The RETRAN Newsletter

Published by Computer Simulation & Analysis, Inc.
for the Electric Power Research Institute

September, 1996

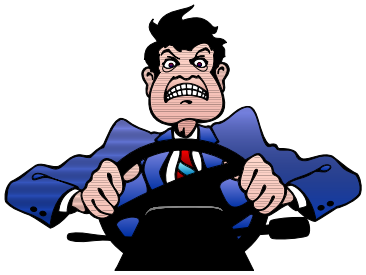
Summary of Activities

This issue of the RETRAN Newsletter contains information on the Steering Committee for the RETRAN Maintenance Group and several interesting articles from a number of code users. Your contributions are greatly appreciated. We, EPRI and CSA, encourage everyone to participate in this newsletter.

In addition to these topics, a description of the RETRAN Maintenance Program is included, as well as information about how to make contributions to this newsletter.

In This Issue . . .

Steering Committee for RETRAN Maintenance Group



G. Swindlehurst,
Duke Power Company

The EPRI-sponsored RETRAN Maintenance Group is organized to support and promote the ongoing maintenance of the RETRAN computer programs. Members of the Maintenance Group pay an annual fee for membership. In return, they receive code maintenance (error corrections and new versions), may attend the User Group Meeting without an additional fee, receive a quarterly RETRAN Newsletter, and have input relative to the overall functions of the Maintenance Group. The Maintenance Group also takes the lead in having the NRC review and revise the RETRAN-02 Safety Evaluation Report when a new version of that program is released.

A steering committee, comprised of five individuals, is selected to represent the Maintenance Group in matters involving EPRI and CSA. I am the Chairman of the Steering Committee at this time. The other members are Chris Brennan (PSE&G), James Boatwright (TU Electric), Chet Lehmann (PP&L), and Yuki Fujita (YAEC).

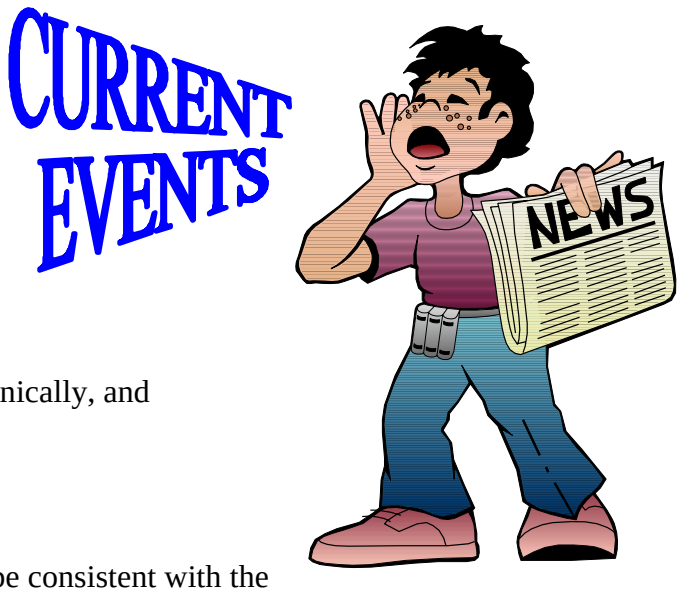
All RETRAN users are encouraged to participate in the Maintenance Group activities. You can do this by

- submitting summary contributions or longer articles for the RETRAN Newsletter,
- offering suggestions for future work tasks, and
- attending User Group meetings and presenting the results of work performed at your organization.

Steering Committee for RETRAN Maintenance Group (Cont'd)

You can also assist by being a member of the Steering Committee. EPRI will begin the process of selecting a new Steering Committee at the User Group Meeting at Commonwealth Edison. Each member of the Maintenance Group has individuals designated to represent that organization. These individuals will nominate five people to serve on the Steering Committee. All individuals nominated by October 31, 1996, will have their name placed on a ballot which will be mailed November 1, 1996. The five nominees receiving the highest number of votes will be members of the Steering Committee for 1997, and the person with the most votes will serve as Chairman.

