THERMAL HYDRAULIC DIVISION NEWSLETTER

Spring 2010

Message from the Chair

Dear Colleagues,

Since I last reported to you, the Thermal Hydraulics Division has twice received high marks from ANS for our Division standing. The first came at the 2009 Winter Meeting in Washington DC. The Professional Divisions report to the ANS Board of Directors on a two-year rotation and our turn had come.

I prepared our Professional Division report with the help of the Officers. As key measures of the Division's vitality, we were able to show a continued increase in the number of paid members, financial stability and contributions to ANS in a large number of categories. Earning particular praise from the Board were the large number of sessions at ANS meetings, the high numbers of papers authored by Division members in ANS and non-ANS publications and the multi-year spending plan that we developed to ensure financial stability. As further evidence of the quality of our presentation, a Division Chair who will present for his Division this June asked about using our presentation as a template for their presentation.

For some actual statistics, the number of members with paid membership is 1034 as of December 2009, an increase from the previous year of 1.2%. To this may be added 143 paid student memberships. At least 5 sessions and 30 abstracts have been provided by the Division at each Annual and Winter Meeting since 2005, except in 2008 when we had between 25 and 30 abstracts at each meeting.

Our second measure of recognition was approval of the Division's Rules. This has been a multi-year effort, but we have succeeded in completing this task too. Our newly approved Rules are posted on our website at http://thd.ans.org.

Our current Division efforts include:

- Young Member Group participation
  A Young Professional Thermal Hydraulics Research Competition will be held in cooperation with the Young Members Group at the 2010 ANS Winter Meeting. We will serve as the Technical Division sponsor of the session.
- Student and Young Member recruitment
  We meet students at the university and national student conference levels, encouraging them to become involved in the Division. In addition to providing financial support of the 2010 ANS Student Conference at the University of Michigan this spring, we advertised our Division and the upcoming research competition session in the student conference program.
- Collaboration with other Divisions
  This effort includes co-sponsoring technical sessions.
- International members in the Program Committee
  The Division has at least one international member on the Program Committee at all times.
- Industry participation in THD
  We could use ideas here. Members from industry participate in Division activities. We should ensure that we provide value to the industrial sector as further exchange on the organizational level is desirable.
- Professional development programs
  The Division will offer a tutorial session on scaling analysis at the 2010 ANS Annual Meeting.
- High quality research presentations
  The Division hosts not only abstract-only sessions, but also full-length paper sessions at ICAPP and other conferences. Division members are working on calls for host organizations for future international conferences.

I encourage you to look at the Preliminary Program for the 2010 ANS Annual Meeting and join us in San Diego this June (http://www.new.ans.org/meetings/m_69). To avoid conflict with the President's Reception on Sunday evening, we were asked to reschedule our meetings. ***Please note the new meeting time for our Program Committee and Executive Committee meetings.*** The new times are Sunday afternoon at 2:30-4:30 pm and 4:30-6:00 pm respectively.

We have several sessions planned for this June.

- Computational Two-Phase Flow
- Thermal Hydraulics of VHTR's
- Computational Thermal Hydraulics
- Scaling Analysis Techniques – Tutorial
- General Thermal Hydraulics I
- General Thermal Hydraulics II

As a recent initiative, we are returning tutorial sessions to the Division lineup. In a tutorial on Scaling Analysis techniques, participants will hear from leading experts about scaling techniques as applied to nuclear power reactors. Pradip Saha of GE Hitachi and Jose Reyes of Oregon State University were confirmed panelists at the time of the Preliminary Program printing. The tutorial is free and open to all meeting participants.

Of special note, Brian Collins of Pacific Northwest Laboratory volunteered to serve as our liaison with the Young Members Group. We have not had a liaison to the YMG in recent years and appreciate his initiative to invigorate this role. Brian's first task is to organize the Young Professional Thermal Hydraulics Research Competition which our Division will sponsor at the 2010 ANS Winter Meeting. He may be soliciting judges for the competition, so please consider assisting if he requests. Thank you, Brian, for stepping up to the plate.

In June, I will pass the Chair's baton to Professor Hisashi Ninokata (currently Vice Chair/Chair-elect). At the conclusion of the meeting, our other newly elected officers will be: Professor Brian Woods (Vice Chair/Chair-elect); Professor Xiaodong Sun (Secretary) and Dr. David Aumiller (Treasurer). It is an honor to serve as your Division Chair for the current year and work with these great people!

