■ AMERICAN NUCLEAR SOCIETY ● THERMAL HYDRAULICS DIVISION ■

NEWSLETTER

June 2000

MESSAGE FROM THE CHAIR

As my term as 1999-2000 Chair of the Thermal Hydraulics Division (THD) draws to a close, I reflect on what a challenging experience it has been to serve in this capacity, especially in this new era of electronic communications. Amidst the rapid changes in the technical world, the THD Division remains fully committed to support the mission of the ANS and to serve the thermal hydraulics community. Over the past year, the Division has actively sponsored sessions at the ANS annual conferences and at the National Heat Transfer Conference. Moreover, the Division has successfully organized and held a major international topical meeting, NURETH-9 in San Francisco, California. The Division has continued its leadership in ANS, in maintaining high technical standards with full-length, peer-reviewed publications in all these meetings. However, the THD must do more to cope with the rapid changes in the new era. The Division must foster the growth of the membership, both at the national and international levels. The Division must encourage a greater active participation of its members in the affairs of the Division. The Division must strengthen its position within the ANS by having its members to involve in the national committees and offices. The Division must reach out to the entire nuclear community, particular the nuclear industry. Last, but not least, the Division must get involved politically in public affairs on issues related to research directions, research funding, education, and public opinion on nuclear power.

In any organization, the single most important element is people. As THD enters into the new millennium, it is paramount that the Division continues to absorb new blood to serve and participate in the Division's affairs. This perhaps is the key to the success and well being of the Division in the new millennium. We should actively seek new blood in the following categories:

- People who are active in thermal hydraulics research, including those working in emerging as well as traditional areas of thermal hydraulics.
- People from different communities, including but not limited to industry, academia, government laboratories, and federal agencies.
- People who are willing to serve, especially those who are generous in devoting their time and energy to the Division.

On behalf of the THD Executive Committee, we urge you to help recruit new members of the Division and participate more actively in the Division's affairs. The well being of the Division depends on your efforts and dedication.

Fan-Bill Cheung

Outgoing Chair, Thermal Hydraulics Division

NURETH-9 MEETING

The Ninth International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-9) was held October 3 - 8, 1999 in San Francisco, California. NURETH - 9 was sponsored by the San Francisco Section and the Thermal Hydraulics Division of the American Nuclear Society together with many cosponsoring organizations from the international technical community. The meeting provided a forum for specialists in nuclear thermal hydraulics to exchange information, present the results of new work, review the state-of-the-art, and discuss the future directions and needs for further development of nuclear power plant design, analysis and operation. Over 230 papers were presented at the meeting, from researchers representing 18 different countries, covering a wide breadth of thermal hydraulics topics. The final program, showing the papers presented, is available at http://www.nuc.berkeley.edu/NURETH9/. Copies of the conference proceedings, on CD-ROM, can be purchased for $125.00 plus shipping and handling from the American Nuclear Society, by calling (708) 579-8210 and asking for ANS order #700275.

The meeting included four plenary lectures and six keynote lectures. There was also a special session in honor of the late L.S. Tong.

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Expert panel honors memory of L.S. Tong at NURETH-9

Special thanks go to Sol Levy, General Chairman; Jong Kim, Program Chair; and Per Peterson, Publications Chair, for organizing a very successful meeting, and to the students at Oregon State University for their help with registration and session audio visuals.

THD MEMBERSHIP

Both the ANS and the THD have suffered from a steady decline in membership in recent years. This trend, however, has been reversed in the Division from Spring 1999 to Spring 2000 as the paid membership of the Division has actually increased by 1.5%. As a matter of fact, the Division's U.S. membership has increased faster than 1.5% since the above rate of increase has been offset by the decline in the international membership (from 78 to 68) in the same period. As the THD enters into the new millennium, a greater emphasis will be placed on recruiting new members, especially at the international level.

The THD cordially invites you to become a member of the Division and participate in the Division's activities. Current activities of the Division include paper review, paper presentation, organizing and chairing technical sessions, sponsoring topical meetings, serving on the Editorial Committee, Membership Committee, Program Committee, and Executive Committee, public relations, honors and awards, and student conferences. If you are interested in becoming a member or if your are currently a member interesting in any of the above activities, please contact any of the THD Officers.

