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June 4, 2013
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Attention: Mr. Christopher P. Jackson
Reactor Systems Branch, NRR
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Units 1 and 2
RETRAN-02 MOD005.3 Code Version.

The attachment to this letter provides notification to the NRC regarding the release of RETRAN-02 MOD005.3 Code Version.

There are no commitments in this letter.

If you should have any questions on this matter, please contact Mr. Charles Albury at (361) 972-8901.

Roland Dunn
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MK/

Attachment: RETRAN-02 MOD005.3 Code Version Notification of Code Release

A001
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May 30, 2013

Mr. Christopher P. Jackson
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11555 Rockville Pike
Rockville, MD 20852

Subject: RETRAN-02 MOD005.3 Code Version
Notification of Code Release

Dear Mr. Jackson:

The purpose of this letter is to inform the NRC that the RETRAN-02 MOD005.3 code version has been released by the RETRAN User Group for use by the industry. RETRAN-02 is a non-LOCA system thermal-hydraulic transient analysis code that is widely used by licensees in the U.S. and also internationally. The Electric Power Research Institute originally developed RETRAN, but has authorized the RETRAN User Group to provide ongoing maintenance and support.

Based on previous discussion with the NRR described in a November 24, 1997 letter to Mr. Timothy E. Collins from Mr. Gregg Swindlehurst of Duke Power Company who was the Chairman of the RETRAN Maintenance Group, NRC review and approval of the RETRAN-02 MOD005.2 code version was not required since no new models were included. Changes included in MOD005.2 contained only error corrections that were developed under an Appendix B QA program. Similarly, changes made in preparation of the MOD005.3 code version contain only error corrections (12) and no new models, and were also done under an Appendix B QA program. Therefore, the NRC is hereby notified that RETRAN-02 MOD005.3 has been released for general use by the industry, consistent with the limitations of the NRC's prior safety evaluation report issued for RETRAN-02 MOD005.0 and subsequently extended to MOD005.1 and MOD005.2.

For your information, the attachment summarizes each error corrected, the associated code modification, and the affect each modification had on the results for a set of standard sample problems. The testing procedure and standard sample problems that were used for the MOD005.2 code version were also used to test the MOD005.3 code version. They are discussed in the attachment to the November 24, 1997 letter noted previously.

Should you or your staff require any additional information, please do not hesitate to contact me at (361) 972-8901. Thanks for your attention to this matter.

Charles R. Albury

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Attachment
RETRAN-02 MOD005.3
Error Correction and Testing Summary

RETRAN-02 MOD005.3 contains 12 modifications that were made to RETRAN-02 MOD005.2.1 to correct identified errors. Table I summarizes error reports and modifications made to resolve the errors. It should be noted that RETRAN-02 MOD005.2.1 is the MOD005.2 code version with code modifications required to correct syntax errors trapped by newer compilers and modifications required to transport the code to newer operating systems. No model error corrections or enhancements were included in RETRAN-02 MOD005.2.1. It is functionally equivalent to MOD005.2.

The modifications summarized in Table I were added sequentially to MOD005.2.1. Testing was performed after each modification was added and consisted of running the 10 standard sample problems and then comparing the results with those from RETRAN-02 MOD005.2.1. The comparisons were made by use of an automated program COMPAR, which compares auxiliary output files containing time histories of key output variables for each problem. Any differences between the revised code and the MOD005.2 results that exceeded 0.1% were reported. The number of differences reported for each sample problem are shown in Table II. They provide a macro-level view of how the modifications affect the standard sample problems, which use typical RETRAN-02 modeling and options.

Table III gives more detail about the magnitude of the observed differences between the MOD005.2.1 and MOD005.3 results. The modification dependent differences are consistent with the error correction and were expected. None of the corrections resulted in significant differences in results for the standard sample problems.

