THERMAL HYDRAULICS DIVISION NEWSLETTER

Spring 2009

Message from The Chair

On behalf of the Division's Executive Committee, I am pleased to be able to provide positive news from the division. As you know, the goal of this newsletter is to provide the readers with an update on the state of the Division and current events, including past and future conferences and other activities. A Division goal is to increase member participation by creating new technical sessions geared towards current research topics in the nuclear field and industry needs, and making Division participation a rewarding and productive part of your professional activities.

The good news is our membership is growing steadily and the job market for the new graduates, in particular, for nuclear engineering majors, is very good at this time. Sad news is that we lost our long-time member, Mr. M. Akiyama, Professor Emeritus from the University of Tokyo. An article in memory of Professor Akiyama follows later in this newsletter.

This newsletter also includes a Program Committee report by Kurshad Muftouglu, an Honors and Awards Committee report by Yassin Hassan, a Treasurer's report by Karen Vierow, a Nominating Committee report by Shripad Revankar, and call for papers for future conferences.

With improvements to our Division's custodial fund, we can now undertake initiatives to further improve service to our members in terms of best student paper competition, workshops, and other activities. We strive to ensure that all THD members receive value for their membership in the THD.

The THD remains one of the most active Divisions in the ANS. We have traditionally been successful in organizing many technical sessions in the US and abroad.

I report the status of the 2008 ANS Winter meeting in Reno and future conferences briefly here and conference organizers will report the details in their respective articles.

The sessions hosted by the Division at the 2008 ANS Winter Meeting in Reno is summarized in the following table.

Session	No. of Speakers	Chair(s)
Young Professional Thermal Hydraulics Research Competition	3	X. Sun
General Thermal Hydraulics	5	Muftuoglu
Computational Thermal Hydraulics	5	Woods, Powers
Award Session in Memory of Professor L. Hochreiter	2	Hassan
General Two-Phase Flow	6	Muftuoglu
Thermal Hydraulics of High-Temperature Gas-Cooled Reactor Technology	6	Oh, Arndt

NURETH-13 will be held in Kanazawa, Japan from September 27 to October 2, 2009. The details can be found in the attached conference announcement at at http://www.nureth13.org.

NURETH-14 will be hosted by the Canadian Nuclear Society. The conference dates are September 25 to September 30, 2011 to maintain a required 30-day interval between this topical meeting and the ANS Winter Meeting. The venue will be the Hilton Hotel in Toronto.

The THD will participate in the 14th International Heat Transfer Conference (IHTC14) as an endorser. The conference will be held in Washington DC from August 7 to August 13, 2010. The website is: http://www.asmeconferences.org/IHTC14. Two renowned THD members were recommended to the IHTC14 organizer as plenary speakers.

Last but not least, our Division is open to new and energetic members who are willing to help the Division. New volunteers are encouraged to contact me or anyone in the THD committees to discuss how to become involved.

The Executive Committee decided to reorganize the conference selection committee, which leads the conference host screening process among other functions. Each of five new members was recommended by the Division's Assistant Program Committee Chair, Treasurer, Secretary, Vice-chair, and Chair. The new members all accepted serving on the ad

hoc committee. They are: Steven Arndt at NRC; Qiao Wu at Oregon State University; Jong Kim at EPRI; Mike Podowski at RPI; and Randy Gauntt at Sandia National Laboratories. Please welcome them on board.

Additional information is continually updated at our website http://thd.ans.org.

Thanks to all of you who have supported me as Chair. See you in Atlanta.

Chang H. Oh
Chairperson (2008-2009)
Thermal-Hydraulics Division
Idaho National Laboratory
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In Memory of Professor M. Akiyama

Professor Mamoru Akiyama was an internationally renowned thermal hydraulic researcher and nuclear engineering professor in the nuclear engineering and mechanical engineering communities for several decades. His leadership and vision spawned many highly successful research programs in the nuclear engineering field, including development reactor safety analysis techniques and investigations to advance the current understanding of phenomena in nuclear reactors. The technical guidance he provided as President of the Institute of Applied Energy helped the institute maintain its status as a showcase of Japanese excellence in energy engineering.

Professor Akiyama received his bachelor's degree in 1958 and a doctorate in 1970, both in mechanical engineering, from the University of Tokyo. Following five years at the Japan Atomic Energy Research Institute, Professor Akiyama joined the University of Tokyo in 1963 as a faculty member in the Nuclear Engineering Department. From 1996, he served as Professor Emeritus of the University of Tokyo while holding a series of prestigious and demanding positions including:

- President, Saitama Institute of Technology
- Member, Science Council of Japan
- President, Atomic Energy Society of Japan
- President, Pacific Nuclear Council
- Vice President, Japan Atomic Industrial Forum
- President, Institute of Applied Energy since 2003

Recognizing the need for international collaboration among researchers, Professor Akiyama promoted international meetings and other interactions among the nuclear communities of various countries. He was a member of the American Nuclear Society from 1992 to 1999 and frequently attended and chaired multinational conferences. Professor Akiyama was an influential member in growing the ICONE (International Conference on Nuclear Engineering) conference series, a joint JSME-ASME (Japan Society of Mechanical Engineers – American Society of Mechanical Engineers) effort which has developed into the premier international conference for the nuclear industry.

Born in 1935, Professor Akiyama died at age 73, on April 1, 2009. A memorial service will be held on May 19, 2009 at the Toranomon Pastoral in Tokyo Japan.

The Thermal Hydraulic Division and its members are grateful for his technical contributions and always kind and gentle manner. A remembrance event will be held at the NURETH-13 conference in October 2009, for which Professor Akiyama had agreed to be the Honorary Co-Chair.

