



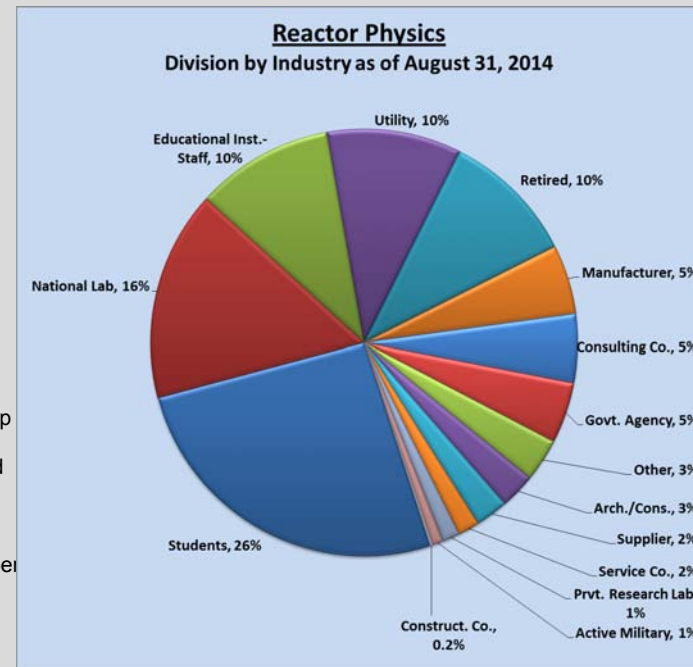
Fausto Franceschini
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Treasurer
2014-2015

Treasurer's Report

The Reactor Physics Division financial status is excellent. The support of the membership and a number of financially successful topical meetings led to a conspicuous balance which allowed us to invest \$30,000 as our 1st year contribution to the 2nd RPD endowed undergraduate scholarship.

The 2015 projected balance is \$38,566, with a \$70,750 balance carried from the current year, a \$30,000 allocation for the 2nd RPD endowed scholarship, and a projected member allocation income of \$3,816 (actual for 8 months of 2014 reported at \$3,356). A pie chart showing the makeup of the RPD membership is shown in the right.

We continue to support student conferences and student travel to national meetings annually at \$5,000, and invest \$1,000 in our website development efforts.



A Message from the Chair

By Ron Ellis
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I would like to take advantage of this opportunity to use my Message to provide an overview of the goals and activities of our Reactor Physics Division. With about 2000 members, we are one of the larger of the 22 ANS professional divisions.

The Reactor Physics Division exists as a service organization formed to serve the needs of its membership within the scope and under the leadership of the American Nuclear Society. It is not as a proactive advocacy organization for the nuclear industry. Our mission statement provides that we as a division seek to promote the advancement of theoretical, applied, and experimental research in reactor physics, and a better understanding of the fundamental physical phenomena characterizing nuclear reactors and other nuclear systems. RPD seeks a better understanding of reactor operations and in-core fuel management through the development and application of fundamental tools. The division supports the testing of tools and data in reactor experiments, and encourages the improvement in basic physical data.

One of the most visible activities of RPD is the organization and implementation of series of technical sessions at the two national ANS meetings, and support for the biennial PHYSOR meetings (RPD topical meeting on advances in reactor physics). In addition, RPD partners with other professional divisions and organizations in other topical meetings and events: for instance, the M&C topical meetings and the Advances in Nuclear Fuel Management (ANFM) (co-sponsored by FCWMD) meetings. (Elsewhere in our newsletter, information is provided about the upcoming ANFM2015 and the triple-conference (MC, M&C, and SNA)-2015 meeting). Just last month, a very successful and well-organized PHYSOR2014 meeting took place in Kyoto, Japan. (Details about PHYSOR2014 are presented elsewhere in this newsletter).

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American Nuclear Society Reactor Physics Division

November 2014
Reactor Physics Division Newsletter

Arzu Alpan, Editor

RPD website: <http://rpd.ans.org/>

These meetings with their regular and special technical sessions provide and showcase the technical content that highlights the ongoing work in our area of the nuclear energy field. A lot of effort, planning, and devotion to reactor physics is invested by the RPD program committee and many other volunteers to make these sessions successful. It is this area where RPD can use most help from our membership. We are always seeking interested and talented people to become involved with our division!

Education is of key importance in the development and involvement of the next generation of reactor physicists and nuclear engineers. Accordingly, RPD supports student participation in technical meetings, both by providing support to students attending national and topical meetings and by supporting student conference meetings with both financing and professional participation. The division annually awards a graduate scholarship (the Henry-Greebler Scholarship) to a deserving student pursuing a graduate degree in research related to Reactor Physics. RPD has recently established a second scholarship, the endowed Rudi Stamm'ler Undergraduate Scholarship. We expect to award the first of these scholarships in 2015.

RPD is working with ANS national leadership and other groups in efforts to engage college students in division activities at all levels. Activities of the RPD division are led and coordinated by the elected officers and members of the RPD Executive Committee. The Executive Committee meets twice a year at national meetings and maintains the division budget, spending and leads the various tasks. The staff of the national ANS organization plays a significant role in public education, advocacy and policy. However, while ANS drives the overall programs, they rely on the professional divisions for technical contributions. The divisions often provide subject matter experts as resources for external organizations or media relations, drawn from within the division.

Professional divisions, including RPD, are responsible for the development and affirmation of ANS National Standards. Working groups formed of volunteers from the RPD membership are formed to create the text of such standards, and to make decisions about a standard's maintenance and respond to requests for clarification or interpretation. RPD volunteers lead the ANS-19 Standards Committee "Physics of Reactor Design" which encompasses 12 standards (nine active standards, and three proposed standards) maintained by working groups. These standards, coordinated with the American National Standards Institute (ANSI), and to some extent the International Standards Organization (ISO), provide technical guidance in a broad range of reactor physics applications. It should be pointed out that the existing standards - those designated with the prefix ANSI, are generating substantial revenue for the Society. The broad and diverse extent of these standards can be seen in the list below:

ANSI/ANS-19.1	Nuclear Data Sets for Reactor Design Calculations (Revision)
ANSI/ANS-19.3	Steady State Neutronics Methods for Power Reactor Analysis
ANSI/ANS-19.3.4	Thermal Energy Deposition Rates in Reactors
ANSI/ANS-19.4	Acquisition and Documentation of Power Reactor Physics Reference Measurements for Nuclear Analysis Verification (Revision in preparation)
ANSI/ANS-19.5	Requirements for Reference Reactor Physics Measurements
ANSI/ANS-19.6.1	Reload Startup Physics Tests in PWRs (Latest Version)
ANSI/ANS-19.10	Pressure Vessel Fluence Calculations
ANSI/ANS-19.11	Moderator Temperature Coefficients in PWRs
ANSI/ANS-5.1	Decay Heat Power in Light Water Reactors (soon to be released).