Table I
RETRAN-02 MOD005.2
Trouble Report and Associated Modification Summary

Trouble Report Number	Trouble Report Description	Modification Number	Modification Description
431	Failure in junction properties occurs for a negative fill junction. The flow is zero and the valve that is closed.	406	The slip convection term for the negative fill was not being set to zero after the valve at the fill junction was closed and the flow stopped. The modification sets the slip convection term to zero when the valve is closed.
436	In subroutine QDOT, the Prandtl number is discontinuous for wall temperatures exceeding 1500 degrees F. In the Bennett problem, this resulted in conduction solution converge warning messages to be printed during steady-state initialization.	405	A correction has been developed for subroutines htrc and qdot based on similar changes to RETRAN-3D. In the original coding, the Prandtl number was set to a constant if the wall temperature was greater than 1500 F since 1500 F represents the upper limit for the water properties: however, the value was not consistent with the computed value at 1500 F, introducing a discontinuous transition in the Prandtl number. The limiting Prandtl number value is now computed based on properties evaluated at a temperature of 1500 F.
438	A failure in restart is encountered when using the temperature transport delay option.	407	The modification resets the values for the IPTN flags for restart cases by checking the PHASE flag for the volume as well as the restart flag LDMP on the problem dimension card and if these conditions are both true, the IPTN flag is changed to the negative of its absolute value. This turns temperature transport off for the two-phase volume.
439	If the actinide breeding ratio is not supplied on the 140000 data card, the code defaults to a value of 0.0. This is not what is discussed in the RETRAN input manual.	408	Subroutine INRKEN was modified to set the value of UDUF to 1.0 if it is the default case (UDUF=0.0) as stated in the RETRAN-02 User's Manual, EPRI NP-1850-CCM-A, Volume 3 Revision 6.
440	When a system turbine trip calculation is exercised, error messages relating to junction property evaluation are observed. Review of the information indicates a problem in the calculation of the kinetic energy at junctions that have time-dependent flow areas.	414	The coding for calculating the mixture velocity and resulting kinetic energy was revised to insure that the junction flow rate and area are at consistent time levels. This prevents unreasonable kinetic energy values from resulting in out or range enthalpies.
443	While reviewing the RETRAN-3D pressurizer model and its performance relative to RETRAN-02, an error was	411	The sign of two derivative terms in term DAMP were corrected in subroutine PRZR.

Trouble Report Number	Trouble Report Description	Modification Number	Modification Description
	discovered in the formulation of the liquid region work term. This error also exists in RETRAN-02. In equations VIII.5-29 and VIII5.-30 (EPRI-1850-CCM, Vol. 1 Rev. 6) the partial derivatives for the liquid region volume with respect to vapor and liquid energy are transposed incorrectly. The coding in the subroutine PRZR is also incorrect.		
445	The behavior of the general transport system in some large analysis models was inconsistent with expected behavior. The sample deck illustrates that the impurity (e.g., boron) concentration of an accumulator varies significantly during blowdown. The expected behavior would be to have a constant boron concentration in the accumulator during blowdown. Changes in boron concentration were noted when flow rate or time-step size changes significantly, and the potential exists when the implicit convergence criteria are not satisfied.	409	The changes in concentration reflect the explicit nature of the generalized transport model. A more implicit formulation was achieved by moving the generalized transport calculation (subroutine GENTRN) after the material properties have been updated to new time-step values (as in RETRAN-3D) in subroutine TRAN. Also, for reported case with the extreme conditions, the transport medium mass ratio (Mm previous/ Mm current) may be far from 1.0 By including the transport mass ratio term, the transport model can better handle these extreme condition cases; however, it is still possible to have such extreme conditions that the explicit formulation for the generalized transport model will exhibit numerical errors. Code was added to GENTRN to include the transport medium mass ratio. FTB File ID71 was modified to save the previous time-step transport medium mass for each volume. Logic was added to SAVIMP, RESET and EDATA4 to insure these new values are reset properly for the iterative numerical solution and saved to allow RESTART.
450	The vector momentum option contains an error for models using junction angles that are not 0, 90, 180, or 270 degrees. Use of any of the above angles in any combination will not encounter the error. This error applies to all versions of RETRAN-02 prior to and including MOD005.2 and RETRAN-3D MOD003 and prior versions.	410	Subroutine injun was modified to write an error message and terminated code execution if angles other than 0, 90, 180, or 270 are provided by the user.
451	At 900 seconds, the vessel head (Volume 10) is all vapor yet the heat transfer mode for Conductor 23, the metal mass in Volume 10, incorrectly indicates forced convection to liquid.	413	The test on low flow conditions to allow condensation in subroutine htrc was removed and replaced with a test on ihtmap=0, which indicates the forced convection only