H. Ninokata
Secretary (2008-2009)
Thermal Hydraulics Division
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Personal Reflections on Professor Akiyama

What comes to mind when we think of Professor Akiyama? I think those of us who knew him personally would probably agree that he was a kind, decent, and graceful leader – the kind of leader whom we would love to follow because he possessed quiet magnetism - friendly, gentle, warm yet firm, with a sense of care for others - that naturally endeared him to us. In this era of exhibitionism, we may be prone to exude an air of self-importance but for Professor Akiyama such demeanor seemed to be below his dignity - he was always considerate, unassuming, and never imposing.

I am not writing anything new here, but Professor Akiyama was a consummate professional – an outstanding scholar, educator, innovator, and administrator, all rolled in one. He was passionate about nuclear energy, particularly nuclear safety and thermal hydraulics in which he made significant contributions. Along the way, he had touched the hearts of many, helping them grow professionally.

Many of us are fortunate to have known him and to have enjoyed the privilege of working with him on occasions, invariably benefiting from his knowledge, wisdom, and friendship. As a senior member of ANS THD, he was an icon for major international conferences such as NUTHOS, NURETH, ICONE, Pacific Basin Nuclear Conference (PBNC), and ICAPP, particularly when these events were held in the Pacific Rim countries. His passing is so untimely and unfortunate for NURETH-13 to be held later this year for which he was to serve as Honorary Co-Chair.

Professor Akiyama was well loved by everyone around him and his contributions to his profession are highly respected by

the international community of nuclear safety and thermal hydraulics. We should all be grateful that our times partly coincided with his.

Professor Akiyama will be missed but his legacy and the memories we have shared with him will live forever in our hearts and thoughts.

Jong H Kim
Program Committee Member
Korea Advanced Institute of Science and Technology
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Program Committee Report

The division continues to put together strong sessions at the annual meetings. Thanks to the support of many members, the program committee

At the 2009 Annual Meeting in Atlanta, Georgia, THD is organizing 8 contributed paper sessions. This year, our division received a record number of summaries. We have received total of 48 summaries. This represents a new high for our division, and it is the highest among all divisions in this conference. All the efforts of the session organizers are greatly appreciated. The sessions, in chronological order, are:

- Computational Thermal Hydraulics I [Mon. p.m.]
- General Thermal Hydraulics [Tues. a.m.]
- Computational Thermal Hydraulics II [Tues. p.m.]
- General Two-Phase Flow [Wed. a.m.]
- Rod Bundle Thermal Hydraulics [Wed. p.m.]
- Severe Accidents and Fluid-Structure Interaction [Wed. p.m.]
- Thermal Hydraulics of Advanced Reactors [Thur. a.m.]
- Thermal Aspects of Nuclear Material Handling and Environmental Monitoring [Wed. a.m.]

Our sessions span throughout the conference and two sessions had to be scheduled concurrently on Wednesday afternoon due to time and space limitations.

Looking ahead, for the 2009 Winter Meeting (Washington D.C.), the THD is planning to organize five sessions. One of these sessions is dedicated to the late Prof. Larry Hochreiter. This special session will host both invited and contributed papers on research areas and on contributions of Prof. Hochreiter. Two of the sessions will be in panel format with all-invited speakers. The sessions planned for the Winter Meeting are as follows:

- Special Session on Research Contributions of Prof. Larry Hochreiter
- General Thermal Hydraulics
- Status of Next Generation Nuclear Plant – Panel
- Fundamentals of Multi-Phase Flow
- 10CFR50.46 LOCA Criteria Revision – Panel

In addition to these five sessions, the Division is supporting the young professional competition session as part of the embedded topical meeting 2009 Young Professional Congress.

The THD Program Committee meeting will be held on Sunday June 14, starting at 3:00 p.m. in "Courtland" room. We are continuously looking for members who are interested in actively participating to support the division. This meeting is a good opportunity to observe the PC activities. To find out more on how to get involved, please contact the Division's Program Committee chair.

Kurshad Muftouglu
Program Committee Chair
PCchair@thd-ans.org

Honor and Awards Report

The winner of the 2008 ANS Technical Achievement award was the late Professor Larry Hochreiter. Professor Jack Brenizer accepted the award on behalf of Larry's family and friends during a memorial session honoring Larry. The session was chaired by Prof. Y. A. Hassan and Prof. S. Kim.

During the ANS Thermal Hydraulic Sessions, two 2008 THD best papers were announced and the winners received plaques. The best papers are:

- RCCS Experiments and Validation for High Temperature Gas-Cooled Reactor, Chang Oh and Cliff Davis, Idaho National Laboratory, Goon C. Park, Department of Nuclear Engineering, Seoul National University.

- Applicability of Small-Scale Test data to the 4500 MWt ESBWR Loss-of-Coolant Accidents, Pradip Saha et al., General Electric.

A special session entitled "Young Professional Thermal-Hydraulics Research" was held during the 2008 ANS Winter Meeting. This session was organized by Don Todd. The best paper was selected as Stephen Fortenberry's paper on "The Temporal Evolution of Nanoparticle Suspensions". Steve is a young engineering graduate from Texas A&M in December 2008 and he is currently working as Engineer at Westinghouse (fortensd@westinghouse.com). The judging panel consisted of Steven Arndt, Kurshad Mutuoglu and Danna Powers. The paper's co-authors were E. E.Dominguez-Ontiveros and Y. A. Hassan.

The Technical Achievement Award is the highest award of the THD and we ask for nominations. The deadline of the submission is July 1, 2009. The details including the award form can be found at http://thd.ans.org/Awards/Awards.htm.

