
922	P_FLOW
1069	P_FLOW_AUX_SPRAY
2573	P_FLOW_AUXSP_NONC
1072	P_FLOW_BLEED
943	P_FLOW_CRIT
1176	P_FLOW_LAST
2557	P_FLOW_NONC
2558	P_FLOW_NONC_MOM
2559	P_FLOW_NONC_NONM
1202	P_FLOW_PRZR_CONT
1080	P_FLOW_PRZR_QT
1073	P_FLOW_RELIEF
1066	P_FLOW_SPRAY
1089	P_FLOW_UHEAD_CONT
1087	P_FLOW_UHEAD_QT
2560	P_FRAC_NONC
2561	P_FRAC_NONC_TOT
178	P_GEOM
1029	P_NODE_DOWN

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Index	Long Variable Name	Index	Long Variable Name
154	P_NODE_EXIT	232	PLT_RCS_RCP
132	P_NODE_INLET	21	PLT_RCS_TYPE
1028	P_NODE_UP	186	PLT_RCS_VES
1078	P_NONC_PRZR_CONT	329	PLT_RCS_VLVAREA
1079	P_NONC_PRZR_QT	379	PLT_SGS
1113	P_NONC_QT_CONT	463	PLT_SGS_FWS
1097	P_NONC_UHEAD_CONT	425	PLT_SGS_HEAT
1098	P_NONC_UHEAD_QT	380	PLT_SGS_INTERNAL
970	P_QUAL	439	PLT_SGS_MSLH
179	P_RADIUS	512	PLT_SGS_MSLH2
1013	P_STM_DOWN	497	PLT_SGS_SGBD
992	P_STM_UP	335	PLT_VLVAREA_PRZR_CONT
968	P_SVOL	334	PLT_VLVAREA_PRZR_MOV
1377	P_SVOL_LB	337	PLT_VLVAREA_PRZR_MSPRAY
1075	P_SVOL_RELIEF	332	PLT_VLVAREA_PRZR_PORV
991	P_VOID	336	PLT_VLVAREA_PRZR_QT
1376	P_VOID_LB	333	PLT_VLVAREA_PRZR_SAFETY
122	PATH_ANNUL_CORE	339	PLT_VLVAREA_QT_CONT
200	PATH_CEA_LOW	338	PLT_VLVAREA_QT_GWS
201	PATH_CEA_UP	340	PLT_VLVAREA_QT_NSUPPLY
128	PATH_CL	330	PLT_VLVAREA_UHEAD_CONT
123	PATH_CORE_UHEAD	331	PLT_VLVAREA_UHEAD_QT
127	PATH_HL	815	POW_AXIAL_DATA
182	PATH_KLOSS_NEG	747	POW_CORE_TRIP_FRACTION
181	PATH_KLOSS_POS	751	POW_DKHT_ANSDHC
125	PATH_LB_LOCA	748	POW_DKHT_COMMON
184	PATH_LEN_DIAM	753	POW_DKHT_DHCBEG
126	PATH_PUMP	754	POW_DKHT_DHCFCT
129	PATH_SG	756	POW_DKHT_IFDHC
124	PATH_SPRAY	749	POW_DKHT_INP
121	PATH_SURGE	752	POW_DKHT_NDHC
180	PATH_TLOA	755	POW_DKHT_STATE
130	PATH_UCEA	757	POW_DKHT_TIMDHC
402	PERIM	750	POW_DKHT_TIMDHT
6	PLANT_DATA_DATE	811	POW_EXCORE_CALIB
3	PLANT_DATA_FILE_NAME	804	POW_EXCORE_DATA
2	PLANT_DATA_LABEL	797	POW_EXCORE_DISP
5	PLANT_DATA_TIME	813	POW_EXCORE_GAIN
4	PLANT_DATA_TITLE	807	POW_EXCORE_OFFSET
520	PLT_CTL	809	POW_EXCORE_OFFSET_AV
13	PLT_DATA	796	POW_EXCORE_OUT
18	PLT_RCS	806	POW_EXCORE_POWER
19	PLT_RCS_DESIGN	808	POW_EXCORE_POWER_AV
31	PLT_RCS_NODALIZATION	805	POW_EXCORE_POWERD
30	PLT_RCS_NODE	814	POW_EXCORE_SVR
96	PLT_RCS_PATH	810	POW_EXCORE_TAU
210	PLT_RCS_PRZR	812	POW_EXCORE_TUNE
226	PLT_RCS_QT	724	POW_IFUPOW_TIM

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Index	Long Variable Name	Index	Long Variable Name
765	POW_INITIAL_CONDITIONS	767	POW_KIN_HERMITE_INPUT
689	POW_KIN_ALPHA	768	POW_KIN_HERMITE_PARAM
693	POW_KIN_BBAR	688	POW_KIN_INP
694	POW_KIN_BBARR	782	POW_KIN_MIX_CON_COLD
691	POW_KIN_BETA	783	POW_KIN_MIX_CON_HOT
791	POW_KIN_BORON_FB_OPTION	781	POW_KIN_MIXING_INPUT
742	POW_KIN_CHI2	793	POW_KIN_MOD_DENSITY_FB_OPTION
687	POW_KIN_COMMON	794	POW_KIN_MOD_DENSITY_OPTION
779	POW_KIN_CORE_W_FRACTAB	792	POW_KIN_MOD_TEMP_FB_OPTION
789	POW_KIN_CUT_ROD_OPTION	700	POW_KIN_MODDK
725	POW_KIN_CUTBACK	727	POW_KIN_NCUTBACK
720	POW_KIN_DENCOR	701	POW_KIN_NDKCON
785	POW_KIN_DH_FACTOR	702	POW_KIN_NDKCTM
732	POW_KIN_DK	703	POW_KIN_NDKDEN
729	POW_KIN_DK_INIT	723	POW_KIN_NDKINS
733	POW_KIN_DKBOR	704	POW_KIN_NDKTMP
709	POW_KIN_DKCON	705	POW_KIN_NQDK
695	POW_KIN_DKCONZ	730	POW_KIN_OUT
711	POW_KIN_DKCTM	692	POW_KIN_PLAM
696	POW_KIN_DKCTMZ	775	POW_KIN_POWTOFLOW_MAX
739	POW_KIN_DKCUT	772	POW_KIN_POWTOFLOW_MIN
713	POW_KIN_DKDEN	744	POW_KIN_QD2
697	POW_KIN_DKDENZ	717	POW_KIN_QDK
735	POW_KIN_DKDOP	745	POW_KIN_QF2
740	POW_KIN_DKHERMC	788	POW_KIN_REG_ROD_OPTION
721	POW_KIN_DKINS	787	POW_KIN_SCRAM_ROD_OPTION
699	POW_KIN_DKINSZ	706	POW_KIN_SIGD2
734	POW_KIN_DKMOD	728	POW_KIN_SOURCE
737	POW_KIN_DKROD	707	POW_KIN_STARL
738	POW_KIN_DKSCRAM	741	POW_KIN_STATE
731	POW_KIN_DKT	719	POW_KIN_T
736	POW_KIN_DKTMD	726	POW_KIN_TCUTBACK
715	POW_KIN_DKTMP	710	POW_KIN_TDKCON
698	POW_KIN_DKTMPZ	712	POW_KIN_TDKCTM
690	POW_KIN_DLAM	714	POW_KIN_TDKDEN
790	POW_KIN_DOPPLER_FB_OPTION	722	POW_KIN_TDKINS
784	POW_KIN_EDGE_WEIGHT	716	POW_KIN_TDKTMP
746	POW_KIN_EN2	774	POW_KIN_TEMP_TILT_MAX
743	POW_KIN_EX2	771	POW_KIN_TEMP_TILT_MIN
786	POW_KIN_FEEDBACK_OPTIONS	718	POW_KIN_TQDK
773	POW_KIN_FLOWFRAC_MIN	708	POW_KIN_TSS
795	POW_KIN_HERM_CREDIT_OPTION	676	POW_USER_COMMON
780	POW_KIN_HERM_CREDITTAB	679	POW_USER_IFUPOW
777	POW_KIN_HERM_FLOW_REF	677	POW_USER_INP
770	POW_KIN_HERM_MULT	681	POW_USER_NPOWT
778	POW_KIN_HERM_N_FLOWFR	682	POW_USER_POWT
776	POW_KIN_HERM_POW_REF	680	POW_USER_POWZ
769	POW_KIN_HERM_TD	816	POW_USER_QAXL

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Index	Long Variable Name	Index	Long Variable Name
685	POW_USER_QC	316	QT_VENT_MULT
686	POW_USER_QCD	1121	QUAL_GLOB
758	POW_USER_QCD_LOOKUP	881	QUAL_MIX
684	POW_USER_STATE	917	QUAL_MIX_SECT
683	POW_USER_TPOWT	2543	QUAL_NONC_SEP
759	POW_ZRH2O_COMMON	2544	QUAL_NONC_SEP_TOT
762	POW_ZRH2O_FZBJ	880	QUAL_TOT
764	POW_ZRH2O_H2M	269	RATED_BUS_VOLT
760	POW_ZRH2O_INP	263	RATED_PUMP_DENS
817	POW_ZRH2O_IZX	264	RATED_PUMP_HD
761	POW_ZRH2O_NYZIR	261	RATED_PUMP_SPEED
818	POW_ZRH2O_PCZR	266	RATED_PUMP_SYNCH
820	POW_ZRH2O_QZRH2O	265	RATED_PUMP_TORQ
763	POW_ZRH2O_STATE	262	RATED_VOL_FLOW
819	POW_ZRH2O_ZX	2362	RATIO_CONC_SOLU
675	POWER_COMMON	1493	RBINIT
2547	PPRES_NONC	1345	RCP_ADMI_FLOWCORR
2548	PPRES_NONC_TOT	368	RCP_ADMI_FLOWCORR_MULT
2549	PPRES_STM	1210	RCP_ADMI_IM
189	PRES_ATWS_MAX	1301	RCP_ADMI_MULT
187	PRES_ATWS_MIN	1209	RCP_ADMI_RE
1115	PRES_GLOB	1346	RCP_AMPS
1172	PRES_LAST	1224	RCP_BREAK
227	PRES_N2	372	RCP_CAVIT_LOAD_MULT
837	PRES_PRED	1331	RCP_CAVIT_SGDP_FRAC
1103	PRES_QT	358	RCP_CAVIT_SGDP_FRAC_MIN
838	PRESS	357	RCP_CAVIT_SGDP_MULT
275	PRESS_LDN	371	RCP_CAVIT_VIBR_MULT
2552	PRESS_STM_LAST	1204	RCP_COMMON
1448	PRSI_HEATER_VOLT_FRAC	369	RCP_DELAMPS
281	PRZR_HEATER_MULT	1302	RCP_DELSPEED_LOCKED
282	PRZR_PORV_MULT	1334	RCP_DT_LAST_TRIP
286	PRZR_QT_MULT	1206	RCP_ELECTRIC
285	PRZR_RELIEF_RTD_TAU	367	RCP_FLOW_REF
283	PRZR_SAFETY_MULT	362	RCP_FR_SP_RUB_RATCH
280	PRZR_SPRAY_MULT	1208	RCP_FREQ
284	PRZR_VENT_MULT	277	RCP_FREQ_RATED
2553	PTEMP_STM_SAT	1303	RCP_FRIC_COEFF
564	PTTAB	1217	RCP_HEAT
2550	PVOL_NONC_TOT	304	RCP_HEAT_MULT
429	QSG_TBL	1225	RCP_HI_VIB
428	QSG100	1205	RCP_INTERNAL
317	QT_FLOW_FRAC	1226	RCP_LOCKED
315	QT_GWS_MULT	1223	RCP_MALFUNCTION
1352	QT_J4_P	1213	RCP_MECHANICAL
1476	QT_MOD_INPUTS	303	RCP_MOM_INERTIA
314	QT_N2_MULT	305	RCP_MOM_INERTIA_SPLIT
231	QT_RUPTURE_SPOINT	1212	RCP_PF

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Index	Long Variable Name	Index	Long Variable Name
1312	RCP_RCP_START	1401	RCS_CHT_PRESS
1227	RCP_RCS_LEAK	1404	RCS_CHT_QUAL
1228	RCP_SEALS_LEAK	1407	RCS_CHT_QUALIN
1211	RCP_SLIP	1410	RCS_CHT_QWALL
1222	RCP_SPEED_DERIV	1411	RCS_CHT_TWALL
309	RCP_SPEED_DERIV_SHAKE	826	RCS_COMMON
1220	RCP_SPEED_MOTOR	1141	RCS_CONC_BORON
1219	RCP_SPEED_PUMP	1142	RCS_CONC_HYD
1335	RCP_STOPPED	1143	RCS_CONC_IOD
1353	RCP_TBEARING_HIGH	1144	RCS_CONC_PART
1215	RCP_TORQ_ELEC	1140	RCS_CONC_SOLU
1216	RCP_TORQ_FRIC	2538	RCS_CONC_SOLUTE
1214	RCP_TORQ_HYD	1145	RCS_CONC_XEN
363	RCP_TORQ_RUB_RATCH	324	RCS_COND_SURF_MULT
1336	RCP_TRIPPED	278	RCS_CONST
1218	RCP_VIBR	318	RCS_CONST_GENERAL
1221	RCP_VIBR_AMP	325	RCS_CONST_LEAKS
307	RCP_VIBR_MAX	310	RCS_CONST_LOOP
306	RCP_VIBR_NORM	279	RCS_CONST_PRZR
308	RCP_VIBR_TIME	302	RCS_CONST_PUMPS
1207	RCP_VOLT	313	RCS_CONST_QT
276	RCP_VOLT_RATED	293	RCS_CONST_UHEAD
1451	RCPI_FREQ_FRAC	311	RCS_CONT_HEAT_MULT
1449	RCPI_VOLT_FRAC	1040	RCS_CORE
92	RCS_ANNUL_ASECT	1177	RCS_CORE_FLASH_LAST
93	RCS_ANNUL_HSECT	1294	RCS_CORE_HYD_REL_MAX
91	RCS_ANNUL_NSECT	356	RCS_CRIT_FLOW_CHECK
1378	RCS_AREA_LB_LAST	1256	RCS_CRIT_MODEL
2284	RCS_BALANCE	2545	RCS_CUM_NONC
376	RCS_BHTR_RLD_MULT	2539	RCS_CUM_SOLU
1399	RCS_BORON_CORE	1052	RCS_DELH_HLTILT
1101	RCS_CEA_AV	1360	RCS_DELT
1100	RCS_CEA_MULT	1247	RCS_DELT_HEATER
301	RCS_CEAIN_KTERM	1363	RCS_DELT_WALL
950	RCS_CHGS_ENTH	1362	RCS_DELTA_T
927	RCS_CHGS_FLOW	1383	RCS_DELTEM_SG_LB
160	RCS_CHGS_PELEVIN	290	RCS_DFLASH_MAX_PRZR
137	RCS_CHGS_PNODEIN	1370	RCS_DHEAT_FASTT
975	RCS_CHGS_QUAL	370	RCS_DHEAT_FASTT_UHEAD_FRAC
997	RCS_CHGS_STM_UP	1371	RCS_DHEAT_MAX_FASTT
1406	RCS_CHT_ENTHIN	1372	RCS_DHEAT_STEP_FASTT
1402	RCS_CHT_ENTHLIQ	1305	RCS_DHF_MIN
1403	RCS_CHT_ENTHSTM	288	RCS_DM_FLASH_PRZR
1405	RCS_CHT_FLOWIN	1163	RCS_DOSE_2HR
1408	RCS_CHT_LEVMIX	1164	RCS_DOSE_8HR
1409	RCS_CHT_LEVSAT	1156	RCS_DOSE_BF
1413	RCS_CHT_MASSBUB	1157	RCS_DOSE_CF
1412	RCS_CHT_MASSLIQ	1161	RCS_DOSE_COND_DF

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Index	Long Variable Name	Index	Long Variable Name
1160	RCS_DOSE_CONT_LEAK	1317	RCS_INIT_P
1155	RCS_DOSE_FLASH	1324	RCS_INIT_T_LOOP
1154	RCS_DOSE_INIT_IOD	1323	RCS_INIT_T_PRZR
1162	RCS_DOSE_TOT_CURIE	1488	RCS_INITIAL_CONDITIONS
1153	RCS_DOSE_VARIABLES	1482	RCS_INPUTS_PRZR_RELIEF
1158	RCS_DOSE_XOQ2	834	RCS_INTERNAL
1159	RCS_DOSE_XOQ8	2294	RCS_IOD_REL_RATE
1306	RCS_DP_ELEV_SURGE	2293	RCS_IOD_REL_TOT
1380	RCS_DP_LEAK_LAST_LB	321	RCS_ITER_DH_NE
1325	RCS_DRAINS_SDC	319	RCS_ITER_DP
322	RCS_DROP_COND_MULT	320	RCS_ITER_DP_NE
1263	RCS_DTFOPEN_LB	1307	RCS_ITER_DPL
1310	RCS_DW_SDC	378	RCS_K_TEMPCL_LOCA
1350	RCS_DW_SIT	323	RCS_KLOSS_MULT
346	RCS_DWSOLID_SDC	208	RCS_KWEIGHT_HTILT
1311	RCS_DWSTP_SDC	1260	RCS_L_EFF_SPR
373	RCS_DWSTP_SIT	1373	RCS_LARGE_BREAK
1182	RCS_EQUILIBRIUM	1388	RCS_LB_LOCA_FIRST
1354	RCS_FAILURE_STATUS	1379	RCS_LB_SGDRAIN
1361	RCS_FDELT	960	RCS_LBLOCA_ENTH
1387	RCS_FLAG_COARSE_NODES	937	RCS_LBLOCA_FLOW
1382	RCS_FLAG_DP_LEAK_LB	171	RCS_LBLOCA_PELEVIN
1264	RCS_FRAC_SIT_12B	148	RCS_LBLOCA_PNODEIN
1276	RCS_FTIME_BUB	985	RCS_LBLOCA_QUAL
1368	RCS_FTIME_CVCS	1007	RCS_LBLOCA_STM_UP
1365	RCS_FTIME_HEAT	951	RCS_LDNS_ENTH
1246	RCS_FTIME_HEATER	928	RCS_LDNS_FLOW
1366	RCS_FTIME_PATHS	161	RCS_LDNS_PELEVIN
1292	RCS_FTIME_PRZR	138	RCS_LDNS_PNODEIN
1269	RCS_FTIME_SDC	976	RCS_LDNS_QUAL
1369	RCS_FTIME_SIT	998	RCS_LDNS_STM_UP
1253	RCS_FTIME_SPRAYS	289	RCS_LEVL_SAT_PRZR
1364	RCS_FTIME_WALL	2363	RCS_LINPROP_USER
165	RCS_GAS_PELEVIN	1184	RCS_LOCA_MAPPING
142	RCS_GAS_PNODEIN	1262	RCS_MAL038
1114	RCS_GLOBAL_AVERAGE	1194	RCS_MALFUNCTION
1266	RCS_H_SIT_CONT	1275	RCS_MAX_BC_EXT
1268	RCS_H_SURGE_TAU	1270	RCS_MAX_CHGS
1384	RCS_HA_PRIM	1326	RCS_MAX_DRAIN_SDC
1367	RCS_HEAT_FASTT	1241	RCS_MAX_EXT_ENTH
1381	RCS_HEAT_SG_MAX_LB	1272	RCS_MAX_LDNS
1450	RCS_HEATER_VOLT_BUS	1271	RCS_MAX_SIT
1286	RCS_HIGHP_COARSE_NODES	1273	RCS_MAX_WDRAIN
1181	RCS_HOMOGENEOUS	1274	RCS_MAX_WSDC
1236	RCS_ICOUNT_FLOWLIM_P	912	RCS_MBUB_SS
1231	RCS_ICOUNT_MUKPR_P	1240	RCS_MIN_EXT_ENTH
1319	RCS_INIT_AIR_PRZR	1414	RCS_MOD_INPUTS
1318	RCS_INIT_LEVEL_PRZR	1415	RCS_MOD_INPUTS_BOP

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Index	Long Variable Name	Index	Long Variable Name
1474	RCS_MOD_INPUTS_CONT	2556	RCS_NONCOND_PATHS
1452	RCS_MOD_INPUTS_MALFUNCTIONS	1230	RCS_NSTEP_CALCULATIONS
1431	RCS_MOD_INPUTS_VLVCONTR	1237	RCS_NUM_FLOWLIM_P
1447	RCS_MOD_INPUTS_VOLTCONTR	2364	RCS_NUM_LINPROP
1390	RCS_MOD_OUTPUTS	25	RCS_NUM_MSPRAYVLVS
1400	RCS_MOD_OUTPUTS_CHT	1232	RCS_NUM_MUKPR_P
1396	RCS_MOD_OUTPUTS_CORE	26	RCS_NUM_PORVS
1391	RCS_MOD_OUTPUTS_INSTRUM	27	RCS_NUM_SAFETYVLVS
341	RCS_MORE_VARIABLES_504_RO	108	RCS_NUMIN_CHGS
1330	RCS_MORE_VARIABLES_504_SR	112	RCS_NUMIN_SIS
1238	RCS_MORE_VARIABLES_A	114	RCS_NUMMAX_CHGSIN
1239	RCS_MORE_VARIABLES_I	116	RCS_NUMMAX_DRAINSOUT
1257	RCS_MORE_VARIABLES_II	115	RCS_NUMMAX_LDNSOUT
1285	RCS_MORE_VARIABLES_III	119	RCS_NUMMAX_MOM
1290	RCS_MORE_VARIABLES_IIIA	113	RCS_NUMMAX_RCP
1295	RCS_MORE_VARIABLES_IIIB	117	RCS_NUMMAX_SDCOUT
1298	RCS_MORE_VARIABLES_IV	118	RCS_NUMMAX_SISIN
1309	RCS_MORE_VARIABLES_V	109	RCS_NUMOUT_LDNS
1315	RCS_MORE_VARIABLES_VI	110	RCS_NUMOUT_RCWDRAINS
2286	RCS_NET_EXT_FLOW	111	RCS_NUMOUT_SDC
2287	RCS_NET_HEAT_RATE	1229	RCS_OPTIMIZATION
1355	RCS_NEVER_STOP_AUTO	959	RCS_ORING_ENTH
2285	RCS_NODAL_EXT_FLOWS	1344	RCS_ORING_FAIL
897	RCS_NODE_BUBBLES	936	RCS_ORING_FLOW
900	RCS_NODE_CONDENSATION	170	RCS_ORING_PELEVIN
883	RCS_NODE_DERIVATIVES	147	RCS_ORING_PNODEIN
839	RCS_NODE_ENERGIES	984	RCS_ORING_QUAL
847	RCS_NODE_ENTHALPIES	1006	RCS_ORING_STM_UP
70	RCS_NODE_GEOMETRY	1130	RCS_P_BORON
868	RCS_NODE_HEAT_RATES	1234	RCS_P_CONDUCT
40	RCS_NODE_HL	156	RCS_P_ELEV_INLET_MOM
876	RCS_NODE_LEVELS	157	RCS_P_ELEV_INLET_NONM
842	RCS_NODE_MASSES	1304	RCS_P_ELEV_MOD_SURGE
39	RCS_NODE_NUMBERS	946	RCS_P_ENTH_MOM
64	RCS_NODE_OTHERS	947	RCS_P_ENTH_NONM
836	RCS_NODE_PRESSURES	923	RCS_P_FLOW_MOM
87	RCS_NODE_SECTIONALIZED	924	RCS_P_FLOW_NONM
59	RCS_NODE_SL	1200	RCS_P_FLOW_PORV
854	RCS_NODE_SPEC_VOLUME	1203	RCS_P_FLOW_PRZR_QT1
906	RCS_NODE_STATES	1081	RCS_P_FLOW_PRZR_QT2
879	RCS_NODE_STEAM_FRAC	1201	RCS_P_FLOW_SAFETY
860	RCS_NODE_TEMPERATURE	1131	RCS_P_HYD
76	RCS_NODE_TH_VARS	1135	RCS_P_HYD_AUX_SPRAY
32	RCS_NODE_TOTALS	1132	RCS_P_IOD
835	RCS_NODE_VARIABLES	1136	RCS_P_IOD_AUX_SPRAY
2527	RCS_NONCOND_CONSTANTS	133	RCS_P_NODE_INLET_MOM
2572	RCS_NONCOND_INTERF	134	RCS_P_NODE_INLET_NONM
2540	RCS_NONCOND_NODES	1343	RCS_P_ORING