RPD is also responsible for coordinating efforts in support of a number of awards that are intended to recognize the professional contributions of its membership. These include the Eugene P. Wigner Reactor Physicist Award and nomination of ANS Fellows.

There is much more that I can discuss to provide a sense of "What is RPD?" and what are the important RPD activities. For more background and current information about RPD, please visit our webpage, which is undergoing continual upgrade and improvement, at <http://rpd.ans.org>. Another relatively new outreach effort implemented by the RPD leadership team is a Facebook group (Reactor Physics Division of the American Nuclear Society); there are currently about 500 members and everyone is encouraged to join: it is a venue for discussion and news of items of interest to the reactor physics community.

I hope I have provided a little insight into the technical and governance activities for our division. I will sign-off by encouraging participation from our membership! The RPD division Executive Committee meeting will be held at the upcoming ANS 2014 National Meeting in Anaheim from 4-6 pm on the Sunday preceding the meeting (November 9) and is open to all (space permitting). The RPD Program Committee meeting, which embodies the technical essence of ANS meetings, will also be held on Sunday, from 2-4 pm. Prior to this meeting, the RPD Goals & Planning meeting will be held from 1-2 pm on the Sunday. All three meetings are conveniently held in the same meeting room. These meetings provide activities and venues in which you can see the opportunities for participation and become involved as a volunteer. The only requirement for active participation is membership in the ANS and in the RPD. Existing and especially young members are encouraged to become involved in RPD governance and technical activities and (ad)ventures!

Dr Ronald J. Ellis (ellisrj@ornl.gov)
Chair of RPD (2014-2015)
Oak Ridge National Laboratory

Program Committee News

By Alexander Stanculescu
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Outgoing and New Members

There was no outgoing member of the Technical Program Committee.

Best wishes and welcome to the new member of the Program Committee: Alberto Talamo (Argonne National Laboratory). The engagement and the expertise he is committing for his three-year tenure is key to maintaining the current high standards of the Division. The roster of the current membership is included at the end of this article.

Finally, my renewed gratitude and appreciation go to the RPD reviewers, session chairs, special session organizers and panel organizers for their enthusiasm, reliability and unwavering effort. They are the foundation of the many accomplishments achieved by our Division.

ANS 2014 Annual Meeting, Reno, Nevada

The 2014 Annual Meeting was held in Reno, Nevada (June 15 – 19, 2014). The RPD faced strong competition from the reactor physics topical meeting PHYSOR 2014 that was held 3 months later in Kyoto, Japan. This led to only 39 papers being submitted and accepted to the ANS 2014 Annual Meeting. The papers were assigned to the standing RPD session "Reactor Physics General I, II, III, IV and V" (28 papers) and to two special sessions, viz. "ANS Reactor Physics Division Session in Memory of Richard (Dick) McKnight (co-sponsored with the NCSD, 6 papers) and "Nuclear Criticality Safety and Space Technology Applications" (co-sponsored with the AAD and the ANSTD, 5 papers).

The RPD special session dedicated to the memory of Dick McKnight was one of two special sessions honoring the memory of our colleague, with the other one being a NCSD special session. Both these special sessions were co-sponsored by the two Divisions. The efforts of Blair Briggs, Michael Dunn and Luiz Leal in making these sessions happen are gratefully acknowledged.

The overall technical quality of the RPD contributions was high, and all sessions enjoyed good attendance.

The first Request for Proposal (RFP) to host the 2016 PHYSOR topical meetings was broadcasted in May 2014. At the RPD Program Committee meeting held on Sunday, June 15th, 2014 during the ANS 2014 Annual Meeting in Reno, Nevada, two interested organizations, viz. the Canadian Nuclear Society (CNS) and the ANS Idaho Section made formal presentations in support of their respective organizations' bid to host PHYSOR 2016. The presentations were given by Eleodor Nichita/Ben Rouben (University of Ontario Institute of Technology) on behalf of the CNS, and by Mark DeHart (INL) on behalf of the ANS Idaho Section. Both proposals were well received, and after a very close vote (two rounds of voting were necessary to decide a tie), PHYSOR 2016 will be held in Sun Valley, Idaho, USA in late spring 2016.

ANS 2014 Winter Meeting, Anaheim, California

The RPD has organized ten sessions at the ANS 2014 Winter Meeting: the three standard ones (Reactor Physics: General; Reactor Physics Analysis Methods; and Reactor Physics Design, Validation, and Operating Experience), four special sessions [Core Design Perspective on Accident Tolerant Fuels (organizer Massimiliano Fratoni); Advances in Fast Reactor Designs and Concepts (organizer Florent Heidet, co-sponsor FCWMD); Physics of Compact Reactors for Terrestrial and Space Applications (organizers John Bess and Blair Bromley, co-sponsor ANSTD); Physics and Engineering Analysis of Sub-Critical Driven Systems, organizers James Stubbins, Blair Briggs, Jack Law and Arnold Lumsdaine, co-sponsors FCWD, AAD, FED)], one panel [(New Nuclear Data Formats and Processing Capabilities (organizer Jeremy Lloyd, co-sponsor NCSD)], and two tutorials [Tutorial on Radiation Protection and Shielding in Aeronautics and Space Applications, organizer Blair Bromley, co-sponsors ANSTD, RPSD]; MOOSE Multi Physics Tutorial, (organizer Mark DeHart)]. Unfortunately, this latter tutorial had to be cancelled since none of the presenters was able to travel to the meeting.

