

# The RETRAN Newsletter

April, 1998

### Summary of Activities

*This issue of the RETRAN Newsletter contains information on the 1998 Steering Committee, Ninth International RETRAN Meeting, and interesting articles from code users . Your contributions are greatly appreciated. We, EPRI and CSA, encourage everyone to participate in this newsletter.*

*Previous issues of the RETRAN Newsletter are available from the RETRAN Web Pages at <http://www.csai.com/retran>.*

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### In This Issue...

<b>Use of EPRI Codes at the Paul Scherrer Institute .....</b>	<b>1</b>
<b>Ninth International RETRAN Meeting ..</b>	<b>3</b>
<b>TechTips .....</b>	<b>3</b>
<b>A New Interphase Mass Transfer Model for RETRAN-3D .....</b>	<b>4</b>
<b>1998 Steering Committee .....</b>	<b>5</b>
<b>Summary of RETRAN-3D Code Trouble Reports .....</b>	<b>5</b>
<b>Summary of RETRAN-02 Trouble Reports .....</b>	<b>6</b>
<b>RETRAN-02 MOD005.2 Ready for Licensing Applications .....</b>	<b>7</b>
<b>Calendar .....</b>	<b>8</b>
<b>About this Newsletter .....</b>	<b>8</b>

## Use of EPRI Codes at the Paul Scherrer Institute in Switzerland

**M. Zimmermann, PSI**

At the Paul Scherrer Institute, the active involvement with the EPRI codes began with RETRAN-02, and the use of this code culminated in its application within a design study of a 20 MW<sub>th</sub> district heating reactor. Based on this positive experience, the participation in the RETRAN-03 development project was a logical extension of PSI's commitment to RETRAN.

Meanwhile, the analytical activities relating to the safety analysis of the Swiss NPPs have been organized within the STARS project. The goal of this project is to provide an independent capability for the deterministic safety analysis of the Swiss NPP (two BWRs and three PWRs of four different designs) to the Swiss Nuclear authority (HSK). The scope includes the analysis of plant behavior for conditions both within and beyond design bases transients, but excludes the analysis of severe accident sequences.

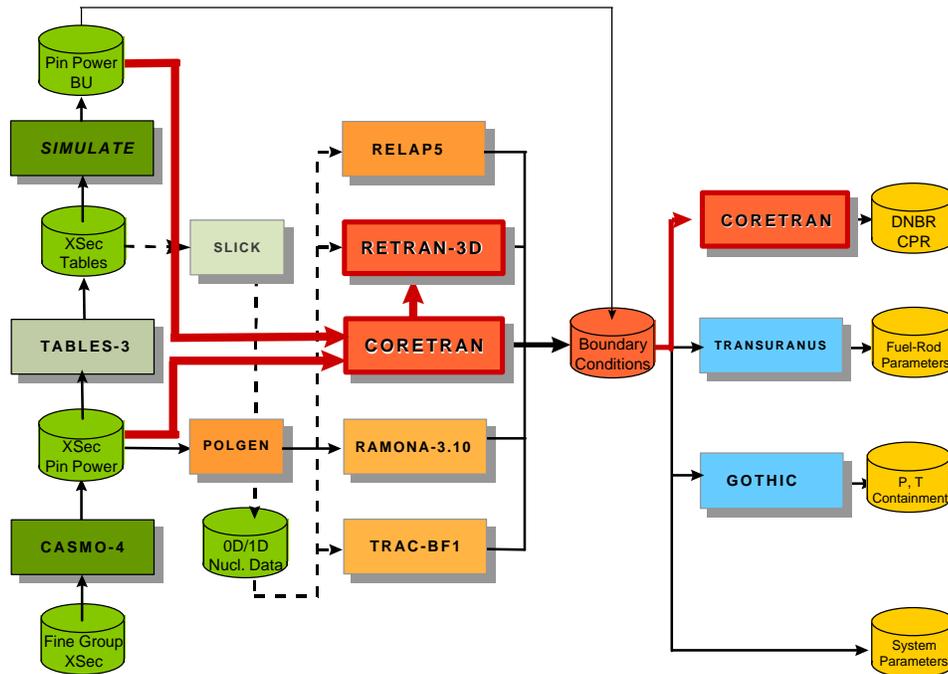
The STARS project includes the following technical fields:

- steady-state and transient core analysis,
- plant transient analysis,
- loss of coolant accidents (SB and LB),
- fuel behavior, and
- containment analysis (limited activity).