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366	RCS_P_ORING_FAIL	1289	RCS_PRZR_COND_WALL
1133	RCS_P_PART	1242	RCS_PRZR_CONT_HEAT_MULT
1137	RCS_P_PART_AUX_SPRAY	342	RCS_PRZR_DH_SPRAY_EQ
1235	RCS_P_PRANDTL	1299	RCS_PRZR_DT_BOIL
971	RCS_P_QUAL_MOM	1332	RCS_PRZR_DT_SUB_BOIL
972	RCS_P_QUAL_NONM	1300	RCS_PRZR_DT_SUBC
1129	RCS_P_SOLU	344	RCS_PRZR_DT_SUBH
1245	RCS_P_SPIKE_OUTPUT	1342	RCS_PRZR_DT_SUBSS
993	RCS_P_STM_UP_MOM	287	RCS_PRZR_FLASH_MULT
994	RCS_P_STM_UP_NONM	1254	RCS_PRZR_FLASH_TAU
1233	RCS_P_VISCOS	1199	RCS_PRZR_FLOW_VALVES
1134	RCS_P_XEN	1327	RCS_PRZR_FRAC_AIR
1138	RCS_P_XEN_AUX_SPRAY	364	RCS_PRZR_HAX_WALL
1165	RCS_PAST_VALUES	1291	RCS_PRZR_HLIQ_MULT
1024	RCS_PATH_DERIVATIVES	90	RCS_PRZR_HSECT
944	RCS_PATH_ENTHALPIES	1288	RCS_PRZR_HWALLF_MULT
921	RCS_PATH_FLOW_RATES	1328	RCS_PRZR_KH_STM
1014	RCS_PATH_PRESS_DROPS	1329	RCS_PRZR_KP_STM
969	RCS_PATH_QUALITIES	351	RCS_PRZR_L_BOIL
1027	RCS_PATH_UPDOWN	1283	RCS_PRZR_L_COND_OFF
920	RCS_PATH_VARIABLES	1297	RCS_PRZR_LEVEL
948	RCS_PATHEXT_ENTH	1338	RCS_PRZR_LEVL_LAST
925	RCS_PATHEXT_FLOW	1281	RCS_PRZR_LOWP_COND_LOG
158	RCS_PATHEXT_PELEVIN	365	RCS_PRZR_LVLDT_SUBC
135	RCS_PATHEXT_PNODEIN	1314	RCS_PRZR_MASS_AIR
973	RCS_PATHEXT_QUAL	1313	RCS_PRZR_MASS_STM
995	RCS_PATHEXT_STM_UP	359	RCS_PRZR_MSPRAY_TAU
961	RCS_PATHINT_ENTH	88	RCS_PRZR_NSECT
938	RCS_PATHINT_FLOW	1082	RCS_PRZR_PRES
172	RCS_PATHINT_PELEVIN	2568	RCS_PRZR_Q_COND
149	RCS_PATHINT_PNODEIN	1340	RCS_PRZR_Q_CONT
986	RCS_PATHINT_QUAL	2567	RCS_PRZR_Q_EFF
1008	RCS_PATHINT_STM_UP	1341	RCS_PRZR_QAX_WALL
955	RCS_PATHLEAK_ENTH	1322	RCS_PRZR_QUAL_RELIEF
932	RCS_PATHLEAK_FLOW	964	RCS_PRZR_RELIEF_ENTH
166	RCS_PATHLEAK_PELEVIN	941	RCS_PRZR_RELIEF_FLOW
143	RCS_PATHLEAK_PNODEIN	175	RCS_PRZR_RELIEF_PELEVIN
980	RCS_PATHLEAK_QUAL	152	RCS_PRZR_RELIEF_PNODEIN
1002	RCS_PATHLEAK_STM_UP	989	RCS_PRZR_RELIEF_QUAL
131	RCS_PATHS_GEOMETRY	1011	RCS_PRZR_RELIEF_STM_UP
97	RCS_PATHS_NODALIZATION	2534	RCS_PRZR_SPR_GAS_ENTR
120	RCS_PATHS_NUMBERS	343	RCS_PRZR_SPRAY_EQ
98	RCS_PATHS_TOTALS	1339	RCS_PRZR_T_WALL
375	RCS_PHTR_RLD_MULT	345	RCS_PRZR_TAU_DTSUB
360	RCS_PRES_COARSE_MAL034	1293	RCS_PRZR_TREF_TAU
1054	RCS_PRESSURIZER	347	RCS_PRZR_VENT_RIG
89	RCS_PRZR_ASECT	350	RCS_PRZR_VENT_RIG_FRAC
1337	RCS_PRZR_COND_SURF	377	RCS_PRZR_VLV_LVIB_MULT

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Index	Long Variable Name
374	RCS_PRZR_VLV_REVH_TAU
361	RCS_PRZR_VLVH_MAX_TAU
1034	RCS_PUMPS
1050	RCS_Q_CEA_CORE
297	RCS_Q_CEA_CORE_MULT
1053	RCS_Q_UHEAD_CORE
1282	RCS_QUAL_MIN_NE
1102	RCS_QUENCH_TANK
1348	RCS_RCP_CAVITAT
1347	RCS_RCP_SVOL
1333	RCS_RCP_VOIDF
949	RCS_RCPLEAK_ENTH
926	RCS_RCPLEAK_FLOW
159	RCS_RCPLEAK_PELEVIN
136	RCS_RCPLEAK_PNODEIN
974	RCS_RCPLEAK_QUAL
996	RCS_RCPLEAK_STM_UP
1389	RCS_RCSLB_FIRST
952	RCS_RCW_ENTH
929	RCS_RCW_FLOW
162	RCS_RCW_PELEVIN
139	RCS_RCW_PNODEIN
977	RCS_RCW_QUAL
999	RCS_RCW_STM_UP
1316	RCS_REINITIALIZE
1139	RCS_RELE_NONC
913	RCS_RELE_PRIME
1146	RCS_RELE_SOLU
1147	RCS_RELE_SOLU_CORE
958	RCS_RODEJ_ENTH
935	RCS_RODEJ_FLOW
169	RCS_RODEJ_PELEVIN
146	RCS_RODEJ_PNODEIN
983	RCS_RODEJ_QUAL
1005	RCS_RODEJ_STM_UP
957	RCS_SBLOCA_ENTH
934	RCS_SBLOCA_FLOW
168	RCS_SBLOCA_PELEVIN
145	RCS_SBLOCA_PNODEIN
982	RCS_SBLOCA_QUAL
1004	RCS_SBLOCA_STM_UP
953	RCS_SDC_ENTH
930	RCS_SDC_FLOW
163	RCS_SDC_PELEVIN
140	RCS_SDC_PNODEIN
978	RCS_SDC_QUAL
1000	RCS_SDC_STM_UP
1308	RCS_SDCSIT_CONSIST_TEST
1185	RCS_SEARCH_ITER
1186	RCS_SEARCH_TYPE
911	RCS_SECT_NODE_VARIABLES
352	RCS_SG_DP_ADD
1287	RCS_SG_DP_MULT
354	RCS_SG_DP_W_MULT
1498	RCS_SG_NSECT
1499	RCS_SG_SECT_DH
1500	RCS_SG_SECT_DW
1510	RCS_SG_SECT_ENTH
1501	RCS_SG_SECT_LH
1502	RCS_SG_SECT_LW
1507	RCS_SG_SECT_PRESS
1504	RCS_SG_SECT_QP
1505	RCS_SG_SECT_QS
1503	RCS_SG_SECT_TEMP
1509	RCS_SG_SECT_TOPT
1506	RCS_SG_SECT_TTUBE
353	RCS_SG1112_DP_ADD
355	RCS_SG1112_DP_W_MULT
956	RCS_SGTR_ENTH
933	RCS_SGTR_FLOW
312	RCS_SGTR_FLOWMULT
167	RCS_SGTR_PELEVIN
144	RCS_SGTR_PNODEIN
981	RCS_SGTR_QUAL
1003	RCS_SGTR_STM_UP
954	RCS_SIS_ENTH
931	RCS_SIS_FLOW
164	RCS_SIS_PELEVIN
141	RCS_SIS_PNODEIN
979	RCS_SIS_QUAL
1001	RCS_SIS_STM_UP
1128	RCS_SOLUTE
2511	RCS_SPECIES_CONSTANTS
2570	RCS_SPECIES_CORE
2535	RCS_SPECIES_NODES
2554	RCS_SPECIES_PATHS
1277	RCS_SPRAY_DELH_DEG
1258	RCS_SPRAY_EFF
1259	RCS_SPRAY_EFF_MULT
1278	RCS_SPRAY_EFF1
1280	RCS_SPRAY_EFF2
962	RCS_SPRAY_ENTH
939	RCS_SPRAY_FLOW
1284	RCS_SPRAY_PDEG_TERM
173	RCS_SPRAY_PELEVIN
150	RCS_SPRAY_PNODEIN

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name	Index	Long Variable Name
1279	RCS_SPRAY_PRES_DEG	1392	RCSL_PMP1_DP
987	RCS_SPRAY_QUAL	1393	RCSL_PMP2_DP
1009	RCS_SPRAY_STM_UP	1394	RCSL_PMP3_DP
963	RCS_SPRAYBLEED_ENTH	1395	RCSL_PMP4_DP
940	RCS_SPRAYBLEED_FLOW	1479	RCW_QT_FLOW
174	RCS_SPRAYBLEED_PELEVIN	1425	RCW_RCS_FLOW
151	RCS_SPRAYBLEED_PNODEIN	898	RELE_BUB
988	RCS_SPRAYBLEED_QUAL	216	RESI_HEATER
1010	RCS_SPRAYBLEED_STM_UP	1494	RKPUMP
2365	RCS_SS_CONTROL	1490	RLINIT
2366	RCS_SS_USER	1489	RPINIT
1178	RCS_STATUS	1495	RSINIT
1032	RCS_STEAM_GENERATOR	1492	RTCLIN
1356	RCS_STEP_FAILURE	207	RTRV_BYPASS
1357	RCS_STEP_RECOVERY	296	RTRV_HEAD_SEAL_MULT
327	RCS_SUBCRIT_FLOW_MULT	294	RTRV_KLOSS_CORE
326	RCS_SUPERCRIT_FLOW_MULT	299	RTRV_MIX_INLET
1261	RCS_T_SURGE_TAU	300	RTRV_MIX_OUTLET
1351	RCS_TEMP_CL12B	295	RTRV_VENT_MULT
1386	RCS_TEMP_SG_LAST	431	RTUBES
1385	RCS_TEMP_SG_PRE	1111	RUPTURE_QT
1358	RCS_TIME_CONTROL	1491	RWINIT
1359	RCS_TIME_SCALE	1522	SB_DELTA_ELEV
2289	RCS_TOTAL_ENERGY	1517	SB_LOCA_PIPE_DATA
2291	RCS_TOTAL_IODINE	1518	SB_PIPE_AREA
2288	RCS_TOTAL_MASS	1521	SB_PIPE_KENT
916	RCS_TRANS_CORR	1520	SB_PIPE_KGEOM
1255	RCS_UHEAD_CONT_HEAT_MULT	1519	SB_PIPE_LOD
1099	RCS_UHEAD_PRES	2273	SCRAM_DELAY
965	RCS_UHEAD_RELIEF_ENTH	1426	SDC_RCS_FLOW
942	RCS_UHEAD_RELIEF_FLOW	1119	SENG_GLOB
176	RCS_UHEAD_RELIEF_PELEVIN	565	SEQNCE
153	RCS_UHEAD_RELIEF_PNODEIN	403	SF_CONC_IO
990	RCS_UHEAD_RELIEF_QUAL	381	SG_DESIGN
1012	RCS_UHEAD_RELIEF_STM_UP	424	SG_ECONOMIZER
298	RCS_UHEAD_RING_SEAL_MULT	434	SG_HCONV
348	RCS_UHEAD_VENT_RIG	414	SG_HT4_MAX
349	RCS_UHEAD_VENT_RIG_FRAC	418	SG_REF_BOT
1086	RCS_UPPER_HEAD	416	SG_REF_LEGS
1188	RCS_VALVES	417	SG_REF_NUM
1189	RCS_VLV_AREA	419	SG_REF_TOP
914	RCS_VOID_TOP	435	SG_RWALL
915	RCS_VOID_TRAN	422	SG_TUBE_AREA
1296	RCS_VOLT_HTR_BUS	1496	SG_TUBE_SECTIONS
1320	RCS_W_PRZR_CONT	404	SG_U12
1321	RCS_W_PRZR_QT	405	SG_U23
1349	RCS_W_SIT	406	SG_V2_ACTIVE
1265	RCS_W_SIT_CONT	407	SG_V4_MAX

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name	Index	Long Variable Name
408	SG_V5_MAX	1827	SGBD_SINK_FLOW
498	SGBD_ACROSS	1833	SGBD_SINK_IO
505	SGBD_BOT_COEFF	1842	SGBD_SINK_P
1814	SGBD_BOT_ENTH	1824	SGBD_SINK_POS
1811	SGBD_BOT_FLOW	1836	SGBD_SINK_PT
508	SGBD_BOT_HTNOZ	1839	SGBD_SINK_XE
1817	SGBD_BOT_IO	504	SGBD_SURF_COEFF
1808	SGBD_BOT_POS	1813	SGBD_SURF_ENTH
1820	SGBD_BOT_PT	1810	SGBD_SURF_FLOW
1823	SGBD_BOT_XE	507	SGBD_SURF_HTNOZ
1788	SGBD_CON_IO	1816	SGBD_SURF_IO
1789	SGBD_CON_PT	1807	SGBD_SURF_POS
1790	SGBD_CON_XE	1819	SGBD_SURF_PT
1791	SGBD_DVDH	1822	SGBD_SURF_XE
1792	SGBD_DVDP	1800	SGBD_SV
1793	SGBD_H	1801	SGBD_SVF
1794	SGBD_HF	1802	SGBD_SVG
1795	SGBD_HG	1803	SGBD_T
1796	SGBD_L	1804	SGBD_TWALL
1797	SGBD_M	502	SGBD_VOL
1798	SGBD_ML	1805	SGBD_X
510	SGBD_OUT_COEFF	432	SGMTCP
1831	SGBD_OUT_ENTH	2281	SGS_ALPHA_DOWNCOMER
1828	SGBD_OUT_FLOW	2280	SGS_AREA_DOWNCOMER
509	SGBD_OUT_HTNOZ	1850	SGS_ASEP_TUNE
1834	SGBD_OUT_IO	1543	SGS_BOT_P
1843	SGBD_OUT_P	1541	SGS_COMMON
1825	SGBD_OUT_POS	1550	SGS_CON_BORON1
1837	SGBD_OUT_PT	1551	SGS_CON_BORON2
1840	SGBD_OUT_XE	1544	SGS_CON_IO1
1799	SGBD_P	1545	SGS_CON_IO2
511	SGBD_RELIEF_AMAX	1546	SGS_CON_PT1
1832	SGBD_RELIEF_ENTH	1547	SGS_CON_PT2
1829	SGBD_RELIEF_FLOW	1548	SGS_CON_XE1
1835	SGBD_RELIEF_IO	1549	SGS_CON_XE2
1844	SGBD_RELIEF_P	1881	SGS_CRIT_MODEL
1826	SGBD_RELIEF_POS	2278	SGS_DEBUG_SGHEAT
1838	SGBD_RELIEF_PT	2277	SGS_DEBUG_SGSINI
1841	SGBD_RELIEF_XE	1552	SGS_DELTV
503	SGBD_SG_COEFF	1851	SGS_DELTV_MAX
1812	SGBD_SG_ENTH	1553	SGS_DP
1809	SGBD_SG_FLOW	1554	SGS_DVDP
506	SGBD_SG_HTNOZ	1560	SGS_E1
1815	SGBD_SG_IO	1561	SGS_E2
1806	SGBD_SG_POS	1562	SGS_E3
1818	SGBD_SG_PT	1563	SGS_E4
1821	SGBD_SG_XE	1564	SGS_E5
1830	SGBD_SINK_ENTH	1901	SGS_ECON_ASUB

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name	Index	Long Variable Name
1903	SGS_ECON_CNVRG	1579	SGS_RHO2
1904	SGS_ECON_FLIM	1580	SGS_RHO3
1902	SGS_ECON_TCAV	1581	SGS_RHO4
1899	SGS_ECON_TFIN	1582	SGS_RHO5
1900	SGS_ECON_TFOUT	1860	SGS_SEP_PMIN
1897	SGS_ECON_TPIN	1787	SGS_SGBD
1898	SGS_ECON_TPOUT	2283	SGS_STEAM_VEL31
1896	SGS_ECON_VARS	1647	SGS_STEAMLINE
1555	SGS_ENTH1	1583	SGS_SV1
1556	SGS_ENTH2	1584	SGS_SV2
1557	SGS_ENTH3	1585	SGS_SV3
1558	SGS_ENTH4	1586	SGS_SV4
1559	SGS_ENTH5	1587	SGS_SV5
1852	SGS_FK3_TUNE	1590	SGS_T1
1632	SGS_FLOW_CHOKED	1591	SGS_T2
1853	SGS_FTIME	1592	SGS_T3
1854	SGS_FTIME_PMAX	1593	SGS_T4
1725	SGS_FWS	1594	SGS_T5
1855	SGS_HASUB_OPTION	1879	SGS_TAU_FLOW
1633	SGS_HEAT	1863	SGS_TAU_WOUTSG
1643	SGS_HEAT_LOAD	1861	SGS_TAURC1_TUNE
1565	SGS_HF	1862	SGS_TAURC2_MAX
1566	SGS_HG	2292	SGS_TOTAL_IODINE
1567	SGS_HLEVEL	1588	SGS_TREFLG
1568	SGS_HT2	1888	SGS_TUBE_AREA_DEGRAD
1569	SGS_HT3	1889	SGS_TUBE_AREA_OPTION
1570	SGS_HTI	1846	SGS_TUNE
1883	SGS_INITIAL_CONDITIONS	1589	SGS_TWALL
1542	SGS_INTERNAL	1864	SGS_UADROP_PERIM
1571	SGS_M1	1865	SGS_UADROP_WFDMIN
1572	SGS_M2	1595	SGS_USTM
1573	SGS_M3	1866	SGS_USTM_MIN
1574	SGS_M4	1602	SGS_V1
1575	SGS_M5	1603	SGS_V2
1890	SGS_MASS_FULL_TUBE_AREA	1604	SGS_V3
1891	SGS_MASS_ZERO_TUBE_AREA	1605	SGS_V4
1882	SGS_MORE_VARIABLES	1606	SGS_V5
1508	SGS_NSECT	1867	SGS_VCNVRG
1576	SGS_P	2282	SGS_VEL31_MULT
1856	SGS_PCNVRG	1596	SGS_VF
1857	SGS_PMIN	1876	SGS_VF_REF
1644	SGS_Q_CONT	1597	SGS_VF2
1645	SGS_Q_WALL1	1598	SGS_VF3
1646	SGS_Q_WALL3	1599	SGS_VF4
1577	SGS_RECIRC	1600	SGS_VF5
1858	SGS_RECIRC_DELVOL	1601	SGS_VG
1859	SGS_RECIRC_MIN	1877	SGS_VG_REF
1578	SGS_RHO1	1878	SGS_VLEG_REF

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name	Index	Long Variable Name
1617	SGS_W13	1513	SGTR_TUBE_ENTRANCE_K
1618	SGS_W21	1512	SGTR_TUBE_LENGTH
1619	SGS_W23	1430	SI_TANK_FLOW
1623	SGS_W25	1429	SIS_RCS_BORON
1620	SGS_W31	1428	SIS_RCS_ENTH
1621	SGS_W32	1427	SIS_RCS_FLOW
1625	SGS_W42	2574	SIS_RCS_NONC
1622	SGS_W51	2575	SIS1_RCS_NONC
1624	SGS_W53	2576	SIS2_RCS_NONC
1607	SGS_WF1	2577	SIS3_RCS_NONC
1608	SGS_WF2	2578	SIS4_RCS_NONC
1609	SGS_WF3	2579	SIS5_RCS_NONC
1610	SGS_WF4	2580	SIS6_RCS_NONC
1611	SGS_WF5	1887	SKAMUL
1868	SGS_WFMIN	2361	SL_FLOW_COEFF
1612	SGS_WG1	1685	SL_P_FLOW
1613	SGS_WG2	458	SLI_CHECK_VALVE
1614	SGS_WG3	459	SLI_DP100
1615	SGS_WG4	444	SLI_FLOW_COEFF
1616	SGS_WG5	1885	SLINIT
1626	SGS_WOUTSG	919	SLIP_SECT
1627	SGS_X1	271	SLIP_TAB
1628	SGS_X2	460	SLO_DP100
1869	SGS_X2_1	445	SLO_FLOW_COEFF
1629	SGS_X3	11	SNAPSHOT_DATE
1630	SGS_X4	8	SNAPSHOT_FILE_NAME
1631	SGS_X5	7	SNAPSHOT_LABEL
1880	SGS_XTAU_FLOW	10	SNAPSHOT_TIME
1870	SGT_HTCRTC	9	SNAPSHOT_TITLE
1871	SGT_HTCRTH	401	SPACE
1872	SGT_HTCSCW	1035	SPEED_PUMP
1873	SGT_HTCSTM	1884	SPINIT
433	SGT_HYD_DIAM	1671	STEAMLINE_STATE
2275	SGT_INIT_OPTION	866	SUBC_LIQ
1874	SGT_Q_MULT	1047	SVOL_DOWNCOMER
1636	SGT_RCS_QCOLD	1120	SVOL_GLOB
1638	SGT_RCS_QECON	856	SVOL_LIQ
1634	SGT_RCS_QHOT	858	SVOL_LIQ_SAT
1637	SGT_SG_QCOLD	1124	SVOL_LIQ_SAT_GLOB
1639	SGT_SG_QECON	857	SVOL_STM
1635	SGT_SG_QHOT	859	SVOL_STM_SAT
1641	SGT_TEMP_COLD	1125	SVOL_STM_SAT_GLOB
1642	SGT_TEMP_ECON	855	SVOL_TOT
1640	SGT_TEMP_HOT	1092	SVOL_UHEAD_TOP
1514	SGTR_BREAK_ELEV	585	TABMAX
1511	SGTR_DATA	410	TAU_IO
1516	SGTR_SLOT_BREAK_AREA	411	TAU_PT
1515	SGTR_SLOT_BREAK_OPT	420	TAU_REFLG_DN