Yassin Hassan
H&A Committee Chair
hassan@ne.tamu.edu

Treasurer's Report

For 2008, the Division's income of $27,114 came from the 2007 carry forward, our 2007 member allocation and the 20% share of NURETH-12 net proceeds. The Division income from meeting revenue support (i.e. by contributing more than the expected number of technical abstracts) is no longer received because the membership allocation has been increased from $1/member to $2/member. THD expenses were support for awards and plaques, national meeting costs, donation to the student conference at Texas A&M University in February-March 2008, student travel support to the ANS Annual Meeting (June 2008) and the ANS Winter Meeting (November 2008), and scholarships including the NEED program.

Revenue		
Type	**Item**	
Member Allocation	$2/THD Member	1,986
Carry Forward from 2007		14,430
Division Income from meeting revenue support	NURETH-12, Pittsburgh, October 2007	10,698
TOTAL REVENUE		**27,114**
Expenses		
Type	**Item**	
Awards, Plaques		1,342
National Meeting Costs	Meeting supplies for Nov. '08 meeting ($65) + L. Hochreiter memorial ($50)	115
Student Conference Support	Texas A&M Univ. meeting	2,500
Student Travel Support	June 08 Meeting	250
Student Travel Support	Nov. 08 Meeting	250
Scholarship/NEED	Scholarship ($250) + NEED Program ($250)	500
TOTAL EXPENSES as of 12/31/08		**4,957**
Balance as of 12/31/08		**22,157**

Awards-related expenses for the year 2008

- Recognition plaque for outgoing Division Chair at $70
- Young Professionals Thermal Hydraulic Research Presentation Award plaque at $72
- Best Paper Award at $500 to Pradip Saha
- Best Paper Award at $500 to Chang Oh
- Best Paper Award plaques at $200

Although the Technical Achievement Award recipient had been selected in late summer, his untimely passing precluded award disbursement. Therefore, the Division did not have the budgeted expenses of Technical Achievement Award at $1000 and Technical Achievement Award plaque at $60.

As a result of a tie, two best paper awards were given in 2008. One award had been budgeted.

2009 Budget

For 2009, the Executive Committee approved the following expenses at the November 2008 meeting:

- $1800 for awards and plaques (same as in 2008)
- $2500 for ANS Student Conference support (same as in 2008)
- $500 total for student travel support to the ANS Annual Meeting (June 2009) and the ANS Winter Meeting (same as in 2008)
- $500 for Scholarship/NEED (same as in 2008)
- $2,500 as a special one-time contribution towards endowment of a "distinguished speaker series" in honor of Prof. L. Hochreiter, to be established within the Nuclear Engineering Program at Penn State University

This budget, which is based on the recommendation made by the Ad-hoc Committee (Vierow, Cheung and Rempe) on Long-Term Finances, was approved by the EC.

Karen Vierow, Texas A&M University
2008-2009 Vice Chair/Chair-elect
ANS Thermal Hydraulics Division
vierow@ne.tamu.edu

Nominating Committee Report

The current Division Officers and Executive Committee members are listed below.

Current THD Officers (July 2008-June 2009):
Division Chair: Chang Oh, *chang.oh@inl.gov*
Vice Chair: Karen Vierow, *vierow@ne.tamu.edu*
Treasurer: Kune Suh, *kysuh@snu.ac.kr*
Secretary: Hisashi Ninokata, *hninokat@nr.titech.ac.jp*

Executive Committee Members

Fan-Bill Cheung (2009)	*fxc4@psu.edu*
Whee Choe (2009)	*whee.choe@txu.com*
Yassin Hassan (2009)	*y-hassan@tamu.edu*
Hisashi Ninokata (2009)	*hninokat@nr.titech.ac.jp*
Don Todd (2009)	*donald.todd@areva.com*
Kurshad Muftuoglu (2010)	*muftuoak@westinghouse.com,*
Xiadong Sun (2010)	*sun.200@osu.edu*
Robert Martin (2010)	*RobertP.Martin@areva.com*
Brian Woods (2011)	*Brian.Woods@oregonstate.edu*
Prof. H. C. No (2011)	*hcno@kaist.ac.kr*

The nominees for the Division Officers for year 2009-2010 are listed below. The ANS elections results are yet to be announced.

Incoming THD Officers (July 2009-June 2010):
Division Chair: Karen Vierow, *vierow@ne.tamu.edu*
Vice Chair: Hisashi Ninokata, *hninokat@nr.titech.ac.jp*
Treasurer: Xiadong Sun **,** *sun.200@osu.edu*
Secretary: Brian Woods, *brian.woods@oregonstate.edu*

Since five EC members' terms expire by June 2009, five new EC members have been nominated as listed below: The ANS elections results are yet to be announced.

Executive Committee Members for Three-year Term:
Randall O Gauntt *rogaunt@sandia.gov*
John Luxat *luxatj@mcmaster.ca*
Stephen Bajorek *Stephen.Bajorek@nrc.gov*
Frepoli, Cesare *FrepolC@westinghouse.com*

Executive Committee Members for Two-year Term:
David Aumiller *aumiller@bettis.gov*

I am glad to report that our current Program Committee Chair Dr. Kurshad Muftouglu ***(****muftuoak@westinghouse.com)* was nominated for another 3-year term as THD Program Committee Chair. The EC has approved his nomination and Dr. Muftouglu has accepted the position.

The Nominating Committee is responsible for the nomination of THD members to leadership positions on both the Program and Executive Committees. The THD would like to encourage members interested in becoming more involved to contact one of the officers listed above. In particular, the division is usually in need of volunteers for technical meeting session organizers and paper reviewers.