1999 ANS THD AWARDS

Professor Victor H. Ransom was the recipient of the ANS-THD TECHNICAL ACHIEVEMENT AWARD for 1999. A plaque and a check of $500.00 were presented to selecting Professor Ransom at the dinner banquet on Tuesday, October 5,1999 during NURETH-9 in San Francisco. In selecting Professor Ransom for this prestigious award, the ANS-THD Honors and Awards Committee recognized his outstanding contributions to nuclear thermal hydraulics science through the numerical implementation of two-phase flow models into the RELAP5 system simulation code and for his contributions to the better understanding of the interaction between numerical methods and the dynamics of two-fluid models.

Professor Ransom initiated the development of the RELAP5 series of codes and was the principal investigator for the project for over ten years. Since the completion of the RELAP5/MOD2 development in 1985 he has continued to serve as a consultant for guidance on continued development of the current RELAP5/MOD3 which is to be used for advanced LWR systems. The RELAP5 code is used internationally for transient simulation of light water reactor systems. Many international code development efforts have been benefited from assimilation of the RELAP5 methods (e.g.:CATHARE). The code received intensive review by "blue ribbon" peer groups and his steadfast, and at times single-handed, support of the technical approach earned him the nickname "Father of RELAP5". The development of the RELAP5 code has contributed significantly to better understanding of nuclear power system behavior under postulated accident conditions. This result can be traced directly to the technical leadership and effort of selecting Professor Ransom who persisted and emerged preeminent in this important field. Furthermore, Professor Ransom has contributed to the technology of system simulation through the training of personnel who have joined laboratories, universities, and commercial nuclear power organizations. This process continues in a formal way through education of graduate and undergraduate students at Purdue University where he was Head of the School of Nuclear Engineering for eight years. His technical contributions have been well documented in the peer-reviewed literature. He has received recognition from the ANS (Fellow), the NRC (citation for RELAP5 development), the Society of Computer Simulation (citation) and the University of Idaho (elected to the Alumni Hall of Fame).

Dr. Ransom receives the 1999 Technical Achievement Award from THD Honors and Awards Chairman, Gunol Kojasoy.

THERMAL HYDRAULICS RESEARCH IN PROGRESS

There are several exciting thermal hydraulics research activities going on around the world as we enter into the new millennium. One such activity is the Rod Bundle Heat Transfer (RBHT) program at Penn State funded by the U.S. Nuclear Regulatory Commission. The RBHT program aims at improving the best-estimate computer code reflood heat transfer and two-phase flow models using a new test facility (i.e., the RBHT test facility) that is specifically designed to aid in code component model development and validation to address the individual component models employed in reflood heat transfer calculations. The RBHT facility, having a 7x7 bundle array arrangement with four unheated corner rods, has 45 full-length, heavily instrumented, heater rods that are electrically heated. The housing uses six pairs of quartz windows along the length to allow the use of a Laser Illuminated Digital Camera System to determine drop size and velocities, as well as other

advanced instrumentation for void fraction, flow, and heat transfer measurements. The facility is designed to perform a series of separate effects tests that can be used to determine the various component heat transfer phenomena identified in a reflood Phenomena Identification and Ranking Table for the reflood period of a large-break LOCA for PWRs and BWRs. One unique feature of the RBHT facility is that the test design, instrumentation, operation, data analysis are driven from the code modeling point of view as compared to an experiment such as FLECHT that was designed primarily to investigate allowable limits. It is believed that the RBHT program will provide an important contribution in this area such that the accuracy of best-estimate calculations will improve. The RBHT facility is under construction at Penn State and will become operational this fall.

