The modular HTR is advancing towards reality
The Institute of Nuclear and New Energy Technology (INET) of Tsinghua University was founded in 1960 as a top nuclear research and experimental base in China. After near fifty years, it has developed into a comprehensive research center with multidisciplinary research, design and engineering projects mainly on nuclear technology. In 2003, a new department within INET has been established to promote researches on new energy formats such as hydrogen, solar energy, fuel cells and biomass.

Three nuclear reactors have been built to facilitate the researches at INET since it was founded. The first reactor is a twin-core experimental shielding reactor. The second is a 5MW nuclear heating reactor (NHR-5), on which many experiments have been performed, including heat-electricity cogeneration, air-conditioning and seawater desalination. The most recently built reactor is the HTR-10, the only operating reactor of the kind in the world. This modular high temperature gas-cooled reactor (HTGR), with 10MW thermal output, serves as a research base to test and develop the nuclear fuel elements, verify modular HTGR safety features, demonstrate cogeneration of electricity and heat, and provide experience in modular HTGR design, construction and operation. At present, projects involving technological development of a closed helium turbine cycle of the HTR-10 and the construction of an industrial scale modular HTGR nuclear power plant are underway.

INET has two sites on and off the main campus of Tsinghua University. The main site, with a total area of around 750,000 m², is in the northern suburb of Beijing, about 50km away from the campus. INET has about 500 faculty members, over 200 graduate students. They work and study in 17 research divisions and other support centers/offices. The graduate education offered by INET covers both master’s and doctoral programs in Engineering.

www.inet.tsinghua.edu.cn
Welcome to the
HTR2014
7th International Topical Meeting on High Temperature Reactor Technology

On behalf of the organizing committees, I would like to extend my warmest welcome to all the participants to the 7th International Topical Meeting on High Temperature Reactor Technology (HTR2014) that will be held from October 27th to 31st 2014 in Weihai, China.

HTR2014 aims at providing an international platform for researchers, engineers and industrial professionals to share their innovative ideas, valuable experience and recent progresses on high temperature gas-cooled reactor (HTR) and its application technologies.

We have fortunately been able to invite many renowned speakers in keynote/plenary sessions, and receive more than 200 full papers for eight technical tracks. We firmly believe that your participation will contribute a great deal to the success of HTR2014, and to the development of HTR technologies worldwide.

Also, I would like to express my sincere acknowledgement to our co-organizers and sponsors, who have provided very important support to this conference.

Dear friends, I hope this conference, together with the technical tour to the HTR-PM construction site and beautiful conference venue, will leave a pleasant and memorable experience to all of you.

Prof. Dr. ZHANG Zuoyi
Chair, HTR2014 International Organizing Committee
Director of Institute of Nuclear and New Energy Technology (INET)
Tsinghua University
HTR 2014
Organizing Committee
Member List

International Organizing Committee

Chair: ZHANG Zuoyi (INET, CN)
Co-chair: Michael A. FUETTERER (JRC, EU)
Members: SUN Yuliang (INET, CN)
Jan-Leen KLOOSTERMAN (TU Delft, NL)
Josef KRALOVEC (NRI-Res, CZ)
Afaque SHAMS (NRG, NL)
Takis MANOLATOS (European Commission)
Ludwik PIENKOWSKI (AGH Krakow, PL)
Franck CARRE (CEA, FR)
N. G. KODOCHGOV (OKBM, RU)
Dominique HITTNER (AREVA NP, FR)
B. M. TYOBEKA (NNR, RSA)
Antonio HURTADO (TU Dresden, DE)
Yong Wan KIM (KAERI, KR)
Frederik REITSMA (IAEA)
Yassin HASSAN (Texas A&M U., USA)
Yasumasa FUJII (U. Tokyo, JP)
Layla SANDELL (Westinghouse, USA)
Ryutarou HINO (JAEA, JP)
Arka S. SHENOY (GA, USA)
Shigeaki NAKAGAWA (JAEA, JP)
Carl SINK (DOE, USA)
Masuro OGAWA (JAEA, JP)
Finis SOUTHWORTH (AREVA NP, USA)
Tetsuaki TAKEDA (U. Yamanashi, JP)

Local Organizing Committee

Chair: SUN Yuliang (INET, CN)
Co-chair: DONG Yujie (INET, CN)
Members: BO Hanliang
CHAI Guohan
HUANG Xiaoqin
LI Guanxing
LIU Enqiang
LU Daogang
MA Wenjun
SHI Jianfei
TANG Bo
WANG Guohong
WU Xinxin
XU Kaixiang
ZHONG Chengkun

Technical Program Committee

Chair: LI Fu (INET, CN)
Co-chair: SHI Lei (INET, CN)
Members: CHANG Xiuxiong
DENG Lintao
HE Lingbo
HUANG Jianchi
LIU Bing
LV Huaquan
SHI Jianfei
SUN Yongbin
TANG Weibao
XU Yuanhui
YANG Di
ZHANG Zhiyi

CHEN Xiaojian
HE Yunseng
JIANG Guojie
LI Songbai
LI Zhiying
MA Shaoqin
QI Renrong
SHI Lei
WANG Dianxiang
WANG Xiaohui
WU Yulong
YOU Zheng

CEN Song
HE Yunseng
JIANG Guojie
LI Songbai
LI Zhiying
MA Shaoqin
QI Renrong
SHI Lei
WANG Dianxiang
WANG Xiaohui
WU Yulong
YOU Zheng
Track Leaders/Co-leaders

Track 1: National Research Programs and Industrial Projects
   Carl SINK (DOE, USA)
   WANG Haitao (INET, CN)

Track 2: Industrial Applications and Markets
   Won Jae LEE (KAERI, KR)
   ZHANG Ping (INET, CN)

Track 3: Fuel and Waste
   David A PETTI (INL, USA)
   LIU Bing (INET, CN)

Track 4: Materials and Components
   Manuel A. POUCHON (PSI, CH)
   ZHANG Zhengming (INET, CN)

Track 5: Reactor Physics Analysis
   J.L. KLOOSTERMAN (TU Delft, NL)
   ZHOU Zhiwei (INET, CN)

Track 6: Thermal-hydraulics and Coupled Code Analyses
   Yassin HASSAN (Texas A&M U., USA)
   SHI Lei (INET, CN)

Track 7: Development, Design and Engineering
   Kazuhiko KUNITOMI (JAEA, JP)
   WU Xinxin (INET, CN)

Track 8: Safety and Licensing
   Hans-Josef ALLELEIN (RWTH-Aachen, DE)
   CHAI Guohan (NRSC, CN)
## Overall Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Date</th>
<th>10/27/2014 (Mon)</th>
<th>10/28/2014 (Tue)</th>
<th>10/29/2014 (Wed)</th>
<th>10/30/2014 (Thu)</th>
<th>10/31/2014 (Fri)</th>
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<td><strong>Time</strong></td>
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<tr>
<td>08:30-12:30</td>
<td>10/27/2014</td>
<td>Conference Hall :</td>
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<td></td>
<td>• Plenary Session 1 - part I</td>
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<td>13:30-15:00</td>
<td>10/28/2014</td>
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<td>15:15-16:45</td>
<td>10/30/2014</td>
<td>Room 1 : Track 6-5</td>
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<td>Room 2 : Track 7-5</td>
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<td>Room 3 : Track 2-3</td>
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<td>16:45-17:00</td>
<td>10/31/2014</td>
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<td><strong>REMARKS</strong></td>
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<td>Room 1: Huang Hai Room</td>
<td>Room 2: Rong Tai Room</td>
<td>Room 3: Ming Zheng Room</td>
<td>Room 4: Rong Chang Room</td>
<td>Room 5: De Zheng Room</td>
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</tbody>
</table>

**REMARKS:** Room1: Huang Hai Room  
Room2: Rong Tai Room  
Room3: Ming Zheng Room  
Room4: Rong Chang Room  
Room5: De Zheng Room

### Technical Tour HTR-PM

- **Date:** 10/29/2014 (Wed)  
- **Time:** 13:30-16:30  
- **Room:** Room 5: De Zheng Room  

**REMARKS:** Room1: Huang Hai Room  
Room2: Rong Tai Room  
Room3: Ming Zheng Room  
Room4: Rong Chang Room  
Room5: De Zheng Room
HTR2014 Conference Keynote/Plenary Sessions

October 27, Monday

<table>
<thead>
<tr>
<th>Contents</th>
<th>Time</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>14:00-18:00</td>
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<td>Reception</td>
<td>18:00-20:00</td>
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### October 28, Tuesday

<table>
<thead>
<tr>
<th>Contents</th>
<th>Session Chairs</th>
<th>Time</th>
<th>Participants/Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Session</td>
<td>SUN Yuliang</td>
<td>08:30-09:30</td>
<td>ZHANG Zuoyi</td>
<td>Welcome Address</td>
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<tr>
<td>Keynote Address</td>
<td>SUN Yuliang</td>
<td>09:30-10:00</td>
<td>WANG Dazhong</td>
<td>HTR Development in China</td>
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<td>10:00-10:30</td>
<td>J.K. Park</td>
<td>IAEA's Perspectives on Global Nuclear Power</td>
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<td>Break</td>
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<td>10:30-10:50</td>
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<tr>
<td>Plenary Session 1: National &amp; International Status &amp; Progress</td>
<td>Tom O'Connor, Frederik Reitsma</td>
<td>10:50-11:05</td>
<td>ZHANG Zuoyi</td>
<td>HTR-PM Project Progress</td>
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<td>11:05-11:20</td>
<td>Tom O'Connor</td>
<td>The United States Advanced Reactor Technologies Research and Development Program</td>
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<td>11:20-11:35</td>
<td>N.N. Ponomarev-Stepnay</td>
<td>High-Temperature Gas-Cooled Reactors in Russia: Status and Prospects</td>
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<td>Panel Discussion</td>
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<td>Technical Sessions</td>
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<td>13:30-18:30</td>
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<tr>
<td>Banquet</td>
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<td>19:00-20:30</td>
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</table>