The RPD sessions received 64 summaries, of which 19 were graded by the reviewers "reject unless revised". Three summaries were withdrawn during the peer review process, and two submissions were included in the panel New Nuclear Data Formats and Processing Capabilities. The 59 summaries accepted for publication in the ANS Transactions were assigned to the various sessions as follows: 3 to Core Design Perspective on Accident Tolerant Fuels, 6 to Advances in Fast Reactor Designs and Concepts, 2 to Physics of Compact Reactors for Terrestrial and Space Applications, 12 to Physics and Engineering Analysis of Sub-Critical Driven Systems, 20 to Reactor Physics: General, 11 to Reactor Physics Analysis Methods, and 5 to Reactor Physics Design, Validation, and Operating Experience.

ANS 2015 Annual Meeting, San Antonio, Texas

The ANS 2015 Annual Meeting Nuclear Energy: An Essential Part of the Solution will be held June 7th – 11th, 2015 at the Grand Hyatt in San Antonio, Texas. The deadline for summary submissions is January 9th, 2015. In addition to the three standing sessions (Reactor Physics Design, Validation, and Operating Experience; Reactor Physics Analysis Methods; and Reactor Physics: General), the RPD is organizing four special sessions [Advanced Monte Carlo Methods for Reactor Physics Analysis (Organizer Mark DeHart, co-sponsor MCD); Progress in Student Research and Design Projects (organizer Blair Bromley, co-sponsors ETWDD, ANSTD, AAD, FED); Small Modular Reactors (SMRs): Reactor Physics and Fuel Cycle (organize Florent Heidet, co-sponsor FCWMD); and LWR Fuel Reliability (organizer Moussa Mahgerefteh), and one panel (Current Issues in LWR Core Design and Reactor Engineering Support (organizers Moussa Mahgerefteh and Gianluca Longoni)]. Organizers, RPD Program Committee members, and the RPD community at large is kindly asked to spread the word and solicit high quality papers.

Participation in RPD Program Committee Activities

I would like to commend all RPD members who have supported the PHYSOR 2014 topical meeting, in particular by participating in the peer review process.

Would you like to be added to the RPD reviewer roster, please send your request to the RPD Program Committee Chairman (alexander.stanculescu@inl.gov).

Our Division can only be successful thanks to the active involvement of its members. I would like to encourage you to continue contributing to the Division's success by submitting technical papers, organizing special sessions, reviewing papers, chairing sessions, and by becoming actively engaged with both Program Committee and general RPD governance activities.

ANS Reactor Physics Division Program Committee

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Reactor Physics Standards

By Dimitros Cokinos
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Revision of ANSI/ANS-19.1, "Nuclear Data Sets for Reactor Design Calculations" is nearing completion. As its title implies, this standard provides guidance on the selection and use of nuclear data for use in reactor design codes. It is a companion to the revised standard ANSI/ANS-19.3, "Steady State Neutronics Methods for Power Reactor Analysis", which covers most major areas of reactor design. Among other useful features, this standard provides criteria for the use and handling of cross section libraries needed to carry out core design, core tracking and predictive analysis in all types of reactors from fast to thermal, light water reactors, heavy water reactors, HTGRs, LMRs as well as research reactors.

Work on the revision of ANSI/ANS-19.4, "Acquisition and Documentation of Power Reactor Physics Reference Measurements for Nuclear Analysis Verification", has started under the leadership of its new Working Group Chair, Ed Knuckles. This is an important standard as it is intended to be used as a benchmarking tool in power reactor calculations.

The latest version of ANSI/ANS-19.6.1, "Reload Startup Physics Tests in PWRs" specifies tests that are being performed prior to cycle startups to ensure that the observed core behavior matches the predictive analyses. This standard under the leadership of Working Group chair Charles Rombough, is widely used by nuclear utilities. The ANS Standards Office regularly receives questions by users on various areas of this standard. Such questions usually involve requests for clarification on the testing procedures and are being responded to through the appropriate channels by the Working Group chair.

ANSI/ANS-19.11, "Moderator Temperature Coefficient in PWRs", a standard that has been recently revised under the guidance of its past Working Group chair, Russ Mosteller, is now ready for release. The new Working Group chair, Moussa Mahgerefteh, is in the process of assembling a new team to start monitoring the use of the standard.

ANSI/ANS-5.1, "Decay Heat Power in Light Water Reactors" is a standard enjoying widespread popularity both here and abroad. Under its current Working Group chair, Ian Gauld, the revision of the standard has just been completed and is now being routed through the appropriate ANS standards committees. It is expected to be released in the near future. This standard has an expanded Foreword and provides useful information on the historical/technical aspects from its inception in the mid-1970s to the present. Helpful information is also provided in the appendices.

The next ANS-19 Reactor Physics Standards meeting will be held in Anaheim on Monday morning from 8:30 a.m. to 10:30 a.m. Please check the back of the Final Program for the meeting room.

Dimitrios Cokinos, Chair

ANS-19 Reactor Physics Standards

Honors and Awards

By Dimitrios Cokinos

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Members of the Reactor Physics community are reminded that the deadline for nominations for the "Eugene P. Wigner Reactor Physicist Award" is April 1, 2015. This award is intended to recognize reactor physicists who have made outstanding contributions to the field of reactor physics. Nominees may be of any nationality, regardless of ANS membership. The award is made on a yearly basis, whenever possible. Emeritus Professor Elmer Lewis of Northwestern University is this year's winner of the Wigner award. Dr. Lewis is scheduled to be presented with the Wigner Award at the start of the Monday Plenary during the November ANS meeting in Anaheim. The Reactor Physics Division wishes to congratulate Prof. Lewis for his outstanding achievements. Professor Lewis will deliver his "Wigner Lecture", highlights of his pioneering work that led to his selection as this year's Wigner Award recipient, at the start of the Tuesday afternoon Reactor Physics technical session.

The RPD Membership is also reminded about nominations for the ANS Fellow award. Information about both the Wigner and ANS Fellow awards can be found at the ANS Website.

Dimitrios Cokinos, Chair

RPD Honors and Awards Committee

Website

By Pavel Tsvetkov

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The Reactor Physics Division Website is being updated to bring up to date all the areas and to reflect the current division status. The website is accessible at <http://rpd.ans.org>.