Table G.3: Alphabetized Index of Long Variable Names

Index	Long Variable Name
421	TAU_REFLG_UP
412	TAU_XE
409	TAURC1
2217	TBASE
391	TBL2_NUM
398	TBL3_NUM
867	TEMP_CONT
1059	TEMP_HEATER
862	TEMP_LIQ
2551	TEMP_NONC
1063	TEMP_PRZR_REF
1065	TEMP_PRZR_RTD
1064	TEMP_PRZR_SURGE
1109	TEMP_QT
1110	TEMP_QT_SURGE
864	TEMP_SAT
1126	TEMP_SAT_GLOB
863	TEMP_STM
861	TEMP_TOT
1077	TEMP_VALVE_RELIEF
865	TEMP_WALL
602	TGAPIN
2218	TIME
2219	TIME_SCALE
2222	TIMQUE
430	TMP_TBL
217	TOP_HEATERS
1037	TORQ_PUMP
272	TORQ_TAB
2220	TSTOP
568	UNUSED
446	UNUSED_FLOW_COEFF
14	UNUSED_VAR_PLT01
678	UNUSED_VAR_POW01
2272	USER_COMMON
395	V3_TBL
396	V3_TBL_DSGN1
397	V3_TBL_DSGN2
2358	VATTENFALL_MISCELLANEOUS
447	VEL100
1076	VIBR_VALVE_RELIEF
1438	VLV_PRZR_CONT
1484	VLV_PRZR_FLOW_OPTION
1486	VLV_PRZR_FLOW_TABLE
292	VLV_PRZR_KLOSS_DOWN
291	VLV_PRZR_KLOSS_UP
1437	VLV_PRZR_MOV
1440	VLV_PRZR_MSPRAY
1445	VLV_PRZR_MSPRAY_SIG
1485	VLV_PRZR_NPOINTS_TAB
1435	VLV_PRZR_PORV
1446	VLV_PRZR_PORV_SIG
1085	VLV_PRZR_PRES_DOWN
1084	VLV_PRZR_PRES_UP
1487	VLV_PRZR_PROP_TABLE
1439	VLV_PRZR_QT
1483	VLV_PRZR_QUAL_DF
1436	VLV_PRZR_SAFETY
1442	VLV_QT_CONT
1441	VLV_QT_GWS
1443	VLV_QT_NSUPPLY
1432	VLV_RCS_POS
1444	VLV_RCS_SIG
1433	VLV_UHEAD_CONT
1434	VLV_UHEAD_QT
882	VOID_FRAC
910	VOL_MIX
448	VOL_MSLH
413	VOLSGS
1055	VOLT_HEATER
218	VOLT_HEATER_MAX
1094	VOLU_NON_UHEAD
228	VOLU_QT
388	VST_TBL
389	VST_TBL_DSGN1
390	VST_TBL_DSGN2
415	W32_FLOW_COEFF
436	WALL_AREA
437	WALL_MCP
466	WFW100
268	WIND_TORQ_MULT
215	XFER_HEATER
84	XFER_SURF_POFF
85	XFER_SURF_PON
566	XTAB
567	YTAB
822	ZSHAPIN

Table G.4: Alphabetized Index of Short Variable Names

Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
92	AANN	2021	CCFVAL	2086	CEELEV	2145	CFSMUL
2281	ALPHA3	2009	CCGRAT	2087	CEFLCO	2163	CFSSIG
89	APZR	2005	CCLSP1	2066	CEGHPS	2156	CFTAUT
94	ASECVA	2006	CCLSP2	2071	CEGLPS	2146	CFTLO
399	ASEPSG	2007	CCLSP3	2082	CEHHLP	2150	CFTRP
440	ASLMAX	2008	CCLSP4	2068	CEHNUM	2153	CFVAUT
461	ASLMIN	2018	CCPMPO	2084	CEHSIT	2167	CFVBYP
383	ASPTB1	2004	CCSET	2230	CEINIT	2162	CFVEPO
384	ASPTB2	2030	CCTEMP	2091	CEIVAL	2159	CFVESI
382	ASPTBL	2020	CCVALV	2073	CELNUM	2166	CFVISO
237	BAD	1995	CCVCS	2080	CEMISC	2161	CFVPO
235	BAN	2120	CDAUTO	2065	CENHPS	2160	CFVPOS
241	BAR	2367	CDCONT	2070	CENLPS	2158	CFVSI
239	BAT	2247	CDELAY	2085	CENSIT	2157	CFVSIG
238	BVD	2267	CDFTRP	2061	CEPCHI	2137	CFWS
236	BVN	2256	CDGRCS	2067	CEPHPS	2105	CGCAUT
242	BVR	2270	CDGRTR	2059	CEPLO	2103	CGFDEM
240	BVT	2261	CDGSGM	2072	CEPLPS	2104	CGGRAT
2178	CAAUTO	2269	CDGSTR	2089	CEPSIT	2106	CGLOAD
2174	CADELA	2265	CDGTRP	2063	CEPSLL	2189	CGRAUT
2173	CADPHI	2266	CDITRP	2058	CESET	2191	CGRTRP
2175	CAFMUL	2253	CDLPHI	2069	CESHPS	2188	CGSAUT
2168	CAFWS	2260	CDLSGH	2064	CESIS	2186	CGSCON
2172	CAGMAX	2259	CDLSGL	2092	CESLIQ	2099	CGSET
2171	CALHI	2271	CDMISC	2074	CESLPS	2187	CGSSET
2170	CALLO	2264	CDMIST	2062	CETAVL	2190	CGSTRP
2177	CAMOTR	2262	CDPCHI	2321	CETOPC	2108	CGTAUT
2169	CASET	2249	CDPOHI	2078	CETRP	2100	CGTCLS
2179	CASSIG	2252	CDPPHI	2079	CETRPP	2107	CGTRP
2176	CATURB	2251	CDPPLO	2075	CETRPT	2109	CGTRPP
1991	CAUTO	2258	CDPSGL	2090	CEVGAS	2102	CGTRPT
2130	CBAUTO	2268	CDQTRP	2093	CEVLIQ	2101	CGVTC
2124	CBDELP	2118	CDSET	2151	CFAUT	2044	CHAUTO
2214	CBLOCK	2257	CDSIAS	2152	CFAUTO	2032	CHEATR
2129	CBMODE	2250	CDSRHI	2143	CFDELA	2034	CHLBSP
2128	CBNCLS	2254	CDTMAR	2154	CFEAUT	2035	CHLOFF
2126	CBNOPN	2248	CDTRIP	2148	CFEMAX	2038	CHPBOF
2123	CBPOPN	2119	CDTSP	2147	CFENTH	2039	CHPBON
2127	CBQCLS	2117	CDUMP	2149	CFETC	2036	CHPPOF
2125	CBQOPN	2263	CDUSER	2144	CFGMAX	2037	CHPPON
2122	CBSET	2255	CDWMAR	2141	CFLHI	2040	CHPREF
2121	CBYPAS	2077	CEAUTO	2140	CFLLO	1	CHR
2017	CCAUTO	2081	CEBHLP	2139	CFLPRG	2033	CHSET
2022	CCAVAL	2083	CEBSIT	2155	CFPAUT	589	CHT
1978	CCEA	2057	CECCS	2142	CFRAMP	664	CHTAXA
2031	CCENTH	2088	CECGAS	2138	CFSET	652	CHTAXB
2029	CCFLOW	2076	CEDEL	2164	CFSFRC	671	CHTSEO
2016	CCFPMP	2060	CEDPSL	2165	CFSMAX	646	CHTAXF

Table G.4: Alphabetized Index of Short Variable Names

Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
645	CHTAXL	196	CORBOT	1987	CRMIN	2356	CTPC6
590	CHTINP	796	CORE3D	1985	CRMOTL	2357	CTPC7
605	CHTNUM	1969	COREQ	2180	CRPCS	1943	CTPCHI
2233	CHTOFF	2279	COREQA	1992	CRPERF	2343	CTPI1
607	CHTPRP	1970	COREQT	1988	CRPOS	2344	CTPI2
633	CHTSTT	2318	CORHFR	1979	CRSET	2345	CTPI3
2042	CHVBAK	2237	CORINI	1989	CRSPD	2346	CTPI4
2041	CHVPRP	197	CORTOP	1994	CRSPDL	2347	CTPI5
2043	CHVRAT	2316	CORW0	1990	CRSTEP	2348	CTPI6
2115	CIAUTO	2317	CORWFR	1981	CRTFUL	2349	CTPI7
2114	CIGSLO	1960	COSIAS	1980	CRTNO	2342	CTPINP
2225	CINCON	1953	COSRHI	2131	CSAFE	2350	CTPLNK
2113	CIPCHI	1957	COTMAR	2136	CSAOPN	2319	CTPMIN
2112	CIPSLO	1967	COUSER	2135	CSCLOS	2320	CTPMNT
2111	CISET	2203	COUT	2094	CSDCCN	2323	CTPO1
2116	CITRP	2212	COUT3D	2095	CSDCDH	2332	CTPO10
1974	CKAUTO	2211	COUTCL	2096	CSDCHM	2333	CTPO11
1975	CKTRP	2206	COUTCT	2097	CSDCSP	2334	CTPO12
1977	CKTRPP	2209	COUTFI	2192	CSETPT	2335	CTPO13
1976	CKTRPS	2208	COUTGR	2134	CSFULL	2336	CTPO14
1968	CKTRPT	2204	COUTIN	2133	CSOPEN	2337	CTPO15
2019	CLAUTO	2210	COUTLO	2213	CSPAR2	2338	CTPO16
2227	CLCONT	2205	COUTOP	2228	CSPARE	2339	CTPO17
2027	CLENTH	2207	COUTTI	2045	CSPRAY	2340	CTPO18
2239	CLEVEL	1951	COVER	2132	CSSET	2341	CTPO19
2241	CLEVP	1958	COWMAR	2014	CTAVG	2324	CTPO2
2240	CLEVSG	2012	CPLERR	1927	CTCONT	2325	CTPO3
2025	CLFLOW	1998	CPLEV	1942	CTDTUR	2326	CTPO4
2028	CLFRAC	2013	CPLINS	1945	CTGKSP	2327	CTPO5
2003	CLGSP	2011	CPLPRG	1936	CTGRCS	2328	CTPO6
2002	CLLSP	1972	CPOWFL	1948	CTGSBY	2329	CTPO7
2001	CLSET	1971	CPOWFR	1941	CTGSGM	2330	CTPO8
2026	CLTEMP	2010	CPPROG	674	CTHHOP	2331	CTPO9
2110	CMSIS	1996	CPSET	2202	CTIMCN	1929	CTPOHI
1973	CNRPS	1999	CPSLIQ	1926	CTIME	1947	CTPORA
1965	CODTUR	2000	CPSSTM	1925	CTL	2322	CTPOUT
1959	COGRCS	1997	CPTEM	573	CTLDBG	1932	CTPPHI
1964	COGSGM	2182	CQAUTO	584	CTLMAX	1931	CTPPLO
1956	COLPHI	2181	CQSET	1933	CTLPHI	1938	CTPSGL
1963	COLSGH	2183	CQTRP	1940	CTLSGH	2015	CTREF
1962	COLSGL	2184	CQTRPP	1939	CTLSGL	1928	CTSET
2236	CONOFF	2185	CQTRPT	12	CTLT	1937	CTSIAS
2243	CONT	1993	CRACCM	2226	CTLUN	1946	CTSRBY
1966	COPCHI	2514	CRATIO	2351	CTPC1	1930	CTSRHI
1952	COPOHI	1982	CREXP	2352	CTPC2	1934	CTTMAR
1955	COPPHI	1984	CRFPOS	2353	CTPC3	1949	CTTUBY
1954	COPPLO	1983	CRGAIN	2354	CTPC4	2098	CTURB
1961	COPSGL	1986	CRMAX	2355	CTPC5	1950	CTUSBY

Table G.4: Alphabetized Index of Short Variable Names

Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1944	CTUSER	524	DCCCON	487	DFCLIN	310	DLOOPC
1935	CTWMAR	574	DCCONS	488	DFCLN	327	DLSBMU
2056	CVAUTO	551	DCDNUM	483	DFCPMP	326	DLSPMU
2055	CVBLDN	552	DCDPAT	484	DFCVAL	516	DM2AC1
2054	CVCLOS	537	DCECOT	485	DFCVL	517	DM2AC2
1523	CVDAT	548	DCFBCN	495	DFDELN	514	DM2AFR
2053	CVOPEN	525	DCFCON	493	DFDLIN	515	DM2FKB
2052	CVPSET	528	DCFCOT	494	DFDLN	518	DM2KC1
2050	CVRELF	526	DCFECN	477	DFEJUN	519	DM2KC2
1535	CVRHHC	549	DCFICN	465	DFG100	512	DM2SLH
1534	CVRHHL	527	DCFPMP	481	DFGNUM	513	DM2SLO
1538	CVRHQ	541	DCGCOT	478	DFGTAB	341	DM504
1533	CVRHTC	545	DCGRUN	479	DFHTAB	451	DMABY
1532	CVRHTL	544	DCGSET	476	DFJUN	449	DMAREA
1537	CVRHWC	576	DCHALF	475	DFLJUN	458	DMCHKV
1536	CVRHWL	529	DCHCON	473	DFNJUN	29	DMDINV
1531	CVRHX	531	DCICON	472	DFNPMP	459	DMDPII
2051	CVSET	532	DCICOT	474	DFPJUN	460	DMDPOI
2049	CWAUTO	569	DCINIT	482	DFSNUM	441	DMHAWI
2048	CWPOFF	543	DCKCUT	480	DFSTAB	442	DMHAWO
2047	CWPON	530	DCLCON	492	DFVELN	443	DMMCPW
2046	CWSET	579	DCLIMS	490	DFVLIN	28	DMODIN
2024	CXHA	533	DCMCON	491	DFVLN	456	DMPATM
2023	CXREG	578	DCMONE	463	DFWS	446	DMSLC
496	DANPMP	521	DCNCON	318	DGENC	439	DMSLH
557	DBADD	577	DCONE	328	DGPMA	444	DMSLIC
511	DBAMAX	311	DCONMU	212	DHBURN	445	DMSLOC
498	DBATNK	278	DCONST	215	DHHA	457	DMTATM
505	DBCBOT	546	DCPCOE	214	DHHCAP	452	DMVAMX
503	DBCOEF	547	DCPCOP	217	DHLTOP	454	DMVEX
558	DBCOM	523	DCRCON	211	DHNUM	453	DMVIN
510	DBCOUT	539	DCTACO	216	DHOHMS	455	DMVNUM
2278	DBGSGH	553	DCTANU	218	DHVMAX	448	DMVOL
2277	DBGSGI	554	DCTAPA	450	DIAMAX	23	DNBACK
499	DBHAWI	536	DCTCON	204	DIEXBO	24	DNCHGS
500	DBHAWO	542	DCTCOT	206	DIEXMP	322	DNDMUL
508	DBHBOT	520	DCTL	205	DIEXTO	321	DNIDHN
506	DBHNOZ	540	DCTRCO	207	DIFBY	319	DNIDPE
509	DBHOUT	534	DCVPOR	208	DIFTLT	320	DNIDPN
507	DBHSUR	535	DCVPSV	199	DIHACE	30	DNODE
501	DBMCPW	587	DCWARN	209	DIHAUI	26	DNPORV
1844	DBPRRL	538	DCWCON	203	DIHCEA	22	DNPROP
504	DBSCUR	575	DCZERO	299	DIIMIX	27	DNPRSV
502	DBVTNK	373	DEDGDT	202	DINCEA	324	DNSMUL
522	DCACON	2215	DELT	186	DINVES	25	DNSPRA
550	DCAVCN	467	DFAFWB	300	DIOMIX	96	DPATH
555	DCBNUM	489	DFCELN	378	DLBCLC	376	DPBHMU
556	DCBPAT	486	DFCEVL	325	DLCONS	279	DPCONS

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
356	DPCRFL	302	DRCONS	434	DSHWAL	292	DVKDWN
346	DPDGMX	232	DRCP	437	DSMCPW	291	DVKUP
290	DPDMAX	18	DRCS	417	DSNREF	222	DVLREL
288	DPFLSH	274	DRCURR	416	DSREFL	361	DVTMAX
287	DPFMUL	369	DRDAMP	435	DSRWAL	213	DWABLD
350	DPFRIG	19	DRDESN	420	DSTDN	559	ELEMS
2534	DPGASP	273	DRDTDW	419	DSTREF	560	ELIN
364	DPHAXW	234	DRFRAC	421	DSTUP	2244	ELLAST
344	DPHDT	277	DRFRAT	596	DTAHT	580	ELMAX
281	DPHMUL	367	DRFREF	595	DTDENS	561	ELTYPE
323	DPKMUL	362	DRFRUB	594	DTH2	400	EVAPSS
351	DPLBOL	305	DRISPL	606	DTNFC	2420	FAEXTF
220	DPLRBO	372	DRLMUL	591	DTNRAD	2462	FATABL
347	DPLRIG	267	DRNPOL	604	DTNZ	2461	FBTABL
219	DPLRTD	233	DRNUM	592	DTROUT	586	FCTMAX
221	DPLRTO	275	DRPLEK	190	DUAMAX	2381	FCV
289	DPLSAT	304	DRQMUL	188	DUAMIN	2406	FCVAFL
365	DPLSBO	271	DRSLIP	298	DUAMUL	2408	FCVDPM
360	DPM034	270	DRTNUM	191	DUAROD	2440	FCVP
375	DPPHMU	272	DRTORQ	293	DUCONS	2407	FCVRES
282	DPPMUL	363	DRTRUB	370	DUFAST	2436	FCVV
286	DPQMUL	21	DRTYPE	349	DUFRIG	2505	FDCLMS
285	DPRTAU	269	DRVBUS	301	DUKCEA	2216	FDELT
210	DPRZR	307	DRVMAX	294	DUKCOR	2473	FDHEAT
342	DPSDE	371	DRVMUL	348	DULRIG	2490	FDMODL
343	DPSEQ	306	DRVNOR	1456	DUM001	2411	FDNODE
283	DPSMUL	276	DRVRAT	15	DUMMY1	2379	FDPATH
345	DPTDT	309	DRVSPD	366	DUORFL	2380	FDPEL
359	DPTMSP	308	DRVTIM	189	DUPMAX	2454	FDPUMP
374	DPTREV	438	DSAEHT	187	DUPMIN	2509	FDSYST
284	DPVMUL	426	DSAFLO	296	DUPMUL	2433	FDVALV
377	DPVVMU	427	DSAHT	297	DURMUL	2506	FECLMS
280	DPWMUL	422	DSATUB	295	DUVMUL	1742	FEELIN
313	DQCONS	436	DSAWAL	334	DVAMOV	1751	FEENOZ
315	DQGMUL	418	DSBREF	337	DVAMSP	1741	FELIN
229	DQHT	433	DSDHYD	340	DVANC	1740	FELINE
230	DQMASS	352	DSDP	335	DVAPCO	1750	FENOZ
314	DQNMUL	353	DSDP12	332	DVAPOR	1749	FENOZZ
227	DQPN2	354	DSDPW	336	DVAPQT	2484	FFDPS0
231	DQPRUP	355	DSDPW1	333	DVAPSV	1737	FGELIN
317	DQSFRC	424	DSECON	339	DVAQTC	1748	FGENOZ
226	DQTANK	423	DSETUS	338	DVAQTG	1736	FGLIN
316	DQVMUL	497	DSGDB	329	DVAREA	1735	FGLINE
228	DQVOL	381	DSGDES	331	DVAUHQ	1747	FGNOZ
368	DRAREF	379	DSGS	330	DVAVNT	1746	FGNOZZ
2362	DRATIO	380	DSGSIN	223	DVGPOR	2397	FGPMCO
358	DRCMIN	312	DSGTRM	224	DVGPS1	1734	FGPMP
357	DRCMUL	425	DSHEAT	225	DVGPS2	1738	FGTOT

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1893	FHENTH	2409	FNFLO	2382	FRESL	1739	FWSENT
2392	FHEXT	2489	FNHDPT	2390	FRESV	2459	FWSHT
2419	FHEXTF	2449	FNHDV	2393	FRHOEX	2403	FWSICK
2413	FHEXTN	2487	FNHTBL	2383	FRHOFD	2404	FWSIMF
2485	FHFWBI	2471	FNMFWP	2417	FRHOND	2410	FWSKEY
1886	FHINIT	2424	FNNOD	2455	FSPDMD	2488	FWSNHT
1894	FHLOAD	2442	FNPATH	2456	FSPEED	2491	FWSNRC
2416	FHNODE	2429	FNPFLB	1732	FSPMP	2415	FWSP
1895	FHNUM	2486	FNPHET	2441	FSTP	2414	FWSP0
2388	FHPATH	2467	FNPMPE	2434	FSTROK	2395	FWSPS
1733	FHPMP	2466	FNPMPM	2396	FSUMP	2394	FWSRP
1892	FHTBL	2500	FNPMRC	2458	FTAUOF	2422	FWSUM
2479	FHTHMX	2463	FNPMTH	2457	FTAUON	2387	FWSW
2476	FHTRHV	2431	FNPPRV	2438	FTCLOS	2386	FWSW0
2501	FIAURC	2428	FNPSGA	2482	FTEHDP	2460	FWSWT
2402	FICPMP	2427	FNPSGE	1757	FTENOZ	1745	FXECON
2423	FIMN	2426	FNPSGM	2502	FTIMET	1754	FXENOZ
2445	FINDXF	2468	FNPTMP	2439	FTLAG	1753	FXNOZ
1743	FIOCON	2465	FNPTP	1756	FTNOZ	1752	FXNOZZ
2503	FITRIP	2498	FNPTRC	1755	FTNOZZ	562	GROUPS
2504	FITRPO	2444	FNPTV	2437	FTOPN	2245	GROUT
198	FLA	2469	FNPUM	2480	FTPOWR	583	GRPMAX
1772	FLBEH	2432	FNSG	2474	FTPWR	245	HAD
1760	FLBEIN	2443	FNTABL	2475	FTQLAG	253	HADC
1778	FLBEIO	2464	FNTABP	2481	FTWHDP	243	HAN
1763	FLBEOU	2453	FNTAFV	2430	FWAFLB	251	HANC
1781	FLBEPT	2470	FNTBFP	464	FWCOEF	249	HAR
1769	FLBEW	2448	FNVAL	2418	FWEXTF	257	HARC
1775	FLBEX	2447	FNVBFV	1766	FWLBEF	247	HAT
1784	FLBEXE	2450	FNVHDV	1765	FWLBF	255	HATC
1771	FLBH	2499	FNVLRC	1770	FWLBH	673	HCORE
1759	FLBIN	2446	FNVMFV	1758	FWLBIN	1033	HEATSG
1777	FLBIO	1731	FPEVAL	1776	FWLBIO	260	HMUL
1762	FLBOU	2384	FPEXT	1764	FWLBLO	90	HPZR
1780	FLBPT	2421	FPEXTF	1761	FWLBOU	1657	HSLHHF
1768	FLBW	2412	FPEXTN	1779	FWLBPT	386	HSPTB1
1774	FLBX	1728	FPJUN	1767	FWLBW	387	HSPTB2
1783	FLBXE	2405	FPOISO	1773	FWLBX	385	HSPTBL
2224	FLGQUE	2435	FPOSIT	1782	FWLBXE	393	HT3TB1
2483	FMAXTU	1726	FPPIN	2508	FWLMSS	394	HT3TB2
2452	FNAFV1	1727	FPPMP	2385	FWMAS	392	HT3TBL
2451	FNAFVT	1744	FPTCON	2497	FWRCIN	414	HT4MAX
2401	FNCPMP	1730	FPVAL	2495	FWRCIR	469	HTNOZ
2400	FNDEXT	1729	FPVALV	2496	FWRCOT	471	HTNOZA
2398	FNDIN	2477	FPWRTB	2492	FWRCPB	470	HTNOZE
2399	FNDOUT	2389	FQCURR	2493	FWRCRE	468	HTNOZF
2472	FNEFWP	2478	FQPTBL	2494	FWRCSP	246	HVD
2425	FNEXTN	2391	FRES	2378	FWSCOM	254	HVDC