Trouble Report Number	Trouble Report Description	Modification Number	Modification Description
			map is used. If the combination heat transfer map is selected (ihtmap#0) and if twall < tsat then condensation heat transfer is used.
453	While evaluating the compiler upgrade on a Sun platform, this case showed a floating point exception (divide by zero.) The transient finishes without a code failure, and the results appear reasonable, but the code reports that a single divide by zero has occurred.	415	A modification was made in WAT9 to test that the relative volume is greater than zero as well as smaller than the minimum value. A modification was also made so that if the assumed state in region 1 is two-phase, the calculated enthalpy is forced toward a two-phase value. This eliminates the inconsistency as the region transitions from barely two-phase to single phase liquid.
456	A bad junction enthalpy causes the code to fail in the critical flow model. The error is the result of small valve areas that result in very large kinetic energy terms that lead to bad junction enthalpies.	414	The coding for calculating the mixture velocity and resulting kinetic energy was revised to insure that the junction flow rate and area are at consistent time levels. This prevents unreasonable kinetic energy values from resulting in out or range enthalpies.
457	The junction enthalpy exiting hot leg volumes 101, 102, 103 demonstrate a peculiar (but small) change in the junction enthalpies when the temperature transport delay model is active.	417	The convective term in subroutine TRNSPT (temperature transport delay time model) used variables HSPIN and HSPOUT. These variables include the junction enthalpy and an enthalpy effect for the elevation change between the center of the upstream and downstream volumes, respectively. They were replaced with the junction enthalpy, which corrects the reported problem.
458	An error in the decay heat model can result in under prediction of power for models using 1-D kinetics (generally BWRs).	419	The prompt power is now calculated as the product of the sum of the yield fractions (the steady-state prompt power fraction) and the amplitude as was implemented in RETRAN-3D mod_368.
460	The pressurizer liquid region is not re-established after the level goes to 0, followed by an in-surge.	418	Subroutine WAT8 contained logic that prevented the liquid region from re-establishing unless a minimum liquid mass appears during a single time step. With small time -step sizes, the amount of liquid mass that can be rained out of the vapor region is proportionately smaller, causing the minimum mass test to fall. When this occurs, a single region pressure search is performed and the liquid region does not appear. Removing the quality limits from WAT8 resolved the problem. When the liquid region is re-established, some of the

Trouble Report Number	Trouble Report Description	Modification Number	Modification Description
			partial derivatives used in subroutine PRZR to determine the liquid volume change (DVOL) are zero (not defined) because two regions did not previously exist. The liquid volume change is computed using the product of the liquid mass and saturated liquid specific volume. A similar calculation was added for the situation where the vapor region re-establishes (taken from RETRAN-3D).

Table II
Summary of RETRAN-02 MOD005.3
Modification Differences

Modification mod	Standard Sample Problem Differences									
	1 sp1	2 vol8	3 sp5	4 tlta	5 ttwob	6 urcw	7 fl2d	8 turb	9 ttqx1	10 atws
405	0	0	0	0	0	6	0	0	0	0
406	0	0	0	0	0	6	0	0	0	0
407	0	0	0	0	0	6	0	0	0	0
408	0	0	0	0	0	6	0	0	0	0
409	0	0	0	0	0	6	0	0	0	0
410	0	0	0	0	0	6	0	0	0	0
411	0	0	0	0	11	24	0	0	0	61
413	0	0	0	0	11	24	0	102	0	61
414	12	314	4	7	1138	97	0	358	144	66
415	12	314	4	7	1138	97	0	358	144	66
417	12	314	4	7	1138	96	0	358	144	66
418	12	314	4	7	1137	96	0	358	144	78
419	12	314	4	7	1137	96	0	358	169	78