CSA Launches Web Page



The CSA Web page that includes information of interest to RETRAN users is available on http://www.csai.com. The page includes

- general information on RETRAN activities,
- lists of RETRAN-02 and RETRAN-3D trouble reports,
- a bibliography of RETRAN-related publications,
- a form to submit RETRAN trouble reports electronically, and
- back issues of the RETRAN Newsletter.

A news group feature is planned for the future.

The lists of trouble reports will be revised monthly, to be consistent with the reporting requirements of the RETRAN quality assurance program.

The RETRAN bibliography section includes the capability to perform a keyword search of the complete bibliography. We think this feature can be beneficial to all code users, provided the entries are continually updated. At CSA, we will perform periodic searches of data bases in an effort to obtain recent publications. RETRAN users can also contribute to this effort by sending us references to documents they write on RETRAN and RETRAN analyses. Please include information on company reports, technical publications, and topical reports so that these items can be added to the bibliography. A simple E-mail message to pam@srv.net is all that is needed to have your reports added to the bibliography.

User Group Meeting

As this newsletter is being distributed, the RETRAN User Group Meeting is being held at Commonwealth Edison. The next issue of the RETRAN Newsletter will include a summary of the presentations and discussions from the User Group Meeting.

Validation of RETRAN-03 Against a Wide Range of Rod Bundle Void Fraction Data

D. Maier and P. Coddington, Paul Scherrer Institute

INTRODUCTION

The work reported in this paper is a validation of the RETRAN-03[1] code's ability to calculate the void fraction in a reactor core and so presents an assessment of the code against a wide range of void fraction measurements in rod bundles. The current version of RETRAN (RETRAN-03) uses the Chexal-Lellouche void fraction correlation[2] as the basis for the calculation of the liquid vapor slip, either in the framework of a drift-flux model or as the basis of its dynamic slip model. The current assessment is based on data sets not included in the original correlation data base. The data sets are from experimental facilities in Switzerland (NEPTUN-III), France (PERCILES), the United Kingdom (THETIS), and Japan: the Large Scale Test Facility (LSTF) and the Two Phase Flow Test Facility (TPTF).

DATA AND MODEL DESCRIPTION

The investigated data is taken from five rod bundle facilities with a minimum of 24 heated rods, spanning a wide pressure range from slightly above atmospheric pressure (0.2 MPa) up to normal operating conditions of a PWR (15 MPa). The NEPTUN and PERCILES facilities operate at low pressures (0.3 - 0.55 MPa), THETIS at low and intermediate pressures (0.2 - 4 MPa), and LSTF and TPTF at intermediate to high pressures (1 - 15 MPa). The mass and heat fluxes range from low flow, decay heat values, to close to normal operating conditions in PWRs and BWRs. Figure 1 shows the mass and heat flux ranges of the analyzed experiments as well as those included in the data base used for the qualification of the Chexal-Lellouche void fraction correlation. The analyzed void fraction data, obtained differential pressure measurements, is from level swell or boil off experiments operated under either steady-state or transient conditions.

All the experimental facilities were modeled using a single channel with between 10 and 13 axial nodes over the heated length. Of the wide range of user options available within RETRAN-03, the default values were used except for those appropriate to the void correlation (slip option). The code was used in its algebraic slip mode, i.e., as a drift flux code, using both steady state and the transient