We welcome anyone who would like to volunteer their time to Division-related matters. We also encourage your suggestions and comments.

Looking forward to seeing you all in June!

Karen

Karen Vierow, Texas A&M University
2009-2010 Division Chair
ANS Thermal Hydraulics Division
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Honor and Awards Report

The winner of the 2009 ANS THD Technical Achievement Award was Mujid S. Kazimi, TEPCO Professor of Nuclear Engineering and Director at the Center for Advanced Nuclear Energy Systems at the Massachusetts Institute of Technology. Professor Kazimi received this recognition for his "[p]ioneering role in the fields of design and safety analysis of nuclear power plants, nuclear fuel cycles, and fusion technology" at both the ANS Honors and Awards ceremony and a special technical session during the 2009 ANS Winter meeting in Washington, D.C. During the THD Technical Achievement Award special session, Dr. Kazimi delivered a lecture entitled, "Re-Engineering the Light Water Reactors".

Bo Feng, an MIT graduate student, accepted the THD best paper award on the behalf of himself and his coauthors, Julien Beccherle, Pavel Hejzlar, and Mujid S. Kazimi. Their paper, entitled "Thermal Hydraulics of PWRs Transitioning to High Performance Annular Fuel," was published in the proceedings of the 7th International Topical Meeting on Nuclear Reactor Thermal Hydraulics, Operation and Safety (NUTHOS-7) held October 5-9, 2008 in Seoul, Korea.

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.

Robert P. Martin, AREVA NP Inc.
2009-2010 Honors and Award Committee Chair
ANS Thermal Hydraulics Division
RobertP.Martin@areva.com

Treasurer's Report

For 2009, the Division's income of $26,731 came from the 2008 carry forward ($22,907), our 2009 member allocation ($2,044), and Division income from meeting revenue support (i.e., by contributing more than the expected number of technical summaries and organizing technical panels, $1,780). THD expenses were support for newsletters postage, awards and plaques, donation to the student conference at University of Florida in April 2009, student travel support to the ANS Annual Meeting (June 2009) and the ANS Winter Meeting (November 2009), scholarships including the NEED program, and one-time donation to the Larry Hochreiter Endowed Lecture Series. The total THD expenses for 2009 were $7,730, which was slightly below the EC approved 2009 budget, $7,800 (See the THD Fall 2009 Newsletter). The details of the income and expenses are included in the table below.

Revenue		
Type	**Item**	
Member Allocation	$2/THD Member	2,044
Carry Forward from 2008		22,907
Division Income from meeting revenue support	June meeting 29 papers @ $30, $870 Nov. meeting 27 papers @ 30, $810 Nov. meeting 2 panels @ $50, $100	1,780
TOTAL REVENUE		**26,731**
Expenses		
Type	**Item**	
Newsletters (Postage)		11
Awards, Plaques		1,719
Student Conference Support	University of Florida meeting	2,500
Student Travel Support	June 09 Meeting	250
Student Travel Support	Nov. 09 Meeting	250
Scholarship/NEED	Scholarship ($250) + NEED Program ($250)	500
Other Expenses	One-time donation to the Larry Hochreiter Endowed Lecture Series	2,500
TOTAL EXPENSES as of 12/31/09		**7,730**
Balance as of 12/31/09		**19,001**

Awards-related expenses for the year 2009 ($1,719)

- THD Technical Achievement Award for 2009 at $1,000
- THD Technical Achievement Award plaques at $76
- Best Paper Award at $500
- Best Paper Award plaque at $72
- Recognition plaque for outgoing Division Chair at $71

2010 Budget ($5,300)

For 2010, the Executive Committee approved the following expenses at the November 2009 meeting:

- $1,800 for awards and plaques (same as in 2009)
- $2,000 for ANS Student Conference support ($500 less than that in 2009)
- $500 targeted to student support with details to be identified at the June 2010 EC meeting (additional item, not in the 2009 budget)
- $500 total for student travel support to the 2010 ANS Annual Meeting and Winter Meeting (same as in 2009)
- $500 for Scholarship/NEED (same as in 2009)

2010 Income and Expenses (by March 31, 2010)

For 2010, the Division's income of $21,039 included the 2009 carry forward ($19,001) and our 2010 member allocation ($2,068). The Division's only expense by March 31, 2010 was the donation to the student conference at the University of Michigan in April 2010, $2,000. The balance of the THD general funding account as of March 31, 2010 was $19,039.