Plant-specific models are being developed for all the codes used for this broad field of analysis and are validated against available test data from the NPPs.

It is evident from the above description, that a collection of well validated codes is needed. Figure 1 shows the current system of codes used in the STARS project.

# Use of EPRI Codes at the Paul Scherrer Institute in Switzerland (Cont'd)



**Figure 1: Codes Used in the STARS Project**

Nuclear cross sections are generated with the help of CASMO-4 and SIMULATE, both from Studsvik, Inc. CORETRAN is used for the analysis of reactivity initiated accidents while RETRAN-3D is used for transient analysis of both BWRs and PWRs. LOCA analysis is conducted with RELAP5 for PWR and TRAC-BF1 for BWR. Subchannel analysis is performed with the help of CORETRAN (VIPRE-02) while the TRANSURANUS code (from the TRANSURANUS Institute) is used for fuel analysis. BWR stability is currently analyzed with the help of RAMONA-3.10 from Scandpower Inc.

It is evident from the above list that EPRI codes play a central role in the STARS project. There are several reasons for this:

- EPRI took the lead in the long-term development of a fully integrated code package (which eventually will cover the

whole spectrum needed in the STARS project);

- EPRI's codes are developed within a framework of strong relations to the utility industry and therefore address "real life" problems;
- EPRI's codes apply both for BWR and PWR; and
- EPRI's codes attract a sizable user community that exchanges its experiences and shares the cost of maintenance, a key element for the survival of any computer code.

The operational implementation of 3D kinetics into RETRAN-3D is a high priority item for 1998.

Here at PSI this will follow the route: two-group nuclear cross sections generated with CASMO-4 will be transferred to CORETRAN and integrated into the plant core model, from there the transient cross sections together with the core model will be

*(Continued on Page 7)*

# Ninth International RETRAN Meeting

J. McFadden, CSA

The Ninth International RETRAN Meeting will be held in Monterey, California on June 7-10, 1998. The meeting is sponsored by the Electric Power Research Institute and Computer Simulation & Analysis, Inc. The objectives of the meeting are: 1) to allow an exchange of RETRAN-related information between EPRI and the code licensees and 2) to document the analyses effort of the RETRAN code users.

**The Plenary Session** on Monday, June 8, will include an introductory address summarizing various activities related to RETRAN and a panel discussion on "Analysis Needs for Supporting Nuclear Plants in the 21<sup>st</sup> Century". The panel is comprised of representatives from EPRI, the utility industry, and other organizations involved in nuclear power activities.

**The Technical Program** will include presentations of RETRAN development efforts and applications of RETRAN for boiling water reactors and pressurized water reactors. The technical

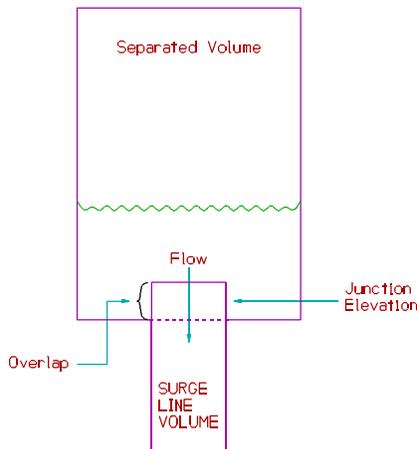


sessions on Wednesday, June 10, will be devoted to presentations in EPRI's new software analysis tools, CORETRAN, and RETRAN-3D.