Table III
Summary of Differences Observed by Modification

Modification Number	Sample Problem	Observed Differences
405	ucrw	No effect. The differences reported in Table II were due to a change in the compiler version used and not the modification itself.
		The differences are indistinguishable when both results are plotted on a single chart.
406	all	No effect.
407	all	No effect.
408	all	No effect.
409	all	No effect.
410	all	No effect.
411		Differences in results were expected as a result of this code correction.
	ttwob	One flow value at the steam line entrance was out of tolerance prior to the peak power at ~0.8 seconds. It is 1 volume removed from the two-region nonequilibrium volume that will be affected by the modification. All other differences were after the scram with the largest error being in the void reactivity at 0.45%, which has no effect on the long term power.
	ucrw	The surge line flow was the only parameter that was out of tolerance. During one time step it differed by 0.9% and the rest of the time it differed by 0.2% to 0.45%.
	atws	No parameters are out of tolerance for the first 88 seconds. Between 88 and 100 seconds there are minor differences in the secondary side mixture level, relief valve flows and SG heat transfer, but they are generally less than 0.9%. These differences go away between 100 and 140 seconds. After 140 seconds some minor difference in the SG mixture reappear, but the level is essentially zero. At 90 seconds, the pressurizer pressure differs by 1.1% (expected), but returns within tolerance after 93 seconds.
412		**Not included in MOD005.3 – deemed to be a model change.**
413		Differences in results were expected as a result of this code correction.
	turb	All differences are in the feedwater heater where the pressure differs by a constant 0.4%. No other parameters are out of tolerance.

Modification Number	Sample Problem	Observed Differences
414		The correction will affect the enthalpy for any junction containing a valve that opens or closes.
	sp1	Prior to 0.4 seconds there are no significant differences (marginally greater than the tolerance). Between 0.4 seconds and 0.46 seconds when t the problem terminates, the pressure and flow at the center of the pipe segment differ by up to 0.3%.
	vol8	When the break flow initiates, it differs by up to 1.5% for the first few time steps, but there after returns to tolerance. The pump exit flow differs most of the transient by up to 7% for short periods of time but returns to differences less than 1%.
	sp5	The differences are minimal on only marginally greater than the tolerance.
	tlta	The differences are minimal on only marginally greater than the tolerance during a very short period near the beginning of the transient.
	ttwob	There are many parameters out of tolerance for the duration of the transient. Overlay plots of the RETRAN-02 MOD005.2 and MOD005.3 results illustrate that they results are in very good agreement. Most parameters show two lines that are seldom more than a line width apart except for the void and Doppler reactivities following the scram when their contributions are insignificant.
	ucrw	The pressurizer pressure differs by 0.7 psia at the end of the transient and the secondary side pressure is approximately 1 psi lower (0.1% difference). The surge line flow differences are similar to those introduced by modification 411.
	turb	The condenser pressure differs by up to 0.65% and the feedwater heater pressure differs by up to 0.2%. The high pressure turbine extraction flow differs by up to 5%.
	ttqx1	The steam line flow differs up to 5% for one time point but is typically less than 0.45%. The power differs by 0.33% at the peak and returns within tolerance shortly thereafter.
	atws	Only slight changes from modification 411 results. Very similar.
415	all	No effect.
416		**Not included in MOD005.3.** Modification already included when installing MOD005.2 on Windows with updated Intel compiler. Resulting code version is identified as MOD005.2.1.
417	all	No effect.
418		It was expected that this modification could affect models with pressurizers.
	atws	Only slight changes from results for modifications 411 and 414.
419		As expected, this modification only affects decay heat for the 1-D kinetics model.
	ttqx1	The power differs by 0.33% at the peak (same as modification 414) but increases to 0.4% at the end of the transient (1 second). This slight difference at the end of the transient is due to the error correction.