THERMAL HYDRAULICS IN THE NEW MILLENNIUM

The field of thermal hydraulics has played a major role in many nuclear-related applications. As we enter into the new millennium, it is important for the THD to proceed in the right direction. This is essential for the well being of the Division in the new millennium and for the Division to continue to make significant contributions to the ANS and the nuclear community as a whole. In view of this, a new item on "Thermal Hydraulics in the New Millennium" is included, in addition to the usual items, in this Newsletter. Answers to the following questions were sought from a number of distinguished members of the Division:

- What would likely be the future trends in thermal hydraulics research?
- In which way the Division should respond to the changes in the technical field?
- How to maintain the well being of the Division in the new millennium?

The views from a selected group of individuals, who are active members and long-term supporters of the Division, follow this editorial.

Owing to the rapid and remarkable changes in the technical world today, it is not possible to forecast what the T/H field will be like at the end of, say, the twenty-first century. If by then a technical historian of T/H were to examine the views of this group of individuals, he might either be surprised by their incredible foresight or simply have a good laugh. In the near-term, however, the views of these individuals may proof to be extremely valuable in leading the Division through the beginning part of the new millennium. I enjoyed reading their views and I hope you would.

Fan-Bill Cheung

Pennsylvania State University

THD Chair (1999-2000)

I believe that the research on two-phase CFD will remain very active in the future. The THD should keep abreast of this field by continuing and promoting the two-phase CFD session at the NHTC. There are many research projects sponsored by the NRC, DOE and the Navy in this area but their results are not being presented at the NHTC-THD session. We need to advertise more aggressively to the researchers working on those projects to capture more papers. At the present time we receive six to eight good papers every year. This number could be easily doubled.

Martin Bertodano

Purdue University

In this new millennium, nuclear community around the world will face the same kind of challenges we have encountered in the past few decades: how to make nuclear reactors operate safely, reliably, and economically. No amount of basic research and intellectual debate will save nuclear community unless they have more direct relevance to utility industry that is the backbone of our nuclear community. No operating reactors, no nuclear future - it is imperative that we all recognize this simple truth. In this regard, practical thermal hydraulic problems associated with license renewal, plant life cycle management, risk-informed technology, fuels, waste disposal, and other issues that are central to the very survival and existence of the industry will be the most cogent problems in the short run. In the long run, new types of reactors may need to be developed and thermal hydraulics of both basic and applied nature can play a prominent role in the design and development of these reactors.

Jong Kim

Electric Power Research Institute

I was more excited than normal to get to work today. It is the year 2031. Scientific advancement in the last 10 years has practically antiquated all preceding discoveries. We live in an amazing time this first few years of the new millennium (depending on how you count). Final touches are being put on complete human genome mapping, protein folding and implications are well understood, drug design tailored for individual symptoms is commonplace, age delaying medications are in routine use, combinations of scientific achievements have resulted in a plethora of clean energy, vehicles that achieve 100s of miles per "gallon equivalent" are widespread but will likely fade away in the next four or five decades due to expected advancements in MDTR (molecular disassembly transport and re-assembly). MDTR promises to revolutionize e-commerce much like Federal Express revolutionized mail order purchase back in the 1980s (yes, you could get it a day or so after you ordered it). Instant gratification will be measured by the appearance of the football in your personal molecular assembler (that is if you are lucky and can afford one) a couple of attoseconds after you placed the order. But I digress - back to my above average excitement.

Yesterday, I got a new computer. Why the big deal about a new computer? Well, this isn't just any computer - it is the top-of-the-line, second-of-a-kind thermal-hydraulics computer. Yes, that's what I said, a thermal-hydraulics computer. You see, general purpose computers went the way of the dinosaur back in 2007. As one of the by-products of genome mapping, we learned how to tailor computers for specific purposes and for dirt-cheap too. The American Nuclear Society Thermal-Hydraulics Division led the crusade for the develop-

ment of the thermal-hydraulics machine. Did I mention, this is a molecular computer - about the size of a shoe box and far more advanced than the optical computer of yesteryear. Capable of gigaterrapetaflop performance and it runs the latest thermal-hydraulics analysis software. The software is wonderful because it has algorithmic and model self-diagnosis, self-configuring capabilities. Yesterday, using the head port connection, it only took me 20 minutes to build a 100 billion node model of one of the old Gen. IX hybrid plants built in about 2012 and start an analysis. Since that was 12 hours ago, by now I should have complete results including the transient analysis, political analysis, decommissioning plan, disposal, long-term health effects, etc. - the whole nine yards. Let's hook up to the head port and see. Wow, look at all that output. Ouch, something is pounding in my head? What's this, the self-diagnosis module says, "calculation ceased, unknown closure relationship not found, discard previous results." Darn, wonder what that means. Which one of the nodes? Back to the lab.