Xiaodong Sun, The Ohio State University
2009-2010 Treasurer
ANS Thermal Hydraulics Division
sun.200@osu.edu

Program Committee Report

Strong participation to the THD sessions at the ANS meetings continues and thanks to the support of the session organizers, reviewers, and contributing authors, the program committee has put together six sessions for the 2010 Annual Meeting at San Diego, CA. These are:

- Computational Two-Phase Flow [Mon. p.m.]
- Thermal Hydraulics of VHTR [Tues. a.m.]
- Computational Thermal Hydraulics [Tues. p.m.]
- Scaling Analysis Techniques – Tutorial [Wed. a.m.]
- General Thermal Hydraulics – I [Wed. p.m.]
- General Thermal Hydraulics – II [Thur. a.m.]

Five of these sessions are all contributed sessions. We have received total of 38 summaries for these sessions and only one paper was rejected by the reviewer recommendations.

The division also prepared a tutorial on "Scaling Analysis Techniques". Organizers and the lecturers of this special session are Dr. Pradip Saha (GE Hitachi) and Prof. Jose Reyes (Oregon State). This tutorial will provide a technical overview of the scaling methodology for application to nuclear power reactors with examples. The program committee plans on supporting future tutorials depending on the audience interest and the success of this session.

The 2010 Winter Meeting will be held in Las Vegas, NV. The division is planning to organize seven sessions. The sessions planned for the Annual Meeting are as follows:

1. General Thermal Hydraulics
2. Computational Thermal Hydraulics
3. Young Professional Research Competition
4. Interfacial Area Transport
5. Two-Phase Heat Transfer Fundamentals
6. Severe Accident Management
7. Experimental and CFD Analysis of Gen-IV Reactors

The young professional research competition has been very successful: it has always been a well-attended session with a remarkable level of preparedness of the presenters. This professional development session provides an opportunity to enhance the technical writing and presentation skills of young professionals working in the area of Thermal Hydraulics through preparation and presentation of an extended abstract related to the Thermal Hydraulics profession. Members' help in promoting and solicitation for this session within their organizations would be appreciated.

In San Diego, the THD Program Committee meeting will be held on Sunday June 13, starting at 2:30 p.m. in "Eaton" conference room. Anyone interested in the program committee activities are invited to participate.

Kurshad Muftuoglu, GE-Hitachi Nuclear Energy
2009-2010 Program Committee Chair
ANS Thermal Hydraulics Division
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Web Page Report

If you have any comments or suggestions for the division website, please contact me via e-mail or at professional meetings.

DuWayne Schubring, University of Florida
Webmaster-in-Training
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Division website: http://thd.ans.org

Young Professionals Report

We have been working with the Young Members Group for the Co-Sponsoring of the Young Professionals Thermal Hydraulic Research Competition. This competition focuses on thermal hydraulic research completed by members early in their career. Student submissions will be considered, but priority is given to professionals. More information regarding the competition can be found on the THD website (http://thd.ans.org/YPTHRC2010.pdf), or by contacting Brian Collins (brian.collins@pnl.gov).

Brian Collins, Pacific Northwest National Laboratory
Young Professionals Liaison
ANS Thermal Hydraulics Division
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NURETH-14 Report

Join us for NURETH-14

Canada is the hosting country for the 14th International Topical Meeting on Nuclear Reactor Thermal hydraulics (NURETH-14). NURETH is an important series of major international topical meetings devoted solely to the advancement of knowledge in the nuclear reactor thermal hydraulics and related areas. It covers wide range of topics assumed in the different types of nuclear reactors of current and future generations. In particular, the meeting has placed a specific emphasis on understanding fundamentals and practical applications to ensure safe operation of current nuclear generation fleet as well as presenting developments and applications for new innovative technologies for the advanced and next generation of nuclear power plants. Since the first meeting in 1980, the Thermal hydraulics Division (THD) of the American Nuclear Society has sponsored NURETH meetings held in the USA, France, Germany, Japan, and Korea. NURETH-14 will be held in beautiful Toronto, Ontario, Canada, from September 25 to 29, 2011, and is organized in cooperation with the Canadian Nuclear Society, along with many co-sponsoring organizations from international nuclear community. Professor John Luxat of McMaster University is the General Conference Chair, Professor Mamoru Ishii of Purdue University is the Honorary