### October 29, Wednesday

<table>
<thead>
<tr>
<th>Contents</th>
<th>Session Chairs</th>
<th>Time</th>
<th>Participants/Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plenary Session 1: National &amp; International Status &amp; Progress</td>
<td>Tom O'Connor, Frederik Reitsma</td>
<td>08:30-08:45</td>
<td>Finis Southworth, Vincent Chauvet</td>
<td>The GEMINI Initiative</td>
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<td>08:45-09:00</td>
<td>Kunitomi Kazuhiro</td>
<td>Present Status of HTTR Project in JAEA</td>
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<td>09:00-09:15</td>
<td>Yong Wan KIM</td>
<td>Nuclear Hydrogen and VHTR Technology Development in Korea</td>
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<td>09:15-09:30</td>
<td>Carl Sink</td>
<td>Generation IV Reactors: Continued Progress toward the Future</td>
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<tr>
<td>Panel Discussion</td>
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<td>09:30-09:50</td>
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<tr>
<td>Break</td>
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<td>09:50-10:10</td>
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<tr>
<td>Plenary Session 2: Safety, Licensing &amp; Technology</td>
<td>H.-J. Allelein, Kunitomi Kazuhiro</td>
<td>10:00-10:25</td>
<td>H. Larry Brey</td>
<td>Initial Start-up and Testing of the Fort St. Vrain HTGR - Lessons Learned which may be Useful to the HTR-PM</td>
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<td>10:25-10:40</td>
<td>Frederik Reitsma</td>
<td>Post Fukushima Action – A Perspective from the IAEA</td>
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<td>10:40-10:55</td>
<td>ZHU Lixin</td>
<td>Guideline for HTR-PM Safety Review</td>
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<td>11:10-11:25</td>
<td>LI Fu</td>
<td>HTR-PM Safety Requirement and Licensing Experience</td>
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<tr>
<td>Panel Discussion</td>
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<td>11:40-12:10</td>
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<td>Technical Sessions</td>
<td></td>
<td>13:30-18:30</td>
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### October 30, Thursday

<table>
<thead>
<tr>
<th>Contents</th>
<th>Session Chairs</th>
<th>Time</th>
<th>Participants/Speaker</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>Plenary Session 3: Equipment, Supply &amp; Project Implementation</td>
<td>WU Yulong, DONG Yujie</td>
<td>08:30-08:45</td>
<td>GONG Bing</td>
<td>Introduction to Progress of HTR-PM Demonstration Project</td>
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<td>08:45-09:00</td>
<td>WU Yulong</td>
<td>EPC Experiences of HTR-PM Project</td>
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<td>09:00-09:15</td>
<td>DONG Yujie</td>
<td>Technologies of HTR-PM</td>
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<td>09:15-09:30</td>
<td>ZHANG Jie</td>
<td>The Progress of HTR-PM Fuel Plant</td>
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<td>Break</td>
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<td>09:30-09:50</td>
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<tr>
<td>Plenary Session 3: Equipment, Supply &amp; Project Implementation</td>
<td>WU Yulong, DONG Yujie</td>
<td>09:50-10:05</td>
<td>WU Xincin</td>
<td>The Design and Research of HTR-PM Steam Generator</td>
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<td>10:05-10:20</td>
<td>ZHU Genfu</td>
<td>HTR, the New Challenge and Improvement for Equipment Manufacturers</td>
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<td>10:35-10:50</td>
<td>WANG Junsan</td>
<td>The Technical Solution of Full Scope Training Simulator of HTR-PM</td>
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<tr>
<td>Panel Discussion</td>
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<td>10:50-11:20</td>
<td>All</td>
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<td>13:30-18:30</td>
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<td>HTR International Organizing Committee Meeting</td>
<td>Micheal A. Fueterer</td>
<td>20:00-21:00</td>
<td>HTR International Organizing Committee</td>
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### October 31, Friday

<table>
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<tr>
<th>Contents</th>
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<th>Time</th>
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<th>Topic</th>
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<tr>
<td>Plenary Session 4: Application &amp; Market</td>
<td>N.G. Kodochigov, Yong Wan KIM</td>
<td>08:30-08:45</td>
<td>Karl Verformaren</td>
<td>Nuclear Cogeneration for Industrial Applications</td>
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<td>08:45-09:00</td>
<td>CUI Shaozhang</td>
<td>Advancing the Commercialization of HTR: The Potential Applications, Market and Challenges</td>
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<td>09:00-09:15</td>
<td>N.G. Kodochigov</td>
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<td>09:15-09:30</td>
<td>ZU Bin</td>
<td>HTR Technology Industrialization Progress</td>
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<td>Plenary Session 4: Application &amp; Market</td>
<td>N.G. Kodochigov, Yong Wan KIM</td>
<td>09:50-10:05</td>
<td>Yukitaka Kato</td>
<td>Progresses in Hydrogen Production and Application for Establishment of Low-carbon Society in Japan</td>
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<td>10:05-10:20</td>
<td>WANG Haitao</td>
<td>Future Development of Modular HTGR in China after HTR-PM</td>
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<td>10:20-10:30</td>
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<td>Closing Session</td>
<td>SUN Yuliang</td>
<td>10:50-11:20</td>
<td>ZHANG Zuoyi</td>
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<td>11:20-11:50</td>
<td>Micheal A. Fueterer</td>
<td>Closing remarks</td>
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<td>Guidance for Technical Tour</td>
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| Technical Tour                                |                         | 13:30-16:30 | All                  |                                                         |
October 27, Monday

REGISTRATION
14:00-18:00

RECEPTION
18:00-20:00
October 28, Tuesday

OPENING SESSION
08:30-09:30

KEYNOTE ADDRESS
09:30-10:30

PLENARY SESSION 1
National & International Status & Progress
10:50-11:50

TECHNICAL SESSIONS
13:30-18:30
Mr. WANG Dazhong
Academician, Chinese Academy of Science
INET, Tsinghua University, China

Prof. Dr. WANG Dazhong is one of the founders of INET. After graduation from the Department of Engineering Physics, Tsinghua University in 1958, he participated the design and construction of the first shielding test reactor in INET. From 1980 to 1982, he carried out HTR research work in the Nuclear Research Center of Juelich, Germany, and obtained the Ph.D. degree from Aachen University. He was the director of INET from 1985 to 1994, and the Chief Engineer of INET till 2006. In 1993, he was selected as Academician, Chinese Academy of Sciences. From 1994 to 2003, he was designated as the President of Tsinghua University. After 2003, he is the Honorary Chairman of Tsinghua University Council.

Prof. Dr. WANG Dazhong has been actively advocating and promoting the R&D of inherent safety of nuclear reactor for more than 30 years. He presided over the design and construction of the 5 MW nuclear heating reactor and created a new field of nuclear heating applications. He established the roadmap of the HTR technology development in China, and was responsible for the design and construction of the HTR-10. He has won many awards and reputations, including the first class of National Science and Technology Progress Award, the National Invention Award and the Gold Patent Award.

HTR Development in China

China is the largest developing country with the largest population and fast-growing economy in the world. Its energy production has achieved remarkable progress over last decades. In the future energy supply, the large-scale development of nuclear energy is essential and promising, and will be an effective response measure to mitigate the energy-derived environmental pollution and guarantee a sound and sustainable national energy security. High temperature gas-cooled reactor (HTR) is recognized as one of the most advanced reactors during the 21st century because of its incomparable inherent safety features, and a huge potential market for process heat applications.

The first part of this speech emphasizes the strategy status of nuclear energy in the future energy development of China. The current energy structure, challenges and sustainable development policies will be introduced. Especially the important role of nuclear energy in China will be discussed here, including the nuclear power status, medium and long-term development plans, as well as the HTR’s great role during the reduction of CO\textsubscript{2}-emission and environment protection.

In the second part, the historical development of the HTR technologies in China will be reviewed in detail. Also, the selection of development roadmap of modular HTR with inherent safety will be explained here. Then the aim, design, construction, commissioning and experiments of the 10 MW HTR test module (HTR-10) will be expressed herein, including the well-known safety experiments carried out on-site. Thereafter the current large demonstration power plant HTR-PM and the future research and development work will be introduced briefly.

Finally, the irreplaceable role of nuclear power in future China’s energy system, the excellent characteristics of HTR for electricity and heat application, and the experience leading to an accumulation of knowledge during the development of Chinese HTR and to strengthen international cooperation will be summarized in the conclusion and outlook.

KEYNOTE ADDRESS
09:30-10:30
Mr. Jong Kyun Park
Director, Division of Nuclear Power
IAEA

Dr. Jong Kyun Park acquired his BS in Nuclear Engineering from Seoul National University in Korea in 1973, and his Master and Ph.D. degrees in Nuclear Engineering and Science from Rensselaer Polytechnic Institute in USA in 1979 and 1981, respectively.

He had served in the Republic of Korean Army as first Lieutenant from February 1973 till June 1975. And he had started his career at KAERI in July 1975 as a researcher in the field of Nuclear Engineering and continued extended research in USA at Rensselaer Polytechnic Institute from September 1978. After his degrees, he had been working for Combustion Engineering, which was one of the US nuclear vendors (which is now merged into Westinghouse), for 5 years in the field of nuclear engineering and reactor design and for Long Island Lighting Company at Shoreham Nuclear Power Station (which was sold to NY State and later dismantled) for 1 year as a nuclear engineer.

He returned back to KAERI in 1987 taking significant leading roles of research and development in nuclear science and engineering, such as Manager of reactor safety analysis, Directors of nuclear fuel and reactor core design project, nuclear policy research, Korean Next Generation Reactor (APR1400) Development, and Nuclear Training Center. He has served as Vice President at KAERI from May 2002 till September 2009 in the area of Advanced Reactor Technology Development, Advanced Nuclear Technology Development, VHTR and Nuclear Hydrogen Development, and Nuclear Policy and International Relations.

He joined the IAEA in October 2009 as Director, Division of Nuclear Power. He is a member of American Nuclear Society and Korean Nuclear Society.

IAEA's Perspectives on Global Nuclear Power

In September 2014, there are 437 nuclear power reactors in operation worldwide, with a total capacity of about 374.5GW and 70 NPPs are under construction. This is the highest number since 1989. Of the total number of reactors under construction, 48 units construction are in Asia with 28 units in China.