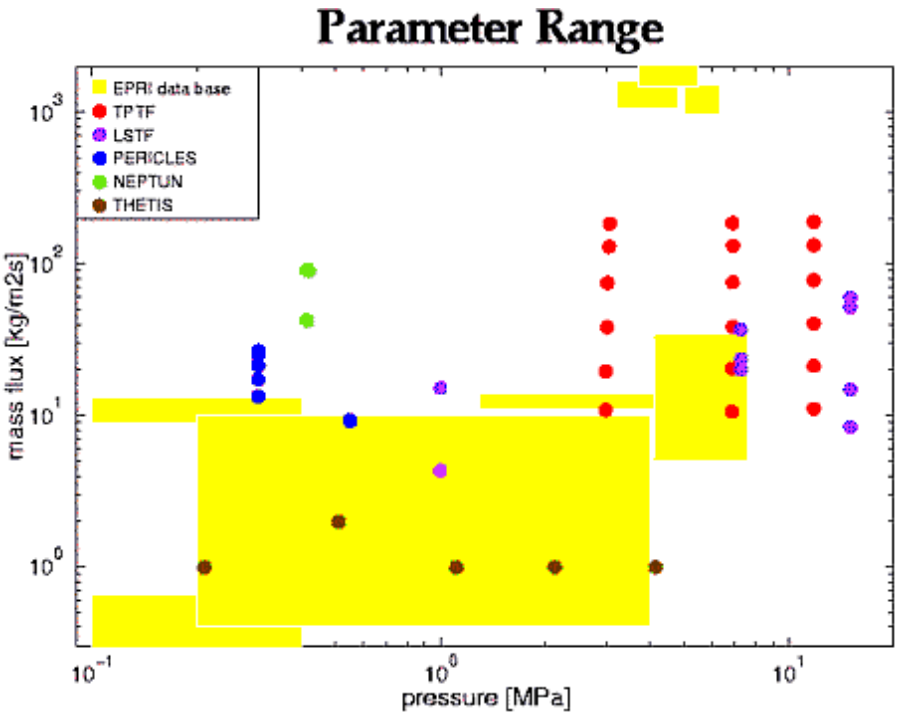


Figure 1. Mass and heat flux of the analyzed experiments included in the data base used for the qualification of the Chexal-Lellouche void fraction correlation.

Validation of RETRAN-03 (Cont'd)

option depending on the experiment analyzed The results calculated by the RETRAN-03 code were compared to the experimental data to determine the quality of the predicted void fractions.

SUMMARY AND CONCLUSIONS

A comparison between the calculated and measured void fractions of the five facilities analyzed is presented in Figure 2 and as can be seen the use of the Chexal-Lellouche void fraction correlation within RETRAN-03 leads to generally good results. For experiments at low pressure (<5 MPa) and low mass flux (>50 kg/m^{2}s) the experimental void fraction values are generally overpredicted. Data with similar parameters used for the qualification of the Chexal-Lellouche void fraction correlation is also mostly overpredicted, thus confirming this trend against data from more than six experimental facilities. Therefore, a modification of the Chexal-Lellouche void fraction correlation should be considered in order to produce an improvement of predictions at low pressure and low mass flux. In addition, there appears to be a tendency towards underprediction at very high pressure (>10 MPa), although currently, this is based on the comparison to one single data set. Since the data base used for the qualification of the Chexal-Lellouche void fraction correlation did not include any data at very high pressures, the use of the Chexal-Lellouche void fraction correlation may not be satisfactory for high pressures.

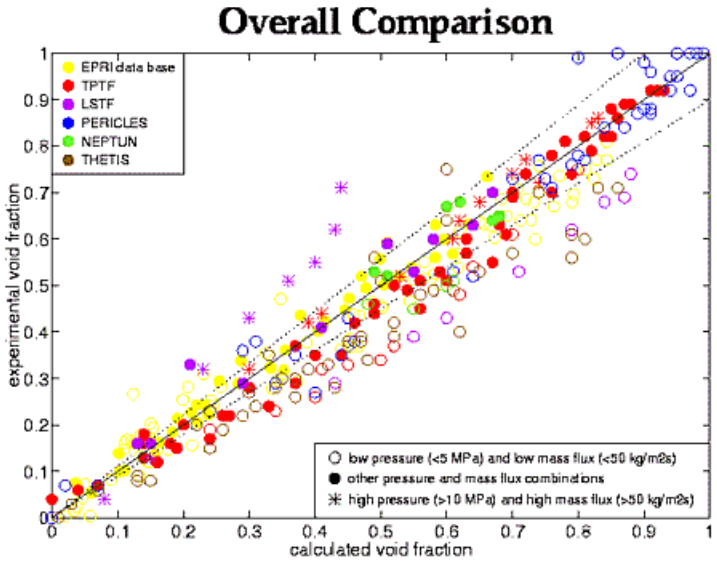


Figure 2. Comparison of void fraction results calculated by RETRAN-03 using the Chexal-Lellouche void fraction correlation to experimental data.

REFERENCES

1. Peterson, C. E. et al., RETRAN-03 - A Program for Transient Thermal-Hydraulic Analysis of Complex Fluid Flow Systems, Computer Code Manual, July 1991, EPRI NP-7450-CCML.