Chair and Professor Fan Bill Cheung of Penn State is the General Co-Chair. Dr Laurence Leung of Atomic Energy of Canada Ltd is the Steering Committee Chair, and Dr Yuksel Parlatan of Ontario Power Generation is the Chairman of the Canadian Organizing Committee. Dr. Jovica Riznic of Canadian Nuclear Safety Commission will serve as the Technical Program Chair and Dr. Chang Oh of Idaho National Laboratory is the Technical Program Co-Chair. Local arrangements will be coordinated by Ben Rouben. Canadian Nuclear Society is providing necessary technical support for organization of the NURETH-14 conference.

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 thermal hydraulics. 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. The theme of NURETH-14 is "Helping the Environment with Advances in Thermal hydraulics". The Conference website URL is http://cns-snc.ca/events/nureth-14/. Every NURETH conference has been highly successful, with a large number of enthusiastic nuclear professionals participating from around the world. Based on the previous experience with NURETH-10 in Seoul in 2003, NURETH-11 in Avignon in 2005, NURERH-12 in Pittsburgh in 2007 and NURETH-13 in Kanazawa in 2009, we expect more than 300 papers for the conference.

Don't miss these NURETH-14 events

Technical Program – NURETH series of conferences has a well earned reputation for bringing together the best and brightest experts from around the world to share the latest in research, development and applications in nuclear engineering and technology and nuclear plant operation. Developed over the years of organizing this series of conferences, the papers and discussions of the overall technical program will focus on 10 topical areas including:

A. Two-phase flow and heat transfer fundamentals
B. Code Development and Applications
C. Severe Accidents and Fires
D. Advanced Code Developments
E. Operation and Safety of Existing Reactors
F. Instrumentation, Measurement Technique and Testing
G. Advanced Reactors Thermal hydraulics (Gen III+, -IV, INPRO and Fusion)
H. Waste Management Thermal hydraulics
I. Thermal hydraulics of Non Electricity Generating Nuclear Equipment
O. Special Topics (Organized Sessions)
   O.1. Thermal Hydraulics and Structural Integrity in Connection to Aging and Life Extension
   O.2. Issues and Future Directions of Thermal Hydraulics R&Ds
   O.3. BEPU (Best Estimate code Plus Uncertainty) method, CSAU, Statistical Methods
   O.4. Radiological Hazard Related Thermal Hydraulics – Aerosol behaviors, consequences
   O.5. Other (Open to proposals from professional community)

Panel Sessions - There will be number of plenary sessions with keynote lectures to provide an updated state-of-the-art in some of the most important topics of thermal hydraulics and nuclear safety.

Pre-Conference Workshops- Organizing Committee is planning to offer the whole day of Sunday, September 25th for number of one-day workshops and seminars to maximize interactions and transfer of knowledge from experienced researchers and engineers to newcomers to the field. The workshops may begin with the fundamentals and then continues to recent developments and some practice guidelines for nuclear engineering applications. If you are interested in developing one of such workshops please contact the NURETH-14 Technical Program Chair.

Gallery of Nuclear Thermal hydraulics – The Gallery of Nuclear Reactor Thermal hydraulics will showcase images and videos submitted by participants of the meeting.

Exposition – Exhibits by leading companies providing range of services from measurement, and testing to sophisticated simulations will be at NURETH.

Networking - The conference is an excellent opportunity to promote and network with the world leaders in the field. It could also potentially act as a catalyst for building future business relationships.

Conference Proceedings - The NURETH proceedings, alone, are worth the registration fee to attend the conference, as the DVD will contain complete set of peer-reviewed full-length publications.