According to the IAEA’s long term projections of nuclear power made in August 2014, the low projections in 2030 and 2050 will be 400.6 and 699.2GW, respectively. These represent about 7.3% increase and 10.5% increase compared to the total nuclear capacity of Aug. 2014. The high projections for 2030 and 2050 will be 412.9GW and 1,091.7GW, respectively, which represent 87.2% and 192.3%.

Approximately 80% of the operating reactors in the world have been in service over 20 years and 50% is more than 29 years in operation. Many countries have given high priority for long term operation beyond the original design life of 30 or 40 years. There are 3 main areas of challenges for safe long term operation of NPPs: implementation of all necessary lessons learned from Fukushima accident, proper management of the non-replaceable system structure and components, ensuring sufficient human and financial resources of the operator.

There are a number of countries which are interested in embarking on nuclear power programme. Introducing a nuclear power programme is a long term commitment that requires significant financial and human resources for the high level of safety and security. It would be a great advantage for newcomer countries to learn the experience from the operating countries. There are several common challenges for the newcomers including: forming a national position, establishing legal and regulatory frameworks, ensuring funding & financing, building up human resources, and developing management programmes.

High Temperature Gas-cooled Reactor (HTGR) is one of the advanced reactors under development and deployment in the world. HTGR has a number of advantages over conventional LWRs including enhanced safety, higher efficiency, etc. However, there may be challenges to overcome in deploying the HTGR for commercial operation. HTR Conference is the forum for sharing the information and experience on the HTGR development and deployment.
HTR-PM Project Progress

HTR-PM project is one of sixteen Chinese National S&T Major Projects supported by central government. The project covers the design of HTR-PM demonstration plant, the construction and operation of the plant, developing of key components as the first of a kind, test of the key components and system in full scale, development of the TRISO fuel element fabrication technology and fabrication plant, and research on new technology, and etc. The development team include S INET, Chinerco Co. Ltd., HSNPC, many domestic manufacturers and organizations. The construction was started in 2012, the manufacturing of components was started since 2008, the test of key components in full scale progress well. Detailed progress will be reported. HTR-PM demonstration plant is scheduled to be connected to grid in the end of 2017.

Mr. ZHANG Zuoyi
Director, Chief Engineer
INET, Tsinghua University, China

He got his Ph.D. degree from Tsinghua University in 1989. Currently he is the director of INET, the chief engineer of INET. He is the chief scientist for HTR-PM project, nominated by the government. He is the vice chairman for Chinerco Co. Ltd., which is the EPC contractor for HTR-PM project, and the vice chairman for Huaneng Shandong Shidaoy Bay Nuclear Power Co. Ltd., which is the owner company for HTR-PM.

Mr. Thomas J. O'Connor
Director, Office of Advanced Reactor Technologies, DOE, USA

Thomas J. O’Connor is the Director of the Office Advanced Reactor Technologies (ART) with responsibility for research and development for advanced Generation IV reactor concepts including helium, sodium, lead, and liquid salt coolants, and for both large and small modular concepts. ART conducts R&D on coated particle fuel, graphite, high temperature metals, thermohydraulic and neutronic scale experiments, modeling and safety analysis, and components and energy conversion technology.

Mr. O’Connor also serves as the US Representative to the Generation IV International Forum Policy Group, a nuclear R&D partnership of 12 countries and the European Union, dedicated to collaborating on the next generation of nuclear reactors.

Mr. O’Connor has 30 years of management and operational experience in all aspects of nuclear science and technology, including management of advanced reactor R&D programs, radioisotope production, nuclear facility construction and operations, and safety management oversight. Mr. O’Connor’s experience extends to the commercial nuclear power sector, including construction with Stone & Webster Engineering Corporation, regulatory oversight with the Nuclear Regulatory Commission, and utility experience with the former Virginia Power.

Mr. O’Connor received his BSME from the University of Notre Dame and MSME from the Georgia Institute of Technology.

The United States Advanced Reactor Technologies Research and Development Program

This presentation will provide an overview of the United States Department of Energy’s Advanced Reactor Technologies Research and Development Program. This program includes fast reactor technologies, high temperature reactor technologies, technologies that are generic to all advanced reactors (such as energy conversion), regulatory framework development for advanced reactors and advanced reactor system studies. The presentation will specifically highlight work being carried out on high temperature gas cooled reactor development, including qualification of TRISO coated particle fuel, high temperature metals, graphite characterisation, integrated scale thermohydraulic test facilities for computational methods validation, interactions with the U.S. Nuclear Regulatory Commission and research being conducted at U.S. universities. This scope of research supports U.S. efforts to deploy affordable advanced nuclear reactors to achieve U.S. clean energy goals.
High-Temperature Gas-Cooled Reactors in Russia: Status and Prospects

The first interest in helium-cooled reactors in Russia dates back to 1945. Since then, the country has more than once returned to the development of high-temperature helium-cooled reactor designs intended to improve the nuclear energy's consumer attractiveness. To address the issues of growing fossil fuel deficit and increasing environmental contamination with hydrocarbons, nuclear energy-along with the conventional electricity generation-has to come into the sphere of energy and chemicals' supply to oil/gas industry, chemical industry, metallurgy, food industry, municipal utilities and production of artificial fuel and hydrogen. This is the sphere for HTGRs.

HTGRs have the following features motivating their nuclear energy applications:

- High temperatures that enable HTGR application in industrial processes; highly efficient energy conversion; and lower heat and radiation impact on the environment;
- High safety level due to inherent safety features, passive systems and modular structure;
- High fuel burnup allowing: efficient uses of different fuels: U, U-Pu, U-Th; operation of small NPPs without refueling; and burning of minor actinides.

Modular structure making it possible to construct small and medium NPPs with high inherent safety and maneuverability, which is important for countries with small grids and also for reactor technology applications. Russia has several HTGR designs at different stages of development, as well as relevant experimental facilities and key technologies available. Experiments are underway to test HTGR fuel, reactor and energy conversion system, as well as equipment and structural materials. Among Russian HTGR designs of the last decades, one should mention the Gas Turbine-Modular Helium Reactor (GT-MHR). The GT-MHR international project was implemented under the Agreement of 01.02.1995, first signed by the Russian Minatom and the U.S. General Atomics, and later also by the French Framatome and the Japan’s Fuji Electric. These companies have financed the GT-MHR project on a parity basis. Since the beginning of 2000, the GT-MHR project activities have been included, on matching financing conditions, in the Russia-U.S. Plutonium Management and Disposition Agreement. In 2002, the conceptual design of GT-MHR has been completed. From 2003 to 2013, relevant R&D was performed with regard to GT-MHR key technologies, i.e. reactor, fuel, graphite and gas turbine. In 2013, Rosatom has suspended its activities under this project, because the U.S. party failed to meet the matching financing conditions. Though the Rosatom State Corporation has decided to suspend the activities within the joint Russia-U.S.A. GT-MHR project, it still keeps the HTGRs on its priority list and is currently looking for new partners and markets. Russian oil and gas companies are being monitored to assess the possibilities of cooperation intended to integrate the HTGRs with respective industrial processes. Russia also continues its cooperation (and looks into new cooperation opportunities) with foreign countries and international programs, such as the United States (High Temperature Gas Reactor Pilots Power Plant), China (MOU), Indonesia (DemoHTGR), Japan, Kazakhstan (KHTGR), Generation-IV and SNETP-NC.
Mr. Hans E. Schweickardt
Chairman
Alpiq Holding, Switzerland

Hans E. Schweickardt was born in 1945. From a very early age he exhibited an interest in electricity. After completing his engineering studies at the Swiss Federal Institute of Technology Zurich (ETH Zürich), Hans E. Schweickardt worked at ABB in Baden, in his final position as Divisional Director for industrial electronics. Following other career moves, amongst others as a member of the Executive Board with Atel AG and of the Board of Directors of EEX AG, in 2002 Hans E. Schweickardt took up the post of General Director of the EOS Holding AG in Lausanne. In 2009, he successfully merged EOS with Atel AG to form the Alpiq Group. Today he is Chairman of the Board of Directors of Switzerland’s largest energy services provider.

The Future of Nuclear Power in the Light of European Energy Policy

1. Energy policy post-Fukushima
   • Following the initial shock: differentiated development, no cohesive European policy
   • EU: Nuclear Power (NP) remains important in the context of climate policy
   • Bulk of European countries: Keep or even expand share of NP (UK, Eastern Europe)
   • Germany and Switzerland (CH): Exit from NP, in Germany based on previously fixed shutdown deadlines for every facility, in CH based on exclusion of new builds.

2. Switzerland’s focus
   • Current CH electricity supply: twin pillars of NP + hydro power; high sustainability.
   • Federal Council’s new energy strategy and its consequences: Strain on economy and companies due to market distortion and high renovation costs; plus growing environmental stress, dependency on imports and social inequality due to artificially high electricity prices.

3. Future of nuclear power in Switzerland
   Conceivable possibilities:
   • Short-term: Relatively rapid ban on nuclear power (but poss. with back-door research/no ban on thinking about the technology)
   • Medium-term: Ban on new facilities but old plants continue to operate
   • Long-term: Re-entry/new start, poss. even sanctioned by politicians, on the following grounds: rather new facilities than old, good for the climate, cost-effectiveness, energy security.