2. Chexal, B. et al., The Chexal-Lellouche Void Fraction Correlation for Generalized Applications, April 1991, NSAC-139.

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
- 2 From MOD005

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

Summary of RETRAN-02 Code Trouble Reports

NO.	TROUBLE REPORT TYPE OF PROBLEM	CORRECTION NO.	IDENT	COMMENTS
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
436	Prandtl Number is Discontinuous	***	MOD005.3	Partial Fix
437	Heat Transfer Logic/CHF	----	----------	Not A Code Error

Summary of RETRAN-3D Code Trouble Reports

The Design Review of RETRAN-3D MOD001f is nearly finished. A summary of the Trouble Report/Code Maintenance Activity is shown below. It includes all errors that were not resolved in MOD001f and errors that have been reported since its completion. MOD001g has not been finalized and includes all error corrections and modifications that have been made to date.

Summary of RETRAN-3D Code Trouble Reports (Cont'd)

NO.	TROUBLE REPORT TYPE OF PROBLEM	CORRECTION NO.	IDENT	COMMENTS
2	Slip Differences Between PREREL & PRE56	----	----------	Change in Defaults
5	Pressure Increase in Last SL Volume	----	----------	Not a Code Error
6	1-D Kinetics Power Level Not Converging	----	----------	Model Limitation
7	Steam Separator Model Fails	***	********	
8	Two-Phase Junction Choking Error	***	********	
10	1st Iteration Failure During Steady State	***	********	
11	Negative Enthalpy When Flow Reverses	***	********	
19	Steady-State Area Adj. for Powered Conductor	053	MOD001g	
24	Pressurizer Mixture Level Not Consistent With the Liquid Level (RETRAN-03 and -02)	***	********	
26	Choked Flow Failure	***	********	
27	Flow Oscillation as Junc. Void Goes to Zero	----	----------	Model Limitation
28	Low Power Steam Generator Init. Fails	***	********	
29	Fails with Minimum Time-Step Size	----	----------	Input Error
30	2-Loop Oconee w/5-Eq Fails in Steady State	***	********	
31	Failure in QDOT14	005	MOD001g	
32	Fails in the Two-Region Nonequilibrium Model	***	********	
33	000040 Data Not Read During Restart	***	********	
34	Different Laminar Flow Friction Transition	001	MOD001g	
35	Initial; NCG States Not Propagated Correctly	042	MOD001g	
36	CHF Calculation for a Single Volume	007	MOD001g	
37	Choked Flow Numerical Instability	013	MOD001g	
38	Core Dump Occurs for One Case Not Others	***	********	
39	Time-Step Error; Pressure is 5997 psia	***	********	
40	Results Do Not Agree With Data	***	********	
41	Anomalous Downcomer Level	***	********	
42	Fails with Time-Step Error in Pressurizer	***	********	
43	Steady-State Convergence Error	***	********	
45	Restart Incorrect Transient Values	***	********	
46	Steady-State Does Not Converge	***	********	
47	Standard Problem One Difference	***	********	
48	Steady-State Fails After 6 Iterations	006	MOD001g	(Partial Fix)
49	Edits for Volume Data Actually Used	009	MOD001g	
50	Void Fraction Comparisons are Poor	002	MOD001g	
51	Pressure Search Failure for Two-Phase MOC	***	********	
52	MOC Does Not Return to the Initial Temp.	***	********	
53	MOC Does Not Work With Noncondensables	----	----------	Model Limitation
54	MOC Solution; No Null Transient for Two-Phase	***	********	
55	Condensation Heat Transfer; Core Dump	008	MOD001g	
56	Steady State Fails - Dynamic Slip Used; 135 Vol.	035	MOD001g	
57	Enthalpy Error at Steady-State Iteration #6	***	********	
58	Condensation Mass Transfer Model Error	002	MOD001g	
59	Error in Fill and TDV BCs for Pure Error	011	MOD001g	
60	Anomalous Countercurrent Flooding	***	********	
61	REEDIT Job Causes FTB Error	014	MOD001g	
62	Code Error Discovered on PC Installation	003	MOD001g	
63	Multi-D Kinetics Input and SS Error Proc.	004 016	MOD001g MOD001g	
64	Format Error for Card 146000	018	MOD001g	
65	Error Turning Enth. Transport off; 5-Eq. Used	028	MOD001g	
66	Error in TRIPDT When DT < TMIN	004	MOD001g	
67	No Check for TMIN or TRTG < TMAX	019	MOD001g	