The Division is maintaining its Facebook presence as "Reactor Physics Division of the American Nuclear Society". The Reactor Physics Division members are encouraged to join and participate in the group, with postings and discussion. The group is accessible at <https://www.facebook.com/groups/ReactorPhysics/>

The suggestions for member links content items are being solicited.

Meeting Summary for PHYSOR2014 ~ The Role of Reactor Physics toward a Sustainable Future ~

Westin Miyako Hotel, Kyoto, Japan September 28th to October 3rd, 2014

By Akio Yamamoto (Nagoya University, Japan)

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PHYSOR2014 Technical Program Chair

The biennial international topical meeting on reactor physics, PHYSOR, was held in Japan for the first time in 18 years. This short article provides a summary of the PHYSOR2014 meeting.

Background

The PHYSOR topical meeting is a prestigious international conference on reactor physics, launched in 1990 and held as an ANS topical meeting in every two years. This topical meeting is sponsored by the Reactor Physics Division, and is held outside of North America every six years, i.e., every third meeting. PHYSOR was held at Marseilles, France in 1990, Mito, Japan in 1996, Seoul, Korea in 2002 and Interlaken, Switzerland in 2008. The recent PHYSOR conferences in North America were at Pittsburg in 2010 and Knoxville in 2012. In 2014 the PHYSOR conference returned to Japan.

During the fall meeting of Atomic Energy Society of Japan (AESJ) in 2011, the reactor physics division of AESJ approved preparation of a proposal for hosting PHYSOR2014 in Japan, and began preparations for presentation to the RPD at an ANS National Meeting.

Each host of the PHYSOR conference is selected through a bid proposal for candidate cities (or countries for international meetings) by the members of the program and executive committees of ANS RPD. The bid for PHYSOR2014 was presented in the ANS RPD meeting at Chicago, June 2012. Presentations were made by candidate cities and Kyoto (Japan) was awarded the bid to host PHYSOR2014.

The organization committee was launched after the bid, and for approximately two years prepared to host PHYSOR2014 from September 28th to October 3rd, 2014 in Kyoto.

Outline of the conference

PHYSOR2014 was held in Westin Miyako Hotel, Kyoto, Japan and was hosted by the Japan Atomic Energy Agency (JAEA) and Kyoto University Research Reactor Institute (KURRI). The meeting had approximately 470 papers and over 500 participants during the conference. Detail on the members of organization committee, technical sessions, and breakdown of participants are shown in the appendix. The abstract book for the meeting can be downloaded from the conference web site: <http://rpg.jaea.go.jp/physor2014/>.

Note that the formal proceedings of PHYSOR2014 will be published as a JAEA-conf report from JAEA and when available may be freely downloaded from the JAEA web site. Furthermore, approximately 20 papers have been selected from the presented papers in the conference and these papers will be published as a special issue of Journal of Nuclear Science and Technology, which is a journal of AESJ, in the summer of 2015.

Operation of the conference

The most crucial concern for the success of PHYSOR2014 was the number of papers submitted to the conference. The previous PHYSOR conference outside North America, PHYSOR2008, was held at Interlaken, Switzerland, which was a very attractive place to visit, and approximately 600 papers were presented at the meeting. However, nuclear power landscape has changed drastically since PHYSOR2008. Although approximately 100 papers were pledged by the Japanese reactor physics community, the number of papers that might be expected from other countries was unpredictable. Therefore, the first priority for meeting organization was to select an inviting venue in Japan in order to make an attractive proposal for the RPD bid.

The strengths and weaknesses of several candidates, e.g., Sapporo, Tokyo, Tsukuba and Kyoto were discussed; ultimately Kyoto was selected as the venue because of its status as a well-known and historic city and its proximity to one of the host organizations, KURRI to facilitate conduct of the conference. It turns out that this was a providential selection, as Kyoto was awarded the title of "World's Best City to Visit" by Travel & Leisure magazine in 2014.

After Japan was selected as the host country, frequent announcements were made accompanied by distribution of flyers at major international conferences, ANS national meetings, and circulation of e-mails through various ANS the mailing lists. The organizing committee strived to provide not only the technical content of the conference, but also an attractive venue. Ultimately, more than 500 papers were submitted to the conference. The largest contributor was US with approximately 130 papers, followed by Japan (~80 papers), France (~60 papers), China (~50 papers), Korea (~30 papers), along with contributions for numerous other countries. The large number of contributions from reactor physicists from all over the world were greatly appreciated. It is felt that the attractiveness of Kyoto greatly stimulated submission of papers, especially those from across the seas. However, there was some concern about weather conditions, since the beginning of October is usually the beginning of typhoon season. Fortunately, excellent weather was experienced during the conference.

The conference was smoothly conducted from start to finish, thanks to significant support from the technical program co-chairs, the workshop organizers, the session co-chairs and attendees as well as members of the local organizing committee, students assistance and the outstanding efforts of the hotel staffs. The PHYSOR2014 team sincerely appreciates everyone's efforts in making the conference a success.

Significance of the conference for Japan

The significance of the PHYSOR conference to the worldwide reactor physics community is unmistakable. However, the impact of PHYSOR2014 for Japan should be noted. With the drastically changing situations within the nuclear power industry after the accident at Fukushima-Daiichi, the successful hosting of PHYSOR2014 in Japan, with the full-scale support of the Japanese reactor physics community, has significant implications. It is believed that Japan's first-hand experiences, accomplishments, future plans for both site recovery and the nuclear industry as a whole, along with social perspective, after the Fukushima Daiichi accident would significantly contribute to promoting an understanding of the significance of this event and its aftermath for attendees from foreign countries. At the same time, Japanese researchers made many contacts and held technical discussions with researchers from all over the world during the conference, thus enhancing global communications and interactions.

This is especially important for younger generations, from whom much will be expected in the future.

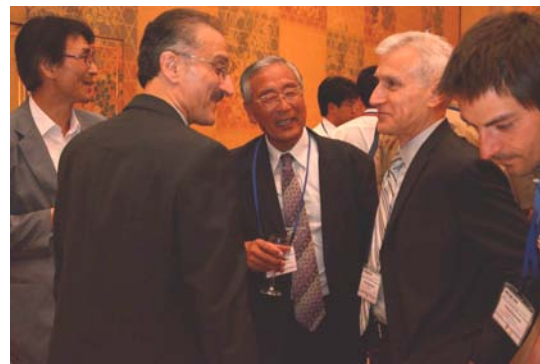
Successful completion of a large international conference such as PHYSOR is rare experience. We believe our experience with PHYSOR2014 will be an invaluable experience from the viewpoint of technical traditions for younger generations. I myself, as the technical program chair, really enjoyed the enterprise of undertaking and technically executing PHYSOR2014.