Shripad T. Revankar
2008-2009 Chair
THD Nominating Committee
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Web Page Report

Want to know what's going on in the nuclear thermal-hydraulics community and the ongoing business and activities of your favorite ANS professional division? The THD website (http://thd.ans.org) includes links to our latest newsletter and recent and upcoming events of interest to thermal-hydraulic practitioners (e.g., NURETH-13 and ICAPP). Follow the sidebar links and learn a little about the THD and current topics of interest. Archives of historical records (meeting minutes and newsletters) going back nearly 20 years are also available. For the truly inspired, the THD website includes our rules for conducting business, recognition of current and past committee members, and contact information of THD officers. Also, if you are interested in nominating a colleague for our prestigious Technical Achievement Award, you can find the necessary application and instructions. Your comments and suggestions about content appearing on our site can be directed to me.

Robert Martin
Web Site Manager
robertp.martin@areva.com

Research News Briefs

New VHTR Air Ingress Mechanism

Chang Oh, Eung Kim, and Hyung Kang
Idaho National Laboratory

The potential for air ingress into the Very High Temperature Gas-Cooled Reactor (VHTR) vessel stems from consideration of postulated depressurized conduction cool-down accidents. If a depressurized conduction cool-down occurs, air may be given the opportunity to move into the reactor vessel. It is presently thought that the worst-case scenario will occur if a double-ended guillotine break is postulated in the hot duct. The hot duct is a large pipe (exact dimensions presently not defined, but the outer diameter is over a meter) that connects the reactor vessel with the vessel housing the power conversion equipment.

For a postulated double-ended guillotine rupture, the transient will commence with a depressurization from operating pressure (assumed to be approximately 7 MPa) as helium is discharged into the reactor cavity. During the depressurization phase, hot helium from the vessel will mix with the air in the reactor cavity. Hence, a helium-laced air mixture will be available to move into the reactor vessel once the break is unchoked and the flow behavior at the break changes from momentum-driven flow from the reactor vessel into the reactor cavity to density-gradient driven stratified countercurrent flow with helium moving into the reactor cavity and helium-laced air moving into the reactor vessel from the reactor cavity.

The potential for density-gradient governed stratified air ingress into the VHTR following the depressurized conduction cool-down has been studied by Oh et al. Studies on air ingress focused on the molecular diffusion as primary mechanism in the VHTR.

A preliminary computational fluid dynamics (CFD) analysis was performed to understand density-gradient-induced stratified flow in the VHTR air-ingress accident. Various parameters were taken into consideration, including turbulence model, core temperature, initial air mole-fraction, and flow resistance in the core. The gas turbine modular helium reactor (GT-MHR) 600 MWt was selected as the reference reactor and three-dimensional CFD analysis was performed to capture the localized hot spot in the lower plenum using CFX code.

Preliminary and scoping analysis results show that the actual onset time of natural convection occurs much faster than that of the molecular diffusion air-ingress mechanism. The new finding of the density-gradient driven air ingress flow will be validated using air ingress experiments planned by INL in year 2009 and 2010.

The first case of CFD calculations was made on "two bulbs" experiment conducted by Duncan and Toor [1]. The

experimental apparatus consists of two bulbs separated by a small horizontal capillary tube. The bulbs had volumes of 77.99 cm^3 and 78.63 cm^3, respectively. The capillary tube joining them was 85.9 mm long and 2.08 mm in diameter. The bulbs were initially isolated by a stopcock installed at the center of the capillary tube. The entire device was maintained at a temperature of 35.2°C in atmospheric pressure.

In a previous study [2], the GAMMA code was used to compare with the experimental results. The 1-D GAMMA results were in good agreement [2]. In this paper, the 2 mm pipe size was changed to 16 mm while other initial conditions and the geometry including the pipe length remained the same as the experiment. Figure 9 shows the two 3-D CFX models [3]. The bulb 1 shown in the left side in Figure 1 contains CO_2 and nitrogen initially while bulb 2 in the right is initially filled with hydrogen and nitrogen.

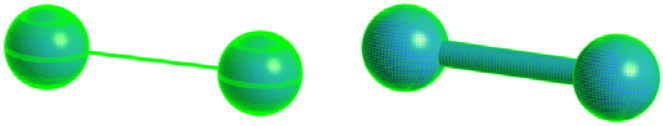

Figure 1. CFX Models of Duncan Experiment (2 mm horizontal pipe (left) vs. 16 mm horizontal pipe (right)).

The initial conditions used for CFX simulations are 0.499 mole fraction CO_2 and 0.501 nitrogen in Bulb 1, and 0.501 mole fraction hydrogen and 0.489 mole fraction nitrogen in the Bulb 2.

Figure 2 shows the calculated concentration of CO_2 in the two bulbs connected with a 16-mm pipe at 30 seconds. As can be seen, the heavier gas of CO_2 in the left bulb (Bulb 1) flows through the pipe initially as the stratified flow with CO_2 flowing along the bottom and underneath the lighter gas hydrogen.

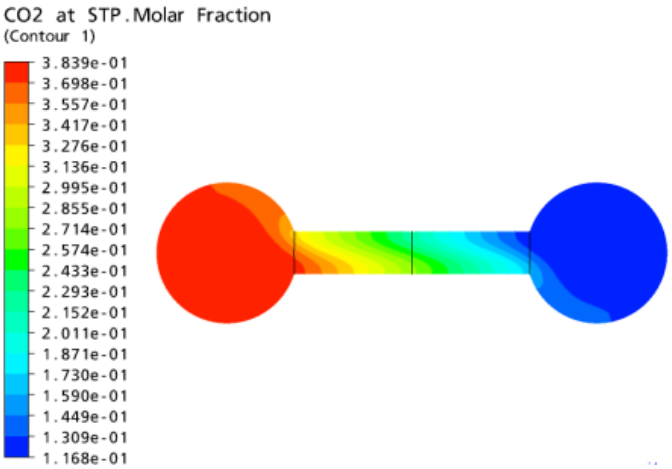

Figure 2. CFX results of two-bulb simulation with 16-mm pipe.