There is a lot of enthusiasm amongst the NURETH-14 organizers that the program will appeal the engineers, scientists and all professionals working in nuclear power, thus, increasing NURETH's attendance, further the exchange of information between different disciplines, and result in safe and sustainable nuclear power technology for our future. Again, your input and support will be the key to the Conference's success and your participation will contribute greatly to this initiative. To aid in nurturing, education, and encouragement of bright, young, raising-star researchers and engineers in the field we are inviting them to take the lead in paper solicitation and session's organization. Further information, call-for-papers, submission of abstracts and status

regarding NURETH-14 may be obtained at the official web site: http://cns-snc.ca/events/nureth-14/ or you may send a note to the Technical Program Chair at jovica.riznic@cnsc-ccsn.gc.ca.

On the final note, it is the Organizing Committee expectations that NURETH will continue to be the world's foremost conference in area of nuclear reactor thermal hydraulics and will continue to attract the highest quality technical papers, presentations, workshops and exhibits.

Jovica Riznic, Canadian Nuclear Safety Commission
Technical Proram Chair, NURETH-14
jovica.riznic@cnsc-ccsn.gc.ca

Nominating Committee Report

Current Division Officers and Executive Committee members are listed below.

Current Year THD Officers:

Division Chair: Karen Vierow, *vierow@ne.tamu.edu*
Vice Chair: Hisashi Ninokata, *hninokat@nr.titech.ac.jp*
Secretary: Brian Woods, *brian.woods@oregonstate.edu*
Treasurer: Xiaodong Sun, *sun.200@osu.edu*

Executive Committee Members

Karen Vierow (2010)	*vierow@ne.tamu.edu*
Kurshad Muftuoglu (2010)	*PCchair@thd-ans.org*
Xiaodong Sun (2010)	*sun.200@osu.edu*
Robert Martin (2010)	*RobertP.Martin@areva.com*
Hisashi Ninokata (2011)	*hninokat@nr.titech.ac.jp*
Brian Woods (2011)	*Brian.Woods@oregonstate.edu*
Hee Cheon No (2011)	*hcno@kaist.ac.kr*
David Aumiller (2011)	*aumiller@bettis.gov*
Randall O. Gauntt (2012)	*rogaunt@sandia.gov*
John Luxat (2012)	*luxatj@mcmaster.ca*
Stephen Bajorek (2012)	*Stephen.Bajorek@nrc.gov*
Cesare Frepoli (2012)	*FrepolC@westinghouse.com*

Committee Chairs:
Program Committee – Kurshad Muftuoglu
Honors and Awards Committee – Bob Martin
Nominating Committee – Chang Oh
Membership Committee – Chang Oh

The results of the 2010 division election are in. The following are the Division Officers and additions to the Executive Committee for 2010-2011.

Incoming THD Officers (July 2010-June 2011):

Chair: Hisashi Ninokata, *hninokat@nr.titech.ac.jp*
Vice Chair: Brian Woods, *Brian.woods@oregonstate.edu*
Secretary: Xiaodong Sun, *sun.200@osu.edu*
Treasurer: David Aumiller, *aumiller@bettis.gov*

Executive Committee Members (3 years)
Steven A. Arndt (2013) *steven.arndt@nrc.gov*
Si Young Lee (2013) *si.lee@srnl.doe.gov*

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.

Chang Oh, Idaho National Laboratory
2009-2010 Nominating Committee Chair
ANS Thermal Hydraulics Division
Chang.Oh@inl.gov

Research News Briefs

Integral Effects Tests and Code Validation for Gas Reactor Thermal Hydraulic Phenomena

Brian Woods, Oregon State University
Yassin Hassan, Texas A&M University
Karen Vierow, Texas A&M University

In 2008, Oregon State University, Texas A&M University and the University of Michigan entered into a cooperative agreement with the US Nuclear Regulatory Commission in order to develop a broad base of experiments and computer code capabilities that could be used to assess a wide range of high temperature gas reactor (HTGR) operations including the prismatic core and pebble bed designs. The work under this agreement has been divided into three primary tasks: (1) Development of coupled reactor physics and thermal hydraulics modeling techniques which is led by the University of Michigan, (2) Separate Effects Tests for Gas Reactor Thermal Hydraulic Phenomena, and (3) Integral Effects Tests and Code Validation for Gas Reactor Thermal Hydraulic Phenomena. Since the establishment of the original agreement the Department of Energy has become a partner with the US NRC, Oregon State and Texas A&M in the integral effects testing program under this agreement.