Thomas Larson

Idaho National Engineering and Environmental Laboratory

One of the major areas that is ripe for further exploration in the next several years is the general topic of fluid structure interactions. This includes a number of specific phenomena: (i) Thermal striping. This field was (and is being, outside the U.S.) pursued in relation primarily to liquid metal reactor behavior, since hot and cold temperature differences in the primary system routinely exceed 200×F. However, in certain PWR systems, delta-T's can be considerable, and even where they are not, the types of steels that are used in LWR primary and auxiliary systems have been shown to be susceptible to striping damage at delta-T's as low as 50-100×F. In fact, there have been several events in the past few years as a result of thermal-related fatigue, including recent pipe breaks/leaks in France, Japan, and the U.S. As plants age, and as licenses are renewed, time-related behavior, such as fatigue, may become extremely important. (ii) Flow-induced vibration. This has been around for awhile and has already caused problems in steam generators and reactor internal structures. With life extension, plants will be operating with structures that have been subjected to decades of corrosion, cracking, structural degradation, etc., and understanding fluid-structure interactions may be important. (iii) Water hammer. There is substantial operating experience with the effects of water hammer, but there aren't very good models for predicting its occurrence and impacts: (iv) Pressurized thermal shock. This is a major area that the NRC is looking at in terms of its approach to risk-informed regulation. Significant progress has been make, but more work is needed. Note that an adjunct to modeling these behaviors is further development and refinement of computational fluid dynamics (CFD) codes. The detailed structure of the flow and temperature fields can be important in trying to model phenomena like thermal striping, and the current state of the art in CFD modeling is not up to the task. While T/H systems modeling will continue to be an essential area of work, T/H behavior at smaller scales is important, as well.

Detailed thermal-hydraulic behavior outside of the reactor core will also be important for development of systems models. Examples include upper plenum entrainment, de-entrainment, flow behavior, etc. The NRC's review of so-called "best estimate" systems codes has indicated that simplistic models are often used to deal with these complex phenomena. Better data and models are needed to permit accurate analyses. Another example is the containment T/H. New (passive) reactor designs often have elaborate containment cooling systems. But containment models are utterly inadequate to deal with the detailed T/H behavior that can occur in these large volumes, including mixing (with the effects of non-condensible gases thrown in), condensation (especially in the presence of non-condensibles), condensate film flows along containment walls, and for plants with heat-exchanger-equipped systems (e.g., the old SBWR design), modeling of the T/H in the HX, which includes the above phenomena plus venting of the non-condensibles. Much more testing and better data are needed to support development of decent models.

Another new area is an old one: DNB/CHF in new fuel designs. Vendors are coming out with new designs incorporating all sorts of innovative ideas--integral burnable poisons, either incorporated in the fuel pellets or as coatings; part-length rods (especially in BWRs); new spacer designs; asymmetric water channels, etc. And then, of course, there's MOX and high burnup fuel, which may have different DNB/CHF behavior either as a result of increased Pu concentrations or (for HBU fuel) cladding property changes due to long residence times (oxide or other corrosion, fluence effects, etc.). There is an increased volume of work on DNB/CHF being reported in the current literature, which is a direct result of these new designs. It may be well worthwhile to go back and assess databases and the capabilities of the correlations that appear in our accident and transient analysis codes, to see if they can be shown to apply to innovative fuel designs and longer burnup times. Note, in this connection, that Toshiba's "ABWR-2" includes a complete re-design of the BWR fuel bundle, which will undoubtedly require testing to support modeling of CHF/critical power.