Summary of RETRAN-3D Code Trouble Reports (Cont'd)

NO.	TROUBLE REPORT TYPE OF PROBLEM	CORRECTION NO.	IDENT	COMMENTS
68	Error in 5-Equation Wall Heat/Mass Transfer	024	MOD001g	
69	5-Equation Option Fails to Initialize	054	MOD001g	
70	Fails in Subroutine DERIVS	052	MOD001g	(Partial Fix)
71	Pressurizer Model Doesn't Match Theory	025	MOD001g	
72	Allow Old TDV Input When No NCG	017	MOD001g	
73	Output Format Error in Subroutine INGAS	020	MOD001g	
74	Correct EOS Failure in GENOPT	021	MOD001g	
75	Eliminate Call to CCFPRP in Steady State	022	MOD001g	
76	Remove Extraneous Deriv. in XANDH	023	MOD001g	
77	Reactivate Slip After Single Phase	026	MOD001g	
78	Correct Phase Flag in STATNE	027	MOD001g	
79	Error in Wilson Bubble Rise Model	030	MOD001g	
80	Error With Restart; Pressures = NaN	032	MOD001g	
81	Steady-State Failure at Iteration #6	***	********	
82	Water Properties Routines Don't Give Unique Answers	046	MOD001g	
83	Separated Volumes Fail to Converge	037	MOD001g	
84	A Reedit Error; FTB Error #11	014	MOD001g	
85	Initialization Error for Accumulator Volume	----	----------	Input Error
86	The Prandtl Number is Discontinuous	036	MOD001g	
87	Subroutine WAT17; VFLAG & DVLP Used, But Not Defined	***	********	
88	Code Fails When 5-Equation Model Activated	045	MOD001g	
89	Failure in Steady State Producing NaN	039	MOD001g	
90	Flow Reversal Causes MOC Solution Failure	038	MOD001g	
91	Steady State Does Not Converge	040	MOD001g	
92	Failure if Momentum Flux Turned Off	034	MOD001g	
93	Temp. Transp. Mdl. Provides Erroneous Results	033	MOD001g	
94	Energy Balance for 12 Node Core	***	********	
95	Derivative Terms in Error	049	MOD001g	
96	Water Vapor Converted to NCG	041	MOD001g	
97	Failure When Pressurizer Fills With Liquid (NUMRCS=3)	050	MOD001g	
98	Failure With Two-Region Nonequilibrium Volume (NUMRCS-3)	050	MOD001g	
99	Default Value of uduf (W6-R)	055	MOD001g	
100	Valid Direct Moderator Heating Cards	056	MOD001g	
101	Error When R3D Ported to Linux OS on P6	057	MOD001g	
102	Error Corrections to R2 Applicable to R3D	015	MOD001g	
103	Incorrect Error Message in INGTRN	043	MOD001g	
104	Water Mass Converted to Air Mass	047	MOD001g	
105	Difference in Unit Conversion Factor	048	MOD001g	
106	Core Dump When >50 Data Points Used	061	********	