The second case was made for three-dimensional model of the GT-MHR using the CFX code. Figure depicts the GT-MHR design and the top view of the reactor vessel.

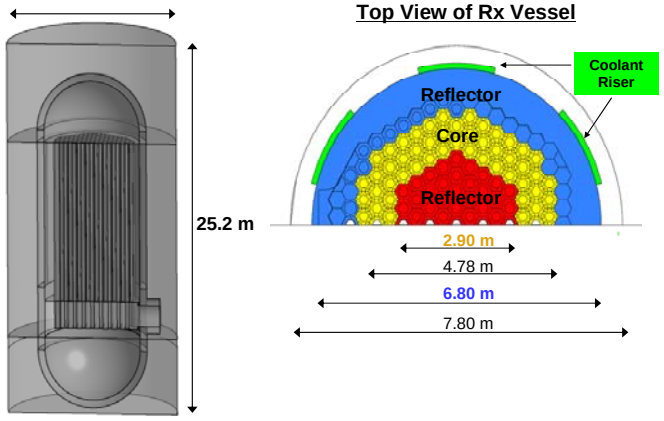

Figure 3. GT-MHR design and the top view of reactor vessel.

Figure 4 shows the detailed reactor with three pieces in one model.
A 180 degree model was developed to capture the localized hot spot in the lower plenum that has one cross duct at the inlet/exit location.

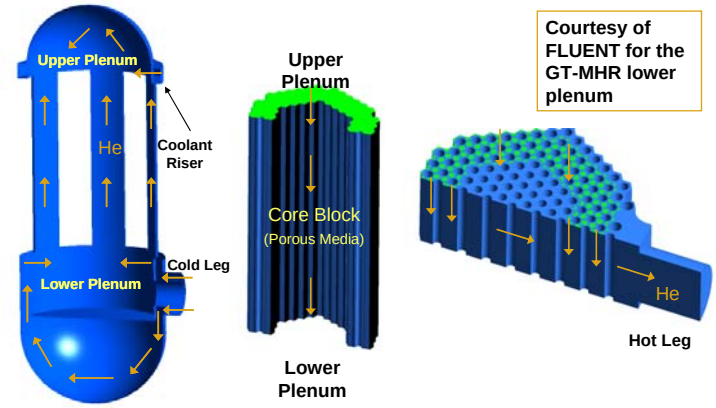

Figure 4. Detailed reactor vessel with risers (left), the core plenum (middle), and the lower plenum (right).

Figure 5 shows calculated buoyancy forces in the lower plenum where the buoyancy force was created while the cold air is heated up. This force pushes air moving upward into the reactor core.

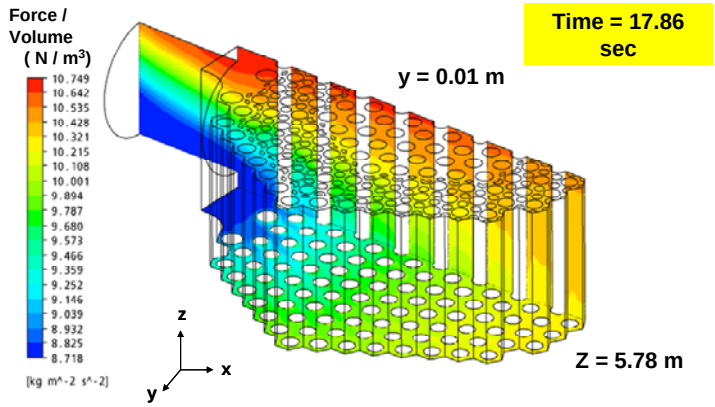

Figure 5. Calculated buoyancy forces in the lower plenum.

References

1. Duncan, J. B., and H. L. Toor, "An Experimental Study of Three Component Gas Diffusion," *A.I.Ch.E. Journal*, 8, 1, 38, 1962.
2. Oh, C. H., C. Davis, L. Siefken, R. Moore, H. C. NO, J. Kim, G. C. Park, J. C. Lee, and W. R. Martin, "Development of Safety Analysis Codes and Experimental Validation for a Very High Temperature Gas-Cooled Reactor," Final Report, Idaho National Laboratory, INL/EXT-06-01362, March 2006.
3. ANSYS CFX, User's Manual, Version 11, 2008.

Tritium Transport Code Development

Eung Kim and Chang Oh
Idaho National Laboratory

Tritium is produced in the VHTR by various sources; ternary fissions and activation reactions with impurities and borons in the materials. In addition, the helium coolant itself is also tritium source in the form of neutron absorbing nuclide ^{3}He with its extremely low isotope abundance. Tritium emissions from nuclear facilities are regulated by the U.S. Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). Because the limits for tritium emissions are quite stringent, the Next Generation Nuclear Plant (NGNP) Project needs to understand how, and to what extent, tritium may be generated and transported from the NGNP to an associated industrial process and its effect on NGNP design and NRC licensing. Appropriate systems can then be designed to mitigate potential tritium impacts.

In order to predict tritium behavior for quantified differences in materials, sizes, conditions, and configurations in the NGNP, INL is developing a tritium permeation analysis code version 1(TPAC-1).