Another area is the T/H contribution to so-called "dynamic PRA" modeling. There have been attempts to couple probabilistic and systems behavior to assist "risk-informed" evaluation of both design-basis and beyond-design-basis events. This effort is still in its infancy, but shows some promise for further development and in providing insights that augment our traditional deterministic assessments. But more work is needed to better integrate the probabilistic and deterministic models, and there may be some areas in which T/H can contribute, particularly with regard to stochastic T/H behavior, such as water hammer.

Last but not least, the advent of risk-informed regulation has resulted in the need for better models of beyond-design-basis accidents. Modeling in codes like MAAP and MELCOR is still relatively primitive in comparison with our more sophisticated systems codes. Better data and more mechanistic mod-

els are needed to deal with what will be a greatly increased demand for these types of analyses in the future.

In which way the Division should respond to the changes in the technical field and how to maintain the well being of the Division in the new millennium? I believe the Division should continue its efforts in sponsoring opportunities for those in the field to present the results of their work, through participation in topical meetings such as NURETH and NUTHOS, the National Heat Transfer Conference, and the ANS national meetings. I also advocate considering formal participation in the ICONE series of meetings, which has become one of the largest and most active nuclear engineering meetings in the world. I also believe that we should be exploring joint efforts with other ANS divisions in areas in which T/H plays a significant role, but not the only one. This includes materials/structures in the fluid-structure interactions areas, PRA in the "dynamic PRA" methodologies, math/comp and reactor physics in advanced code development, and so forth. For many years, I have been critical of the way in which THD supports (or does not) the ANS national meetings. Granted that a good case can be made for ANS to have only one national meeting per year--I have been in favor of that move, as well. But as long as two meetings per year continue to be held, I believe that it is THD's responsibility to fully support them. Not supporting the summer meeting actually diminishes the opportunity for people working in the field to discuss their results with other nuclear engineers, and creates an additional burden for divisional officers, who must often come to the summer meeting anyway for other responsibilities, but must then make an extra trip to the NHTC if they want to participate in divisional governance. Note that what was done last year was especially absurd--there were no governance meetings held at EITHER national meeting; rather they were held two months apart (August, October) at the NHTC and NURETH, which makes absolutely no sense whatsoever. (We are also in direct violation of ANS bylaws and rules--and perhaps of our own, since they are supposed to be consistent with ANS's--which mandate that division governance meetings be held at the national meetings and that new officers assume their positions in June.) For the new millennium, I think that the Division should make a renewed commitment to support ANS by resuming full participation in the summer meetings. Wasn't it Ben Franklin who made the remark about hanging together, or we'd hang separately? Well, the way the ANS has been declining in membership and participation in recent years, if the Divisions don't support the national organization, there soon won't be a national organization to support------and then there won't be any divisions, either.

Alan Levin

U.S. Nuclear Regulatory Commission

The new millennium will see thermal hydraulics evolve from a test-based discipline towards a model-based discipline. The building blocks of current thermal hydraulic codes are semi-empirical flow regime maps and closure laws that are largely based on steady-state lab-scale experiments. Confidence in predictions for nuclear power plant applications is derived from a rich tradition of well-scaled integral testing performed at large scale. A key challenge for the new millennium will be to preserve this knowledge base for future generations.

The rapidly escalating capability of computers, in conjunction with the now nearly prohibitive cost of large-scale testing, has initiated a move away from this test-based tradition. In the tangible future, high fidelity, 3-D modeling will allow researchers to develop a more complete set of advanced, and more fundamental, flow regime maps and closure laws from first principles for use in current generation system codes. Emphasis will be on the topology of the gas-liquid interfaces and the interfacial transfers of mass, momentum, and energy. These advanced modeling activities at the more fundamental level must be supplemented with basic experiment studies that rely on new and sophisticated instruments. In the future, it will become the norm to perform non-deterministic analyses where epistemic and aleatory uncertainties are acknowledged in the model and its input and where the impact of these uncertainties are properly reflected in code predictions. Confidence in code predictions for future industrial-scale applications outside the current database will increasing lie with modern software quality engineering practices, well documented verification programs, and well documented validation programs that will not have the benefit of extensive large-scale testing.