In support of the integral effects testing and code validation effort, scaling analyses and design work are underway for the construction of an integral High Temperature Test Facility (HTTF) at Oregon State University. The HTTF is envisioned

to be a reduced scale model of the Modular High Temperature Gas Reactor (MHTGR). It will be a reduced pressure facility scaled ¼ by height and ¼ by diameter operating at prototypical temperatures.

One of the postulated accident scenarios for HTGRs is the depressurized conduction cooldown (DCC) event which is also known as the Depressurized Loss of Forced Convection event (D—LOFC). The DCC involves some sort of reactor coolant system break which allows primary coolant to leak into the reactor cavity. Depending on the size, orientation and location of the break, significant ingress of an air—helium mixture may occur from the cavity into the vessel. During the DCC event, the primary mode of heat removal from the core is through conduction and then radiation through the reactor cavity.

The HTTF has been scaled and designed primarily to examine the behavior of the HTGR during the DCC event. The scaling analysis is general enough to allow for the application of the HTTF to a number of break scenarios with a variety of sizes, locations and orientations including but not limited to (1) control rod nozzle breaks, (2) instrumentation tube breaks, (3) primary system relief valve openings, and (4) hot and cold crossover vessel breaks. This scaling analysis examines the progression of the DCC event through a number of post-blowdown phases: (1) air ingress by exchange flow, (2) air ingress through molecular diffusion and (3) the onset of natural circulation. To ensure that the scaling objectives are met in an organized and clearly traceable manner, the framework for the HTGR scaling methodology used in the design of the HTTF has been drawn from the NRC's Severe Accident Scaling Methodology presented in NUREG/CR-5809. [1]

Although primarily scaled and designed to examine the behavior of the HTGR during the DCC, the scaling of the facility has been examined to determine the applicability of the HTTF to at-pressure events such as the pressurized conduction cooldown (PCC) event. The scaling analysis examines the progression of the PCC event through a number of post-LOFC phases: (1) flow reversal and the onset of natural circulation, (2) single-phase natural circulation, and (3) system pressurization and transition into a DCC event. The scaling analysis has also examined phenomena specific to the PCC event such as intracore circulation and inlet plenum mixing and heat transfer.

The HTTF uses the MHTGR as its reference design. The facility is scaled at ¼ length and ¼ diameter. The current design of the facility calls for a stainless steel (SS304) pressure vessel with an ASME pressure rating of 9.65 bar at 550ºC. The maximum operating pressure of the test facility will therefore be set at 8 bar. High temperature electric heaters will be used to simulate core decay power. The core and reflectors will be made of ceramic material that allows for transient and steady-state heat transfer scaling in the reduced volume facility. The HTTF is being designed currently as a prismatic block design core although the facility is being designed in a modular fashion to allow it to accommodate a pebble bed designed core at a later date if desired. Operational characteristics, vessel data, and core data for the HTTF are listed in Tables 1, 2 and 3. Figure 1 shows a 3-D cutaway rendering of the HTTF design.

Table 1: HTTF Operational Characteristics.

Parameter	Value	Units
Coolant	Helium	
Maximum Core Power	600	kW
Maximum Coolant Pressure	0.8	MPa
Mixed Outlet Helium Temperature	670	C
Inlet Helium Temperature	235	C
Maximum Mass Flow Rate	0.32	Kg/s

Table 2: HTTF Vessel Dimensions.

Parameter	Value	Units
Inside Diameter	1.638	m
Outside Diameter	1.734	m
Core Barrel Inside Diameter	1.452	m
Core Barrel Outside Diameter	1.490	m
Core Barrel Length	2.731	m
Inlet Duct Flow Area	0.067	m^2
Outlet Duct Flow Area	0.054	m^2

Table 3: HTTF Core Dimensions.