4. A new look for nuclear power?
   HTR technology of particular interest due to the following benefits:
   • Disposal (less waste, recycling)
   • Technical controllability, core meltdown impossible
   • Manageable dimensions (particularly important in CH)
   • Financial feasibility
   Whether NP will remain on the agenda, and which technology wins through also depends heavily on external factors: climate policy, cost-effectiveness/financial feasibility, readiness for market, change in value, trends in other energy sources

5. Summary
   Future of NP difficult to predict. If technology is mature and launched on the market within a reasonable time frame, the potential is there. Opportunities outside Europe probably greater than in Europe itself. Swiss voters usually make pragmatic, cost-aware decisions; this being the case, the long-term opportunities remain intact.
October 29, Wednesday

PLENARY SESSION 1
National & International Status & Progress
08:30-09:30

PLENARY SESSION 2
Safety, Licensing and Technology
10:10-11:40

TECHNICAL SESSIONS
13:30-18:30
Mr. Finis Southworth
Chief Technology Officer, AREVA, USA

Dr. Finis Southworth is the Chief Technology Officer for AREVA Inc. As Chief Technology Officer, he is responsible for Intellectual Property Management, Research and Development programs, University technical relationships, and corporate technical expertise. Finis joined AREVA in 2006. Before joining AREVA, Finis was with the Idaho National Laboratory, serving as Director Project Management, Manager Systems Engineering, and, in the early 1990’s, as Manager of Fuel and Target Technology Development for the gas cooled New Production Reactor (NP-MHTGR). Finis also served as the technical director for DOE’s Generation IV Gas Cooled Reactor Roadmap, and as Manager of DOE’s Plutonium Focus Area. Previously, Dr. Southworth held several management positions within Florida Power and Light Company, including Core Design for their four nuclear units, then Maintenance Superintendent, and Plant Manager, Turkey Point Nuclear Plant. Finis also served as Assistant Professor of Nuclear Engineering at the University of Illinois, with a research focus on fusion. Dr. Southworth earned his doctorate in Nuclear Engineering Sciences from the University of Florida and has over 40 years’ experience in nuclear power.

Mr. Vincent Chauvet
Chartered Engineer, LGI-Consulting Paris, France

Vincent Chauvet is a chartered engineer graduated from ParisTech in 1998. After a career start in the utility industry (now GDF SUEZ), he developed more than 13 years of experience with innovation programmes, essentially in the energy sector. In 2005 he founded the LGI Consulting company, and since then he leads this firm specialised in innovation consultancy. Mr Chauvet has been involved with assignments in the nuclear sector since 2002, and he coordinates the secretariat of Europe’s Sustainable Nuclear Energy Technology Platform (SNETP) since 2008. In the field of high temperature reactors and nuclear cogeneration, he has been actively involved in the European projects RAPHAEL, PUMA, EUROPÁIRS, ARCHER and NC21-R. He supervised a Europe-wide market study of nuclear cogeneration. In the frame of the NC21-R project, he is currently coordinating the dissemination and stakeholder engagement activities of the EU Nuclear Cogeneration Industrial Initiative (NC2I).

The GEMINI Initiative

High Temperature Gas cooled Reactor (HTGR) technology, which has been developed up to the stage of industrial demonstration since the 1960s, has benefitted from new developments during the last decade, with several reactor projects in different countries and with a prototype industrial plant presently under construction in China.

Compared to other nuclear systems, HTGR technology has two very specific merits:
• operation at significantly higher temperatures, which grants high efficiency and versatility;
• unique intrinsic safety features allowing to exclude, for modern modular designs, significant radioactive releases outside of the nuclear plant in any possible accident situation.

Because of these specific features, the NGNP Industry Alliance (NIA) in the US and the Nuclear Cogeneration Industrial Initiative (NC2I) in Europe** consider that this type of nuclear system has a high potential not only as an electric power generation SMR, but also as a cogeneration plant to supply both electricity and process heat to large industrial sites. Industry and the public would widely benefit since nuclear cogeneration would drastically reduce the emission of CO$_2$ and other pollutants, and would secure energy supply and stabilize costs. Therefore, NIA and NC2I, have agreed to cooperate closely.
The deployment of modern high temperature nuclear cogeneration will be a major breakthrough in energy applications and require industrial scale demonstration. Therefore, NIA and NC2I have launched the GEMINI Initiative in order to combine their efforts toward parallel design, licensing and ultimately demonstration projects in both the U.S. and the EU. The common vision of the GEMINI partners is developed in the paper. While, at the same time, the NIA is endeavoring to get support from the US DOE and other sources, NC2I and NIA are working together on a project proposal for the Euratom Horizon 2020 Program of the European Commission, as a preliminary step for the demonstration project. The objectives of this project are:

- To define the main design options of the demonstration plant for Europe, maximizing the synergies with the US design efforts and addressing the requests of the call for proposals for enhanced safety, while reaching, for future commercial deployment, a high level of competitiveness with fossil fuel cogeneration units.
- To build synergy between the US and Europe for the design and licensing phase of the demonstration plant, with a large sharing of the effort between Europe and the US in terms of funding, competences, engineering work and to complete the remaining development work.

NIA and NC2I are open to extend collaboration with other partners who would share the objectives of the GEMINI initiative.

** The NIA and the NC2I are comprised of major actors in the fields of nuclear and process heat user industries, energy supply and nuclear technology development, and embody long European and American experience in HTGR technology.

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** Mr. Kunitomi Kazuhiko**

*Director General of Nuclear Hydrogen and Heat Application Research Center*  
*JAEA, Japan*

Dr. Kazuhiko Kunitomi is Director General of Nuclear Hydrogen and Heat Application Research Center in Japan Atomic Energy Agency (JAEA). He is responsible for HTTR (High Temperature Engineering Test Reactor) project in JAEA. The HTTR project consists of R&D on HTGR reactor technology and hydrogen production technology, and design study on an innovative HTGR system. He has more than 30 years of experiences on HTGR technology development. Especially he was involved in safety evaluation and construction of HTTR, and design of the first JAEA’s commercial gas turbine HTGR system named GTHTR300. His specially is safety of the HTGR system.

**Present Status of HTTR Project in JAEA**

A new energy policy in Japan issued in April states the importance and necessity of HTGR development in Japan. Based on this policy, an evaluation committee established by the Ministry of Education, Culture, Sports, Science & Technology (MEXT) authorized a revised HTGR development program in October. He will present the revised HTGR development program in Japan and current status of HTTR project in JAEA.
Mr. Yong Wan KIM
Division Director,
KAERI, Korea

Director of Nuclear Hydrogen Reactor Technology Development Division (2010–), KAERI
PM of Nuclear Hydrogen Key Technology Development Project
Korean Representative of Gen-IV VHTR System Steering Committee.

Nuclear Hydrogen and VHTR Technology Development in Korea

Very high temperature gas cooled reactor is an inherently safe Generation IV reactor system that can produce heat of up to 950°C. High temperature heat generated from VHTR can be used to produce clean massive hydrogen, to supply cheap process heat for industry to replace fossil fuel, and to generate high efficiency electricity. Current hydrogen demand is mainly from oil refinery and chemical industries. Hydrogen is mostly produced by steam reforming using the fossil fuel heat that emits large amount of greenhouse gases. Today in Korea, more than 1M tons/yr of hydrogen is produced and consumed at oil refinery industries. In 2040, it is projected at hydrogen roadmap that the 25% of total hydrogen demand is supplied by the nuclear hydrogen, which is around 3M tons/yr even without considering the hydrogen iron ore reduction market.

KAERI takes the leading role of the project and the development of the VHTR technologies. Key technology consist of four basic technologies; development of computational design tools, development of very high temperature experimental technology including materials, development of TRISO fuel fabrication technology, and Sulfur-iodine thermo-chemical hydrogen production technology. Prototypes of important VHTR design computer code were developed and are in the stage of verification and validation. TRISO fuel manufactured by KAERI is under irradiation test in HANARO research reactor. Helium loop having capacity of 150kW in test section was constructed to perform high temperature experiments. As for hydrogen production technology, Lab scale hydrogen production integral test is being done in pressurized condition. Korea is participating in the multi-nation Generation-IV International Forum (GIF) in the areas of fuel, hydrogen, materials and computational methods validation and benchmark projects. With its high temperature and inherent safety, the VHTR is well equipped to provide a practical and safe solution against the fossil fuel scarcity which will undoubtedly come in future. Other benefits are the effective use of fuel resources as well as its carbon emission free. Also, the hydrogen iron ore reduction in steel making company to reduce carbon emission and the effective use of fuel resources as well as its carbon emission free. Also, the hydrogen iron ore reduction technology for industry to replace fossil fuel, and to generate high efficiency electricity. Current hydrogen demand is mainly from oil refinery and chemical industries. Hydrogen is mostly produced by steam reforming using the fossil fuel heat that emits large amount of greenhouse gases. Today in Korea, more than 1M tons/yr of hydrogen is produced and consumed at oil refinery industries. In 2040, it is projected at hydrogen roadmap that the 25% of total hydrogen demand is supplied by the nuclear hydrogen, which is around 3M tons/yr even without considering the hydrogen iron ore reduction market.

Mr. Carl Sink
Program Manager,
DOE, USA

Carl Sink is the Program Manager for the Advanced Reactor Technologies Program within the Office of Nuclear Energy, United States Department of Energy. He has been closely associated with the Next Generation Nuclear Plant Project since 2004, and has been the program manager for that project since 2009. Mr. Sink currently serves with Dr. LI, Fu of INET as Co-Chairman of the GIF VHTR System Steering Committee, and was a past Chairman of the GIF Hydrogen Production Project Management Board. Mr. Sink holds a Masters Degree in Engineering Management from the Catholic University of America, and is a graduate of the United States Naval Academy. Before joining the Department of Energy in 1992, Mr. Sink spent nine years as a qualified Nuclear Engineering Officer in the United States Navy, serving tours a nuclear powered cruiser and a nuclear powered aircraft carrier.

Generation IV Reactors:
Continued Progress toward the Future

Most of us grew up with promises of amazing possibilities of nuclear energy. Electricity would be “too cheap to meter,” abundant, long-lasting power supplies; nuclear rockets for interplanetary space travel; reactors that could create more fuel than they used. At the same time, many of us experienced the fears from the threat of nuclear war. Since the origins of much of our nuclear engineering experience lay in national security programs, the lines between nuclear weapons and peaceful uses of nuclear energy were often blurred. And finally, many of us lived through the uncertainties about these promises caused by the Three Mile Island and Chernobyl accidents, and most recently the impacts of the Great East Japan Earthquake at points in our careers when our faith in nuclear technology was being solidified or renewed.