There are those in the thermal hydraulics community that hold forth the dream of one day performing three-dimensional analyses for industrial scale problems entirely from first principles. Improvement in computer capabilities and the associated infrastructure must be many orders of magnitude before this dream can be realized; consequently, this dream, in my mind's eye, is relegated to the intangible future. Nonetheless, the high-fidelity 3-D modeling in the tangible future will position the discipline to realize its ultimate dream should the growth in computer capabilities continue to follow its historical growth well into the future. Never say never!

Martin Pilch

Sandia National Laboratories

Trends in the nuclear technology in the last decade necessitate us to debate the future direction of the research we do in the area of thermal hydraulics. There are several reasons that we may continue to debate the direction in thermal hydraulics research. One of the reasons is the recently announced Nuclear Energy Research Initiative (NERI) program that identified four major areas of interests for further research. These were (i) Proliferation Resistant Reactors and Fuel Technology, (ii) New Reactor Designs, (iii) Reactors to Achieve Improved Performance/Higher Efficiency and Reduced Cost, and (iv) Low Output Power Reactors. Among these four groups, Proliferation Resistant Reactors and Fuel Technology and New Reactor Designs have new challenges and goals. The new reactor technology development efforts concentrate on modular, proliferation resistant, fully passively cooled reactors. One of the key issues in developing these new designs will be the characterization of the natural circulation cooling mechanism. This may not be surprising news to many of us. However, some of the proposed designs involve partial boiling at the top of the core while some others consider new coolant geom-

etry such as a triangle channel. The natural circulation becomes the primary mode of cooling as oppose to a mechanism for emergency cooling. It seems to me that the instability of analysis of these systems will be one of the challenges for THD community in the new millennium.

The new modular reactor design concepts also consider using liquid metals as a coolant. One possible and most mentioned fluid is the lead-bismuth. The lead or lead-bismuth systems are studied about 50 years ago in the U. S. extensively and abandoned because of corrosion problems. Russians successfully use this technology in their submarines. The lead-bismuth systems are known to have good neutronics and thermal hydraulic characteristics. Not only the new reactor design concepts employ the lead-bismuth as a coolant, but the accelerator applications (targets) also propose to use liquid metals as coolants as well as targets. For example, the accelerator transmutation of waste (ATW) project is currently investigating the feasibility of the lead-bismuth systems to burn the nuclear waste. The liquid-metal cooled systems may play a key role in the development of the new reactor designs in the new millennium.

My personal opinion is that the accelerator applications will get more attention in the new millennium. The natural circulation cooling again will be one of the key aspects in the analysis of the design basis accidents for these systems. In general, designers of accelerator targets consider very narrow cooling channels to maximize the neutron production. Characterizations of the critical heat flux and the flow instability in narrow (less than 1 mm) slender and parallel channels are key issues to develop better target designs. High temperature metal-water or metal-air reactions are the concerns of the design and beyond design basis accident analysis in this area. As I was listing these new applications that I am aware of, I asked myself a question that how the presently available computer codes would help us to simulate the thermal hydraulics of these new systems. The thermal hydraulic computer codes are considerably matured during the last decade. However, the capabilities of existing codes are not rich enough to handle new challenges that these new design concepts will introduce. For example, the three-dimensional axial conduction and spatially and temporally varying heat generation (decay heat) in the coolant channels, the chemical reactions at the surface coolant channels, transport of reaction products in the coolant are not readily available features in most of these codes. As the new reactor concepts or accelerator applications evolve the thermal hydraulics under chemical interactions will be the challenge we will face in the new millennium. Needless to say, the turbulent flow, flow regimes, interfacial phenomenon in two-phase flow etc. in next generation as well as present reactors will remain as interesting areas for most of us.

How should our division respond to these new challenges? We are already responding and in the circle. However, we could do more. We should interact with other divisions and organize more co-sponsored technical sessions in these new areas. In addition, we could organize open-forums or include invited speakers into our technical sessions. The invited speakers from different national projects will give us a much better idea how we can contribute to their projects.