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
244	HVN	713	KDKMD	681	KNPOWT	773	KWFRMN
252	HVNC	697	KDKMDZ	705	KNQDK	777	KWHER
259	HVOID	734	KDKMOD	778	KNWFR	680	KWPOWZ
250	HVR	711	KDKMT	761	KNYZIR	811	KXCALB
258	HVRC	696	KDKMTZ	791	KOPBOR	804	KXDISP
248	HVT	737	KDKROD	789	KOPCUT	813	KXGAIN
256	HVTC	738	KDKSCR	793	KOPDEN	809	KXOFFA
588	INEDFL	729	KDKSUB	790	KOPDOP	807	KXOFFS
572	INEDPG	736	KDKTMD	786	KOPFB	805	KXPOWD
571	INEDSQ	731	KDKTOT	795	KOPHER	806	KXPOWR
2229	INIFLG	732	KDKUSR	792	KOPMOD	808	KXPWAV
2359	INIOUT	690	KDLAM	788	KOPREG	814	KXSVR
582	INMAX	728	KDSRC	787	KOPROD	810	KXTAU
570	INPED	746	KEN2	818	KPCZR	812	KXTUNE
2313	INSGV	743	KEX2	776	KPHER	759	KZRH2
2315	INSLBI	816	KFAXIL	692	KPLAM	760	KZRH2I
2314	INSLBO	785	KFDH	768	KPRHER	763	KZRH2S
2312	INWRCS	751	KFDHC	772	KPTWMN	819	KZX
1723	IOCTL	753	KFDHC0	775	KPTWMX	1525	LDPAR
1722	IOCTLK	754	KFDHCM	744	KQD2	1524	LDPDAT
1718	ITOTAT	794	KFLDEN	717	KQDK	1529	LDPDZ
1719	ITOTCD	756	KFLGDH	745	KQF2	1528	LDPKE
1720	ITOTCT	682	KFPOWT	820	KQZRH2	1527	LDPKG
2290	ITOTP	685	KFQC	780	KRHER	1526	LDPLOD
1721	ITOTTU	686	KFQCD	821	KSHPIN	1539	LDRCH
2360	JUNK1	758	KFQCDT	706	KSIGD2	1540	LDRCP
689	KALPHA	766	KFRAIN	707	KSTARL	581	LSTMAX
693	KBBAR	747	KFTRIP	710	KTBO	1906	M2CIO
694	KBBARR	762	KFZBJ	726	KTCT	1907	M2CPT
691	KBETA	764	KH2M	750	KTDHC	1908	M2CXE
742	KCHI2	767	KHER3D	769	KTDHER	1909	M2DVDH
782	KCONSC	765	KINCON	722	KTDKIN	1910	M2DVDP
783	KCONSH	817	KIZX	716	KTFT	1918	M2QARM
720	KDCORE	687	KKIN	719	KTFUEL	1912	M2SLHF
709	KDKBO	688	KKINI	757	KTIMDH	1913	M2SLHG
733	KDKBOR	730	KKINO	771	KTLTMN	1911	M2SLHH
695	KDKBOZ	741	KKINS	774	KTLTMX	1914	M2SLM
725	KDKCT	700	KLMOD	714	KTMD	1915	M2SLML
739	KDKCUT	679	KLUPOW	712	KTMT	1916	M2SLP
735	KDKDOP	781	KMHER	683	KTPOWT	1917	M2SLQ
715	KDKFT	770	KMLHER	718	KTQDK	1919	M2SLSV
698	KDKFTZ	701	KNBO	708	KTSS	1922	M2SLT
740	KDKHER	727	KNCT	724	KTUPOW	1924	M2SLX
748	KDKHT	752	KNDHC	676	KUSER	1920	M2SVF
749	KDKHTI	723	KNDKIN	677	KUSERI	1921	M2SVG
755	KDKHTS	704	KNFT	684	KUSERS	1923	M2TWAL
721	KDKIN	703	KNMD	784	KWEDGE	1687	MAATM
699	KDKINZ	702	KNMT	779	KWFHET	1688	MACOND

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1689	MACONT	1700	MPATM	86	NAMULT	2524	NONC14
2246	MALCTL	1705	MPCOND	68	NANNUL	2525	NONC15
1686	MAOUT	1710	MPCONT	69	NCEASH	2527	NONC16
593	MATTYP	1849	MPRESC	55	NCL1	2528	NONC17
1690	MATURB	1675	MPSL	56	NCL2	2529	NONC18
1651	MCIO	1715	MPTUR	57	NCL3	2530	NONC19
672	MCORES	1663	MQARM	58	NCL4	2531	NONC20
1652	MCPT	1724	MSCHOK	65	NCORE	2532	NONC21
1678	MCSL	1672	MSLBI	73	NELBOT	2533	NONC22
1653	MCXE	1649	MSLBO	1717	NETIOU	2535	NONC31
1875	MDPMIN	1647	MSLH	74	NGEOM	2536	NONC32
1654	MDVDH	1656	MSLHH	41	NHL1	2537	NONC33
1655	MDVDP	1658	MSLHHG	42	NHL2	2569	NONC34
1698	MEATM	1659	MSLHM	43	NHL3	2538	NONC35
1703	MECOND	1660	MSLHML	44	NHL4	2539	NONC36
1708	MECONT	1661	MSLHP	2238	NINIT	2540	NONC37
1713	METUR	1662	MSLHQ	38	NNODCL	2541	NONC38
1848	MFTMAX	1664	MSLHSV	36	NNODHL	2542	NONC39
1697	MGATM	1667	MSLHT	34	NNODSE	2562	NONC40
1702	MGCOND	1670	MSLHX	35	NNODSG	2543	NONC41
1707	MGCONT	1671	MSLIN	37	NNODSL	2544	NONC42
1696	MGOUT	1665	MSVF	71	NODEA	2545	NONC45
1673	MGSLBI	1666	MSVG	54	NODECL	2546	NONC46
1650	MGSLBO	1676	MTSL	40	NODEHL	2547	NONC47
1712	MGTUR	1668	MTWALL	31	NODENO	2548	NONC48
1674	MHSL	1683	MVPOS	39	NODENU	2549	NONC49
1699	MIATM	1684	MVSIG	64	NODEOT	2563	NONC50
1682	MIBYPO	1692	MWATM	45	NODESG	2550	NONC51
1704	MICOND	1693	MWCOND	59	NODESL	2551	NONC52
1709	MICONT	1694	MWCONT	76	NODETH	2553	NONC54
2295	MINMAX	1669	MWIN	32	NODETO	2570	NONC55
1680	MIPOS	1691	MWOUT	70	NODGEO	2571	NONC56
1681	MISIG	1695	MWTURB	2526	NON15A	2554	NONC57
1677	MISL	1701	MXATM	2564	NON50A	2555	NONC58
1714	MITUR	1706	MXCOND	2565	NON50B	2556	NONC59
1648	MNODE	1711	MXCONT	2510	NONC	2557	NONC60
1905	MNODE2	2298	MXHTFR	2511	NONC01	2558	NONC61
2302	MNPPR	2299	MXHTT	2512	NONC02	2559	NONC62
2303	MNPPRT	2296	MXPOW	2513	NONC03	2560	NONC65
2306	MNRCSP	2297	MXPOWT	2515	NONC05	2561	NONC66
2307	MNRPT	2300	MXPPR	2516	NONC06	2572	NONC67
2310	MNSGP	2301	MXPPRT	2517	NONC07	2573	NONC68
2311	MNSGPT	2304	MXRCSP	2518	NONC08	2575	NONC72
2221	MODELQ	2305	MXRPT	2519	NONC09	2576	NONC73
2242	MODERR	2308	MXSGP	2520	NONC10	2577	NONC74
2231	MODOFF	2309	MXSGPT	2521	NONC11	2578	NONC75
2223	MODQUE	1679	MXSL	2522	NONC12	2579	NONC76
2274	MOISTC	1716	MXTUR	2523	NONC13	2580	NONC77

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
2581	NONC78	201	PCEAUH	145	PISB	180	PTLOA
2582	NONC79	123	PCORUH	140	PISDC	564	PTTAB
2583	NONC80	6	PDATE	144	PISGTR	130	PUCEA
2574	NONCSI	185	PDIA	141	PISIS	200	PUPCEA
75	NOSECT	174	PEBLED	150	PISPRA	2568	PZQCND
563	NOTAB	160	PECHGS	153	PIUHR	2567	PZQEFF
66	NPRZR	162	PEDRN	182	PKXNEG	428	QSG100
87	NSECT	177	PEEXIT	181	PKXPOS	429	QSGTBL
47	NSG1C	158	PEEXT	2	PLABEL	1198	RALEAK
46	NSG1H	165	PEGAS	125	PLBLOC	2363	RAUSER
60	NSG1P	155	PEINIT	184	PLDIAM	2284	RBAL
49	NSG2C	172	PEINT	13	PLT	899	RBDRFT
48	NSG2H	171	PELB	14	PLT01	1493	RBINIT
61	NSG2P	166	PELEAK	114	PNCHGM	897	RBNODE
51	NSG3C	161	PELET	108	PNCHGS	898	RBRELE
50	NSG3H	156	PEMOM	106	PNCL	902	RCBOIL
62	NSG3P	157	PENONM	110	PNDRN	1418	RCBORN
53	NSG4C	170	PEORIN	116	PNDRNM	905	RCBUB
52	NSG4H	175	PEPZRR	100	PNEXT	1417	RCENTH
63	NSG4P	159	PERCP	105	PNHL	1416	RCFLOW
67	NUHEAD	402	PERIM	102	PNINT	1270	RCHGMX
91	NUMANN	169	PERODE	101	PNLEAK	1419	RCHYD
33	NUMNOD	168	PESB	109	PNLET	904	RCINJ
88	NUMSEG	163	PESDC	115	PNLETM	1420	RCIOD
20	NUMSG	167	PESGTR	99	PNMOM	1100	RCKMUL
824	NUMSHP	164	PESIS	119	PNMOMM	1101	RCLCEA
462	NUMSL	173	PESPRA	107	PNNONM	900	RCNODE
81	NWLMXC	176	PEUHR	103	PNPATH	1421	RCPART
82	NXBOIL	154	PEXIT	113	PNRCP	1204	RCPCOM
80	NXBOT	3	PFILE	104	PNSB	1206	RCPELE
79	NXCON	943	PFLOWC	111	PNSDC	1205	RCPINT
83	NXINJ	178	PGEOM	117	PNSDCM	1227	RCPLEK
77	NXLIQ	151	PIBLED	112	PNSIS	1223	RCPMAL
84	NXSPOF	137	PICHGS	118	PNSISM	1213	RCPMEC
85	NXSPON	139	PIDRN	675	POW	1256	RCRMOD
78	NXSTM	135	PIEXT	678	POW01	826	RCS
72	NZTOT	142	PIGAS	815	POWAX	1040	RCSCOR
122	PANCOR	148	PILB	2234	POWOFF	1114	RCSGLO
183	PAREA	143	PILEAK	303	PPINER	1373	RCSLB
128	PATHCL	138	PILET	2552	PPSLST	1389	RCSLBL
1029	PATHDN	133	PIMOM	126	PPUMP	1194	RCSMAL
131	PATHG	132	PINLET	179	PRADII	2232	RCSOFF
127	PATHHL	134	PINMOM	825	PRISHP	1229	RCSOPT
97	PATHNO	149	PINT	124	PSPRAY	1054	RCSPZR
120	PATHNU	147	PIORIN	992	PSTMUP	1102	RCSQT
129	PATHSG	152	PIPZRR	121	PSURGE	1034	RCSRCP
98	PATHTO	136	PIRCP	5	PTIME	1032	RCSSG
1028	PATHUP	146	PIRODE	4	PTITLE	1128	RCSSOL

Table G.4: Alphabetized Index of Short Variable Names

Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1178	RCSSTA	1310	RDWSDC	997	RFCHGS	932	RGLEAK
1086	RCSUH	1311	RDWSTP	1361	RFDELT	928	RGLET
903	RCSURF	963	REBLED	1370	RFDQHT	1116	RGMASS
1188	RCSVLV	950	RECHGS	1371	RFDQMX	923	RGMOM
901	RCTOT	1350	REDGST	999	RFDRN	924	RGNONM
1422	RCXEN	952	REDRN	995	RFEXT	936	RGORNG
1360	RDEL	1263	REDTLB	1008	RFINT	921	RGPATH
1362	RDELTA	1266	REELB	1007	RFLB	1115	RGPRES
1363	RDELWL	948	REEXT	1276	RFLBUB	941	RGPZRR
890	RDHDM	1264	REFLB	1251	RFLCHT	1121	RGQUAL
889	RDHDU	1265	REGLB	1365	RFLCOL	926	RGRCP
893	RDHFDP	1349	REGSIT	1368	RFLCVC	935	RGRODE
1305	RDHFMN	1316	REINIT	1002	RFLEAK	934	RGSB
894	RDHGDP	961	REINT	998	RFLET	930	RGSDC
1163	RDM2HR	960	RELB	1246	RFLHET	1119	RGSENG
1164	RDM8HR	1031	RELDN	1366	RFLNON	933	RGSGTR
1156	RDMBF	955	RELEAK	1292	RFLPZR	931	RGSIS
1161	RDMCDF	951	RELET	1269	RFLSDC	1124	RGSLQS
1157	RDMCF	849	RELIQ	1369	RFLSIT	939	RGSPRA
1160	RDMCLR	852	RELIQS	1253	RFLSPR	1125	RGSSTS
1155	RDMFSH	1308	RELTST	1364	RFLWAL	1120	RGSVOL
1154	RDMIIO	1030	RELUP	993	RFMOM	1126	RGTSAT
1162	RDMTCU	1262	RELVLB	994	RFNONM	942	RGUHR
1158	RDMXQ2	851	REMIX	1006	RFORNG	1056	RHADMI
1159	RDMXQ8	946	REMOM	1011	RFPZRR	1058	RHENGY
883	RDNODE	839	RENNOD	1367	RFQHT	909	RHETRO
1023	RDOCHK	847	RENODE	996	RFRCP	1448	RHFVLT
1022	RDPACT	947	RENONM	1005	RFRODE	1057	RHQELE
885	RDPDML	841	RENSTM	1004	RFSB	1060	RHQHTR
886	RDPDMS	840	RENTOT	1000	RFSDC	1061	RHQPZR
884	RDPDMT	959	REORNG	1372	RFSDQS	1059	RHTEMP
888	RDPDUS	944	REPATH	1003	RFSGTR	1247	RHTIME
887	RDPDUT	964	REPZRR	1001	RFSIS	1296	RHVBSP
1017	RDPELE	949	RERCP	1009	RFSPRA	1450	RHVBUS
1020	RDPEXT	958	RERODE	1026	RFSUBK	1055	RHVOLT
1016	RDPFRC	957	RESB	1012	RFUHR	916	RIBCOR
1019	RDPHED	953	RESDC	1423	RGASPR	912	RIBUBM
1018	RDPLOS	956	RESGTR	940	RGBLED	1474	RICONT
1015	RDPMOM	954	RESIS	927	RGCHGS	913	RIDBUB
1014	RDPPAT	962	RESPRA	1127	RGDP	1044	RILLIQ
1021	RDPTOT	853	RESRMS	929	RGDRN	1045	RILMIX
1425	RDRNG	850	RESTM	1122	RGELQS	1452	RIMAL
1273	RDRNMX	1025	RESUBK	1118	RGENGY	918	RIMBUB
1153	RDSPAR	848	RETOT	1117	RGENTH	1415	RINBOP
892	RDVDHT	965	REUHR	1123	RGESTS	1488	RINCON
891	RDVDPT	1275	REXBMX	925	RGEXT	1414	RINPUT
896	RDVGDP	1354	RFAIL	938	RGINT	834	RINTER
895	RDVHDP	1010	RFBLED	937	RGLB	1482	RIPZRR

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1476	RIQT	1173	RLELIQ	1315	RMOR6	1475	RPCONT
2294	RIRELR	1175	RLELQS	1238	RMORA	1286	RPCORS
2293	RIRELT	1166	RLENST	828	RMORCP	1337	RPCSUR
919	RISLIP	1167	RLENTO	831	RMORCS	1289	RPCWAL
1307	RITDPL	1182	RLEQUI	1471	RMRLOC	1024	RPDER
2291	RITOT	1174	RLESTM	1473	RMROD	1062	RPDPLV
1431	RIVLVC	1424	RLETG	1457	RMRODE	1306	RPDPMD
1447	RIVOLT	1272	RLETMX	1470	RMRSHB	1299	RPDTBL
914	RIVTOP	1176	RLFLOW	1472	RMRVIB	1300	RPDTSB
915	RIVTRN	1181	RLHOMO	1453	RMSB	1342	RPDTSS
917	RIXMIX	1179	RLIERR	1455	RMSGTR	1241	RPEMAX
1187	RKASUR	1490	RLINIT	845	RMSTM	1240	RPEMIN
1043	RKBORN	1177	RLKFLS	843	RMTOT	945	RPENTH
1048	RKBOUY	1196	RLLB	1458	RMVALV	1327	RPFAIR
1148	RKBREL	1184	RLLBMP	1463	RMVMOV	922	RPFLOW
1049	RKDPUH	878	RLLIQ	1464	RMVPCR	1202	RPGCON
1051	RKEDIS	1170	RLMBUB	1461	RMVPOR	1200	RPGPOR
1052	RKETLT	2566	RLMGAS	1465	RMVPQT	1203	RPGQT1
1042	RKGIN	877	RLMIX	1468	RMVQTC	1081	RPGQT2
1149	RKHREL	1168	RLMLIQ	1467	RMVQTG	1201	RPGSAF
1294	RKHRMX	1169	RLMSTM	1469	RMVQTN	1080	RPGSQT
1328	RKHSTM	1171	RLMTOT	1462	RMVSAF	1320	RPGVCN
1150	RKIREL	876	RLNODE	1466	RMVSPR	1321	RPGVQT
1046	RKLMIX	2364	RLNUP	1459	RMVUHC	1291	RPHLMU
1151	RKPREL	1180	RLOERR	1460	RMVUHQ	1288	RPHWMU
1329	RKPSTM	1172	RLPRES	1141	RNBOR	1131	RPHYD
1494	RKPUMP	1195	RLRODE	907	RNECAN	1236	RPICRT
1041	RKQ	1245	RLSPIK	906	RNENOD	1489	RPINIT
1050	RKQCEA	1324	RLTINT	908	RNESTA	1132	RPIOD
1053	RKQUH	1330	RM504	1355	RNEVER	1185	RPITER
1047	RKSANN	846	RMBUB	1282	RNEXMN	1231	RPITRP
1398	RKSAV	1183	RMBUBP	1142	RNHYD	1319	RPLAIR
1147	RKSREL	1454	RMLB	1143	RNIOD	1283	RPLCOF
1397	RKTAV	1530	RMLDNB	835	RNODEV	1318	RPLINT
1152	RKXREL	844	RMLIQ	2285	RNODFL	966	RPLIQ
1378	RLBALS	842	RMNODE	1144	RNPART	1338	RPLLAS
1387	RLBCOS	830	RMOCHT	1139	RNREL	1281	RPLLOP
1380	RLBDPL	827	RMODEL	1140	RNSOL	1297	RPLREF
1383	RLBDTS	829	RMOOIL	1145	RNXEN	1314	RPMAIR
1374	RLBEL	833	RMOPOW	1400	ROCHT	1313	RPMSTM
1375	RLBES	832	RMOQT	1396	ROCORE	1230	RPNCAL
1382	RLBLDP	1239	RMOR1	1391	ROPUMP	1078	RPNCON
1379	RLBLDR	1257	RMOR2	1390	ROUTPT	1237	RPNCRT
1197	RLBLOW	1285	RMOR3	1165	RPASTV	836	RPNODE
1381	RLBQMX	1290	RMOR3A	920	RPATHV	1079	RPNQT
1388	RLBRCS	1295	RMOR3B	1191	RPAVLV	1232	RPNTRP
1377	RLBS	1298	RMOR4	1130	RPBOR	1133	RPPART
1376	RLBVFR	1309	RMOR5	1234	RPCOND	1317	RPPINT