While light water reactor technology has established itself as the predominant source of commercial, privately operated nuclear power, we are fortunate that hundreds of engineers around the globe have continued their efforts to develop and perfect other nuclear energy technologies that do not rely on water for coolant or moderation. Fast spectrum reactors with coolants ranging from gases to liquid metals, and thermal spectrum reactors with gas or liquid salt coolants have been developed to a high degree of maturity, and have even been deployed beyond the laboratory in many countries. In January of 2000, a group of senior governmental representatives from nine countries came together to begin discussions on international collaboration in the development of these “next generation” nuclear energy systems. This group was the origin of the Generation IV International Forum (GIF).
Among the six Generation IV concepts eventually selected for international cooperative development, the Very High Temperature Reactor (VHTR) was seen as an early favorite among many of the members. Indeed, among the seven original members of the VHTR System Arrangement (SA), three had already operated or tested high temperature gas-cooled reactors. The accession of the People’s Republic of China to the VHTR SA in 2008 brought that number to five. My presentation will describe how the continued cooperative development of the VHTR concept as a Generation IV system will deliver on nuclear energy’s promises of sustainable, economic, safe, reliable and proliferation resistant power and energy supply.

PLENARY SESSION 2
Safety, Licensing and Technology
10:10-11:40

Mr. H. L. (Larry) Brey
Public Service Company of Colorado, USA

40 YEARS OF HTGR RELATED EXPERIENCE
Public Service Company of Colorado: Thirty years with this electric utility, twenty-four of which were associated with the Fort St. Vrain HTGR, including principal management positions for Nuclear Engineering (3 years), Operations (6 years), Quality assurance (3 years) and Nuclear Licensing (7 years).

Plant Design Control Office: Three years focused on technical review of documentation associated with the US HTGR program.

International Atomic Energy Agency (IAEA): Three years as the primary Nuclear Engineer managing the IAEA’s High Temperature Reactor program.

Consultant on International HTGR Related Activities: Ten years as a consultant basically to the IAEA including organizations within IAEA Member States on a myriad of HTGR reactor concepts and related scientific investigation.

Initial Start-Up and Testing of the Fort St. Vrain HTGR – Lessons Learned which may be Useful to the HTR-PM

Although the activities presented in this paper occurred 40 years ago, there are many observations and lessons associated with Fort St. Vrain (FSV) which may be beneficial in support of the start-up, testing and licensing of the HTR-PM.

This report includes a review of the FSV NPP design including an overview of the requirements and testing program utilized to bring the plant from initial start-up to full power. A sampling of the test results as well as a comparison of the plant design characteristics to actual values achieved at 100% power along with selected overall experiences gained through operation of this plant is also included.
Post Fukushima Action – A Perspective from the IAEA

The great east Japan earthquake and tsunami was a natural disaster with tragic loss of life, impairment of infrastructure and an unprecedented scenario that lead to the meltdown at three reactors in the Fukushima Daiichi Nuclear Power Plant complex, and the associated evacuation zones affecting hundreds of thousands of residents. In response, the IAEA Action Plan on Nuclear Safety was adopted by the Board of Governors in September 2011 and was endorsed by all Member States at the 55th session of the General Conference in 2011. The purpose of the Action Plan is to define a programme of work to strengthen the global nuclear safety framework and covers all aspects relating to nuclear safety, emergency preparedness and response, and radiation protection of people and the environment. Twelve key actions will be highlighted that includes safety assessments, peer review and update of the IAEA safety standards. The success of its implementation requires the full cooperation and commitment of Member States, the Secretariat and other relevant stakeholders. As an important development within the action plan, the IAEA will publish a report on the assessment of the accident that is detailed, factual and balanced. In particular it addresses the causes and consequences and highlights the lessons learned. The report will provide a knowledge base for the future and aims to make the event understandable to a wider audience. The over 1000 page report includes contributions from more than 170 experts.

HTR Safety Requirement

National Nuclear Safety Administration (NNSA) issued the Construct Permit (CP) for HTR-PM demonstration plant in 2012. This is the first CP for modular HTR power plant in world. In general, HTR-PM follows the same safety requirement and standards that are developed mostly from the experience of LWR in China. The detailed safety requirement with some special consideration and modification for HTR are discussed, as the joint effort from both the designers and safety authority, based on the design features and safety characteristics of modular HTR and the experience from HTR-10 project. Before the start of the review of HTR-PM Preliminary Safety Analysis Report (PSAR), NNSA published the guideline for HTR-PM safety review, to declare the NNSA position on HTR, and to address some key issues for safety review. The main points in guideline include: qualitative safety objective, quantitative safety objective, defense-in-depth philosophy, design basis, containment, accident source term, emergency plan, application of PSA, safety software V&V. This guideline make the HTR-PM licensing process smooth and efficient.
Mr. Fred Silady
CEO and President
Technology Insights, USA

Over forty years of professional experience at General Atomics and Technology Insights in engineering design and development of HTGRs with emphasis on design integration, safety and licensing and risk assessment. Recent major support has been for Pebble Bed Modular Reactor (Pty) Ltd., AREVA, General Atomics, Idaho National Laboratory, and X-energy. Current emphasis areas include:

Systems engineering development and analyses, including requirements development, functional analyses, and safety analyses of HTGRs for the power and process heat industries.

Engineering management including direction of plant and system-level trade studies and design integration of multi-disciplinary areas.

Nuclear reactor licensing for HTGR power, process heat, and cogeneration applications.

A principal architect of requirements-based advanced reactor licensing with insights from Probabilistic Risk Assessment.

Mr. LI Fu
Deputy Chief Engineer
INET, Tsinghua University, China

He got his Bachelor degree from Tsinghua University in 1990, PhD degree from Tsinghua University in 1995. He worked in INET since 1995. His research areas include reactor physics, safety analysis, digital Instrumentation and control system, general design of HTR. Currently he is the deputy chief engineer of INET, working for HTR-PM project.

Working Towards Unified Safety Design Criteria for Modular High Temperature Gas-cooled Reactor Designs

The Nuclear Power Development Section of the IAEA recently received approval for a Coordinated Research Project (CRP) to investigate and make proposals on modular High Temperature Reactor Safety (HTGR) design criteria. It is expected that these criteria would consider past experience and existing safety standards in the light of modular HTGR material and design characteristics to propose safety design criteria. It will consider the deterministic and risk-informed safety design standards that apply to the wide spectrum of off-normal events under development worldwide for existing and planned HTGRs. The CRP would also take into account lessons from the Fukushima Daiichi accident, clarifying the safety approach and safety evaluation criteria for design and beyond design basis events, including those events that can affect multiple reactor modules and/or are dependent on the application proximate to the plant site. (e.g., industrial process steam/heat). The logical flow of criteria is from the fundamental inherent safety characteristics of modular HTGRs and associated expected performance characteristics, to the safety functions required to ensure those characteristics during the wide spectrum of off-normal events, and finally to specific criteria related to those functions. This is detailed in the paper with specific examples included of how it may be applied. The results of the CRP will be made available to the member states and HTGR community.

HTR-PM Safety Requirement and Licensing Experience

HTR-PM is a 200MWe modular pebble bed high temperature reactor demonstration plant which is being built in Shidaoy Bay, Weihai, Shandong, China. The main design parameters of HTR-PM were fixed in 2006, the basic design was completed in 2008. The review of Preliminary Safety Analysis Report (PSAR) of HTR-PM was started in April 2008, completed in September 2009. In general, HTR-PM design complies with the current safety requirement for nuclear power plant in China, no special standards are developed for modular HTR. Anyway, Chinese Nuclear Safety Authority, together with the designers, developed some dedicated design criteria for key systems and components and published the guideline for the review of safety analysis report of HTR-PM, based on the experiences from licensing of HTR-10 and new development of nuclear safety. The probabilistic safety goal for HTR-PM was also defined by the safety authority. The review of HTR-PM PSAR lasted for one and a half years, with 3 dialogues meetings and 8 topics meetings, with more than 2000 worksheets and answer sheets. The heavily discussed topics during the PSAR review process included: the requirement for the sub-atmospheric ventilation system, the utilization of PSA in design process, the scope of beyond design basis accidents, the requirement for the qualification of TRISO coating particle fuel, and etc. Because of the characteristics of first of a kind for the demonstration plant, the safety authority emphasized the requirement for the experiment and validation, the PSAR was licensed with certain licensing conditions. The whole licensing process was under control, and was re-evaluated again after Fukushima accident to be shown that the design of HTR-PM complies with current safety requirement. This is a good example for how to license a new reactor.
Mr. Micheal A. Fuetterer
JRC, Netherlands

Safety Requirements for HTR Process Heat Application

Safety requirements for HTR process heat application have to contain all the requirements on nuclear safety for a power plant generating electricity and in addition safety requirements covering on one hand the potential impact of the nuclear installation on process steam or process gas which will leave the facility, and on the other hand the impact of the facility using the process gas or process steam on the nuclear island. It is to be expected that these facilities will contain burnable or explosive gases in large quantities.

Following the first small scale experimental reactors (AVR, DRAGON, Peach Bottom I) the general licensibility of HTRs for generation of electricity has been demonstrated at their time with the medium sized Fort St.Vrain reactor in the US and the THTR in Germany. Following the TMI accident, the HTR development turned to smaller, modular reactors in order to make maximum use of the inherent safety features of the HTR concept.

Low power density, strong negative temperature coefficient, the fuel concept of coated particles retaining virtually most fission products up to 1600°C within the first barrier, and single phase coolant, altogether yield an easily predictable and failure forgiving behaviour of the reactor. Properly designed, a modular HTR can withstand even hypothetic reactivity accidents, needs no active systems for decay heat removal, and can thus withstand indefinite periods of station blackout. Invoking arguments of incredibility of failure or basis safety for the primary pressure boundary, will also rule out from the design basis air ingress with its potential of slow core degradation and subsequent release of fission products. In the range of beyond design basis accidents, the current modular HTR concepts may be further developed either in terms of development of corrosion resistant fuel elements or in terms of engineered features to inertize the reactor building after a hypothetical large break of the primary pressure boundary.