How do we maintain the well being of the Division in the new millennium? My personal opinion is to keep producing high quality technical papers and sessions and be a good contributor to the industry we are in. We need to continue to let people in the industry know that we play a key role and are best in what we do. I hope the new opportunities I discussed above give us a chance to keep our well-deserved reputation in the area of thermal hydraulics and to further improve our contribution to the field.

Cetin Unal

Los Alamos National Laboratory

2000 ANS ELECTION RESULTS

Congratulations to our new Thermal Hydraulics Division Officers and additions to our Executive Committee. Their term of office begins at the close of the summer THD executive committee meeting. Following are the results of 2000 ANS Election:

Chair, THD

Martin M. Pilch, ***mpilch@sandia.gov***

Vice Chair/Chair Elect

Cetin Unal, ***cu@lanl.gov***

Secretary

Martin Lopez De Bertodano
Bertodan@helios.ec.purdue.edu

Treasurer

Robert P. Martin
robert_martin@nfuel.com

Executive Committee (3-Year Term)

Yassin Hassan
hassan@hassan.tamu.edu

UPCOMING MEETINGS

2000 National Heat Conference

Pittsburgh Hilton and Towers

Pittsburgh, PA

August 20-22, 2000

Information about the 2000 National Heat Transfer Conference can be found at:

http://www.asme.org/conf/ht00

2000 ANS/ENS International and Technology Exhibit

Marriott Wardman Park Hotel

Washington DC

November 12-16, 2000

Information about the 2000 ANS/ENS International Meeting and Technology Exhibit can be found at

http://www.ans.ort/meetings/text.cgi?category=0

2001 ANS Annual Meeting

Milwaukee Convention Center and Hyatt

Milwaukee, WI

June 17-21, 2001

Information about the 2001 ANS Annual Meeting can be found at:

http://www.ans.org/meetings/text/cgi?category=0

THD '99 - '00 OFFICERS

The following is the list of 1999-2000 THD Officers:

Fan-Bill Cheung	***Chair***
Martin M. Pilch	***Vice Chair***
Martin Bertodano	***Secretary***
Necdet Kurul	***Treasurer***

Executive Members

David Bessette	***2002***
Martin Bertodano	***1999***
Fan-Bill Cheung	***2000***
Dominique F. Grand	***1999***
Barclay G. Jones	***2001***
Necdet Kurul	***2001***
Alan E. Levin	***2002***
Robert P. Martin	***2002***
Martin P. Pilch	***2001***
Jose N. Reyes, Jr.	***1999***
Cetin Unal	***2001***

Ex Officio

Joseph C. Braun
Professional Division Chair

Jose N. Reyes, Jr.
Immediate Past Chair

Committee Chairs

Theo G. Theofanous
Editorial Committee

Gunol Kojasoy
Honors & Awards Committee

Thomas K. Larson
Membership Committee

Jose N. Reyes, Jr.
Nominating Committee

Jong H. Kim
Program Committee

We Want You

THD of the ANS cordially invites you to serve in the following areas:

- ☞ Review papers
- ☞ Write papers
- ☞ Serve on the Program Committee
- ☞ Public Relations
- ☞ Student Conferences
- ☞ Plan, Organize, and Chair sessions
- ☞ Serve on the Editorial Committee
- ☞ Serve on the Membership Committee
- ☞ Executive Committee

If you are able to and willing to help, contact the chair of the THD. Also, if you would like to nominate a colleague for membership in the ANS please contact the chair of THD or send in the following form to 555 North Kensington Avenue, La Grange Park, IL 60526.

Colleague Nomination:

Name_____ Title_____

Company_____

Address_____

Email_____

Phone_____ Fax_____

Areas I would like to help/serve on:

- ❑Review papers
- ❑Write papers
- ❑Serve on the Program Committee
- ❑Public Relations
- ❑Student Conferences
- ❑Plan, Organize, and Chair sessions
- ❑Serve on the Editorial Committee
- ❑Serve on the Membership Committee
- ❑Executive Committee

Name_____ Title_____

Company_____

Address_____

Email_____

Phone_____ Fax_____