Acknowledgements

PHYSOR2014 could not have been held without the support and cooperation of many organizations and individuals. On behalf of the organization committee of PHYSOR2014, I would like to again express our sincere appreciation for the support of ANS RPD, the co-sponsoring societies of many countries, financial sponsors, paper contributors, attendees of the conference, and especially the efforts of the staff engaged in the logistics of PHYSOR2014.



Entrance sign of the conference



Honorary Chair Prof. Takeda and his friends



Key note address by ANS President, Dr. Raap



Atmosphere of a workshop



Atmosphere of a technical session



In banquet: General Chairs Prof. Nakajima, Dr. Okajima, and ANS RPD Chair Dr. Ellis (from left to right). Dr. Ellis is being bitten by "Shishi"

"Shishi" is a legendary Lion. If one is bitten by "Shishi", he/she will get healthy and long life.

PHYSOR 2016 Announcement

The Physics of Reactors (PHYSOR) conferences, held every two years, represent a series of international forums organized and sponsored to bring together worldwide expertise related to reactor physics, nuclear reactor research and analysis and related topical areas. The next PHYSOR meeting will be hosted by the Idaho Section of the ANS, and held at Sun Valley, Idaho, May 1-5, 2016.

PHYSOR 2016: Unifying Theory and Experiments in the 21st Century, will be a venue focused on both modeling/simulation & experimental aspects of reactor physics and exploration of common aspects & requirements of the two focus areas. The meeting will also include plenary discussions, technical tours, workshops, and sessions in other topics relevant to the physics of nuclear reactor

In keeping with the concept of unifying theory and experiments, PHYSOR 2016 will feature technical topic areas of Experimentation and Measurements, Modeling and Simulation, and General Reactor Physics. Four workshops are planned prior to the meeting, along with tours to the Idaho Accelerator Center in Pocatello and of facilities at Idaho National Laboratory.

The General Chair for the meeting is Finis Southworth of AREVA. The Technical Program Chairs are Mark DeHart (Idaho National Laboratory), Todd Palmer (Oregon State University) and Kent Welter (NuScale Power). The formal Call for Papers will come out in March 2015, with submission of extended summaries due by July 2015, and full papers due by January 2016. The conference website will go online in early 2015 at www.physor2016.org



M&C+ SNA + MC 2015

Joint International Conference on Mathematics and Computation (M&C), Supercomputing in Nuclear Applications (SNA) and the Monte Carlo (MC) Method

<http://mc2015.org>

The Oak Ridge/Knoxville Section of the American Nuclear Society (ANS) will host and sponsor the FIRST combined Mathematics and Computations (M&C) ANS topical, with Supercomputing in Nuclear Applications (SNA) and Monte Carlo (MC) 2015. The joint international conference will be held at the Sheraton Music City in Nashville, Tennessee during the week of April 19-23, 2015. M&C is the latest in the series organized by the Mathematics and Computation Division of the American Nuclear Society. Prior to 2010, SNA and MC existed as separate conferences. In 2010, SNA and MC combined and held SNA+MC 2010 in Tokyo, Japan. This was followed by SNA+MC 2013 held in Paris, France.

The technical program will consist of plenary sessions, parallel oral presentation sessions, and poster sessions. There will also be several workshops, special sessions, and roundtable discussions requested and organized by participants.

Scope of the conference

The joint conference will provide an international review of the status and trends of research and applications in the field of numerical simulation and physical modeling for classical and advanced nuclear concepts, including the role and benefits of high-performance computing.

Particular emphasis will be placed on deterministic and Monte Carlo methods and their applications.

The main topics will be:

- Computational Methods Using High-Performance Computers
- Computational Reactor Physics and Particle Transport, Computational Thermal-hydraulics
- Computational Materials Sciences, Computational Plasma Physics/Fusion, Nuclear Reactor Analysis
- Radiation Physics, Particle Accelerator Physics, Computational Science, Deterministic and Monte Carlo Methods.
- Mathematical Methods in Safeguards and Nonproliferation.

The conference will also include workshops of interest to the community and exhibits by corporate sponsors.

Co-sponsors of the conference include Oak Ridge National Laboratory (ORNL) Radiation Safety Information Computational Center (RSICC), the Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency (NEA) and the Japan Atomic Energy Society (JAES).

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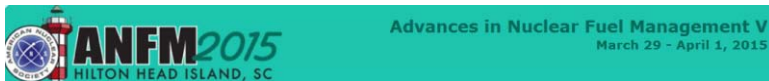
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Advances in Nuclear Fuel Management V

The American Nuclear Society's ANFM2015 meeting will be held on Hilton Head Island, South Carolina, March 29 – April 1, 2015. The meeting is a forum for addressing a broad spectrum of front-end nuclear fuel management activities, within the context of reactor physics and fuel cycle economics. Topics will range from methods development and verification to design and implementation of new in-core fuel products and strategies.

For up-to-date information about this conference, visit their website at <http://anfm2015.org>.

Resumption of Transient Testing at the INL Transient Reactor Test Facility

By Mark DeHart

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Reactor Physics Modeling & Simulation Lead, Idaho National Laboratory

The U.S. Department of Energy is preparing to restart the Transient Reactor Experiment And Test Facility at Idaho National Laboratory (INL), more commonly known as TREAT. The pulsed reactor, built in 1959, has not operated since 1994. It is expected that the facility will become operational no later than 2018. Resumption of operations at the TREAT facility was approved in February 2014 for meeting the U.S. Department of Energy Office of Nuclear Energy's objectives in transient testing of nuclear fuels.

Completed in November 1958 and operated from 1959 to 1994, TREAT is an air-cooled reactor test facility. TREAT was designed for transient testing of fuels and structural materials. For much of its history, TREAT was used primarily to test liquid-metal reactor fuel elements, initially for the Experimental Breeder Reactor-II, then for the Fast Flux Test Facility, the Clinch River Breeder Reactor Plant, the British Prototype Fast Reactor, and finally, for the Integral Fast Reactor. Both oxide and metal elements were tested in dry capsules and in flowing sodium loops.