In the late 1980s the German HTR-Modul has successfully undergone a conceptual licensing evaluation in which, however, commensurate with the nuclear regulations of the time, the focus was on design basis accidents. Beyond design basis events have been discussed and evaluated in a parallel process. With their inherent safety features addressed above modular HTR are, however, well prepared for today’s licensing processes with their deeper consideration of very rare events and their requirements to limit the radiological consequences of any accident to the immediate vicinity of the reactor, however improbable it may be.

The potential impact of the reactor on process gas or process steam may be seen in their contamination with Tritium produced in the reactor. It has recently been shown in the ARCHER project that compliance with plausible tritium control requirements can be achieved with reasonable effort.

The potential impact of burnable or explosive gases on the nuclear island will most likely be ruled out by use of intermediate heat transfer circuits and consideration of a minimum distance between the nuclear island and the chemical plant, thus reducing the problem for the nuclear island to the external blast wave respectively intrusion of dangerous gases accidents which reactors have to withstand already today. Concepts investigated in the 1980s in Germany with a steam reformer located in the reactor building and directly heated with the primary Helium appear no longer feasible today.
October 30, Thursday

PLENARY SESSION 3
Equipment, Supply and Project Implementation
08:30-09:30

PLENARY SESSION 3
Equipment, Supply and Project Implementation
09:50-10:50

TECHNICAL SESSIONS
13:30-18:30

HTR INTERNATIONAL ORGANIZING COMMITTEE MEETING
20:00-21:00
PLENARY SESSION 3
Equipment, Supply and Project Implementation
08:30-09:30

Mr. GONG Bing
HSNPC, China

As the Chief Engineer of Huaneng Shandong Shidao Bay Nuclear Power Co., Ltd., Mr. GONG Bing is in charge of the technical management, science and technology management of the company. He was graduated from Tsinghua University, majored in nuclear engineering. Having worked in nuclear power plants for 24 years, he has an intimate knowledge of NPP process systems and equipment, operation management and preliminary works for new NPP projects.

Introduction to Progress of HTR-PM Demonstration Project

As the owner, Huaneng Shandong Shidao Bay Nuclear Power Co., Ltd is fully responsible for the construction and operation management of 200MW HTR-PM Demonstration Project, of which China owns the IPR. Since the kick-off construction in December 2012, HTR-PM Demonstration Project has made smooth progress in civil works and installation, significant progress has been made in technology research and development, engineering design, equipment manufacturing, nuclear fuel supply, commissioning and operation preparation and other domains.

Mr. Frank Yulong WU
President,
Chinergy, China

Mr. Yulong Wu received his bachelor and master degree from Tsinghua University. He received his Ph.D. from the City University of New York.

Mr. Wu has been working as President /CEO of Chinergy Co. Ltd., since 2003. He is also the deputy chief scientist for HTR-PM project.

Prior to joining Chinergy, Mr. Wu held numerous senior positions in corporations based in New York area. He served as senior project manager in MEDJET Inc., Executive Vice President in General Information Technologies Inc., and President/CEO in Tristone Technologies Inc., etc.

EPC experiences of HTR-PM Project

As the enterprise undertaking industrialization and the EPC contractor of High Temperature gas-cooled Reactor (HTR) technology, CHINERGY co., Ltd (CHINERGY) long-term devotes to research and develop the CHINA’s HTR technology and its cooperation.

Under the joint efforts of all departments, HUANENG SHIDAOBAY HTR-PM demonstration plant was listed by Chinese government as one of 16 national science and technology major projects in Outlines of National Medium-term Science & Technology Development Program (2006-2020). It means HTR-PM will become the first pebble-bed modular HTR NPP in the world. Because of the differences between other projects, such as special requirements of nuclear safety and nuclear quality, high technology & high difficulty, needing huge investments and a long time, facing many of the risk or uncertain factors, etc, the new organization model and new EPC organization was founded by CHINERGY, and a lot of EPC works have been organized and implemented in this model. The Implementation planning had approved by Chinese government. At last, the report also compendiously presents the experiences of engineering, procurement and construction based on summarizing EPC works of HTR-PM.
Mr. DONG Yujie
Deputy Director, Deputy Chief Engineer,
INET, Tsinghua University, China

Professor in Nuclear Engineering of Tsinghua University, Beijing, China. He graduated from Tsinghua University and got his PhD degree in Nuclear Reactor Engineering and Safety. Then he worked to develop advanced nuclear reactors in Institute of Nuclear and New Energy Technology, INET, Tsinghua University. He once took charge of Division of Reactor Physics, Thermal-hydraulics and system simulation, and Division of General Design of High Temperature Gas-cooled Reactor (HTGR). Currently, he is a Deputy Director and Deputy Chief Engineer of INET in charge of HTGR projects.

Technologies of HTR-PM

HTR-PM takes a technological route which is based upon Chinese technological practices and industrial manufacturing capabilities. It effectively avoids major technological risks so that on the whole the design of HTR-PM is advanced and meanwhile main components can be fabricated domestically. Firstly, a steam turbine cycle acts as the power conversion system to avoid the big technological challenges caused by a direct gas turbine cycle. Secondly, a simple cylindrical core instead of an annular core eliminates some technological uncertainties. Thirdly, two modules are coupled to a single steam turbo-generator set in order that technologies related to a multiple-module power plant can be confirmed. The designs of several key components including the steam generator and helium blower keep the balance between technological advance and realizability. Compared to early HTRs or existing designs, HTR-PM’s reactivity manipulation and storage of spent fuel elements are advanced noticeably. This presentation outlines overall design of HTR-PM and elaborates major technological selections made for HTR-PM by means of comparisons and analyses. Latest progresses of the construction of HTR-PM demonstration power plant are presented also.

Mr. ZHANG Jie
General Manager Assistant,
China North Nuclear Fuel Co., Ltd, China

2013.07-Now: General Manager Assistant of China North Nuclear Fuel Co., Ltd. & Director of Candu Fuel Plant.
2012.05-2013.07: Director of CANDU Fuel Plant, CNNFC.
2006.01-2012.05: Deputy Director of CANDU Fuel Plant, CNNFC.
1996.07-2006.01: Process Engineer of Candu Fuel production line, Manager of product department of CANDU Fuel Plant, CNNFC.

The Introduction of HTR-PM Fuel Production Line

The fuel production line for HTR-PM was started to build in China north nuclear fuel Co., Ltd, Baotou, Mongolia, China from March 16, 2013. It will provide 300000 spherical fuel elements/year for HTR-PM demonstration project, which belongs to Shandong Shidao Bay Nuclear Power Company (HSNPC). The fuel plant manufacture technology and equipment are based on the success of INET Tsinghua University HTR-10, and then take large scale process of HTGR fuel. It contains chemical conversion, kernel preparation, coated particle preparation, fuel Sphere preparation, matrix graphite preparation, solid waste recovery and waste water treatment. The detailed fuel plant design and schedule will be introduced.
Ms. WU Xinxin
Head of Division,
INET, Tsinghua University, China

The Design and Research of HTR-PM Steam Generator

There are two Once-through Steam Generators in HTR-PM which are key equipment. The power of each Steam Generator is 253MW. It consists of 19 heat exchange components and each component is composed five layers of helical tubes. Super-cooled water which pressure is 13.5MPa in tube side(second side) is heated from 250°C to 566°C of superheated steam by helium in shell side (primary side). This presentation introduces the structure design of Steam Generator, materials and manufacturing technology research and development and process.

Mr. ZHU Genfu
Vice President,
Shanghai Electric Group Co., Ltd., China

HTR, the New Challenge and Improvement for Equipment Manufacturers

The presentation introduces the history, experience and the progress of some HTR critical equipment manufacturing in SHANGHAI ELECTRIC, starting from 10MW HTR in 1990’s till 200MW HTR right now, including the difficulties in manufacturing and their progresses. It also briefly introduces the SHANGHAI ELECTRIC capability and the achievements for nuclear power equipment manufacturing, to show its satisfaction to the market needs based on the capability it has had on both PWR and HTR critical equipment.
Ms. SHI Guilan
Chief Engineer of R&D Department, China Techenergy Co. Ltd., China

Education: China University of Petroleum, Beijing.
Work Experience:
4/2006-present: Chief Engineer of R&D department/Software Engineer, China Techenergy Co., Ltd. (CTEC), Beijing.

Development and Design of Digital I&C System in HTR-PM

Instrumentation and control (I&C) system, as the central nervous system of a nuclear power plant (NPP), plays an important role in keeping NPP in a safety and economical operation state. Shidao Bay Power Plant adopts a all-digital I&C system design, which applies safety DCS product FirmSys for the reactor protection system (1E part) and non-safety DCS product HOLLiAS-N for the plant control system (NC part) both developed by CTEC, and the advantage in high reliability, high precision, friendly HMI, high scalability, good maintainability, etc. In this paper, we first give a brief introduction to the progress of development, design and project implementation of the DCS system in Shidao Bay Power Plant. Then, we introduce the design of the DCS system, including overall architecture, system function, performance and main design feature of the DCS product. In the end, we also give the expectations for the future work.

Mr. WANG Junsan
Project Executive Manager, Lead Engineer, CNPSC, China

Mr. Wang Junsan, with more than 10 years of experience in power plant simulation, had finished several FSS of fossil power plant as project manager before 2008. Since joining CNPSC in 2008, Mr. Wang have finished FSS of 550MW Supercritical thermal power project in KEPCO (Korea Electric Power Corp), and FSS of CPR1000 (Ningde Nuclear Power Station). Now Mr. Wang is project executive manager and lead engineer of HTR-PM FSS.

The Technical Solution of Full Scope Training Simulator of HTR-PM

The report describes overview of CNPSC briefly, the technical aspects and progress of the Full Scope Training Simulator developed for HTR-PM Plant in Shidao Bay is introduced, including the hardware configuration, nuclear island model, control system simulation approach.
October 31, Friday

PLENARY SESSION 4
Application and Market
08:30-09:30

PLENARY SESSION 4
Application and Market
09:50-10:20

CLOSING SESSION
10:50-11:20

GUIDANCE FOR TECHNICAL TOUR
11:20-11:50

TECHNICAL TOUR
13:30-16:30
Mr. Karl Verfondern  
FZJ, Germany

Karl Verfondern (Study of Physics, diploma at University of Bonn, 1978; PhD at RWTH Aachen, 1983) is employed at the Research Center Juelich at the Institute of Energy and Climate Research, Nuclear Waste Management and Reactor Safety. His work is dedicated to high-temperature gas-cooled reactors with respect to fuel performance and fission product release behavior, as well as to safety aspects of hydrogen as an energy carrier and of combined nuclear/chemical systems for nuclear process heat applications. The work is mainly conducted within the frame of EU or IAEA projects.