**Proceedings** containing the complete text of the keynote address and all invited and contributed papers will be printed. One copy of the proceedings will be sent to each meeting participant. Additional copies may be ordered at the meeting or from EPRI.

For additional information or registration forms, please contact Pam Richardson at (208) 529-1700 or [pam@csai.com](mailto:pam@csai.com).

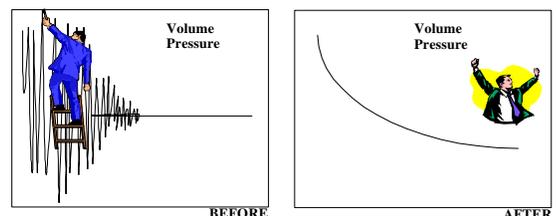
## TechTips



Sometimes bubble rise volumes can experience numerical difficulties when the mixture level passes through the elevation of the outflow junction.

The numerical problems show up as volume pressure and energy spikes. You can generally eliminate the problem by changing the junction from a horizontal "point" to a vertical junction.

Just orient the junction vertically (JVERT = 1 on the 08XXXY record) and then overlap the connected volumes as shown in the figure. Make sure to move the junction elevation to the midpoint of the overlapping region. You don't need very much of an overlap. Usually a few tenths of a foot will do. The result of this little change will smooth the junction enthalpy as the mixture level passes through the junction elevation, eliminating those problem pressure spikes!



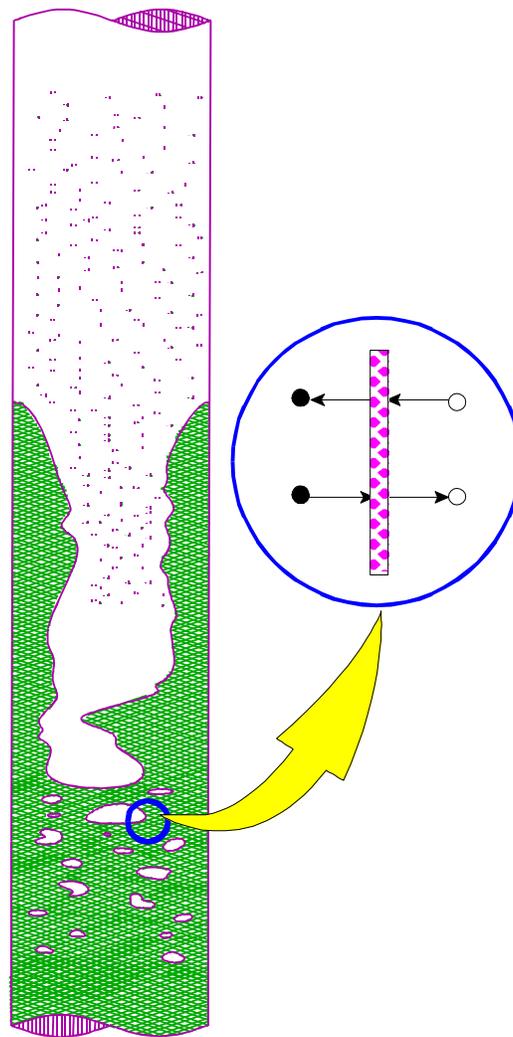
# A New Interphase Mass Transfer Model for RETRAN-3D

P. Cebull, CSA, and R. Macian, PSI

The five-equation model in RETRAN-3D was implemented in order to allow the simulation of nonequilibrium thermal-hydraulic phenomena. It currently includes a pressure change, or  $dP/dt$ -based model which is used to calculate the rate of vapor generation during pressure transients, such as turbine trips, small-break LOCAs, etc. However, experience gained from analyses of these types has shown that the model can produce unrealistic mass transfer rates and liquid superheat values which are too large, often resulting in numerical instabilities and subsequent code failure. Coefficients used to mitigate the problem are problem dependent and have not been correlated against a reasonable independent parameter.