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1082	RPPLOC	873	RQSTM	1216	RRTFRI	1359	RTIMSC
1304	RPPMOD	1109	RQTEMP	1214	RRTHYD	862	RTLIQ
1235	RPPRAN	872	RQTOT	1037	RRTORQ	1408	RTLMIX
1341	RPQAXW	1110	RQTSUR	1336	RRTRIP	1409	RTLSAT
1242	RPQCMU	869	RQWALL	262	RRVFLO	1413	RTMBUB
1340	RPQCON	1392	RR1DP	1218	RRVIBR	1412	RTMLIQ
970	RPQUAL	1393	RR2DP	1333	RRVOID	860	RTNODE
837	RPRESP	1394	RR3DP	1207	RRVOLT	2289	RTOTE
838	RPRESS	1395	RR4DP	1426	RSDCG	2286	RTOTFL
1129	RPSOL	1345	RRADFC	1325	RSDCGF	2287	RTOTHR
967	RPSTM	1210	RRADIM	1326	RSDCGM	2288	RTOTM
968	RPSVOL	1301	RRADMU	1274	RSDCMX	1401	RTPRES
1293	RPTAUR	1209	RRADRE	1287	RSDPMU	1404	RTQUAL
1254	RPTFLS	1346	RRAMPS	911	RSECT	1410	RTQWAL
1323	RPTINT	1221	RRAVIB	1356	RSFAIL	864	RTSAT
1063	RPTREF	1399	RRBORL	1384	RSHAOV	863	RTSTM
1065	RPTRTD	1224	RRBREK	1495	RSINIT	866	RTSUBC
1332	RPTSB	1303	RRCFRC	1429	RSISB	1267	RTTMAX
1064	RPTSRG	263	RRDD	1428	RSISE	1248	RTTMSC
1339	RPTWAL	1039	RRDP	1427	RSISG	1261	RTTSRG
1186	RPTYPE	1302	RRDSLO	1430	RSITG	1411	RTTWAL
1027	RPUPDN	1222	RRDSPD	1271	RSITMX	431	RTUBES
1233	RPVISC	1334	RRDTTP	856	RSLIQ	865	RTWALL
1199	RPVLV	1331	RRFCAV	858	RSLIQS	1407	RTXIN
991	RPVOID	1451	RRFFRQ	854	RSNODE	1190	RUAVLV
1134	RPXEN	1208	RRFREQ	1357	RSRECV	1090	RUECON
1322	RPXREL	1449	RRFVLT	1146	RSREL	1088	RUEQT
1193	RQAVLV	1038	RRHEAD	2365	RSSCON	1091	RUETOP
875	RQCOND	1036	RRHEAT	857	RSSTM	1089	RUGCON
870	RQCONT	1225	RRHIVI	859	RSSTMS	1087	RUGQT
1478	RQEDMW	1348	RRLCAV	2366	RSSUSE	1344	RULORG
1105	RQENGY	1228	RRLEAK	1013	RSTDN	1093	RUMNON
1104	RQENTH	1226	RRLOCK	855	RSTOT	1097	RUNCON
871	RQEXT	1353	RRLTHI	1385	RSTPRE	1096	RUNDIL
1477	RQGDMW	1212	RRPF	1351	RTC12B	1098	RUNQT
1481	RQGGWS	264	RRPHD	1492	RTCLIN	1099	RUPLOC
1479	RQGRCW	265	RRPHT	867	RTCONT	1095	RUPNON
1106	RQLEVL	1217	RRQRCP	1249	RTDEL	1343	RUPORG
874	RQLIQ	1211	RRSLIP	1252	RTDELT	1255	RUQCMU
1111	RQLRUP	1220	RRSMOT	1406	RTEIN	1092	RUSTOP
1108	RQMGAS	261	RRSPDR	1402	RTELIQ	1094	RUVNON
1107	RQMWAT	1035	RRSPED	1268	RTESRG	1189	RVAREA
1113	RQNCON	1219	RRSPMP	1403	RTESTM	1074	RVEREL
868	RQNODE	1312	RRSTAR	1250	RTFDEL	1437	RVFMOV
1480	RQPGWS	1335	RRSTOP	1244	RTFRAC	1438	RVFPC
1352	RQPJ4	1347	RRSVOL	1405	RTGIN	1435	RVFPOR
1103	RQPRES	266	RRSYNC	1243	RTHSMU	1439	RVFPQT
1112	RQSOLU	1215	RRTELE	1358	RTIMEC	1442	RVFQTC

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1441	RVFQTG	986	RXINT	1788	SBITNK	1554	SDVDP
1443	RVFQTN	985	RXLB	1845	SBMODF	1858	SDVREC
1436	RVFSAF	980	RXLEAK	1543	SBOTP	1786	SEAFWS
1444	RVFSIG	976	RXLET	1518	SBPAR	1896	SECON
1440	RVFSPR	881	RXMIX	1820	SBPBOT	1555	SENTH1
1433	RVFUHC	971	RXMOM	1517	SBPDAT	1556	SENTH2
1434	RVFUHQ	972	RXNMOM	1522	SBPDZ	1557	SENTH3
1486	RVGPZR	879	RXNODE	1521	SBPKE	1558	SENTH4
1073	RVGREL	984	RXORNG	1520	SBPKG	1559	SENTH5
1485	RVNPZR	969	RXPATH	1519	SBPLOD	565	SEQNCE
882	RVOIDF	989	RXPZRR	1837	SBPOUT	2195	SETDDT
1484	RVOPZR	974	RXRCP	1838	SBPREL	2198	SETDM
1085	RVPDN	983	RXRODE	1843	SBPROT	2197	SETDP
1432	RVPOS	982	RXSB	1842	SBPRSN	2194	SETDT
1487	RVPPZR	978	RXSDC	1836	SBPSNK	2196	SETP
1084	RVPUP	981	RXSGTR	1819	SBPSUR	2201	SETRT
1446	RVSPOR	979	RXSIS	1818	SBPT	2193	SETT
1075	RVSREL	987	RXSPRA	1789	SBPTNK	2199	SETW
1445	RVSSPR	880	RXTOT	1802	SBSVG	2200	SETWD
1077	RVTREL	990	RXUHR	1804	SBTWAL	403	SFCONI
1076	RVVRLE	1888	SADEG	1808	SBVBOT	1865	SFDMIN
1483	RVXPZR	1890	SADFUL	1825	SBVOUT	8	SFILE
1135	RWAHYD	1889	SADGOP	1806	SBVPOS	1852	SFK3T
1136	RWAIO	1891	SADZER	1826	SBVREL	1904	SFLIME
1137	RWAPT	2280	SAREA3	1824	SBVSNK	1854	SFPMAX
1192	RWAVLV	1850	SASEPT	1807	SBVSUR	1853	SFTIME
1138	RWAXE	1901	SASUBE	1823	SBXBOT	2507	SGAFWS
1071	RWBAUX	1797	SBBDM	1821	SBXE	1787	SGBD
1068	RWBPAT	1791	SBDVDH	1840	SBXOUT	1793	SGBDH
1277	RWDELH	1792	SBDVDP	1841	SBXREL	1794	SGBDHF
1070	RWEAUX	1814	SBEBOT	1839	SBXSNK	1795	SGBDHG
1083	RWEBLD	1812	SBENTH	1822	SBXSUR	1796	SGBDL
1258	RWEFF	1831	SBEOUT	1790	SBXTNK	1798	SGBDML
1278	RWEFF1	1832	SBEREL	1550	SCBOR1	1799	SGBDP
1280	RWEFF2	1830	SBESNK	1551	SCBOR2	1800	SGBDSV
1259	RWEFFM	1813	SBESUR	1549	SCEX2	1803	SGBDT
1067	RWEPAT	1809	SBG	1544	SCIO1	1805	SGBDX
1069	RWGAUX	1811	SBGBOT	1545	SCIO2	1632	SGCHOK
1072	RWGBLD	1828	SBGOUT	1903	SCNVRG	432	SGMTCP
1066	RWGPAT	1829	SBGREL	1870	SCOLDT	1785	SGNAFW
1491	RWINIT	1827	SBGSNK	1546	SCPT1	1499	SGQDH
1260	RWLEFF	1810	SBGSUR	1547	SCPT2	1500	SGQDW
1279	RWLPRS	1817	SBIBOT	1881	SCRMOD	1501	SGQLH
1284	RWPDEG	1815	SBIO	1548	SCXE1	1502	SGQLW
988	RXBLED	1834	SBIOUT	11	SDATE	1498	SGQNNS
975	RXCHGS	1835	SBIREL	2273	SDELAY	1497	SGQNSE
977	RXDRN	1833	SBISNK	1552	SDELTV	1508	SGQNSS
973	RXEXT	1816	SBISUR	1553	SDP	1509	SGQOPT

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Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name	Index	Short Variable Name
1496	SGQPAR	1601	SGSVG	1880	SGXTAU	10	STIME
1507	SGQPR	1617	SGSW13	1873	SH2STM	9	STITLE
1504	SGQQP	1618	SGSW21	1872	SH2SUB	1897	STPINE
1505	SGQQS	1619	SGSW23	1633	SHEAT	1898	STPOTE
1510	SGQSEH	1623	SGSW25	1567	SHLEVL	1588	STREFL
1503	SGQSET	1620	SGSW31	1871	SHOTT	1862	STRMAX
1506	SGQTTB	1621	SGSW32	823	SHPOPT	1861	STRTUN
1541	SGS	1625	SGSW42	1883	SINCON	1846	STUNE
1560	SGSE1	1622	SGSW51	2292	SITOT	1589	STWALL
1561	SGSE2	1624	SGSW53	1887	SKAMUL	1595	SUSTM
1562	SGSE3	1607	SGSWF1	7	SLABEL	1866	SUSTMN
1563	SGSE4	1608	SGSWF2	2361	SLFLC	1867	SVCONV
1564	SGSE5	1609	SGSWF3	1855	SLHASB	2283	SVEL31
1725	SGSFWS	1610	SGSWF4	1885	SLINIT	1876	SVFREF
1565	SGSHF	1611	SGSWF5	1685	SLPFLO	1877	SVGREF
1566	SGSHG	1612	SGSWG1	1882	SMORE	1878	SVLEGR
1570	SGSHT1	1613	SGSWG2	401	SPACE	1801	SVSVF
1568	SGSHT2	1614	SGSWG3	1856	SPCONV	1868	SWFMIN
1569	SGSHT3	1615	SGSWG4	1864	SPERIM	1626	SWOUT
1542	SGSINT	1616	SGSWG5	1884	SPINIT	1869	SX2RG1
1851	SGSM	1627	SGSX1	1857	SPMIN	585	TABMAX
1571	SGSM1	1628	SGSX2	1636	SQCLDR	410	TAUIO
1572	SGSM2	1629	SGSX3	1637	SQCLDS	411	TAUPT
1573	SGSM3	1630	SGSX4	1644	SQCONT	409	TAURC1
1574	SGSM4	1631	SGSX5	1634	SQHOTR	412	TAUXE
1575	SGSM5	1879	SGTAU	1635	SQHOTS	2217	TBASE
2235	SGSOFF	2369	SGTDB1	1643	SQLOAD	391	TBL2NU
1576	SGSP	2370	SGTDB2	1874	SQMULT	398	TBL3NU
1583	SGSSV1	2371	SGTDB3	1638	SQRECN	597	TCFMUL
1584	SGSSV2	2372	SGTDB4	1639	SQSECN	598	TCGAP
1585	SGSSV3	2373	SGTDB5	1645	SQWAL1	600	TCHFMU
1586	SGSSV4	2374	SGTDB6	1646	SQWAL3	601	TCLEV
1587	SGSSV5	2375	SGTDB7	1577	SRECIR	670	TCROD
1590	SGST1	2376	SGTDB8	1859	SRECMN	632	TCSATS
1591	SGST2	2377	SGTDB9	1578	SRHO1	657	TCSTM
1592	SGST3	2368	SGTDBP	1579	SRHO2	631	TCWAT
1593	SGST4	1514	SGTHT	1580	SRHO3	614	TDHFDP
1594	SGST5	2275	SGTIOP	1581	SRHO4	615	TDHGDP
1602	SGSV1	1512	SGTLEN	1582	SRHO5	617	TDTDHS
1603	SGSV2	1513	SGTRK	1860	SSEPMN	616	TDTDPS
1604	SGSV3	1511	SGTRP	1902	STCAVE	621	TDVGDH
1605	SGSV4	1516	SGTSAR	1641	STCOLD	619	TDVGDP
1606	SGSV5	1515	SGTSLT	1847	STCONT	620	TDVLDH
1596	SGSVF	404	SGU12	1642	STECON	618	TDVLDP
1597	SGSVF2	405	SGU23	1899	STFINE	665	TECOOL
1598	SGSVF3	406	SGV2AC	1900	STFOTE	609	TESATL
1599	SGSVF4	407	SGV4MX	1863	STGMAX	608	TESATP
1600	SGSVF5	408	SGV5MX	1640	STHOT	610	TESATS

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603	TFHTGN	613	TTSAT
641	TFLASH	660	TTSURF
659	TFLUX	268	TTWIFR
602	TGAPIN	624	TUSATS
653	TGSTMB	623	TUSTM
649	THFB	622	TUWAT
639	THNB	647	TXFC
658	THSTM	568	UNUSED
640	THSUB	2272	USR
656	TIHT	2282	V3MULT
2218	TIME	396	V3TB1
2222	TIMQUE	397	V3TB2
654	TKGAP	395	V3TBL
669	TKROD	2358	VBMISC
627	TKSATS	447	VEL100
626	TKSTM	910	VOLMIX
625	TKWAT	413	VOLSGS
634	TLBOIL	389	VSTTB1
642	TLMIXL	390	VSTTB2
430	TMPTBL	388	VSTTBL
16	TNMAXL	415	W32FLC
17	TNPROP	2276	WARNOP
629	TPRSTM	466	WFW100
630	TPRSTS	797	XDISP
628	TPRWAT	195	XNEGUP
599	TPSPCR	802	XOFFAV
643	TQAVE	800	XOFFST
661	TQAXIL	194	XPOSUP
635	TQCRIT	799	XPOWER
650	TQDNB	798	XPOWRD
662	TQLIQ	801	XPWRAV
663	TQSTM	566	XTAB
655	TQZRWA	803	XTCONS
667	TRADEX	567	YTAB
861	TRTOT	93	ZANN
2219	TSCALE	193	ZINUP
611	TSSATL	192	ZOUTUP
612	TSSATS	95	ZSECVA
1386	TSTLST	822	ZSHPIN
2220	TSTOP		
666	TTCOOL		
638	TTCRIT		
648	TTCROS		
637	TTERM2		
636	TTERMT		
644	TTFUEL		
651	TTNBFC		
668	TTROD		

APPENDIX H NRC RAI Related to Westinghouse CENTS Topical Report

This appendix documents the history regarding the NRC Request for Additional Information on the CENTS Topical Report. The following documents are contained (in order) within this appendix.

1. NRC Letter, Ascension Number ML031420828, "Request for Additional Information Related to the Westinghouse CENTS Topical Report (TAC No. MB6982)," May 22, 2003

2. WOG-03-305, "Response to Request for Additional Information Related to the Westinghouse CENTS Topical Report (WCAP-15996-P)," June 13, 2003.

3. Change pages (from WCAP-15996-NP) due to responses to the RAI

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 22, 2003

Mr. Gordon Bischoff
Manager, Owners Group Programs
Westinghouse Electric Company
2000 Day Hill Road,
Windsor, CT 06095

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE WESTINGHOUSE CENTS TOPICAL REPORT (TAC NO. MB6982)

Dear Mr. Bischoff:

By letter dated December 13, 2002, the Combustion Engineering Owners Group (CEOG), submitted for the NRC staff review WCAP-15996-P, Rev. 0, Volumes 1-3, "Technical Description Manual for the CENTS Code." This topical report was prepared by Westinghouse Electric Company LLC (Westinghouse). Consistent with its prior approved versions of CENTS, it was requested that the NRC review and approve WCAP-15996-P, Rev. 0 for continued application to both Combustion Engineering- and Westinghouse-designed pressurized water reactors.

WCAP-15996-P, Rev. 0 documents changes made to the CENTS methodology and incorporates a number of minor changes to cleanup and clarify the methodology. The staff has reviewed this submittal and has had several teleconferences with Westinghouse, the last conducted on May 9, 2003. The staff has determined that additional information is needed to complete our review. A request for additional information is enclosed. This request was discussed with Virgil Paggen of your staff on May 9, 2003, and it was agreed that a response would be provided within 30 days of receipt of this letter.

If you have any questions, please contact me at (301) 415-1436.

Sincerely,

Drew G. Holland, Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Request for Additional Information

cc w/encl: See next page

REQUEST FOR ADDITIONAL INFORMATION

WCAP-15996-P, REV. 0, "TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE"

PROJECT NO. 700

CENTS is a computer code for the simulation of pressurized water reactors (PWRs) transient behavior under normal and abnormal conditions. CENTS is intended to be used for prediction of plant behavior for conditions ranging from normal plant operation to operational and licensing transients. WCAP-15996-P, Rev. 0 documents changes made to the CENTS methodology and incorporates a number of minor changes to cleanup and clarify the methodology. The staff has reviewed this submittal and has had several teleconferences with Westinghouse, the last conducted on May 9, 2003. The staff has determined that additional information is needed to complete our review.

The following questions are related to the main steamline and header model, Section 5.6:

1. Equation 5.33, on page 5-40 of Volume I of WCAP-15996-P, Rev. 0, is an equation for flow rate. However, the units of the equation do not result in flow rate units. Equation 5.36 results in break flow being in units of mass per length. Since this appears to be incorrect, please correct the documentation and coding as needed.

2. Should equation 5.54 be A11*Pj+A12*hj=A13? How do you get from "A13=..." at the bottom of page 5-50 to Equation 5.54?

The following questions are related to steam generator tube heat transfer, Section 5.3:

3. The last sentence of Section 5.3.2.2 states that if there is a tube rupture, then the flows are adjusted accordingly. Please expand on how the flows are adjusted.

4. Is W_l of Section 5.3.2.3 mass flow rate?

The following question is related to steam generator tube rupture model, Section 5.7:

5. The slot break model is described in Section 5.7.3. Does the code support flow from both tube sections out the slot break? Please clarify the meaning of the last sentence of Section 5.7.3.

The following question is related to feedwater line model, Section 5.5:

6. On page 5-23, the flow-squared term is linearized from the momentum equation. Please annotate the steps taken to arrive at each step listed.

The following questions are related to Volume 4 of WCAP-15996-P, Rev. 0:

7. Is the time of 668 seconds correct for the peak steam generator pressure on Table 2.2.2.B?

8. Please clarify the reason for the different trends observed on Figure 2.2.1.F.

9. What is the reason for the pressurizer pressure difference between the original version and the current version (models activated) in Figure 2.2.2.Q?

10. Is there actually a second y-axis in Figures 2.2.3.K and 2.2.4.K?

11. Please explain why the iteration described in the second paragraph of Section 3.4.1 is performed.

12. Please describe why there is 30 percent less break flow in the current version as compared to the original version as shown on Figure 3.2.2.K.

13. In most cases outlined in the roadmap, the changes which are requested to be reviewed did not result in changes to the outcome. For each case, please explain whether the reason for making the changes were not as important as originally expected, or if the code does not adequately predict the phenomena expected.

cc:
Mr. Hank A. Sepp, Manager
Regulatory and Licensing Engineering
Westinghouse Electric Company
Mail Stop WEC E 4-7A
P.O. Box 355
Pittsburgh, PA 15230-0355

Mr. Ian C. Rickard, Project Manager
Windsor Nuclear Licensing
Westinghouse Electric Company
Mail Stop 6009-0420
Windsor, CT 06095-0500

Mr. Charles B. Brinkman, Director
Washington Operations
Westinghouse Electric Company
12300 Twinbrook Parkway, Suite 330
Rockville, MD 20852

Mr. Virgil A. Paggen, Licensing Project Engineer
Westinghouse Electric Company LLC
Mail Stop 6009 - 420
2000 Day Hill Road
Windsor, CT 06095-0500

05322816

Domestic Members
AmerenUE
Callaway
American Electric Power Co.
D.C. Cook 1 & 2
Arizona Public Service Co.
Palo Verde 1, 2 & 3
Constellation Energy Group
Calvert Cliffs 1 & 2
Dominion Nuclear Connecticut
Millstone 2 & 3
Dominion Virginia Power
North Anna 1 & 2
Surry 1 & 2
Duke Energy
Catawba 1 & 2
McGuire 1 & 2
Entergy Nuclear Northeast
Indian Point 2 & 3
Entergy Nuclear South
ANO 2
Waterford 3
Exelon Generation Company LLC
Braidwood 1 & 2
Byron 1 & 2
FirstEnergy Nuclear Operating Co.
Beaver Valley 1 & 2
FPL Group
St. Lucie 1 & 2
Seabrook
Turkey Point 3 & 4
Nuclear Management Co.
Kewaunee
Palisades
Point Beach 1 & 2
Prairie Island
Omaha Public Power District
Fort Calhoun
Pacific Gas & Electric Co.
Diablo Canyon 1 & 2
Progress Energy
H. B. Robinson 2
Shearon Harris
PSEG – Nuclear
Salem 1 & 2
Rochester Gas & Electric Co.
R. E. Ginna
South Carolina Electric & Gas Co.
V. C. Summer
Southern California Edison
SONGS 2 & 3
STP Nuclear Operating Co.
South Texas Project 1 & 2
Southern Nuclear Operating Co.
J. M. Farley 1 & 2
A. W. Vogtle 1 & 2
Tennessee Valley Authority
Sequoyah 1 & 2
Watts Bar 1
TXU Electric
Commanche Peak 1 & 2
Wolf Creek Nuclear Operating Corp.
Wolf Creek

International Members
Electrabel
Doel 1, 2, 4
Tihange 1 & 3
Electricité de France
Kansai Electric Power Co.
Mihama 1
Takahama 1
Ohi 1 & 2
Korea Hydro & Nuclear Power Co.
Kori 1 – 4
Ulchin 3 & 4
Yonggwang 1 - 5
British Energy plc
Sizewell B
NEK
Krsko
Spanish Utilities
Asco 1 & 2
Vandellos 2
Almaraz 1 & 2
Ringhals AB
Ringhals 2 – 4
Taiwan Power Co.
Maanshan 1 & 2

June 13, 2003
WOG-03-305

Project No. 692

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Attn: Chief, Information Management Branch
Division of Program Management

Subject: Response to Request for Additional Information Related to the Westinghouse CENTS Topical Report (WCAP-15996-P)

Reference:
1. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, (Proprietary) and WCAP-15996-NP, (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code", CEOG-02-256, December 13, 2002
2. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, Volume 4 (Proprietary) and WCAP-15996-NP, Volume 4 (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code", WOG-03-76, February 19, 2003
3. Letter, D. G. Holland (NRC) to G. Bischoff (Westinghouse), "Request for Additional Information Related to the Westinghouse CENTS Topical Report (TAC No. MB6982)", May 22, 2003

By means of References 1 and 2, the Combustion Engineering Owners Group (CEOG) submitted WCAP-15996-P, Rev. 0, Volumes 1 - 4, "Technical Description Manual for the CENTS Code" for Nuclear Regulatory Commission (NRC) review and approval. During the course of its review the NRC staff determined that it required additional information in order to complete its assessment (Reference 3). The responses to the NRC RAIs are provided in Enclosures 1-P (Proprietary) and 2 (Non-Proprietary).

Enclosure 3 contains:

1. One (1) copy of the Application for Withholding, CAW-03-1662.
2. One (1) copy of Affidavit.
3. Proprietary Information Notice.
4. Copyright Notice.

Westinghouse has determined that the information contained in Enclosure 1-P, "Response to Request for Additional Information Regarding WCAP-15996-P, Volumes 1 – 4, Technical Description Manual for the CENTS Code", is proprietary in nature. Consequently, it is requested that this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and that copies of this information be appropriately safeguarded.