Principal reactor-safety and fuel-behavior issues addressed in TREAT experiment programs have included studies of fuel cladding interactions; the timing and extent of axial fuel relocation within a pin prior to pin failure; cladding failure thresholds, margins, and characteristics; in-channel fuel motions and accumulations following fuel failure; timing and composition of coolant channel blockages; and energetics of molten fuel-coolant interactions. These issues tend to arise from changes in parameters such as fuel design, fuel composition, fuel irradiation characteristics, or transient initiators. Similar tests will be needed to develop the understanding of and qualification of future transuranic-bearing fuels.

TREAT was designed with the capability to subject nuclear fuel to extreme operating conditions in order to study the effects. The TREAT reactor has the capability to expose 36-inch sections of light water reactor (LWR) fuel and full-length fast reactor elements, as well as assemblies and structural materials, to conditions simulating various types of severe nuclear and thermal transient situations, including fuel meltdowns, metal-water reactions, thermal interactions between overheated fuel and coolant, and transient behavior of fuel materials for high-temperature systems.

In addition to supporting extended operation of existing LWRs, TREAT could support licensing of new, advanced LWRs over the next 20 years. While other reactors are capable of transient testing on smaller fuel samples – e.g., the Nuclear Safety Research Reactor in Japan (NSRR) – TREAT is the only reactor capable of fully supporting the range of anticipated transient testing over the next 20 years.

TREAT was placed in standby in 1994, shortly after the plant had been extensively renewed and upgraded. Preventative maintenance on most of the systems has continued over the years while the facility was in standby. No major modifications have been identified as necessary for the restart of the facility. The resumption of operations is currently under way, with the formation of the startup team nearing completion. A move from storage to inspection of an unfueled (moderator only) TREAT element was recently successfully completed, and the restart of the Automatic Reactor Control System is well under way with a successful restart of all major nodes of the system.

In addition, before full power transient tests can be performed, the safety margins of a given experiment must be evaluated. In the past, this was achieved by neutronic assessments using low-order approximate methods that required a number of reduced and full power tests to obtain calibration factors to improve the prediction of the full power transient. These calibration tests were time consuming and expensive. In order to improve the efficiency of the numerous and varied experiments planned for the restarted TREAT facility, the number of calibration tests must be decreased. Additionally, for advanced fuel development, improved understanding of transient fuel behavior during TREAT experiments will result in strategic experimental design, reduced number of TREAT experiments and, ultimately, optimization of advanced fuel performance. Hence, high-resolution deterministic solutions of neutron transport are necessary to represent governing interactions between experiment, neutron filters and the TREAT driver core and to resolve intra-experiment thermo-mechanical phenomena. Preliminary efforts are underway to develop such broad multi-physics capabilities at INL and to validate these methods with pre-shutdown data. Collaboration with a number of universities (University of Florida, Massachusetts Institute of Technology, Texas A&M University, Oregon State University, North Carolina State University, and University of New Mexico) has been initiated directly with INL. In addition, the DOE Nuclear Energy University Program is currently soliciting research proposals that will support INL modeling and simulation, restart, and experiment design efforts.

Update on CASL Reactor Modeling

By CASL Team/Leadership: Doug Kothe (kothe@ornl.gov), Paul Turinsky, Fausto Franceschini, Jess Gehin, Andrew Godfrey, Scott Palmtag

In 2010, the Consortium for Advanced Simulation of Light Water Reactors (CASL) Department of Energy (DOE) Energy Innovation Hub formed a team to develop, apply, and deploy advanced modeling and simulation (M&S) technologies to address light water reactor (LWR) operational and safety performance-defining phenomena. CASL's vision is to predict, with confidence, the performance of commercial nuclear power reactors to achieve enhancements that are applied broadly by the US nuclear energy industry. CASL's strategy is to couple higher-fidelity tools with integrated science-based methods, implemented via the Virtual Environment for Reactor Applications (VERA). CASL-developed and applied models and methods are expected to accelerate advances in the development of nuclear energy. CASL has recently completed its fourth year as DOE's first Energy Innovation Hub and has submitted an application for a second five years (Phase 2, 2015–2019) to support research, development, and deployment.

While the CASL partnership continues to grow and in its nuclear industry outreach expand, the consortium remains grounded by its Founding Partners of DOE national laboratories (ORNL, INL, LANL, SNL), universities (NCSU, MIT, Univ. of Michigan) and industry (EPRI, TVA, and Westinghouse). CASL continues to make progress in the development of reactor simulation capabilities, with activities over the past year including further development of VERA neutronics, fuel performance, thermal-hydraulics and chemistry capabilities [This includes development of a new advanced core simulator technology (VERA-CS) centered on a state-of-the-art pin-resolved neutronics capability (MPACT) developed by the University of Michigan and ORNL and applications to modeling Watts Bar Nuclear Unit 1 (WBN1) Cycle 1 and the AP1000® startup physics testing. A summary of these capabilities and recent activities is provided below, with additional details available, e.g., in recent papers presented at the 2014 PHYSOR conference cited in the references.