CSA is currently involved in a collaborative effort with the Paul Scherrer Institute to implement a new interphase mass transfer model. It is based on a concept commonly used in the six-equation simulation codes, in which the interfacial mass transfer is treated as a heat transfer process. Each phase transfers heat to an interface which exists at the local saturation temperature. The heat transfer coefficient is calculated based on the flow regime and local thermodynamic conditions. Implementation of the new model includes replacement of the flow regime map currently used in RETRAN-3D. The map being used now was empirically derived for heated, small-diameter tubes under high pressure, and thus its use under conditions much different from these (such as low pressure transients) is somewhat questionable. The new flow map is based on the work of Taitel and Dukler. It has been shown to be applicable to a wide range of pressures and flow configurations and was developed from an analysis of the physical phenomena affecting flow regime transitions.

The new model is entering the testing phase of development and should be included in the next formally released version of RETRAN-3D. Its implementation should allow the range of application of RETRAN-3D to be expanded, encompassing new types of transients which were previously beyond its capabilities.



# 1998 Steering Committee

## L. Agee, EPRI

The results of the 1998 election for the RETRAN Steering Committee are as follows.

Chairman: Gregg Swindlehurst  
 Duke Energy Corp.  
 Phone: (704) 382-5176  
 Fax: (704) 382-7852  
 E-mail: gbswindl@duke-energy.com



The other three steering committee members are:

James Boatwright  
 TU Electric  
 Phone: (214) 812-8232  
 Fax: (214) 812-8687  
 E-mail: tboatwright@tuelectric.com

Yuki Fujita  
 Duke Engineering & Services  
 Phone: (978) 568-2130  
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 E-mail: fujita@yankee.com

Shie-Jeng Peng  
 Illinois Power Co.  
 Phone: (217) 935-8881 x4023  
 Fax: (217) 935-8294  
 E-mail: shie-jeng\_peng@illinova.com

Please keep one or more of these people aware of your evolving requirements and what you think is important with respect to RETRAN-02 and RETRAN-3D. The steering committee's role is to assure that the utilities' RETRAN needs are fulfilled in as timely and cost effective a manner as possible. The committee advises EPRI as to priorities and assists in determining the future years' work scope for the code maintenance project.

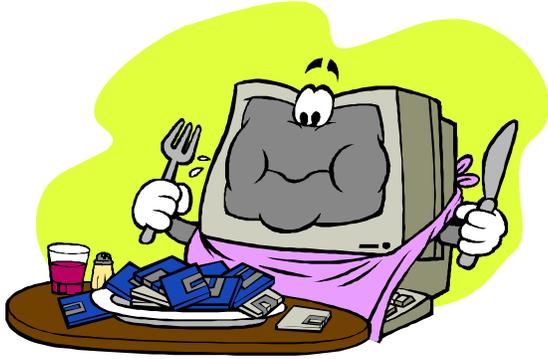
## Summary of RETRAN-3D Code Trouble Reports



A total of 147 trouble reports had been filed as of February 28, 1998. Of these, 132 reports have been resolved, while 15 remain unresolved. A summary of the unresolved trouble reports is shown below. Additional information for RETRAN-3D trouble reports is available at <http://www.csai.com/retran/r3dtrpt/index.html>.

NO.	TROUBLE REPORT TYPE OF PROBLEM	CORRECTION		COMMENTS
		NO.	IDENT	
7	Steam separator model fails	***	*****	
22	Problem using Wilson bubble rise model & error when using low power initialization	***	***** MOD001	(partial fix)
30	2-loop Oconee w/5-eq. fails in steady state	***	*****	
40	Results do not agree with data	***	*****	
48	Steady state fails after 6 iterations	***	*****	
		006	MOD001g	(partial fix)
52	MOC does not return to the initial temp.	***	*****	
54	MOC solution; no null transient for two-phase	***	*****	
60	Anomalous countercurrent flooding	***	*****	
81	Steady-state failure at iteration #6	***	*****	
116	Fails in steady-state initialization	***	*****	
122	Problems with EOS convergence	***	*****	(water packing)
127	Lack of convergence error	***	*****	(mass transfer)
142	Timestep selection causes 3-D kin to fail	***	*****	
144	TAUGL model doesn't apply for horiz. flow	***	*****	
145	SS fails to converge for low press. and flow	***	*****	

## Summary of RETRAN-02 Trouble Reports



The following is a summary of RETRAN-02 Trouble Report/Code Maintenance Activity.