Correspondence with respect to the proprietary aspect of the Applications for Withholding or the supporting Westinghouse affidavits should reference CAW-03-1662, as appropriate, and should be addressed to Mr. H. A. Sepp, Manager of Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P. O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

All correspondence and invoices related to the review of WCAP-15996-P should be addressed to:

Mr. Gordon Bischoff
Manager, Owners Group Program Management Office
Westinghouse Electric Company LLC
2000 Day Hill Road
Windsor, CT 0095-0500

If you require further information, please contact Mr. Jim Molkenthin in the Owners Group Program Management Office at (860) 731-6727

Sincerely,
Westinghouse Owners Group

R. H. Bryan, Chairman

Enclosures

xc: Management Committee
Analysis Subcommittee
Project Management Office
C. B. Brinkman, Westinghouse, w/o enclosures
H. A. Sepp, Westinghouse, w/o enclosures
M. C. Janke, Westinghouse, w/ enclosures
V. A. Paggen, Westinghouse, w/o enclosures
E. J. Schulz, Westinghouse, w/ enclosures
S. E. Colpo, NRC, w/ enclosures
S. Dembek, NRC, w/o enclosures
D. G. Holland, NRC, w/ enclosures (via Federal Express)
J. L. Uhle, NRC, w/o enclosures

WESTINGHOUSE ELECTRIC COMPANY LLC

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING WCAP-15996-NP, VOLUMES 1 — 4 TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE

JUNE, 2003

Response to RAIs Regarding NRC Review of WCAP-15996-P

Questions Related to the Main Steamline and Header Model, Section 5.6

RAI No. 1: Equation 5.33 on Page 5-40 of Volume I of WCAP-15996-P is an equation for flow rate. However, the units of the equation do not result in flowrate units. Equation 5.36 results in break flow being in units of mass per length. Since this appears to be incorrect, please correct the documentation and coding as needed.

Response 1a:

The drain rate constant in Equation 5.33 should be 0.5/sec instead of 0.5, then Equation 5.33 becomes

[ ] a, c

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

Response 1b:

The term C_0 in Equation 5.36 (and 5.24) is a constant that has units of(BTU * in^2) / (lbf * sec * ft^2)

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

RAI No. 2: Should equation 5.54 be A11*Pj+A12*hj=A13? How do you get from "A13=..." at the bottom of page 5-50 to Equation 5.54?

Response 2a:

Yes, Equation 5.54 contains a typographical error. It should read:

[ ] a, c

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

Response 2b:

If a substitution is made for the ($\Sigma W_{in} - \Sigma W_{out}$), and substitute $A_{11} = B_{10}$ and $A_{12} = B_{11}$, then the equation at the bottom of Page 5-50 becomes

[ ] a, c

Then, the terms combine to

[ ] a, c

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

Questions related to Steam Generator Tube Heat Transfer, Section 5.3

RAI No. 3: The last sentence of Section 5.3.2.2 states that if there is a tube rupture, then the flows are adjusted accordingly. Please expand on how the flows are adjusted.

Response 3:

Given a primary tube node with N sections, the inlet and exit flowrates of the node are given by the RCS path information. Those are distributed smoothly over the node's subsections:

$$w_0 = W_0$$

$$w_i = w_{i-1} + (W_N - W_0) / N, \quad \text{for } 1 \le i \le N$$

where

w_i = Flowrate at top of section i
W_0 = Inlet flow to node
W_N = Exit flow from node

If there is a Tube Rupture at tube section M, then the above distribution is adjusted as follows:

$$w_i = W_0 \quad \text{for } 0 \le i \le M-1$$

$$w_M = W_0 - W_{SGTR}$$

$$w_i = w_{i-1} + (W_N - W_M) / (N - M), \quad \text{for } M+1 \le i \le N$$

where

w_{SGTR} = Tube Rupture flow rate

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

RAI No. 4: Is W_i of Section 5.3.2.3 mass flowrate?

Response 4:

Yes, as indicated in the response to Question No. 3, W_i = Flow rate in section i.

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

Questions related to Steam Generator Tube Rupture Model, Section 5.7

RAI No. 5: The slot break model is described in Section 5.7.3. Does the code support flow from both tube sections out the slot break? Please clarify the meaning of the last sentence of Section 5.7.3.

Response 5:

The slot break model does support flow from both tube sections out the slot break. In general, the model supports flow in either direction through the slot and flow in either direction through either tube section.

The last sentence of Section 5.7.3 describes the situation where flow through one tube section is toward the break and flow through the other tube section is away from the break. This situation can occur if the break flow is very small. For a larger break, flow through both tube sections is toward the break.

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

Questions related to Feedwater Line Model, Section 5.5

RAI No. 6: On Page 5-23, the flow-squared term is linearized from the momentum equation. Please annotate the steps taken to arrive at each step listed.

Response:

In addition to adding text to clarify the linearization of the momentum equation, there is a negative sign missing from the right hand side of the equation after the substitution back into the momentum equation. The text below should replace the text on Pages 5-23 and 5-24.

For the momentum equation, the flow-squared term is linearized as follows:

a, c

a, c

When Westinghouse produces the "-A" approved version of the topical report, it will factor the RAI responses into the text so that the body of the report is correct in all aspects.

RAI No. 7: The time of 668 seconds does not seem to be correct for peak steam generator pressure on Table 2.2.2.B.

Response:

There are two peaks for steam generator (SG) maximum pressure. The first peak occurs soon after the peak reactor coolant system (RCS) pressure. The second peak occurs in the intact SG after the main steam isolation valves (MSIV) shut and the SG re-pressurizes to the lift set point of the main steam safety valves, see Figure 2.2.2.H. The first peak is 1121 psia and occurs at 67 seconds. The second peak is slightly higher, 1122 psia, and occurs at 668 seconds. For all the subsequent cases, using the current CENTS version, the first peak is the highest pressure.

RAI No. 8: Please clarify the reason for the different trends observed on Figure 2.2.1.F.

Response:

Figure 2.2.1.F plots the intact loop cold leg temperature for the event of steam line break with loss of AC.

The temperature trend at this position in the RCS is not representative of the overall system response. It is strongly affected by the direction of RCS flow in the intact loop cold legs. The magnitude of the rate of flow in the intact loop is very low after the coastdown of the reactor coolant pumps and is an order of magnitude smaller than in the ruptured loop. The direction of flow reverses soon after the time of coastdown of the reactor coolant pumps. During the time of reverse flow the temperature of the intact loop cold legs decrease rapidly because the reactor pressure vessel, which is upstream, is cooled by flow from the ruptured loop and because of the impact of cold safety injection flow to each of the cold legs. During this time, the results of the current version (models deactivated) and the original version are very close. The lower temperature which is predicted by the current version (models active) is the result of a better prediction of natural circulation flow.

Flow in the intact loop reverses again and becomes positive sometime after the blowdown of the ruptured steam generator is complete so that the direction of flow is from the intact steam generator toward the core. The intact steam generator is hot and reverse heat transfer occurs in the intact steam generator. This causes the temperature of the intact loop cold legs to increase when the flow becomes positive.

The intact loop cold leg temperature response predicted by the current version (models activated) and the current version (models deactivated) are nearly the same during the heatup part of the transient. The temperature increase of the original version occurs later. This is because the second flow reversal (from negative to positive) occurs later for this version. The difference in the predicted time of flow reversal is primarily due to the correction of the implementation of the steam generator heat transfer correlation for reverse heat transfer conditions, which also affects the intact steam generator pressure (Figure 2.2.1.H).

RAI No. 9: What is the reason for the pressurizer pressure difference between the original version and the current version (models activated) in Figure 2.2.2.Q?

Response:

Pressurizer pressure diverges for the two cases at about 380 seconds when the pressure begins to decrease in response to emergency feedwater (EFW) actuation. The CENTS model which causes the differences in EFW timing is the four (4) node steam generator (SG) tube model with sectionalized heat transfer. This model effects the SG blowdown rate, which in turn effects the timing of the EFW flow after the Steam Generator Isolation Signal (SGIS). In the original version case, EFW flow is lost for 52 seconds, from time of SGIS until flow resumes to the intact SG. For the current version (models activated), EFW is lost for only 36 seconds. This reduces the RCS heatup and pressure spike, as shown in Figure 2.2.2.Q.

In the original version, the EFW system must wait for a SG $\Delta P>250$ psi, between the two SGs, prior to receiving a signal to re-start flow. In the current version (models activated), the intact SG pressure rises above the SGIS pressure setpoint which sends the signal to restart flow; therefore, there is no need to wait for the SG ΔP condition. This difference is due to the more accurate heat transfer modeling with the four (4) node SG model.

RAI No. 10: Is there actually a second y-axis in Figures 2.2.3.K and 2.2.4.K?

Response:

Yes, a second y-axis is implicit for the first 60 seconds (Fig. 2.2.3.K) or 25 seconds (Figure 2.2.4.K). These figures are intended to show the number of decades and rate of power increase from the initial power level. Figures 2.2.3.A and 2.2.4.A are linear plot figures to review just the peak power levels.

RAI No. 11: Please explain why the iteration described in the second paragraph of Section 3.4.1 is performed.

Response:

Two (2) codes are used in the iteration. The RELAP code is used to model the feedwater system. CENTS is used to model the rest of the nuclear steam supply system (NSSS), the steam generators (SGs), and the main steam system. For both codes, certain output of the other code is required as input. CENTS determines SG pressure during the transient. RELAP uses SG pressure vs. time as an input boundary condition to determine the feedwater flow and enthalpy. The feedwater flow and enthalpy from RELAP is used, in turn, as input to CENTS. Iteration is required because of the circular flow of data between the codes. Typically, only two (2) iterations are required to reach a converged solution.

The purpose of using the RELAP code was as a benchmark against the CENTS detailed Main Feedwater model.

RAI No. 12: Please describe why there's 30% less break flow in the current versions as compared to the original version as shown on Figure 3.2.2.K.

Response:

The original steam generator tube rupture (SGTR) model allowed the break to originate in only one (1) node. In this case, the hot side tube node was chosen. Thus, all break flow originates from one (1) node and the break flow enthalpy is the enthalpy of the hot side tube node.

In the current SGTR model, the flow through the ruptured tube originates from both ends of the tube, in the inlet and exit plenums of the SG (except for very small slot breaks, as discussed in the response to RAI # 5). Thus, the flow through the break has two (2) components; a hot side component and a cold side component.

Figure 3.2.2.K shows the entire break flow for the original case since all of it is modeled as coming from the "hot" tube node. However, for the current cases, the flow presented in this figure represents only the flow from the hot side of the tube rupture. The rest of the flow comes from the cold side, as shown in Figure 3.2.2.L. In Figure 3.2.2.L, the original case has zero flow. Finally, Figure 3.2.2.M presents the total break flow for all cases. This figure shows very good agreement.

RAI No. 13: In most cases outlined in the roadmap, the changes which are requested to be reviewed did not result in changes to the outcome. For each case, please explain whether the reason for making the changes was not as important as originally thought, or whether the code does not adequately predict the phenomena expected.

Response:

As stated in the Roadmap (Enclosure 2-P to CEOG-02-256, dated 12/13/02), the CENTS technical description was updated to capture the current status of the CENTS code and the documentation was improved to describe the models more completely and accurately. Since the changes described run the gamut from inconsequential to significant, it was not a surprise that most changes had little to no effect on the calculated result; especially with respect to limiting cases. It is recognized that in most cases, the changes outlined in the Roadmap did not have a large effect. The changes were made to increase the general accuracy and capability of the code for specific transient situations that are not necessarily related to the regulatory acceptance criteria for design basis events (i.e., those typically presented in Chapter 15 of a Safety Analysis Report). Most improvements are intended to better model non-licensing best-estimate and non-limiting cases rather than the more limiting design basis events. These non-licensing application cases are examined for setpoint calculations, PRA studies, as-found safety assessments, potential equipment availability or alignment scenarios, etc.

Using a conservative interpretation of 10CFR50.59 as a guide, the entire package of changes was subjected to review. This activity resulted in the categorization of changes being either acceptable without prior NRC review or that NRC review prior to implementation was required. Regardless of the categorization, however, WCAP-15996-P captures changes made in both areas in order to provide a complete description of the CENTS code. Roadmap Sections 3 and 4 delineate, respectively, those changes for which NRC review is not deemed necessary and those for which prior review is requested.

The only changes which result is a significant benefit are the newly added dose model and the detailed main feedwater (MFW) model. For the dose model, the current methodology uses very conservative hand calculations. These will be replaced by the dose model calculation within CENTS. For the detailed MFW model the code user currently inputs conservative feedwater flow and enthalpy boundary conditions for the steam line break and feedwater line break, or alternatively, a separate code is necessary to model the feedwater system and iterations with CENTS are required.

The change in feedwater line break methodology for the location of the steam generator feed ring has a significant effect on the long term effects of the feed line break event and resulting pressurizer level. This is a change in application of the code rather than a model change since the feed ring location (i.e., elevation) is a user input parameter. This change does not have a significant benefit in the calculation of peak RCS pressure.

5.2.6 *Critical Flow*

Critical flow of steam, where required, is calculated using the modified CRITCO equation[5.2]. The CRITCO equation is given as

$$(W/A)_{crit} = C_o\,(P - P_b)/(H - 185) \qquad (5.24)$$

where

W/A = mass flux, lbm/sec-ft^2

C_o = 0.53/0.000268

P = upstream pressure, psia

P_b = back pressure, psia

H = specific enthalpy, Btu/lbm.

Critical flow of liquid or two-phase is calculated using one of two correlations, selected by the user via the flag SGS_CRIT_MODEL. They are the homogeneous equilibrium model (HEM) correlation[5.3] and the HenryFauske (H-F) correlation[5.4]. The HEM and H-F tables are given in Appendix B.

5.3 Steam Generator Tube Heat Transfer

The steam generator heat transfer model is derived from a time dependent conservation of energy equation accounting for the thermal capacitance and conductivity of the steam generator tubes. Heat transfer coefficients are found for the fluid conditions on the primary and secondary side including the effect of voids. Level dependence of heat transfer area is modeled. [ ] is calculated explicitly. Provision is made for forward as well as reverse heat transfer.

[ ]

5.3.2.2 Distribution of Flowrates Through the Sections

Given a primary tube node with N sections, the inlet and exit flowrates of the node are given by the RCS path information. Those are distributed smoothly over the node's subsections:

$$w_0 = W_0$$

$$w_i = w_{i-1} + (W_N - W_0) / N \ , \qquad \text{for } 1 \le i \le N$$

where

w_i = Flowrate at top of section i

W_0 = Inlet flow to node

W_N = Exit flow from node

If there is a Tube Rupture, then the flows are adjusted accordingly.

5.3.2.3 Distribution of Specific Enthalpies Through the Sections

Given a tube node with N sections and the flows determined as above, the specific enthalpies of the node's inlet and exit flows are given by the RCS path information. Those are distributed smoothly over the node's subsections, based primarily on the tube heat transfer rates:

$$h_0 = H_0$$

$$h_i = h_{i-1} - Q_i / W_i \quad , \qquad \text{for } 1 \le i \le N$$

where

h_i = Specific enthalpy at top of section i

H_0 = Specific enthalpy of inlet flow to node

H_N = Specific enthalpy of exit flow from node (used below)

Q_i = Heat transfer rate in section i (positive from the primary fluid to the tubes).

5.3.2.4 Temperature Profile for Heat Transfer

An input option, RCS_SG_SECT_TOPT, determines the method for calculating the section temperatures, for the purpose of interfacing to the calculation of tube metal temperatures and heat transfer rates.

hd_{pump} ≡ pump head, feet.

w ≡ path flow, lbm/sec

For each node:

$$\Sigma w(in) - \Sigma w(out) - w_{extf} = 0.0$$

where:

w ≡ path flow (lbm/sec)

w_{extf} ≡ external flow out of node.

A matrix solution technique is used to simultaneously solve for flow and pressure throughout the feedtrain. The iterative solution is continued until

The steamline flow equations are:

The CRITCO Critical Flow Equation (Section 5.2.6) is:

$$W = C_3 \cdot \text{AREA} \cdot \text{PRESSURE} \tag{5.36}$$

or, as applicable,

$$W = C_3 \cdot \text{AREA} \cdot (\text{PRESSURE} - \text{BACK PRESSURE}) \tag{5.37}$$

where

$$C_3 = \frac{C_0}{\text{ENTHALPY} - 185.0}$$

$$C_0 = 0.53/0.000268 \quad \text{CONSTANT}$$

Steamline flow equations for each steamline:

Flow balance equation (Conservation of mass):

$$W_{out_{SG}}(I) = W_{BK}(I) + W_{RLF}(I) + W_{in_J}(I) \tag{5.38a}$$

Steamline break flow:

$$W_{BK}(I) = A_{BK}(I) \cdot C_3 \cdot (P_{SL} - P_{CONT}) \tag{5.38b}$$

where A_{BK} is the break area, P_{CONT} is the containment pressure (replaced by the atmospheric pressure P_{ATM} for a break discharging to the atmosphere), and C_3 is defined above for Equations (5.36)-(5.37).

Steamline safety valve or atmospheric dump valve flow with valve open area A_{RLF}:

$$W_{RLF}(I) = A_{RLF}(I) \cdot C_3 \cdot (P_{SL} - P_{ATM}) \tag{5.38c}$$

-
-

5.7.3 *Slot Break Model*

APPENDIX I Draft Safety Evaluation History

This appendix documents the history regarding the NRC SER for the CENTS Topical Report. The following document is contained within this appendix.

1. WOG-03-563, Rev. 1, "Comments on Draft Safety Evaluation for WCAP-15996-P, Rev. 0, 'Technical Description Manual for the CENTS Code,'" October 31, 2003.

DOMESTIC MEMBERS
AmerenUE
Callaway
American Electric Power Co.
D.C. Cook 1 & 2
Arizona Public Service Co.
Palo Verde 1, 2 & 3
Constellation Energy Group
Calvert Cliffs 1 & 2
Dominion Nuclear Connecticut
Millstone 2 & 3
Dominion Virginia Power
North Anna 1 & 2
Surry 1 & 2
Duke Energy
Catawba 1 & 2
McGuire 1 & 2
Entergy Nuclear Northeast
Indian Point 2 & 3
Entergy Nuclear South
ANO 2
Waterford 3
Exelon Generation Company LLC
Braidwood 1 & 2
Byron 1 & 2
FirstEnergy Nuclear Operating Co.
Beaver Valley 1 & 2
FPL Group
St. Lucie 1 & 2
Seabrook
Turkey Point 3 & 4
Nuclear Management Co.
Kewaunee
Palisades
Point Beach 1 & 2
Prairie Island
Omaha Public Power District
Fort Calhoun
Pacific Gas & Electric Co.
Diablo Canyon 1 & 2
Progress Energy
H. B. Robinson 2
Shearon Harris
PSEG – Nuclear
Salem 1 & 2
Rochester Gas & Electric Co.
R. E. Ginna
South Carolina Electric & Gas Co.
V. C. Summer
Southern California Edison
SONGS 2 & 3
STP Nuclear Operating Co.
South Texas Project 1 & 2
Southern Nuclear Operating Co.
J. M. Farley 1 & 2
A. W. Vogtle 1 & 2
Tennessee Valley Authority
Sequoyah 1 & 2
Watts Bar 1
TXU Electric
Commanche Peak 1 & 2
Wolf Creek Nuclear Operating Corp.
Wolf Creek
INTERNATIONAL MEMBERS
Electrabel
Doel 1, 2, 4
Tihange 1 & 3
Electricité de France
Kansai Electric Power Co.
Mihama 1
Takahama 1
Ohi 1 & 2
Korea Hydro & Nuclear Power Co.
Kori 1 – 4
Ulchin 3 & 4
Yonggwang 1 - 5
British Energy plc
Sizewell B
NEK
Krško
Spanish Utilities
Asco 1 & 2
Vandellos 2
Almaraz 1 & 2
Ringhals AB
Ringhals 2 – 4
Taiwan Power Co.
Maanshan 1 & 2

October 31, 2003
WOG-03-563, Rev. 1

WCAP-15996-P Rev. 0
WCAP-15996-NP Rev. 0
Project Number 694

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Attn: Chief, Information Management Branch
Division of Program Management

Subject: **Comments on Draft Safety Evaluation for WCAP-15996-P, Rev. 0, "Technical Description Manual for the CENTS Code"**

References:

1. NRC Letter, S. Dembek (NRC) to G. Bischoff (Westinghouse), "Draft Safety Evaluation for Topical Report WCAP-15996-P, Technical Description Manual for the CENTS Code, (TAC No. MB6982)," October 6, 2003

2. WOG Letter, G. S. Pavis to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P (Proprietary) and WCAP-15996-NP (Non-Proprietary), entitled Technical Description Manual for the CENTS Code," CEOG-02-256, December 13, 2002

On October 6, 2003, the Nuclear Regulatory Commission (NRC) issued a draft Safety Evaluation (SE) for WCAP-15996-P, "Technical Description Manual for the CENTS Code the CENTS," for review and comment (Ref. 1). Westinghouse Electric Company LLC (Westinghouse) on behalf of the Westinghouse Owners Group (WOG) has reviewed the draft SE. Comments on the draft SE are provided in Enclosure 1 (proprietary) and 2 (non-proprietary).

Enclosure 1 contains information proprietary to Westinghouse and it is requested that this information be withheld from public disclosure pursuant to 10 CFR 2.790. The reasons for withholding this proprietary information are contained in the affidavit provided with the submittal of WCAP-15996-P (Ref. 2). Correspondence with respect to the proprietary information or the Westinghouse affidavit should be addressed to Mr. John Galembush, Acting Manager, Manager of Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P. O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

All correspondence and invoices related to the review of WCAP-15996-P should be addressed to:

Mr. Gordon Bischoff, Project Manager
Westinghouse Owners Group
Westinghouse Electric Company (Mail Stop ECE 5-16)
P. O. Box 355
Pittsburgh, PA 15230-0355

If you require further information, please contact Mr. Jim Molkenthin in the Owners Group Program Management Office at (860) 731-6727

Sincerely,

Frederick P. "Ted" Schiffley, II
Chairman, Westinghouse Owners Group

Enclosures

cc: Management Committee
Analysis Subcommittee
Project Management Office
C. B. Brinkman, Westinghouse
H. A. Sepp, Westinghouse
J. S. Galembush, Westinghouse
M. C. Janke, Westinghouse
V. A. Paggen, Westinghouse
E. J. Schulz, Westinghouse
S. Dembek, NRC, Westinghouse
D. G. Holland, NRC (via Federal Express)

Proprietary Information Notice

Transmitted herewith are proprietary and non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted).