The tritium generation core models were implemented into the TPAC-1. The core models are depicted in the following equations.

1. Ternary fission

$$\frac{d\left(N_{T(Ter)}\right)}{dt} = K \cdot P \cdot Y - \lambda \cdot N_{T(Ter)}$$

where

$N_{T(Ter)}$ = number of tritium atoms due to ternary fission
K = fission rate per thermal megawatt [fission/MW/s]
P = reactor power [MW]
Y = average yield per fission [1/fission]
λ = tritium decay constant [1/s].

2. Birth from ^{6}Li

$$\frac{d\left(N_{Li6}\right)}{dt} = -\phi_{th} \cdot \sigma_{Li6T} \cdot N_{Li6}$$

$$\frac{d\left(N_{T(Li6)}\right)}{dt} = \phi_{th} \cdot \sigma_{Li6T} \cdot N_{Li6} - \lambda \cdot N_{T(Li6)}$$

where

N_{Li6} = number of ^{6}Li atoms
$N_{T(Li6)}$ = number of tritium atoms from ^{6}Li
ϕ_{th} = thermal neutron flux [neutrons/cm^2/s]
σ_{Li6T} = effective cross section for ^{6}Li (n, α) ^{3}H [cm^2].

3. Birth from ^{7}Li

$$\frac{d\left(N_{Li7}\right)}{dt} = -\phi_f \cdot \sigma_{Li7H3} \cdot N_{Li7}$$

$$\frac{d\left(N_{T(Li7)}\right)}{dt} = \phi_f \cdot \sigma_{Li7T} \cdot N_{Li7} - \lambda \cdot N_{T(Li7)}$$

where

N_{Li7} = number of ^{7}Li atoms, excluding ^{10}B source
$N_{T(Li7)}$ = number of tritium atoms from ^{7}Li, excluding birth from ^{10}B
ϕ_f = fast neutron flux [neutrons/cm^2/s]
σ_{Li7T} = effective cross section for ^{7}Li (n, nα) ^{3}H [cm^2].

4. Birth from ^{3}He

$$\frac{d\left(N_{He3}\right)}{dt} = f \cdot N^{\circ}_{He3} - f \cdot N_{He3} - \phi_{He} \cdot \sigma_{He3T} \cdot N_{He3}$$

$$\frac{d\left(N_{T(He3)}\right)}{dt} = \phi_{He} \cdot \sigma_{He3T} \cdot N_{He3} - \lambda \cdot N_{T(He3)}$$

$$\phi_{He} = \frac{W_{core}}{W_{total}} \cdot \phi_{th}$$

where

N_{He3} = number of ^{3}He atoms
$N_{T(He3)}$ = number of tritium atoms from ^{3}He
f = fractional supply rate of helium coolant [1/s]
N°_{He3} = number of ^{3}He atoms in the supply helium
σ_{He3T} = effective cross section for ^{3}He (n, p) T [cm^2]
ϕ_{He} = average thermal neutron flux experienced by the total primary helium inventory [n/cm^2/s]
W_{core} = helium inventory in core [kg]
W_{total} = total primary helium inventory [kg]. (1)

5. Birth from ^{10}B

$$\frac{d\left(N_{B10}\right)}{dt} = -\left(\phi_{th} \cdot \sigma_{B10Li7} + \phi_f \cdot \sigma_{B10T}\right) \cdot N_{B10}$$

$$\frac{d\left(N_{Li7(B10)}\right)}{dt} = \phi_{th} \cdot \sigma_{B10Li7} \cdot N_{B10} - \phi_f \cdot \sigma_{Li7T} \cdot N_{Li7(B10)}$$

$$\frac{d\left(N_{T(B10)}\right)}{dt} = \phi_f \cdot \sigma_{Li7T} \cdot N_{Li7(B10)} + \phi_f \cdot \sigma_{B10T} \cdot N_{B10} - \lambda \cdot N_{T(B10)}$$

(2)

where

N_{B10} = number of ^{10}B atoms

$N_{Li7(B10)}$ = number of ^{7}Li atoms from ^{10}B

$N_{T(B10)}$ = number of tritium from ^{10}B

σ_{B10Li7} = effective cross section for ^{10}B (n, α) ^{7}Li [cm^{2}]

σ_{B10T} = effective cross section for ^{10}B (n, 2α) ^{3}H [cm^{2}].

TPAC-1 is being validated with Peach Bottom data and will be validated using tritium data to be collected by HTTR in Japan.

Figure 1 shows the TPAC-1 model for the Peach Bottom reactor. The system is composed of reactor, steam generator, concentric pipe, containment, and purification system. For simplicity, two steam generator loops have been simplified to a single steam generator loop in the model. In this system, the tritium flow path is as follows. First, the tritium is generated in the reactor core and released. The majority of the released tritium enters into the main flow distributed in the whole system. The rest of the tritium from the core is purged to the purification system for removing tritium from the primary loop. Some of the tritium in the main flow is permeated to the secondary side through the steam generator walls or leaked to the containment through the pipe lines. A small portion of main flow is purged to another purification system. The temperature and pressure of all the components were set as 809 K and 23 atm, which are the average temperature and pressure in the system.