### Unresolved Trouble Reports

- 1 From MOD001
- 5 From MOD002
- 4 From MOD003
- 3 From MOD004
- 9 From MOD005

A list of trouble reports and the status can be obtained directly from the EPSC.

Additional information is available from the RETRAN-02 Trouble Report Page at <http://www.csai.com/retran/r02trpt/index.html>.

TROUBLE REPORT		CORRECTION		COMMENTS
NO.	TYPE OF PROBLEM	NO.	IDENT	
1	Error 209 in TEMZ	***	*****	MOD001 Error
61	Delta T for Conductor with TDV	***	*****	Need Input Deck
121	OTSG Low Power Initialization	***	*****	
139	Failed Using Large Time Step	***	*****	Need Input Deck
140	Spurious Trips on High Level	***	*****	Need Input Deck
177	Overflow in WAT9	***	*****	Need Input Deck
209	Pump Coast Down Rates	***	*****	Need Correct Deck
272	Junction Properties at Break	***	*****	Need Input Deck
317	Junction Property Error	***	*****	
334	Time-Dep. Volume Input	***	*****	
342	Control Block Output near Zero	***	*****	Cannot Reproduce Error
354	Large Step Change in PHIR	***	*****	
366	Mixture/Liquid Level Difference	***	*****	Need Input Deck
376	Control Reactivity, No Motion	***	*****	
394	Anomalous Heat Trans. Behavior	***	*****	
408	OTSG Heat Transfer Problems	***	*****	
413	Incorrect Vsn No. in IBM Output	***	*****	Cannot Reproduce Error
439	Decay Heat Input	***	*****	
440	Kinetic Energy/Time Dep Area	***	*****	
442	Poor Diagnostics	***	*****	
443	Liquid Region Work Term	***	*****	
444	Positive Slip Velocity	***	*****	

## RETRAN-02 MOD005.2 Ready for Licensing Applications

G. Swindlehurst, Duke Energy

Based on a recent discussion with the NRC, RETRAN-02 MOD005.2 can now be referenced in licensing applications. The licensing history leading up to this recent development is as follows. RETRAN-02 MOD005.0 received an SER from the NRC in a letter dated November 1, 1991. On February 10, 1994, the RETRAN Maintenance Group notified the NRC of the release of MOD005.1. The NRC extended the MOD005.0 SER to cover MOD005.1 by letter dated April 12, 1994. On March 27, 1997, the RETRAN Maintenance Group notified the NRC of the release of MOD005.2 and requested a similar extension of the SER. A supplemental submittal on MOD005.2 was provided on September 2, 1997. During several phone calls with the NRC, the NRC indicated that they could not extend the SER for MOD005.2 as had been done previously for MOD005.1, and that the code would need to be submitted for a formal review. This was not a desirable process for the Maintenance Group, and so a meeting with the NRC was pursued. On November 20, 1997, Gregg Swindlehurst of Duke Energy (Maintenance Group Chairman) met with Tim Collins (NRC Reactor Systems Branch Chief) to



explore options for moving forward with the NRC review. Based primarily on MOD005.2 not including any new models, and also since MOD005.2 has been developed under an Appendix B QA program, the NRC has taken the position that formal NRC review is not necessary for MOD005.2. The NRC did request a letter from the Maintenance Group describing the MOD005.2 code release. The requested letter was sent from Duke Energy to the NRC on November 24, 1997. A copy of the letter will be distributed to the users in a future mailing. RETRAN users can now utilize MOD005.2 in licensing applications, provided that the limitations of the original SER are observed. Future code versions that do not involve any new models will be handled in the same manner. The NRC's oversight of the use of MOD005.2 and other earlier versions will continue to be by audit or inspection.