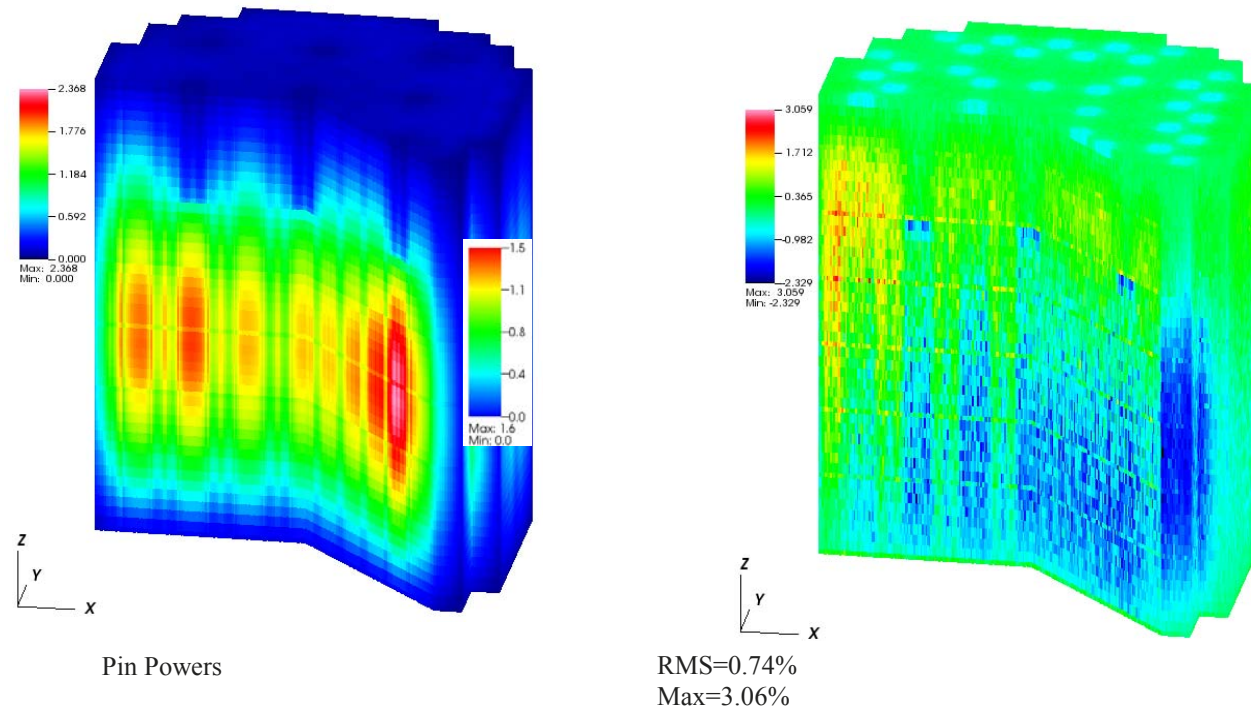
Comparisons with Watts Bar Unit 1 Measurements

In the original (2010) DOE Hub proposal submitted by the CASL Founding Partners to the DOE Office of Nuclear Energy (NE), WBN1 was selected as the CASL "Physical Reactor" and a series of core physics progression problems were created to serve as a guide in developing capabilities. The progression benchmarks start with single pin cell models to progressively move up to include measured plant data all the way from hot zero power (HZP) conditions at the beginning of Cycle 1 to multicycle depletions [1]. Recent achievements include benchmark comparisons with the WBN1 zero power physics tests, addition of coupled neutronics and thermal-hydraulics to enable modeling hot full power conditions[2,3,4], and depletion of WBN1 Cycle 1.

An example of the comparison of the prediction of the WBN1 critical configurations, and comparison of the power distribution between MPACT and continuous energy KENO for the initial critical condition, is given below:

Watts Bar 1 Cycle 1 Criticality Predictions for Several Rodded Configurations

Configuration	Bank D Position	k-eff KENO-VI	k-eff MPACT
Initial	167	0.99933	0.99856
All Rods Out	230	0.99975	0.99902
Bank A In	97	0.99823	0.99726
Bank B In	113	0.99879	0.99773
Bank C In	119	0.99847	0.99746
Bank D In	18	0.99852	0.99766
Bank SA In	69	0.99845	0.99734
Bank SB In	134	0.99876	0.99778
Bank SC In	71	0.99841	0.99738
Bank SD In	71	0.99841	0.99734
Average		0.99871	0.99775



Watts Bar 1 Cycle 1 Criticality Power Distribution (left) and Comparison with CE KENO-VI (right in percent different)

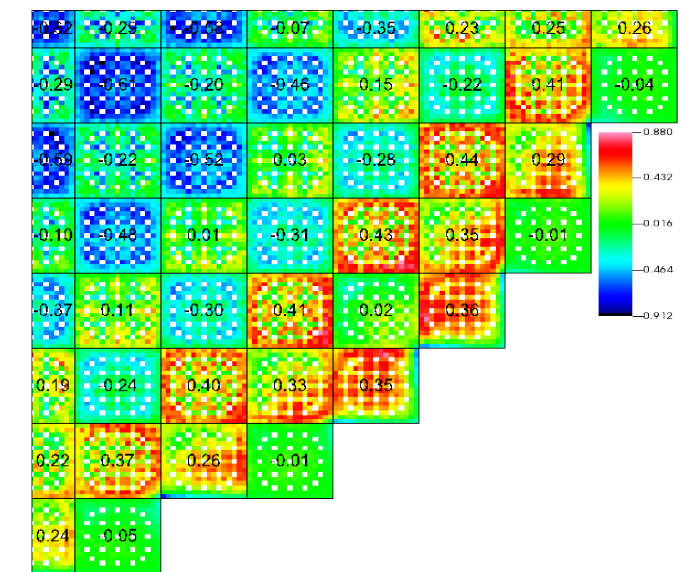
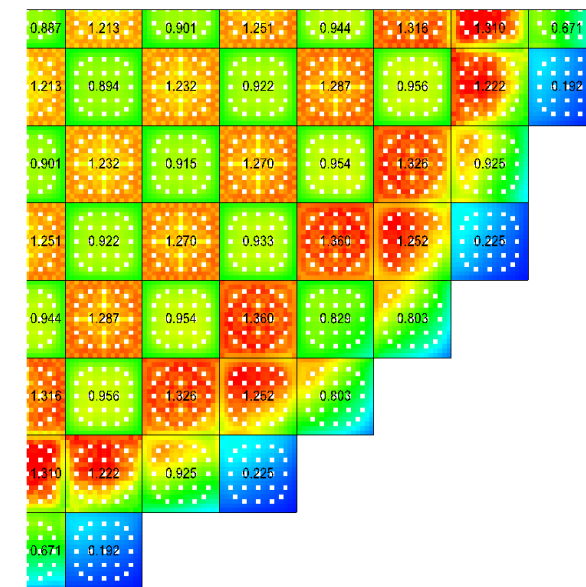
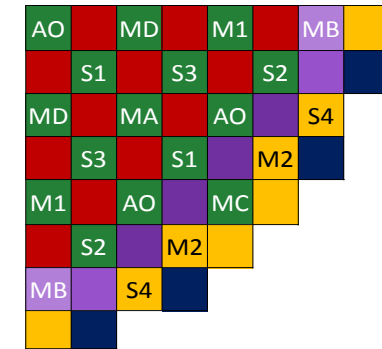
On-going benchmarking against WBN1 Cycle 1 is being performed and will be presented at the Advances in Nuclear Fuel Management V (ANFM-V) Conference in Hilton Head, SC March 29 – April 1 2015 and the M&C Joint International Conference in Nashville, TN, April 19-23, 2015.