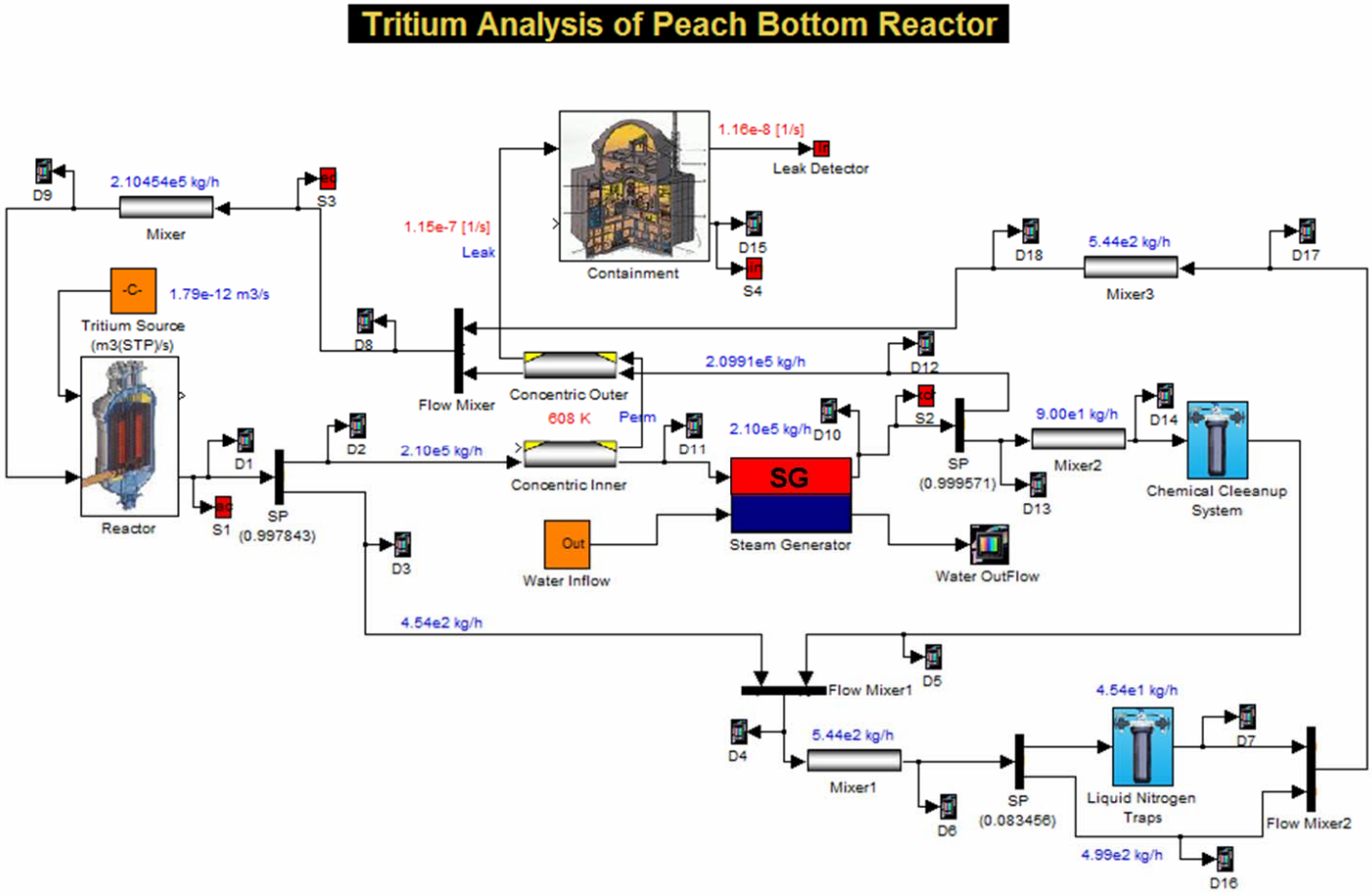

Figure 1. INL tritium code modeling for Peach Bottom reactor.

Second Announcement and Call for Papers

NURETH-13

13th International Topical Meeting on **Nu**clear **Re**actor **T**hermal **H**ydraulics
September 27-October 2, 2009, Hotel Nikko Kanazawa and Ishikawa-ken Ongakudo,
Kanazawa City, Ishikawa Prefecture, JAPAN
http://www.nureth13.org/

International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH) is an important series of international topical meetings in the fields of thermal hydraulics.

NURETH has served for international nuclear society as an open forum where high-quality and up-to-date information is actively discussed and exchanged among world-class experts. Now NURETH-13 is organized by the Thermal Hydraulics Division of Atomic Energy Society of Japan and American Nuclear Society and will bring together all the experts, together with new information and research results from all over the world. It is our utmost pleasure to welcome you to this significant international conference. (*TPC Chairs*)

Topics

- Two-Phase Flow and Heat Transfer Fundamentals
- Boiling and Condensation Phenomena
- Rod Bundle Thermal Hydraulics
- Subchannel Analysis
- Nuclear Reactor Core Thermal Hydraulics
- Nuclear Reactor Plant Thermal Hydraulics and Safety
- Code Development and Applications
- Computational Methods, Modelling, Verification/Validation
- Applications of Computational Methods to Nuclear Systems
- Advanced Code Development and Validation/Verification/Applications
- Experimental Methods and Instrumentation
- Severe Accidents, Phenomena, Modeling and Experiments
- Combustion and Fires, Modeling and Experiments
- Thermal Hydraulics in Accident Management
- Operating LWRs Thermal Hydraulics and Safety
- Thermal Hydraulics in Power Uprating/Life Extension
- Neutronics/Thermal-Hydraulics Coupling
- Fluid-Structures and Materials Interactions
- Sodium-cooled Fast Reactor Thermal Hydraulics
- Next Generation LWR Thermal Hydraulics
- Next Generation Gas-cooled Reactor Thermal Hydraulics
- Generation IV and Future Innovative Nuclear Reactors Thermal Hydraulics
- Application of Nano-Fluid Science and Technology to Nuclear Systems
- Micro-Scopic Fluid Flow and Heat Transfer Phenomena in Nuclear Systems
- Thermal Hydraulics of Non-Electricity Generating Nuclear Equipment
- Thermal Hydraulics of Waste Management
- Miscellaneous Subjects