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## Use of EPRI Codes at the Paul Scherrer Institute in Switzerland (Cont'd)

transferred to RETRAN-3D. The successful implementation of this task will represent a major step towards unifying the code system with the result that: The routine use of the RAMONA code can be terminated upon the successful migration of the stability analysis to RETRAN-3D, and the use of the 'cumbersome' one-dimensional kinetics can be reduced to a bare minimum. In addition, all of the core dynamics analysis (previously performed with RAMONA for BWR's and a German 3D code for PWRs) can be performed with CORETRAN without any further transformation of the nuclear data..

The goals of STARS cannot be achieved without constant involvement in research activities to assess inherent limitations of the current methodology and to open up new modes of safety analysis. Two examples in relation to the EPRI codes are: PSI is

taking the lead in collaborating with CSA to enhance the models pertaining to mass transfer in the RETRAN-3D five-equation flow model (see companion article by Peter Cebull, CSA) in an attempt to extend the range of application of RETRAN-3D. One promising way to achieve acceptably low turn-around times for large simulations including 3D kinetics is to spread the computational effort over several processors. The STARS project intends to take profit of this new calculational technology through a collaboration with Purdue University in the area of parallel RETRAN/CORETRAN that will start this summer.

In conclusion, the EPRI codes and RETRAN-3D in particular have become much appreciated tools for the analysis of reactor transients at PSI and our involvement will continue.

# About This Newsletter

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## RETRAN Maintenance Program

The RETRAN Maintenance Program is part of a program undertaken by EPRI to provide for the support of the software developed in the Nuclear Power Division. The main features of the Subscription Service include:

- the code maintenance activities for reporting and resolving possible code errors,
- providing information to users through the User Group Meetings and this newsletter, and
- preparing new versions of RETRAN.

The RETRAN Maintenance Program now has 31 organizations participating in the program, including 23 member utilities, 5 organizations from outside of the U.S., and 3 nonmember utilities from the U.S. A Steering Committee, composed of representatives from the participating organizations, advises EPRI on various activities including possible enhancements for the code and the scheduling of future code releases. Information regarding the Maintenance Program can be obtained from

Lance Agee  
Electric Power Research Institute  
P. O. Box 10412  
Palo Alto, CA 94303  
lagee@epri.com or (650) 855-2106

## Newsletter Contributions

The RETRAN Newsletter is published for members of the Subscription Service program. We want to use the newsletter as a means of communication, not only from EPRI to the code users, but also between code users. If this concept is to be successful, contributions are needed from the code users. The next newsletter is scheduled for June 1998 and we would like to include a brief summary of your RETRAN activities. Please provide your contribution to CSA, P. O. Box 51596, Idaho Falls, ID 83405, or to the E-mail addresses below by June 5, 1998. **Contributors will receive a RETRAN mouse pad.** We are looking forward to hearing from all RETRAN licensees.

James McFadden	mcfadden@csai.com (208) 529-1700
Mark Paulsen	mpaulsen@csai.com
Garry Gose	gcg@csai.com
Pam Richardson	pam@csai.com

The RETRAN Web Page is located at  
<http://www.csai.com/retran/index.html>.



## Calendar

Ninth International RETRAN Meeting  
June 7-10, 1998  
Marriott Hotel  
Monterey, CA

Basic RETRAN Training  
September 14-18, 1998  
CSA  
Idaho Falls, ID

Advanced RETRAN Training  
September 22-25, 1998  
CSA  
Idaho Falls, ID

## EPSC Contacts

EPSC Hours:	7 a.m. to 8 p.m. EST
EPSC Hotline:	(800) 763-3772
EPSC Fax:	(619) 453-4495
Email:	

For Nuclear Quality Assurance related questions, call Clark Wallace at (619) 622-6611.

*Please supply us with technical tips for our new section  and you will receive a RETRAN mouse pad.*