Parameter	Value	Units
Inner Reflector Equivalent Radius	0.184	m
Inner Reflector Cross Sectional Area	0.102	m^2
Number of Coolant Channels	384	
Coolant Channel Diameter	0.0168	m
Coolant Channel Flow Area	2.21e-4	m^2
Total Coolant Channel Flow Area	0.0848	m^2
Active Core Outer Radius	0.448	m
Active Core Inner Radius	0.184	m
Active Core Height	1.98	m

Although the test facility will have a cavity cooling system that surrounds the vessel, it is not intended for this system to be designed as a scaled version of the prototypical Reactor Cavity Cooling System. Rather, the cavity cooling system at the HTTF will be used to set up and control the radiation boundary condition for heat transfer from the vessel wall.

As mentioned earlier, one of the main objectives of this program is code validation against the thermal hydraulic data acquired by the HTTF. To meet this goal, and in support of the scaling and design effort, MELCOR input models of the test facility have been developed at Texas A&M.

Developed by Sandia National Laboratories for the NRC, MELCOR 2.1 includes models for gas-cooled reactors. Researchers at Texas A&M University have been testing these models and developing input techniques for analysis of the proposed prismatic core and pebble bed core designs [2].

Due to the higher operating temperatures than experienced in light water reactors, radiative heat transfer is important in certain regions of the reactor. Two examples are the Reactor Cavity Cooling System as part of the passive cooling and the upper and lower gas plena. A method was developed to estimate appropriate view factors for the heat structures in the MELCOR input deck that represent components with significant radiation heat transfer. Similarly, other input modeling techniques are being developed and tested.

To assure that the experimental data produced by HTTF is appropriate for code validation, the TAMU analysts and OSU facility designers have been exchanging information regarding data needs. Careful consideration is being given to which data are needed to monitor and operate the facility, which data are needed to characterize the facility for analysis, which data are needed to validate the code, and, finally, which data are needed to further our understanding of gas-cooled reactor thermal hydraulics.

From the MELCOR perspective, the code is a control volume-node junction code. For each control volume, a single value for each thermodynamic property will be evaluated that is uniform throughout the volume. Therefore, instrumentation should be placed to measure values that reflect the property in the volume of MELCOR's control volume input. Of course, the spatial discretization of the facility within the MELCOR input deck may be changed to accommodate desired instrumentation locations. This is one example of the discussions between the facility designers and code validators that will assure a technically correct validation effort.

The scaling and design of the test facility is scheduled for a completion in the summer of 2010. Procurement and fabrication of the facility will commence following that and will continue through spring 2011. It is anticipated that a year of shakedown testing will follow fabrication and then a year of matrix testing to follow after that for a project completion in September of 2013.

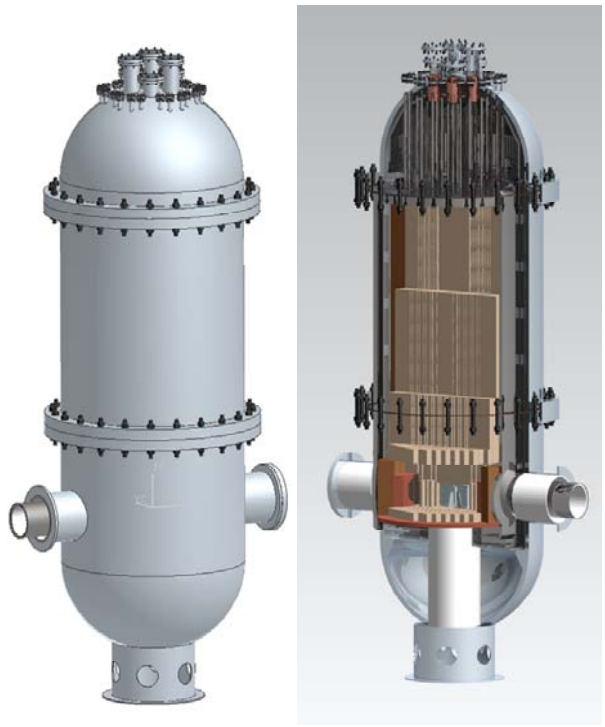

Figure 1: Oregon State HTTF.

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1. Zuber, N. (1991). "Appendix D: Hierarchical, Two-Tiered Scaling Analysis." An Integrated Structure and Scaling Methodology for Severe Accident Technical Issue Resolution (NUREG/CR-5809).

2. J. Corson, K. Vierow (2009). "Representing the 400 MW PBMR using GCR Models in MELCOR 2.1", Transactions of 2009 ANS Winter Meeting, Washington, DC.