Key Dates (Updated October 15, 2008)

Dec.31, 2008	Electronic submission of abstracts due
Jan.31, 2009	Notification of acceptance to authors
Mar.31, 2009	Full Manuscripts due for review
April 1 to May 31: Review Period	
May31, 2009	Review results and comments back to authors
July31, 2009	Final paper manuscripts due
Aug.31, 2009	Last day of early-registration
Aug.31, 2009	Last day of hotel reservation
Sep.27 –Oct. 2, 2009	Date of Meeting
Oct. 2, 2009	Technical Tour to FBR Monju, KEPCO Mihama PWR site

Conference Web-Site for More Information:
http://www.nureth13.org/

Organizers

Honorary Chairs
Neil E. Todreas (MIT)
Mamoru Akiyama (Inst Applied Energy)
General Chairs
Hideki Nariai (JNES)
Jong H Kim (KAIST- EPRI WW)
Advisory Committee
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International Steering Committee
Chair Soon-Heung Chang (KAIST)
Co-chair Yassin Hassan (Texas A&M)
Technical Program Committee
Chair Hisashi Ninokata (TITech)
Co-chair Joy Rempe (INL)
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Kanazawa Tourist Guide:
http://www.kanazawa-tourism.com/

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Special Topics (Organized Sessions)

- Thermal Hydraulics and Structural Integrity in Connection to Aging and Life Extension
- Fusion Reactor Thermal Hydraulics
- Issues and Future Directions of Thermal Hydraulics R&Ds
- BEPU (Best Estimate code Plus Uncertainty) method, CSAU, Statistical Methods
- Radiological Hazard Related Thermal Hydraulics – Aerosol behaviors, consequences

Selected papers from the conference will be published in refereed archival journals as special NURETH-13 issues

Preliminary Call for Papers

"Helping the Environment with Advances in Thermalhydraulics"

14th International Topical Meeting on Nuclear Reactor Thermalhydraulics (NURETH-14)

September 25-29, 2011
Hilton Toronto Hotel, Toronto, Ontario, Canada

Objective

Canada is the hosting country for the 14th International Topical Meeting on Nuclear Reactor Thermalhydraulics (NURETH-14). The conference website will be launched in July 2009 with full details regarding the conference. This Preliminary Call for Papers is being issued to give potential contributors more lead time to work on their papers and allow potential attendees more time to plan their schedules.

Continuing the tradition of the highly successful series of thirteen conferences, NURETH-14 will gather an international group of leading academic and industry researchers and practitioners engaged in engineering and scientific work focused on nuclear reactor thermalhydraulics. This is the only major conference series devoted solely to the advancement of knowledge in the nuclear reactor thermalhydraulics field. NURETH-14 is a unique opportunity for researchers and practitioners in the field, to present results of their work and discuss challenges and new ideas.

Key Deadlines

Abstracts submission ..... *Oct. 11, 2010*
Acceptance/author notification ..... *Jan. 10, 2011*
Draft paper submission ..... *Mar. 07, 2011*
Comments to authors ..... *May 23, 2011*
Final paper submission ..... *June 20, 2011*

Initiating Conference Organizers

General Chair..... *J. Luxat (McMaster U.)*
General Co-Chair.....*F.B. Cheung (Penn. State U.)*
Technical Program Chair..... *J. Riznic (CNSC)*
Technical Program Co-Chair..... *C. Oh (INL)*
Steering Committee Chair .... *L.K.H. Leung, (AECL)*
Technical Program Committee: *To be announced*

Abstract and Full-Paper Submission

Abstracts, and subsequent full papers, must be submitted via an on-line submission link which will be posted on the Conference webpage. The link will be posted on the CNS webpage at http://www.cns-snc.ca

Topics of Interest

Papers related to the following topics are of interest to this conference:

- Two-Phase Flow and Heat Transfer Fundamentals
- Boiling and Condensation Phenomena
- Rod Bundle Thermalhydraulics
- Subchannel Analysis
- Thermalhydraulics and Safety for Nuclear Reactor Plant and Core
- Computational Methods, Modelling, Verification/Validation
- Applications of Computational Methods to Nuclear Systems
- Advanced Code Development and Validation/Verification/Applications
- Experimental Methods and Instrumentation
- Severe Accidents, Phenomena, Modeling and Experiments
- Thermalhydraulics in Accident Management
- Thermalhydraulics in Power Uprating/Life Extension
- Neutronics/Thermalhydraulics Coupling
- Fluid-Structures and Materials Interactions
- Next Generation Reactor Thermalhydraulics
- Generation IV and Future Innovative Nuclear Reactors Thermalhydraulics
- Nano-Fluid Science and Technology Applications to Nuclear Systems
- Micro-Channel Flow and Heat Transfer Phenomena
- Thermalhydraulics of Non-Electricity Generating Nuclear Equipment
- Thermalhydraulics of Waste Management
- Thermalhydraulics and Materials Degradation Issues
- Others

Further Information

Additional information may be obtained by contacting the Technical Program Chair: *Jovica Riznic, Canadian Nuclear Safety Commission, 280 Slater, Ottawa, Ontario K1P 5S9, CANADA, Tel: (613) 943-0132; Fax: (613) 943-1292, E-mail: jovica.riznic@cnsc-ccsn.gc.ca.*