Enclosure 2 (Non-Proprietary) to WOG-03-563

Comments on Draft Safety Evaluation for WCAP-15996-P, Rev. 0, "Technical Description Manual for the CENTS Code"

Comments on Draft Safety Evaluation for WCAP-15996-P, Rev. 0, "Technical Description Manual for the CENTS Code"

Westinghouse Electric Company LLC (Westinghouse) on behalf of the Westinghouse Owners Group (WOG) has reviewed the Nuclear Regulatory Commission (NRC) draft Safety Evaluation (SE) for WCAP-15996-P, "Technical Description Manual for the CENTS Code the CENTS." Comments have been captured in a markup of the draft SE which is provided on the following pages. In order to make any discussion of the comments more efficient, line numbers have been incorporated in the right hand margin of the SE. In general, comments are provided in the form of suggested text changes or as clarification questions incorporated within {brackets}. These comments suggesting text additions or clarification questions show up as <u>underlined</u> text. Comments suggesting text deletions show up as ~~strikethrough~~ text. Several comments relate to rewording of the text to eliminate proprietary information which was inadvertently incorporated in the draft SE. Proprietary text which needs to be expunged from the SE is enclosed in bold **[brackets]**. In all cases, where the SE has been altered in some way, change bars are provided in the left hand margin (as shown here).

CENTS Draft SE Comment Summary

Line Number	Comment Description
11, 13	Suggest incorporating reference for submittal of CENTS Volume 4.
17	Suggest incorporating reference for submittal of CENTS RAI responses.
18, 19, 20	Update reference numbers due to previous incorporation of additional references.
31 - 33	Request for clarification of the intent of the word "supercede" on Line #29.
36 - 40	Suggest incorporating a more specific statement regarding CENTS usage with respect to analysis of loss-of-coolant accidents (LOCAs).
41	Editorial
43, 44	Suggest incorporating a more complete statement regarding staff-approved design codes against which CENTS was originally benchmarked. Also, suggest deleting reference.
60	Editorial
62	Suggest incorporating a more specific statement regarding CENTS usage.
79 - 81	Suggest incorporating specific reference to the sui generis application the SER refers to and also update reference number.
83 - 87	Suggest incorporating a more specific constraint clarification regarding use of CENTS for a portion of a CEA Ejection evaluation, as indicated.
103, 104	Suggest incorporating a more specific statement regarding the dose model assessment.
106	Suggest incorporating a more specific section title.
115	Suggest changing section title to eliminate proprietary information.
118, 119	Suggest deleting text to eliminate proprietary information.
123	Change "channel" to "tube" to clarify that it is steam generator and not core heat transfer that is being discussed.
130 - 132	If SER statement is an limitation, it would seem to follow that it should be included in the Conclusion section where the NRC lists limitations.
161	Suggest incorporating a more specific clarification regarding use of updated CENTS version in a manner which replicates the previously accepted version of the code.
164	Editorial
211 - 212	Suggest incorporating a more specific statement regarding the dose model assessment.
216	Update reference number.
227 - 228	Suggest incorporating a more specific statement regarding the dose model assessment.
238 - 242	Suggest incorporating a more specific statement regarding CENTS usage with respect to analysis of loss-of-coolant accidents (LOCAs).
249 - 253	Suggest incorporating a more specific constraint clarification regarding use

CENTS Draft SE Comment Summary

Line Number	Comment Description
	of CENTS for a portion of a CEA Ejection evaluation, as indicated.
255 - 258	Correction of submittal reference.
259 - 262	Incorporation of submittal reference for CENTS Volume 4.
263 - 265	Incorporation of submittal reference for CENTS RAI responses.
266	Update reference number.
267	Update reference number.
270 - 272	Update reference number and correct document number.
273 - 275	Incorporate reference for CEA Ejection Event sui generis application.
276	Incorporate reference for RELAP5/MOD3.
277 - 278	Incorporate reference for CENPD-190-A, CEA Ejection methodology.
280 - 281	Delete incorrect reference to CEFLASH-4AS.
282	RELAP5/MOD3 reference is now Reference 8.

UNITED STATES

NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT WCAP-15996-P, "TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE"

WESTINGHOUSE OWNERS GROUP

PROJECT NO, 694

1.0 INTRODUCTION

By letters dated December 13, 2002 and February 19, 2003, the Combustion Engineering Owners Group submitted Topical Report (TR) WCAP-15996-P, "Technical Description Manual ~~to~~ for the CENTS Code" (References 1 and 2), to the NRC staff for review and approval of the transient analysis methodology described therein for licensing applications with regard to both Combustion Engineering- (CE) and Westinghouse-designed pressurized water reactors (PWRs). By letter dated June 13, 2002, the Westinghouse Owners Group provided responses to the staff's request for additional information (Reference 3). WCAP-15996-P is an update of CENPD-282-P-A (Reference ~~2~~4); the latter was previously reviewed and approved by the staff for application to CE-designed PWRs (Reference ~~3~~5), and subsequently the staff extended this approval to Westinghouse-designed PWRs (Reference ~~4~~6). Central to the methodology described and discussed at length in both submittals is the CENTS computer code. This review focuses on, although is not limited to, the changes made to the CENTS code, between the approved version described in CENPD-282-P-A and the improved version described in WCAP-15996-P. The changes were made to more accurately model plant systems and transient behavior of the reactor system. To assist the staff in the review, Westinghouse prepared a "Roadmap" that identifies the changes made to the original TR, CENPD-282-P-A, and the rationale for the changes. This review relies to a great extent, although not exclusively, on the submitted "Roadmap."

The Westinghouse TR WCAP-15996-P will, on approval, supercede CENPD-282-P-A; the latter was previously found acceptable by the staff for referencing in licensing actions with respect to the calculation of transient behavior in PWRs. {Does "supercede" mean the documentation or the implementation? Westinghouse assumes that the new CENTS version can still be used in the manner described in CENPD-282-P-A, Rev. 0. That is, with the new models turned off.} In particular, the evaluation and approval of the models in the CENTS code, central to the CENPD-282-P-A methodology, are limited to non-loss-of-coolant accident (LOCA) licensing analyses. That is, CENTS is not approved for demonstrating compliance to 10CFR50.46 acceptance criteria. It is, however, acceptable when used to model small breaks in the primary system, that can be classified as LOCAs, for the purpose of demonstrating compliance to non-LOCA regulatory acceptance criteria. For example, CENTS is used to evaluate the dose consequences of Steam Generator Tube Rupture and Letdown Line Break events. The qualification of the previous versions of the CENTS code~~, to this end,~~ was based on CENTS predictions of startup measurements, operating transients, and comparisons to calculations made with other staff-approved design codes (e.g., CESEC, CEFLASH-4AS, RELAP5/MOD3) ~~(Reference 5)~~. Since model upgrades to the CENTS code are under review, the staff evaluated differences in the predictions of the originally approved code version and those of the upgraded CENTS version described in WCAP-15996-P for the most limiting design basis events. The basis for the approval of WCAP-15996-P is that any variance from previous results due to the model changes precludes exceeding the safety-related limits on which the approved CENPD-282-P-A methodology was based.

2.0 REGULATORY EVALUATION

Section 50.34 of Title 10 of the Code of Federal Regulations (10 CFR) contains requirements for the analysis of abnormal plant operating events by licensees. NUREG-0800, "Review of Safety Analysis Reports for Nuclear Power Plants," provides guidelines to licensees and the staff for evaluating these types of events. Section 50.71 requires licensees to update the final safety analysis report (FSAR) for a given site periodically. Included in the FSAR are the descriptions of abnormal events and accidents for which a given plant is analyzed. These are typically referred to as Chapter 15 analyses, corresponding to Chapter 15 of NUREG-0800.

The CENTS code is intended to provide analysis capability in the areas of engineering, operations and training. It also is intended to provide evaluation capabilities for transients events, accidents, operator actions, design and scoping studies. Under this review, it is specifically being evaluated for demonstration of compliance to acceptance criteria for non-LOCA Chapter 15 analyses for PWRs.

3.0 SUMMARY OF WCAP-15996-P

The Westinghouse submittals identified the specific changes that have been incorporated into the CENTS code since its previous approval. These modifications can be grouped into two classes: those that do not have an impact on the computed results and those that do affect the computed results.

In the former class are the editorial changes to the descriptions in CENPD-282-P-A with regard to the models of the bubble rise velocity used in the heat transfer coefficient for bubble condensation and the annulus bubble release rate. Both changes bring the text in the TR into conformance with the correct and previously approved coding in the CENTS code. The staff approves these changes. Westinghouse also requested a clarification of the restriction on the use of the CENTS code for application to control element assembly (CEA) ejection licensing analyses. With regard to CEA ejection licensing analyses, the safety evaluation for CENPD-282-P-A states, " ... CENTS is not approved for performing CEA ejection licensing analyses." The rationale for this restriction is stated as " Benchmarking for the CEA ejection transient has not been provided...". A sui generis application of the CENTS code to a CEA ejection event, submitted by Arizona Public Service Company for the Palo Verde Nuclear Generating Station Units 1, 2 and 3, has been reviewed and approved by the staff (Reference ~~6~~7). The staff will continue to entertain, on a case-by-case basis, such analyses for review.

Suggest the following wording change for your consideration with respect to CEA Ejection:

CEA Ejection Analyses: CENTS is acceptable for analyzing the NSSS thermal hydraulic response aspects of the CEA Ejection event. CENTS is not approved for evaluation of the fuel failure aspect of the CEA ejection accident. This aspect must be evaluated using STRIKIN-II as documented in Reference 9.

Westinghouse has added a new dose assessment model to the CENTS computer code that has the capability to calculate offsite dose due to an accident condition. Westinghouse has indicated that this model is essentially the same as the currently employed hand-calculated assessments used to determine dose consequences. Westinghouse has indicated that the benefit offered by the incorporation of the new dose model is the improved accuracy afforded by performing more exact iodine tracking and release calculations.

NRC review of this new dose assessment model is ongoing. Pending final approval, applicants may use the new model. Until such time as the new CENTS dose assessment model is approved by the NRC, the NRC will review each licensee's dose assessment on a case-by-case basis.

3.1 Model Changes

To technically justify those upgrades to the CENTS code that provide new modeling capabilities or provide more detail and accuracy for existing models, and, thereby have an impact on the computed results, Westinghouse performed benchmark testing. There are four such modifications to the CENTS code considered in this review; review of the fifth, a modification in the dose model, ~~has not been reviewed by the staff~~ is ongoing as discussed in Section 3.0. The specific models reviewed include:

3.1.1 Core Channel Heat Transfer Model Upgrade

The original channel enthalpy model ignores the heat capacity of the fluid, and is based on the assumption that the change in the enthalpy over a computational section is negligible relative to the transport-time constant over the section. The new version of the CENTS code allows for a time-dependent change in the enthalpy in a computational section by taking into account the heat capacity of the liquid. The differential equation for the rate of change of enthalpy in a computational section is solved analytically. Thus, this new option not only takes into account the heat capacity of the fluid, but also precludes any numerical instability that might be introduced through a finite-difference solution for large time steps.

3.1.2 [ ]a,c Steam Generator (SG) Tube Nodalization Model with Sectional Coolant Enthalpy

The updated SG model consists of an increase in the number of active-tube nodes per SG [ ]a,c. Within each of the [ ]a,c-active-tube nodes of each SG tube, an internal calculation tracks a detailed temperature profile for the coolant and the tubes. For this purpose, each tube node is divided into multiple subsections; the number of sections in each tube node is specified via input. This more detailed nodalization of the primary side of the SG is provided as an option to support the enhanced ~~channel~~ tube heat transfer model described above.

3.1.3 Multiple Node Reactor Pressure Vessel (RPV) Downcomer Model

The updated CENTS code contains an option for a more detailed nodalization in the reactor vessel downcomer. This modification, by introducing both axial and azimuthal nodalization, improves the simulation of the asymmetric effects in the loops of the reactor coolant system (RCS). The form loss coefficients between azimuthal sections are user input and must adhere to the modeling approach used in the demonstration plant supporting approval of this methodology.{This last sentence seems to be an SER imposed limitation. If this is indeed a limitation, it would seem to follow that it should be included in the Conclusion section where the NRC lists limitations.}

3.1.4 Detailed Main Feedwater Model

For the previously approved simplified feedwater line model, the feedwater flowrate delivered by the pumps is specified directly by the control system for each SG. The model feeds the indicated flows to the SGs unless a feedwater line break has occurred. In the latter case, the break flow from the feedwater lines is calculated by the homogeneous equilibrium model, or if the flow is choked, by the Henry-Fauske correlation.

The updated CENTS code allows discrete main feedwater (MFW) and auxiliary feedwater (AFW) models. This capability enables accurate, time-dependent transient simulation of the

MFW and AFW systems. The models are predicated on the availability of a network of discrete MFW and AFW components and piping through user developed and specified input. Thus, the system network is adaptable to different plant designs.

4.0 EVALUATION

Benchmark testing consisted of code comparisons for six events:

7. Main Steam Line Break
8. Feedwater Line Break
9. Control Element Assembly Withdrawal from Sub-critical Conditions
10. Control Element Assembly Withdrawal from Hot Zero Power Conditions
11. Reactor Coolant Pump Seized Rotor
12. SG Tube Rupture

These are viewed as the most limiting design basis events in this review.

To test that all the minor code modifications and error corrections made since 1994 have not had a significant net effect, the above six cases were run with the new version of the CENTS code with the upgrade models described above deactivated. No significant variances in the results were observed when compared to the results from the previously approved version. They are judged to preclude exceeding the safety-related limits on which the approval of the CENPD-282-A methodology is based. The staff accepts that the new version of the CENTS code (with the model upgrades described above deactivated) is comparable to the previously accepted version and that it continues to be acceptable to use CENTS in this manner.

The model upgrades in the new version of the code consist, as a whole, of a more realistic description of physical phenomena and a more detailed description of system components which ~~, such, they will~~ leads to more realistic and accurate results. These results may be noticeably different from those obtained with the previously approved version. To demonstrate that the new models lead to correct results, a second set of comparisons for the same general scenarios was made with all the CENTS upgrade models activated. To isolate the effect of the individual upgrades and evaluate their phenomenological behavior, the upgrades were also separately activated.

The new models in the CENTS code induce the following main changes in the results of the six benchmark cases:

4.1 Main Steam line Break

The new models cause a slightly more severe and rapid blowdown of the affected SG which results in a deeper drop in the core temperatures. This drop in core temperature has a reactivity worth of +0. 002311$\Delta\rho$ compared to the upgraded version with model changes deactivated. This change in reactivity is far from sufficient to induce a return to power; it is conservative. The staff accepts that the CENTS code with the new models continues to give conservative results for this event.

4.2 Feedwater Line Break

The upgrade models, together and individually, result in greater system flow to the intact SG. This results in lower long-term RCS temperatures, pressures and less swell into the pressurizer. The regulatory acceptance criterion for this event, with a limiting single failure, is that the peak RCS pressure must be less than 120 percent of the RCS design pressure. The staff accepts that the CENTS code with the new models continues to give conservative results with respect to this criterion for this event.

4.3 Control Element Assembly Withdrawal from Sub-critical Conditions

The only upgrade that has a significant effect on the results in this event is the channel heat transfer model. The improved modeling of the core fluid heat capacity reduces the positive moderator temperature reactivity feedback, and, thereby, lowers the peak power from ~119 percent to ~105 percent of nominal. The improved modeling reduces the code conservatism, however, it is physically based and is acceptable to the staff.

4.4 Control Element Assembly Withdrawal from Hot Zero Power Conditions

As in the previous event, the only upgrade that has a significant effect on the results is the channel heat transfer model. The improved modeling of the core fluid heat capacity reduces the positive moderator temperature reactivity feedback, and, thereby, lowers the peak power from ~106 percent to ~101 percent of nominal. It is acceptable to the staff as described above.

4.5 Reactor Coolant Pump Seized Rotor

The comparison of results between the upgraded CENTS code with models deactivated and activated shows good agreement, and, thereby, precludes exceeding safety-related limits on which the approved CENPD-282-P-A methodology was based. It is therefore acceptable to the staff.

4.6 SG Tube Rupture

The SG tube rupture event is a penetration of the barrier between the RCS and the main steam system due to the failure of a steam generator U-tube. The integrity of the barrier between the RCS and the main steam system is significant from the radiological release standpoint. The limiting event considered is a double-ended rupture of a SG tube with concurrent loss of alternating current (AC) power. Both phenomenologically and quantitatively, the comparison of thermal-hydraulic plant response parameters between the CENTS code with and without the upgraded model is excellent. The safety-related consequences for this event are mainly predicated on the dose model. The dose model review is ongoing as discussed in Section 3.0 ~~was not reviewed by the staff~~.

Although this review is based solely on the results of the above comparisons of benchmark calculations, Westinghouse has submitted results of a comparative analysis of a main steamline break event and a feedwater line break computed with CENTS with upgrades and RELAP5/MOD3 (Reference ~~7~~8). The agreement is good, and, furthermore, gives some insight into the effectiveness of the model upgrades in the CENTS code. This comparison, although not definitive, adds some weight to material proffered in support of this review.

5.0 CONCLUSIONS

The staff has reviewed TR WCAP-15996-P and the supporting documentation sent in response to the staff's request for additional information. On the basis of this review, the staff approves the transient methodology described in WCAP-15996-P for referencing in licensing actions with respect to the calculation of transient behavior in PWRs designed by CE and by Westinghouse subject to the limitations stated below. These limitations were placed on the approval of the CENPD-282-P-A methodology and apply to WCAP-15996-P methodology, approved herein. This does not include approval of the CENTS code dose model at this time. The CENTS code dose model review is ongoing as discussed in Section 3.0 and will be approved in a separate safety evaluation.

1. CENTS departure from nucleate boiling ratio (DNBR) analysis: The CENTS DNBR calculation for determining overall trends in thermal margin should not be used for licensing analyses. The DNBR licensing analyses should be performed with the presently approved CE DNBR methods.

2. Limitation to CE and Westinghouse Type Plants: The application of CENTS is limited to PWRs of CE and Westinghouse design.

3. LOCA and Severe Accident Analysis : Adequate benchmarking of the CENTS LOCA and severe accident capabilities has not been provided. Consequently, CENTS should not be used for performing LOCA or severe accident licensing analyses. That is, CENTS is not approved for demonstrating compliance to 10CFR50.46 acceptance criteria. It is, however, acceptable for use in modeling small breaks in the primary system, that can be classified as LOCAs, for the purpose of demonstrating compliance to non-LOCA regulatory acceptance criteria.

4. Three-Dimensional Core Neutronics : Benchmarking for the CENTS three-dimensional core neutronics capability has not been provided. Consequently, licensing applications of CENTS should be based on a point kinetics model.

5. CEA Ejection Analyses: This review does not give general approval for the application of CENTS simulations of a CEA ejection transient for licensing analyses. The staff will consider and review such requests on a case-by-case basis.

   Suggest the following wording change for your consideration with respect to CEA Ejection:

   CEA Ejection Analyses: CENTS is acceptable for analyzing the NSSS thermal hydraulic response aspects of the CEA Ejection event. CENTS is not approved for evaluation of the fuel failure aspect of the CEA ejection accident. This aspect must be evaluated using STRIKIN-II as documented in Reference 9.

6.0 REFERENCES

1. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, ~~Rev. 0~~(Proprietary), and WCAP-15996-NP (Non-Proprietary), ~~Volumes 1—3~~entitled, "Technical Description Manual for the CENTS Code", CEOG-02-256, December 13, 2002.

2. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, Volume 4 (Proprietary), and WCAP-15996-NP, Volume 4 (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code", WOG-03-76, February 19, 2003

3. Letter, R. H. Bryan (WOG) to USNRC Document Control Desk, "Response to Request for Additional Information Related to the Westinghouse CENTS Topical Report (WCAP-15996-P)", WOG-03-305, June 13, 2003

~~2.~~4. CENPD-282- A, Rev. 0, "Technical Description Manual for the CENTS Code."

~~3.~~5. Letter, M, J. Virgilio (NRC) to S. A. Toelle (ABB-CE)) , "Acceptance for Referencing of Licensing Topical Report CENPD-282-P, 'Technical Manual for the CENTS Code'," March 17 , 1994,

~~4.~~6. Letter, R. C. Jones (NRC) to S. A, Toelle (ABB-CE), " Acceptance for Referencing of Licensing Topical Report ~~CE-NPD~~ CENPD-282-P, Vol. 4, 'Technical Manual for the CENTS Code " February ~~25~~ 24 1995.

7. Letter, L. R. Wharton (NRC) to G. R. Overbeck (APS). "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 - Issuance of Amendments re: Various Administrative Controls (TAC Nos. ME1668, MB1669, and MB1670)", October 15, 2001

8. RELAP5/MOD3 Code Manual " NUREG/CR5535, INEL-95/0174, Vol. 1.

9. CENPD-190-A, "C-E Method for Control Element Assembly Ejection Analysis," January, 1976.

~~6.CEFLASH-4AS, A Computer Program for the Reactor Blowdown Analysis of the Small Break Loss of Coolant Accident." CENPD-138, Supplement 1 (Non-proprietary), August 1974.~~

~~7.RELAP5/MOD3 Code Manual." NUREG/CR5535, INEL-95/0174, Vol. 1.~~

Principal Contributor: Yuri Orechwa

Date:

APPENDIX J Record of Revision for WCAP-15996

This appendix documents the evolution of WCAP-15996. The tables beginning on the next page document the major changes between CENPD-252-P, Rev. 0 and WCAP-15996-P, Rev. 0. The changes are in tabular form and appear before the table of contents in WCAP-15996-P. The tables have been moved to this appendix for the approved version of the WCAP.

In addition, the following documents follow the tables. These documents are characterized as the "roadmap" to the submittal of WCAP-15996.

1. CEOG-02-256, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P (Proprietary), and WCAP-15996-NP (Non-Proprietary), entitled 'Technical Description Manual for the CENTS Code,'" December 13, 2002.

2. WOG-03-76, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, Volume 4 (Proprietary), and WCAP-15996-NP, Volume 4 (Non-Proprietary), entitled 'Technical Description Manual for the CENTS Code,'" February 19, 2003.

CEOG COMBUSTION ENGINEERING OWNERS GROUP

Westinghouse Electric Company LLC | Calvert Cliffs Nuclear Power Plant, Inc. | Entergy Operations, Inc. | Korea Hydro & Nuclear Power Company | Omaha Public Powe District

Calvert Cliffs 1, 2 | ANO 2 | WSES Unit 3 | YGN 3, 4 | Ulchin 3,4 | Ft. Calhoun

Arizona Public Service Co. | Consumers Energy Co. | Florida Power & Light Co. | Dominion Nuclear Connecticut, Inc | Southern California Edison

Palo Verde 1, 2, 3 | Palisades | St. Lucie 1, 2 | Millstone 2 | SONGS 2,3

December 13, 2002
CEOG-02-256

Project No. 692

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTN: Chief, Information Management Branch
Division of Program Management

Subject: Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, (Proprietary) and WCAP-15996-NP, (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code"

[Enclosures 1-P and 2-P Contain Westinghouse Proprietary Class 2 Information]

References:
1. WCAP-15996-P, Rev. 0, Volumes 1 - 3, "Technical Description Manual for the CENTS Code", December, 2002
2. CENPD-282-P-A, Rev. 0, "Technical Description Manual for the CENTS Code",
3. Letter, M. J. Virgilio (NRC) to S. A. Toelle (ABB-CE), "Acceptance for Referencing of Licensing Topical Report CENPD-282-P,Technical Manual for the CENTS Code" (TAC No. MB2718)", March 17, 1994
4. Letter, R. C. Jones (NRC) to S. A. Toelle (ABB-CE), "Acceptance for Referencing of Licensing Topical Report CE-NPD 282-P, Vol. 4, "Technical Manual for the CENTS Code" (TAC No. M85911)", February 25, 1995

By this letter, the CE Owners Group (CEOG) is submitting WCAP-15996-P, Rev. 0, Volumes 1 - 3, "Technical Description Manual for the CENTS Code" (Reference 1), prepared by Westinghouse Electric Co. LLC (Westinghouse), for Nuclear Regulatory Commission (NRC) review and approval. WCAP-15996-P is an update of CENPD-282-P-A (Reference 2) which was reviewed and approved for application to CE designed pressurized water reactors (PWRs) by the NRC March, 1994 (Reference 3). In February, 1995 (Reference 4) the NRC extended its approval for CENTS for application to PWRs designed by Westinghouse. Consistent with its prior approvals, the CEOG requests that the NRC review and approve WCAP-15996-P, Rev. 0 for continued application to both CE and Westinghouse designed PWRs. The CEOG plans to submit WCAP-15996-P, Rev. 0, Volume 4, which contains the results of the benchmark test cases, in January, 2003.