Algebraic and Dynamic Slip Options in RETRAN-3D

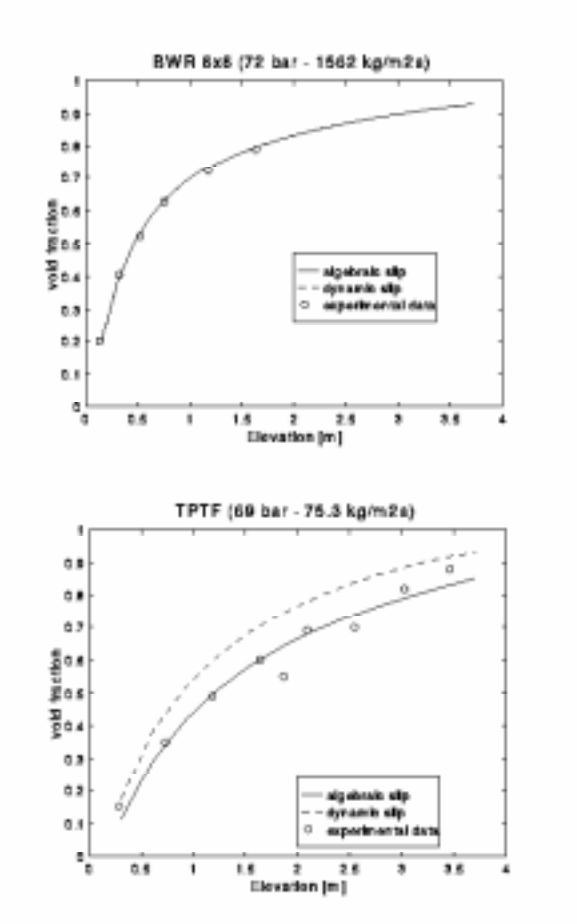
D. Maier, Paul Scherrer Institute

The STARS (Simulation models for the Transient Analysis of the Reactors in Switzerland) group at the Paul Scherrer Institute (PSI) has selected the RETRAN-3D code as its major tool for transient thermal-hydraulic analysis. In the framework of the current project some validation work has been performed. The calculated results using the algebraic and dynamic slip options of the Chexal-Lellouche model were assessed against a wide range of rod bundle void fraction data. The data analyzed is from recently performed experiments at test facilities in France, Great Britain, Japan, and Switzerland.

The calculated results show a good performance of the algebraic slip model over the whole range of experimental data. A tendency toward overprediction of the void fractions for the experiments with low pressure and low mass flux was detected and confirmed by looking at void fraction predictions of experiments used originally for the qualification of the correlation. Therefore an improvement of the prediction quality in this parameter range can only be expected through a modification of the Chexal-Lellouche void fraction correlation.

The dynamic slip model performs well for high mass fluxes over the whole pressure range investigated. The void fractions are increasingly overpredicted for decreasing mass flux (see figure). This is opposed to the expectation that at least for the steady state experiments the results using the dynamic slip option should be the same as those from the algebraic slip option. The source of these differences is currently being investigated.

For further information please contact D. Maier, PSI at +41 56 310 40 62 or Daniel.Maier@psi.ch.



About This Newsletter

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.

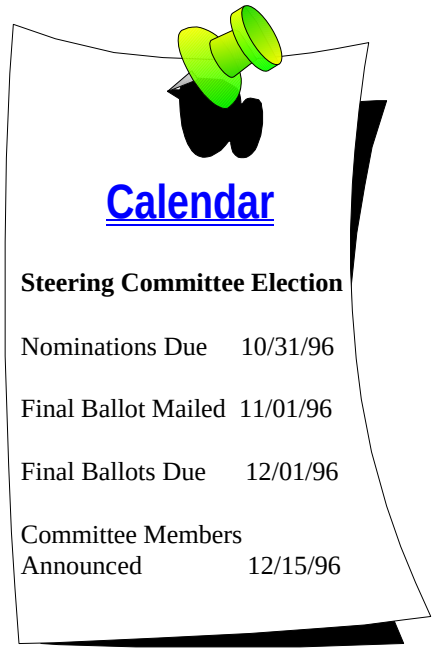
The RETRAN Maintenance Program now has 31 organizations participating in the program, including 23 member utilities, 5 organizations from outside of the U.S., and 3 nonmember utilities from the U.S. A Steering Committee, composed of representatives from the participating organizations, advises EPRI on 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@msm.epri.com, or (415) 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 December 1996 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 December 1, 1996. ***Contributors will receive a RETRAN mouse pad.*** We are looking forward to hearing from all RETRAN licensees.

James McFadden	jm-csa@srv.net
	(208)529-1700
Mark Paulsen	mp-csa@srv.net
Garry Gose	gag@srv.net
Pam Richardson	pam@srv.net



Calendar

Steering Committee Election

Nominations Due	10/31/96
Final Ballot Mailed	11/01/96
Final Ballots Due	12/01/96
Committee Members Announced	12/15/96