**Nuclear Cogeneration for Industrial Applications**

The nuclear share in final energy consumption worldwide is about 16%, almost exclusively dedicated to electricity generation. Although nuclear power has currently little penetration of the non-electric energy market (< 1%), a large demand for non-electric nuclear energy is expected to emerge and grow rapidly owing to a steadily increasing energy consumption, the finite availability of fossil fuels, the replacement of direct use of fossil fuels, and an increased sensitivity to the environmental impacts of fossil fuel combustion. Nuclear cogeneration of heat and electricity is a mature technology with practical advantages such as an increased plant thermal efficiency, the possibility of varying the heat supply according to demand and an easier implementation, as almost all nuclear reactors for electricity production can be adapted. There are no technological impediments to extracting heat/steam from a nuclear plant. This has been proven for low temperatures (≤ 200°C) with nuclear-assisted district heating and desalination with an experience of ~750 reactor operation years from ~70 NPP. Detailed site specific analyses are essential for determining the best energy option. Process heat applications may include cogeneration, coal-to-liquids conversion, and assist in the synthesis of chemical feedstock. The development of nuclear reactors of small and medium size (SMR) would therefore be better suited for cogeneration and facilitate the non-electric applications of nuclear energy. The possibility of large-scale introduction of distribution systems for heat, steam, electricity supplied from a centralized nuclear heat source, a multi-product energy center, could attract and serve different kinds of consumers concentrated in so-called industrial parks. The share of nuclear energy in industrial processes will depend on its competitiveness with the other energy options. Nuclear energy could principally be used, but significant reengineering may be necessary depending on the case considered. Many non-electric applications require energy sources that are relatively small (100 – 1000 MW(th)) in comparison with the size of existing power reactors. The complexity of the combined system requires the development of advanced safety concepts and techniques to ensure proper control of the system. Furthermore, the requirements, conditions and thresholds for market structure, demand pressure, technical basis, economic competitiveness, and public acceptance will be different in each country. Evolutionary and innovative design improvements in nuclear reactor concepts, coupled with stable nuclear fuel prices, will result in an improved competitiveness of the non-electric nuclear applications.
Mr. CUI Shaozhang
Vice President, Huaneng Nuclear Power Development Co. / Deputy Director, Nuclear Power Department, China Huaneng Power Group
China

Advancing the Commercialization of HTR: The Potential Applications, Market and Challenges

In order to meet environmental challenges and achieve comprehensive, balanced and sustainable energy mix, China is currently strengthening the efforts in non-fossil energy, included renewable energy and nuclear power. Even affected by Japan Fukushima accident, China will continue committed to nuclear power development in the future. HTR is the promising reactor system which can provide process heat in a wide range of temperatures, and the HTR-PM is designed as an unsophisticated, safe and universal heat source with a large field of application. At present, the HTR-PM demonstration project is under construction as scheduled in Shidao Bay power plant, and is expected to achieve commercial operation by 2017. With the HTR-PM as a pilot plant, it is time to study and promote the commercialization of HTR technology.

For the commercialization of HTR, besides electricity generation, other potential applications such as process heat supply are becoming attractive. Several feasible domestic applications that include replacing old coal power plants and providing high quality process heat to chemical industry and steel industry will be reported.

To advancing the commercialization of HTR, several issues related to HTR should be stressed and dealt with in the coming future. How to further improve the economic competitiveness for the first built reactors? Whether the emergency preparedness framework can be simplified and whether the emergency plan zone can be restricted to a smaller region? All these issues will be discussed in the report.

Mr. N.G. Kodochigov
OKBM, Russia

Education

Experience
N.Kodochigov is a Chief Designer for High Temperature Reactor plants in JSC “OKBM Afrikantov” . He has 40-year experience in R&D, design and management of projects and experimental works. He took direct part in the development of Russian prototype HTGR intended for production of hydrogen, supply of process heat to petroleum refineries, production of ammonia for fertilizers. Also, he is a Chief Designer of Gas-Turbine MHR Project.

N.Kodochigov is an Honored Designer of Russia, a member of the Russian Nuclear Society.

N.Kodochigov is an Associate Professor at the Nuclear Plant Department of the Nizhny Novgorod State Technical University n.a. after R.E.Alekseev.

HTGR Application/ Markets Prospects in Russia

Prediction of power engineering development in the world and Russia up to 2040, carried out by order of the Government of Russia shows that fossil fuels will continue to prevail and non-carbon resources including nuclear power will slowly grow. One of the reasons that restrains the scale of nuclear power utilization is that it is used only to generate electricity. At the same time, more than half of consumed primary energy carriers are used to generate heat. The annual demand of only machining industries (oil refining, oil chemistry, chemical industry, and metallurgy) in process heat under Russian conditions is 1910 million GJ. HTGR temperature potential is sufficient to supply the needs of most industrial technological processes. Thus, there is a large-scale implementation potential for HTGRs.

Selection of priorities for replacement of fossil energy resources in different countries depends on a number of natural and economic conditions. For Russia, one of the priorities is the oil sector that generates about 40% of Russian fiscal revenues. In order to enhance extraction growth, it is necessary to develop deposits of high-viscosity oil and to increase the level of oil refining. This requires increasing of the energy and hydrogen consumption. These requirements can be met by HTGRs.
Mr. ZU Bin
Vice President of China Nuclear Engineering (Group) Corporation
Chairman of China Nuclear Engineering Corporation Limited
China

ZU Bin, member of the Communist Party, was born in June, 1968, at Lujiang, Anhui Province. He held a Bachelor Degree of Civil Building Engineering and Civil Building Engineering from Southeast University in 1991, and a Master Degree of Quality Management from the Hong Kong Polytechnic University in 2001. He is the researcher-level senior engineer.

ZU Bin now holds the position of Vice President of China Nuclear Engineering (Group) Corporation, Chairman of China Nuclear Engineering Corporation Limited. He was the Chairman, General Manager and Party Secretary of China Nuclear Industry Huaxing Construction Company Limited. He was also the Chairman of Chinergy Co., Ltd.

ZU Bin is the senior management personnel of 511 Talents Project of the Commission of Science, Technology and Industry for National Defense, the expert receiving the State Council Special Allowance, the candidate of New Century Talents Project State-level.

HTR Technology Industrialization Progress
Currently, the international situation and CHINA’s development strategy in nuclear power field brings the opportunity to industrially develop high temperature gas cooled reactor (HTR) nuclear power technology with CHINA’s independent intellectual property rights. As the key state-owned enterprises of CHINA central government, CHINA Nuclear Engineering Group Co. (CNEC) has actively carried out the nuclear energy development and utilization business around HTR nuclear power technology with TSINGHUA University by the Industry-Academia-Research innovative cooperation mechanism. At the same time, CNEC has committed to achieving the industrial chain extension by 600MWe HTR NPP construction.

Mr. Yukitaka Kato
Associate Professor
Tokyo Institute of Technology, Japan

1991 PhD Degree from the Department of Chemical Engineering, Tokyo Institute of Technology
1991-2002 Assistant Professor at the Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology
1997-1998 Research Fellow at the Centre for Study of Environmental Change and Sustainability at the University of Edinburgh, UK
2002- Associate Professor at the Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology
Director, Division of Energy Engineering, Society of Chemical Engineers of Japan (2009-2010)

Research areas: Energy Conversion, Energy Storage, Energy Transportation, Chemical heat pumps, Chemical heat storage system, Hydrogen production system, Zero carbon dioxide emission energy system, Carbon recycling energy system
**Progresses in Hydrogen Production and Application for Establishment of Lowcarbon Society in Japan**

Hydrogen (H\textsubscript{2}) is expected to be a new energy carrier for independent from dependency on fossil fuels. Hydrogen system driven by high temperature gas cooled reactor (HTGR) of inherent safety reactor is one of practical technologies for establishment of lowcarbon society post Fukushima. The high temperature engineering test reactor (HTTR) in Japan Atomic Energy Agency (JAEA) has demonstrated heat output at 950°C which is relatively higher-quality energy than one from other type reactors. For efficient utilization of the high quality thermal energy, it is useful thermodynamically to be used as a heat source of endothermic chemical reaction. Then, thermochemical hydrogen (H\textsubscript{2}) production from water by using heat from HTGR is rational way. A thermo-chemical Iodine-Sulfur (IS) process is a process which can produce H\textsubscript{2} at less than 900°C in liquid-gas flowing type reactor. The IS process in HTTR demonstrated continuous H\textsubscript{2} production of 30 NL/h for a week the world’s first in 2004. Establishment of H\textsubscript{2} consumption and supply systems is needed for practical H\textsubscript{2} energy system. Toyota Motor Corp., Japan, has already called to start mass production of a fuel cell vehicle (FCV) driven by H\textsubscript{2} and plan to sale it at 7 million JPY in 2014. The Research Association of Hydrogen Supply/Utilization Technology (HySUT) was founded in July 2009 aiming to establish hydrogen supply infrastructure and to improve hydrogen business environment with 13 private energy companies in Japan. Technical and social demonstrations of regional hydrogen supply infrastructure including H\textsubscript{2} station for FCV are executing since 2011. A new energy system of Active Carbon Recycle Energy System (ACRES) driven by HTGR has been proposed as low-carbon energy system. A smart iron making system based on ACRES (iACRES) is been discussed in Iron and Steel Institute of Japan. H\textsubscript{2} is important energy material for reduction of carbon dioxide into useful carbon materials in iACRES. Progresses in hydrogen production and application are been expecting for establishment of low-carbon society.