WCAP-15996-P (Enclosure 1-P) documents changes made to the CENTS methodology and incorporates a number of minor changes to clean-up and clarify the methodology. Following NRC approval of WCAP-15996-P, it will be employed in licensing applications by Westinghouse and members of the CEOG. To supplement WCAP-15996-P and assist the NRC in its review, Westinghouse has prepared a 'Roadmap' (Enclosure 2-P) which provides an overview of the changes made to the original topical report,

CENPD-282-P-A, where the changes were made, the nature of the change and a recommendation as to whether or not the changes need to be reviewed by the NRC. Since WCAP-15996-P includes a re-format of the original CENPD-282-P-A, it is hoped that the 'Roadmap' will help direct the NRC reviewer(s) to those sections of the topical report that would represent the major component of their review effort. Along these lines, a Record of Revision table has also been incorporated in the topical report to provide a cross-reference between section numbers in WCAP-15996-P and the corresponding subject matter section numbers in CENPD-282-P-A.

The CEOG requests that the NRC complete the review of WCAP-15996-P, Rev. 0, by June 30, 2003. To this end, Entergy is employing the currently approved CENTS methodology (i.e., CENPD-282-P-A) in support of their upcoming power uprate project for the Waterford Steam Electric Station, Unit 3. Approval of WCAP-15996-P by the requested date will allow use of the updated CENTS methodology, should it be needed. Further, both Arizona Public Service Company and Southern California Edison are also planning to use the updated CENTS methodology described in WCAP-15996-P in future licensing actions for the Palo Verde Nuclear Generating Stations Units 1, 2 and 3 and the San Onofre Nuclear Generating Station Units 2 and 3, respectively.

Consistent with the Office of Nuclear Reactor Regulation, Office Instruction LIC-500, "Processing Request for Reviews of Topical Reports," the CEOG requests that the NRC provide an estimate of the review hours, and target dates for any Request(s) for Additional Information (RAIs) and for completion of the Safety Evaluation for WCAP-15996-P, Rev. 0. For NRC planning purposes, Westinghouse plans to provide responses to RAIs in an expeditious manner so as not to delay the review.

Westinghouse has determined that the information contained in WCAP-15996-P, Rev. 0 (Enclosure 1-P) and the 'Roadmap' (Enclosure 2-P) are proprietary in nature. Consequently, it is requested that this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and that copies of this information be appropriately safeguarded. The reasons for the classification of this information as proprietary are delineated in the affidavit provided in Enclosure 3. Enclosure 4 provides a non-proprietary version of the topical report while Enclosure 5 provides a non-proprietary version of the 'Roadmap'.

The information transmitted herewith bears a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.790 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary version of this report, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

Invoices associated with the review of WCAP-15996-P, Rev. 0 should be addressed to:

Mr. Gordon Bischoff
Manager, Owners Group Program Management Office
Westinghouse Electric Company
2000 Day Hill Road
Windsor, CT 0095-0500

All correspondence related to this matter should be addressed to:

Mr. Gary S. Pavis
Chairman, Combustion Engineering Owners Group
Constellation Energy Group
Calvert Cliffs Nuclear Power Plant, Inc.
P.O. Box 1635

Lusby, MD 20657-4702

If you have any questions regarding this matter, please do not hesitate to call me or Chuck Molnar of Westinghouse's Licensing staff at (860) 731-6286.

Very truly yours,

Gary S. Pavis, Chairman
CE Owners Group

Enclosure(s): As stated

xc: F. M. Akstulewicz (NRC, w/o enclosures)
A. C. Attard ((NRC, w/enclosures)
S. Dembek (NRC, w/o enclosures)
G. S. Shukla (NRC, w/enclosures)
G. C. Bischoff, Westinghouse (1L)
S. Dederer, Westinghouse (1L)
V. Paggen, Westinghouse (1L)
H. A. Sepp, Westinghouse (1L)
K. J. Vavrek, Westinghouse (1L)
CEOG Analysis Subcommittee Representatives (1L)
CEOG Library Task 2027
CEOG Management Committee (1L)

Enclosure 4 to CEOG-02-256

WESTINGHOUSE ELECTRIC COMPANY LLC

NON-PROPRIETARY WCAP-15996-NP
TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE

Enclosure 5 to CEOG-02-256

WESTINGHOUSE ELECTRIC COMPANY LLC

NON-PROPRIETARY ROADMAP FOR WCAP-15996-P TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE

Roadmap for WCAP-15996-P, Technical Description Manual for the CENTS Code

1.0 Purpose

WCAP-15996-P, Rev. 0, "Technical Manual for the CENTS Code", provides an updated description of the CENTS code which was originally submitted by Combustion Engineering and subsequently approved by the Nuclear Regulatory Commission (NRC) under topical report number CENPD-282-P-A, Rev. 0. For the most part, the changes which have been made to CENTS are consistent with the code description given in CENPD-282-P-A Volumes 1 and 2. However, in a few cases the changes disagree with the detailed model descriptions given in CENPD-282-P-A Volumes 1 and 2. Also, new capabilities have been added to the CENTS code which are not described in CENPD-282-P-A.

The CENTS technical descriptions in WCAP-15996-P have been updated to describe the current CENTS code and the documentation has been improved to describe the models more completely and accurately. The new code description replaces CENPD-282-P-A Volumes 1 and 2. In addition, a new benchmarking study has been performed which quantifies the effect of the changes. The study compares the results of the latest version of CENTS to the approved version for a standard set of cases. This study supplements the benchmarking reported in CENPD-282-P-A Volumes 3 and 4.

The purpose of this 'Roadmap' is to highlight changes made in the CENTS code since its original review and approval. This is being done to help maximize the efficiency of the NRC review. The changes can be broken down into four (4) categories as follows:

e. **Clarifications** – *No change* was made to the methodology as approved by the NRC in CENPD-282-P-A, however, the topical report discussion was updated to clarify the original description.

f. **Editorial** – *No change* was made to the methodology as approved by the NRC in CENPD-282-P-A, however, the text was updated to correct typographical and grammatical errors.

g. **New** – This is a completely *new* section not contained in CENPD-282-P-A and, therefore, not previously reviewed by the NRC. Depending on the intended use of the new material, changes falling into this category may or may not require NRC review and approval.

h. **Updated** – A *change* was made to the methodology as approved by the NRC in CENPD-282-P-A and, therefore, new material is presented not previously reviewed by the NRC. In two (2) instances the change was not made to the coded methodology but to the model description instead. In these cases the coded model was correct and the description incorrect. However, in essence the NRC did not review and approve the model actually coded (although the coded model represented the correct formulation and was used for the original benchmark cases presented). Depending on the intended use of the new material, changes falling into this category may or may not require NRC review and approval.

In consideration of the above categorizations, Sections 3.0 and 4.0 below respectively discuss changes made which did not require prior NRC review and approval and those changes for which prior NRC review and approval is required before they can be implemented in licensing applications, such as Chapter 15 safety analyses.

2.0 Introduction

CENTS is a computer code for the simulation of PWR transient behavior under normal and abnormal conditions. CENTS provides an interactive capability for simulating the standard NSSS components and may be used to determine the transient thermal-hydraulic conditions in the primary and secondary systems and the transient core power. CENTS is intended to be used for prediction of plant behavior for conditions ranging from normal plant operation to operational and licensing transients.

CENPD-282-P-A, "Technical Manual for the CENTS Code", was originally submitted to the NRC for review in October 1991. Final approval was received in February 1995.

A number of changes have been made to the CENTS code since NRC approval was obtained. These changes have been made consistent with the guidance provided in 10 CFR 50.59. Generally, these changes have not invalidated the descriptions given in CENPD-282-P-A. However, in a few cases the changes did affect the CENPD-282-P-A descriptions, although the actual code results remained essentially the same.

The updated CENTS code topical report (i.e., WCAP-15996-P, Rev. 0, Volumes 1 – 3) being submitted to the NRC at this time incorporates these existing changes as well as additional changes for which NRC review and approval is required (see Section 4.0 below). Volume 4, which contains the results of the benchmark test cases, will be submitted in January, 2003.

The CENTS technical description has been updated to describe the current state of the CENTS code and the documentation has been improved to describe the models more completely and accurately. The new code description, WCAP-15996-P Volumes 1, 2 and 3, replaces in their entirety CENPD-282-P-A Volumes 1 and 2.

In addition, a new benchmarking study has been performed which quantifies the effect of the changes. The study compares the results of the latest version of CENTS to the previously NRC approved version for a standard set of cases. This study supplements the benchmarking originally provided in CENPD-282-P-A Volumes 3 and 4. Although the benchmarking provided in CENPD-282-P-A Volumes 3 and 4 remains applicable, WCAP-15996-P Volume 4 provides the benchmarking conducted for the latest version of the CENTS code.

Because WCAP-15996-P includes a few changes which require NRC review and many minor changes which do not, this 'Roadmap' discussion is provided to facilitate the review. Additionally, a Record of Revision table has been added to the topical report itself which provides a cross-reference between section numbers in WCAP-15996-P and CENPD-282-P-A. The table also delineates those sections of CENPD-282-P-A which have been deleted.

3.0 Previous CENTS Code Changes Which Did Not Require Prior Review And Approval

All revisions to the CENTS code since the original NRC submittal were evaluated using the guidance provided by 10 CFR 50.59. A screening process was employed to establish which CENTS modifications could be used without prior NRC review, and which changes would require licensee's to obtain NRC review and approval prior to being used. Following this process, it was determined that the following categories of changes to the CENTS do not require prior NRC review and approval:

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9. *CEA Ejection Accident SER Restriction Clarification*

The Nuclear Regulatory Commission (NRC) Safety Evaluation Report (SER) for CENPD-282-P-A contains the following restriction:

> "...CENTS is not approved for performing CEA ejection licensing analyses. The CEA ejection analyses should be performed with the NRC approved ABB-CE methods of Reference-10 (Section-3.3)."

As stated this restriction is ambiguous with respect to exactly how CENTS may be used in regard to CEA ejection evaluations. Westinghouse believes this restriction meant that CENTS could not be used to evaluate the fuel failure aspect of the CEA ejection accident. This portion of the event was to be analyzed using the STRIKIN-II computer code as described in the quoted SER reference. However, CENTS could be used to analyze the NSSS thermal hydraulic response aspects of the event. This NSSS response information determined by CENTS is then used as input to the fuel failure analysis performed by STRIKIN-II in conformance with the quoted SER reference.

In support of this approach, Westinghouse notes that its response to RAI No. 3 ABB-CE stated:

> "The CESSAR analysis of the CEA ejection event used CESEC to determine the NSSS response. However, this portion of the analysis is not limiting. The STRIKIN-II program was used to calculate the hot rod fuel temperature, heat flux, and the number of fuel rods which experience DNB. ABB-CE methods for the CEA ejection analysis are described in Reference 3.1."

In further support of this usage, Westinghouse notes that the NRC has specifically approved such application of the CENTS code to CEA ejection analyses for the Arizona Public Service Company, Palo Verde Nuclear Generating Station Units 1, 2 and 3 in an SER issued on October 15, 2001[1]. In this SER, the NRC indicates that a benchmarking study was performed by APS to demonstrate that the predictions of the NSSS response by the CESEC and CENTS codes for the CEA ejection event are comparable, and that CENTS can replace CESEC in accident analyses to predict the NSSS response.

A detailed NRC review is not being requested for regarding the application of CENTS to the NSSS response portion of a CEA ejection event. Rather, Westinghouse is requesting that the NRC provide a clear statement of the acceptable application of this restriction when the SER for WCAP-15996-P, Rev. 0 is issued.

4. Code Changes Requiring Prior Review and Approval

Several methodology changes have been made to the CENTS code which require prior NRC review and approval prior to their using in licensing applications. These changes are being made to more accurately model the plant systems and transient behavior.

a. *Changes to the Main Steam Line Header Model*

Description

The revised CENTS header model is described in WCAP-15996-P, Volume 1, Section 5.6. The original model is described in CENPD-282-P-A, Section 5.6.

[

[1] Letter, L. R. Wharton (NRC) to G. R. Overbeck (APS), "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 - Issuance of Amendments re: Various Administrative Controls (TAC Nos. ME1668, MB1669, and MB1670)", October 15, 2001

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b. Steam Generator Tube Nodalization

Description

The improved steam generator nodalization is described in WCAP-15996-P, Volume 1, Section 5.3. The original model is described in CENPD-282-P-A, Section 5.3.

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c. Reactor Pressure Vessel Nodalization

Description

The detailed primary side nodalization is described in WCAP-15996-P, Volume 1, Section 4.1. The original model is described in CENPD-282-P-A, Section 4.1.

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d. SG Tube Rupture Model

Description

The improved model is described in WCAP-15996-P, Volume 1, Section 5.7. The original model [ ] is described in CENPD-282-P-A, Section 7.5.2

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e. Dose Model

Description

The new model is described in WCAP-15996-P, Volume 1, Section 5.8. [

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f. Detailed Main Feedwater / Auxiliary Feedwater Model

Description

The new model is described in WCAP-15996-P, Volume 1, Section 5.5. The original model is described in CENPD-282-P-A, Section 5.5.

[

RELAP4 Mod 7 and the CE Small Break LOCA Realistic Evaluation Model (this methodology has not been reviewed and approved by the NRC). The as coded model is the one now described in WCAP-15996-P, Volume 1, Section 4.6.3, in order to bring the description and the coding into congruence. In addition, the definitions of the terms used in the calculation of the heat transfer coefficient were clarified.

Reason for Change

The original topical report description was incorrect and inconsistent with the equation actually coded for use (which was itself correct).

Effect on Results

Since CENTS was always using the correct formulation, there is no effect on previous results. The only effect is on the correction of the topical report description of the model.

Planned use of this modification

The as coded model, correctly described in WCAP-15996-P, Volume 1, Section 4.6.3, will continue to be used in design basis accident analyses. NRC review and approval is requested.

h. Annulus Bubble Release Rate

Description

The model description is given in WCAP-15996-P, Volume 1, Section 4.8.3. The original description is given in CENPD-282-P-A, Section 4.8.3. The governing equation was found to be incomplete as typed in CENPD-282-P-A in that the divisor was omitted. The equation for the bubble release rate from the annulus was presented as:

$$W_{rele} = 2\, V_D\, \rho_g\, A\, \alpha$$

But should have included a divisor term as shown below:

$$W_{rele} = 2\, V_D\, \rho_g\, A\, \alpha \,/\, (1-\alpha)$$

Reason for Change

The original topical report description was incorrect and inconsistent with the equation actually coded for use (which was itself correct).

Effect on Results

Since CENTS was always using the correct formulation, there is no effect on previous results. The only effect is on the correction of the topical report description of the model.

Planned use of this modification

The as coded model now, correctly described in WCAP-15996-P, Volume 1, Section 4.8.3, will continue to be used in design basis accident analyses. NRC review and approval is requested.

i. RCS Line Break Models

Previously, CENTS modeled all leaks from the RCS as a simple hole. An explicit model of a break in a branch line has been added. Also, an explicit model has been added to support the analysis of the letdown line break event. The new models are described in WCAP-15996-P, Volume 1, Section 4.21.1.

Reason for Change

The new models provide more detail and accuracy.

Effect on Results

CENTS is not used for loss-of-coolant accident (LOCA) calculations for the evaluation of regulatory compliance to 10 CFR 50.46 ECCS performance. Therefore, the improved model does not gain margin to these limits.

CENTS is used to analyze the letdown line break accident. However, this is not typically a limiting event. The new model is not expected to gain margin to regulatory limits.

i. RCS Line Break Models

Previously, CENTS modeled all leaks from the RCS as a simple hole. An explicit model of a break in a branch line has been added. Also, an explicit model has been added to support the analysis of the letdown line break event. The new models are described in WCAP-15996-P, Volume 1, Section 4.21.1.

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Effect on Results

CENTS is not used for loss-of-coolant accident (LOCA) calculations for the evaluation of regulatory compliance to 10 CFR 50.46 ECCS performance. Therefore, the improved model does not gain margin to these limits.

CENTS is used to analyze the letdown line break accident. However, this is not typically a limiting event. The new model is not expected to gain margin to regulatory limits.

Planned use of this modification

The improved model will be used in design basis accident analyses. NRC review and approval is requested.

j. Feed Line Break Model

Description

As discussed in CENPD-282-P-A, Volume 3, Sections 2.3.2 and 3.3.2, the analysis of the feedwater line break assumed that the fluid exiting the steam generator through the break consisted of only liquid water. This was accomplished by artificially locating (by input specification) the feedring at the top elevation of the tubesheet. This assumption is unnecessarily overly conservative for the analysis of plants which do not have economizer steam generators.

WCAP-15996-P, Volume 4, Section 3.4.2 describes a more realistic approach for analyzing this event for plants which do not have economizer steam generators. Specifically, the feedring is simply modeled (by input specification) to be at its actual physical elevation so that a steam blowdown commences when the steam generator downcomer water level drops below the feedring elevation. This change did not require a modification to CENTS algorithms since the feedring elevation is an input parameter.

Reason for Change

The previous modeling of the steam generator blowdown was non-physical and overly conservative.

Effect on Results

The effect of the change is discussed in section WCAP-15996-P, Volume 4, Section 3.4.2.1.

Planned use of this modification

This change in feedring modeling will be used in design basis accident analyses. NRC review and approval is requested.

05322842

Westinghouse

Westinghouse Electric Company
Nuclear Services
Engineering Services
2000 Day Hill Road
Windsor, Connecticut 06095
USA

19 February, 2003
WOG-03-76

Project No. 692

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Attn: Chief, Information Management Branch
Division of Program Management

Subject: Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, Volume 4 (Proprietary) and WCAP-15996-NP, Volume 4 (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code"

(Enclosure 1-P Contains Westinghouse Proprietary Class 2 Information)

Reference:
1. WCAP-15996-P, Rev. 0, Volume 4, "Technical Description Manual for the CENTS Code", February, 2003
2. Letter, G. S. Pavis (CEOG) to USNRC Document Control Desk, "Submittal of Combustion Engineering Owners Group Reports: WCAP-15996-P, (Proprietary) and WCAP-15996-NP, (Non-Proprietary), entitled "Technical Description Manual for the CENTS Code", CEOG-02-256, December 13, 2002
3. CENPD-282-P-A, Rev. 0, "Technical Description Manual for the CENTS Code"

By this letter, the CE Owners Group (CEOG) is submitting WCAP-15996-P, Rev. 0, Volume 4, "Technical Description Manual for the CENTS Code" (Reference 1), prepared by Westinghouse Electric Co. LLC (Westinghouse), for Nuclear Regulatory Commission (NRC) review and approval. WCAP-15996-P, Volumes 1 to 3 were submitted on December 13, 2002 (Reference 2). WCAP-15996-P, Rev. 0, Volume 4 provides a set of benchmark cases which are compared to the originally approved CENTS version reported in CENPD-282-P-A (Reference 3). This submittal completes the documentation package necessary for the NRC to review the upgraded version of the CENTS computer code.

Westinghouse has determined that the information contained in WCAP-15996-P, Rev. 0, Volume 4 (Enclosure 1-P) is proprietary in nature. Consequently, it is requested that this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and that copies of this information be appropriately safeguarded. The reasons for the classification of this information as proprietary are delineated in the affidavit provided in Enclosure 2. Enclosure 3 provides a non-proprietary version of the topical report.

The information transmitted herewith bears a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports

which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.790 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary version of this report, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

Invoices associated with the review of WCAP-15996-P should be addressed to:

Mr. Gordon Bischoff
Manager, Owners Group Program Management Office
Westinghouse Electric Company
2000 Day Hill Road
Windsor, CT 0095-0500

All correspondence related to this matter should be addressed to:

Mr. Gary Pavis
Chairman, Combustion Engineering Owners Group
Constellation Energy Group
Calvert Cliffs Nuclear Power Plant, Inc.
P.O. Box 1635
Lusby, MD 20657-4702

If you have any questions regarding this matter, please do not hesitate to call me or Chuck Molnar of Westinghouse's Licensing staff at (860) 731-6286.

Sincerely,
CE Owners Group

Gary S. Pavis

Gary S. Pavis, Chairman

Enclosure(s): As stated

Enclosure 3 to WOG-03-76

WESTINGHOUSE ELECTRIC COMPANY LLC

NON-PROPRIETARY WCAP-15996-P, VOLUME 4
TECHNICAL DESCRIPTION MANUAL FOR THE CENTS CODE

CENTS Revision Record Topical Report		
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2.3	2.3	Two-Phase Fluid Representation
2.4	2.4	Non-Equilibrium States
2.5	2.5	Reactor Core
2.6	2.6	Other Primary System Models
2.7	2.7	Steam Generator Heat Transfer
2.8	2.8	Steam Generator Secondary System Geometric Modeling
2.9	2.9	Secondary System Conservation Equations
2.10	—	*NEW* — Other Secondary System Models
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3.1.1	3.1.1	Point Kinetics Model
3.1.2	3.1.2	Decay Heat Curve
3.1.3	3.1.3	Zirconium-Water Reaction
3.2	—	*NEW* — Other Core Models
—	3.2	*DELETED* — Core Power by Three-Dimensional Neutronics
3.2.1	3.2.4	Fuel Failure
—	3.2.1	*DELETED* — Three-Dimensional Neutronics
3.2.2	—	*NEW* — DNBR Fuel Design Limit
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3.3.2	3.3.2	Discretized Heat Conduction Equation
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3.3.4	3.3.4	Heat Transfer Modes
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3.3.6	3.3.6	Fuel Rod and Fluid Properties
3.4	3.4	References
4.0	**4.0**	**Reactor Coolant System Thermal-Hydraulic Model**

CENTS Revision Record Topical Report		
WCAP-15996-P Section No.	CENPD-282-P-A Section No.	Section Title
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4.4	4.4	Determination of Node State Variables
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