Simulation of Westinghouse AP1000®

Westinghouse, a CASL Founding Partner, has also applied VERA-CS to the simulation of the zero power physics tests for the advanced first core of the AP1000®, in anticipation of the first AP1000 unit startup, and compared results to detailed Monte Carlo analyses performed with continuous energy KENO-VI calculations from the ORNL SCALE package [5, 6]. Excellent agreement was obtained for this challenging advanced core design that includes enrichment zoning, part-length burnable poison inserts, and insertion of multiple control rod banks during at-power operation as part of the MSHIM™ operational strategy. As an example of the results, the table below shows the rod worth comparison for each of the eleven AP1000 PWR control rod banks, including standard Ag-In-Cd banks and lighter Tungsten (“gray”) banks used for the MSHIM operation. A comparison of 2D core power distribution between VERA and KENO is given further down, indicating the Root Mean Square of the delta power for VERA-KENO is 0.4%, with a maximum delta power of less than 1% for all pins of the core. Power distribution analysis employing 3D core simulations with multiple control rod banks insertion has also been performed.

AP1000 PWR Control Bank Worth prediction from KENO and comparison with VERA results. Control bank locations shown in the quarter core map on the right

Rod Bank	Material	Keno VERA (MPACT)		
		Worth (pcm)	ΔWorth (pcm)	ΔWorth (%)
MA	Tungsten	258	3	1.0
MB	Tungsten	217	-1	-0.7
MC	Tungsten	188	4	2.4
MD	Tungsten	234	3	1.3
M1	Ag-In-Cd	651	0	0.1
M2	Ag-In-Cd	887	19	2.1
AO	Ag-In-Cd	1635	23	1.4
S1	Ag-In-Cd	1079	8	0.7
S2	Ag-In-Cd	1096	9	0.8
S3	Ag-In-Cd	1124	6	0.6
S4	Ag-In-Cd	580	8	1.3
	RMS		10	1.3
	Max		23	2.4



KENO pin power distribution for a 2D radial slice of the AP1000 core (left map) and % delta power VERA-KENO (right map)

Other CASL Developments and Future Activities

CASL is approaching the conclusion of its first five-year award and has submitted a renewal application to DOE for a five-year extension. The second five years (Phase 2) for CASL will include a deeper focus on the current CASL challenge problems (i.e. PCI, CIPS, CILC, GTRF, DNB, LOCA and RIA) and will add additional scope for LWR-based small modular reactors and boiling water reactors.

At the end of Phase 2 (2019), CASL will have developed, assessed, applied, and broadly deployed a comprehensive collection of M&S technologies—in one integrated virtual environment for reactor applications (VERA)—capable of addressing many current and emerging challenges and opportunities for the nuclear industry. With more detailed analyses now possible due to advances in HPC, science-based M&S models will support enhanced understanding for improved designs and materials. Proactive extensions of VERA to PWRs, BWRs, and iPWRs will have been realized and deployments to nuclear vendors and utilities as well as the M&S and HPC communities will have taken place. Through these applications and deployments, the CASL technology will demonstrate its capability to improve the cost-effectiveness of nuclear energy generation via design efficiencies and enhanced engineering creativity.

CASL will continue to present results at upcoming ANS conferences and is planning to hold a two-part workshop on VERA at the ANS sponsored ANFM-V topical meeting. Please refer to the topical meeting registration information for more details. Additional information on CASL, including a collection of CASL technical documents can be found at <http://www.casl.gov>.


- [1] A. Godfrey, VERA Core Physics Benchmark Progression Problem Specifications, CASL Technical Report: CASL-U-2012-0131-004, Revision 4, August 2014. (available at <http://www.casl.gov/TechnicalReports.shtml>)
- [2] J. C. Gehin, A.T. Godfrey, T. M. Evans, S. P. Hamilton, F. Franceschini, "Watts Bar Unit 1 Cycle 1 Zero Power Physics Tests Analysis with VERA-CS," *PHYSOR 2014 - The Role of Reactor Physics Toward a Sustainable Future*, American Nuclear Society, Kyoto, September 28 – October 3, 2014, on CD-ROM (2014).
- [3] A.T. Godfrey, J. C. Gehin, K. B. Bekar, C. Celik, "Simulation of Watts Bar Initial Startup Tests with Continuous Energy Monte Carlo Methods," *PHYSOR 2014 - The Role of Reactor Physics Toward a Sustainable Future*, American Nuclear Society, Kyoto, September 28 – October 3, 2014, on CD-ROM (2014).
- [4] Scott Palmtag, et al., "Coupled Neutronics and Thermal-Hydraulic Solutions of a Full-Core PWR Using VERA-CS," *PHYSOR 2014 - The Role of Reactor Physics Toward a Sustainable Future*, American Nuclear Society, Kyoto, September 28 – October 3, 2014, on CD-ROM (2014).
- [5] F. Franceschini, et. al., "AP1000 PWR Reactor Physics Analysis with VERA-CS and KENO-VI – Part I: Zero Power Physics Tests," *PHYSOR 2014 - The Role of Reactor Physics Toward a Sustainable Future*, American Nuclear Society, Kyoto, September 28 – October 3, 2014, on CD-ROM (2014).
- [6] F. Franceschini, et al., "AP1000 PWR Reactor Physics Analysis with VERA-CS and KENO-VI – Part II: Power Distribution", *PHYSOR 2014 - The Role of Reactor Physics Toward a Sustainable Future*, American Nuclear Society, Kyoto, September 28 – October 3, 2014, on CD-ROM (2014).

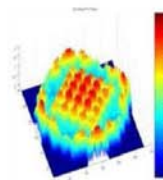
Pictures from the 2014 ANS Annual Meeting



Happy 60th Birthday!

American Nuclear Society





from the

Reactor Physics Division