**Future Development of Modular HTGR in China after HTR-PM**

The modular high temperature gas-cooled reactor (MHTGR) is an inherently safe nuclear energy technology for efficient electricity generation and process heat applications. The MHTGR is promising in China as it may replace fossil fuels in broader energy markets. In line with China’s long-term development plan of nuclear power, the Institute of Nuclear and New Energy Technology (INET) of Tsinghua University developed and designed a MHTGR demonstration plant, named high-temperature gas-cooled reactor-pebble bed module (HTR-PM). The HTR-PM came into the construction phase at the end of 2012. The HTR-PM aims to demonstrate safety, economic potential and modularization technologies towards future commercial applications. Based on experiences obtained from the HTR-PM project with respect to design, manufacture, construction, licensing and project management, a further step aiming to promote commercialization and market applications of the MHTGR is expected. To this purpose, INET is developing a commercialized MHTGR named HTR-PM600 and a conceptual design is under way accordingly. HTR-PM600 is a pebble-bed MHTGR power generation unit with a six-pack of 250MW\textsubscript{th} reactor modules. The objective is to cogenerate electricity and process heat flexibly and economically in order to meet a variety of market needs. The design of HTR-PM600 closely follows HTR-PM with respect to safety features, system configuration and plant layout. HTR-PM600 will have the six modules feeding one steam turbine to generate electricity with capacity to extract high temperature steam from various interfaces of the turbine for further process heat applications. A standard plant will consist of two HTR-PM600 units. Base on the economic information of HTR-PM, a preliminary study is carried out on the economic prospect of HTR-PM600.
## October 28, Tuesday

### Opening Session
08:30-09:30

### Keynote Address
09:30-10:30

### Plenary Session 1: National & International Status & Progress
10:50-11:50

### Technical Sessions
13:30-18:30

### October 28, Tuesday | Conference Hall

#### Opening Session
Chair: SUN Yuliang

- **08:30-09:30** Welcome Address & Invited Speeches

#### Keynote Address
Chair: SUN Yuliang

- **09:30-10:00** HTR Development in China  
  WANG Dazhong. INET, China
- **10:00-10:30** IAEA’s Perspectives on Global Nuclear Power  
  J.K. Park. IAEA

#### Plenary Session 1: National & International Status & Progress
Chairs: Tom O’Connor, Frederik Reitsma

- **10:50-11:05** HTR-PM Project Progress  
  ZHANG Zuoyi. INET, China
- **11:05-11:20** The United States Advanced Reactor Technologies Research and Development Program  
  Tom J. O’Connor. DOE, USA
- **11:20-11:35** High-Temperature Gas-Cooled Reactors in Russia: Status and Prospects  
  N.N. Ponomarev-Stepnoy. Rosenergoatom Concern OJSC, Russia
- **11:35-11:50** The Future of Nuclear Power in the Light of European Energy Policy  
  Hans E. Schweickardt. Alpiq, Switzerland
Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-1: Calculation method and code development
Session Chairs: Tetuaki Takeda, LI Zeguang

Zhihong Deng, Yuliang Sun, Fu Li, Rizwan-uddin. Huaneng Group, China

13:48-14:06 Efficient Simultaneous Solution of Multi-physics Multi-scale Coupled Nonlinear System in HTR Based on Nonlinear Elimination Method. HTR2014-61184
Han Zhang, Fu Li, Jiong Guo, Xiaofeng Zhou, Kai Fan. INET, China

Heikki Suikkanen, Ville Rintala, Riitta Kyrki-Rajamäki. Lappeenranta Univ. of Technology, Finland

14:24-14:42 Nodal Expansion Method for Multi-dimensional Steady Convection-Diffusion Equation. HTR2014-61285
ZHOU Xiaofeng, LI Fu, GUO Jiong, HAO Chen, ZHANG Han, FAN Kai, WANG Lidong, LU Jianan. INET, China

14:42-15:00 First Results for Fluid Dynamics, Neutronics and Fission Product Behaviour in HTR applying the HTR Code Package (HCP) Prototype. HTR2014-60231
H.-J. Allelein, S. Kasselmann, A. Xhonneux, D. Lambertz. FZJ, Germany

Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-2: Gas flow in reactor core and plenum
Session Chairs: Yassin A. Hassan, ZHENG Yanhua

15:15-15:33 Experimental Investigation on Cross Flow in the Prismatic VHTR Core. HTR2014-61100

15:33-15:51 Separate Effects Tests to Determine the Pressure Drop over Packed Beds in the PBMR HPTU Test Facility. HTR2014-61107
CG du Toit, PG Rousseau. North-West Univ., South Africa

Saya Lee, Kyle L. McVay, Jae Hyung Park, Yassin A. Hassan, N. K. Anand. Texas A&M Univ., USA

16:09-16:27 Numerical Simulation of Two-branch Hot Gas Mixing at Reactor Outlet of HTR-PM. HTR2014-61302
Hao Pengfei, Zhou Yangping, Li Fu, Shi Lei, He Heng. Tsinghua Univ., China

16:27-16:45 RANS simulation of the thermal mixing in HTTF LP during normal operation conditions ~ High Temperature Test Facility at Oregon State University. HTR2014-61244
Malwina J. Gradecka, Brian Woods. Warsaw Tech. Univ., Poland
Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-3: Heat transfer and computational method
Session Chairs: Stefan Kasselmann, SUN Jun

17:00-17:18 Evaluation of Effective thermal conductivity models on VHTR fuel block by CFD analysis. HTR2014-61423
Dong-Ho Shin, Hyoung-Kyu Cho, Nam-Il Tak, Goon-Cherl Park. Seoul National Univ., Korea

17:18-17:36 Verification of two-temperature method for heat transfer process within a pebble fuel. HTR2014-61322
Dali Yu, Minjun Peng. Harbin Engineering Univ., China

17:36-17:54 Simulation of Thermal-hydraulic Process in Reactor of HTR-PM. HTR2014-61303
ZHOU Kefeng, ZHOU Yangping, SUI Zhe, MA Yuanle. Ministry of Environment Protection, China

Shinji Kuriyama, Tetsuaki Takeda, Shumpei Funatani. Univ. of Yamanashi, Japan

Track 7: Development, Design and Engineering
Session 7-1: System analysis and control of HTGR
Session Chairs: Lewis Lommers, Kodochigov Nikolay

Liu Dan, Sun Jun, Xu Xiaolin, Ma Yuanle, Sun Yuliang. INET, China

Hangbok Choi. General Atomic, USA

14:06-14:24 Analysis the Response Function of the HTR Ex-core Neutron Detectors in Different Core Status. HTR2014-71279
FAN Kai, LI Fu, ZHOU Xuhua. INET, China

14:24-14:42 Coordinated Control Design for the HTR-PM Plant: From Theoretic Analysis to Simulation Verification. HTR2014-71307
Zhe Dong, Xiaojin Huang. INET, China

14:42-15:00 Control room conceptual design of nuclear power plant with multiple modular high temperature gas-cooled reactors. HTR2014-71317
Jia Qianqian, QuRonghong, Zhang Liangju. INET, China
Track 7: Development, Design and Engineering
Session 7-2: Progresses of new generation reactor
Session Chairs: Hangbok Choi, Michael K. Swann

15:15-15:33  NUCLEAR BURNING WAVE MODULAR FAST REACTOR CONCEPT.  
HTR2014-71098

N.G. Kodochigov, Yu.P. Sukharev.  OKBM, Russia

15:33-15:51  NEUTRONIC ASPECTS OF NUCLEAR BURNING WAVE MODULAR FAST 
REACTOR CONCEPT SUBSTANTIATION.  HTR2014-71099

N.G. Kodochigov, Yu.P. Sukharev.  OKBM, Russia

15:51-16:09  AREVA Modular Steam Cycle – High Temperature Gas-Cooled Reactor 
Development Progress.  HTR2014-71346

L. Lommers, F. Shahrokhi, J. Mayer, F. Southworth.  AREVA, USA

HTR2014-71428

Seong Gu Kim, Seongkuk Cho, Hwanyeal Yu, Yonghee Kim, 
Yong Hoon Jeong, Jeong Ik Lee.  KAIST, Korea

Track 7: Development, Design and Engineering
Session 7-3: Accident analysis and protection
Session Chairs: SHI Qi, SUN Yunlun

17:00-17:18  Development and Reliability Analysis of HTR-PM Reactor Protection 
System.  HTR2014-71114

Duo Li, Chao Guo, Huasheng Xiong.  INET, China

17:18-17:36  Software Unit Testing during the Development of Digital Reactor 
Protection System of HTR-PM.  HTR2014-71116

Chao Guo, Huasheng Xiong, Duo Li, Shuqiao Zhou, Jianghai Li.  
INET, China

17:36-17:54  Research on Fault Diagnosis of HTR-PM Based on Multilevel Flow 
Model.  HTR2014-71338

Yong Zhang, Yangping Zhou.  INET, China

17:54-18:12  The Design and Development of the Radiation Monitoring System for 
the Primary Circuit of HTR-PM.  HTR2014-71240

Feng Xie, Yongnan Liang, Jiang Zhu, Jianzhu Cao, Jiejuan Tong.  
INET, China
Track 2: Industrial application and markets
Session 2-1: Industrial application
Session Chairs: Won Jae Lee, XU Jingming

Johan Carlsson, David Shrupshire, Robert S. Cherry, Arturs Purvins, and Ioulia T. Papaionnoua. JRC-ITU, Netherlands

13:48-14:06 ARCHER HTR Technology in support of a Coal to Liquid Process – An Economic Feasibility View. HTR2014-21104
PW Stoker, JJ Fick, F Conradie. North-West Univ., South Africa

14:06-14:24 Substitute Energy Carriers from Refinement of Coal using HTR-Module. HTR2014-21208
Heiko Barnert, Kurt Kugeler, Michael Will. ARGE KT, Austria

14:24-14:42 For a Global HTR Marketing Initiative. HTR2014-21371
Alexandre Bredimas, Francesco Venneri, Matthew Richards. Strane Innovation, France

14:42-15:00 Viability of HTR-10 As A Primary Driver of an Energy Complex for Remote Settlement. HTR2014-21416
Dr. Philip, T. Choong. Choong-Hsia Foundation Inc., USA

Track 2: Industrial application and markets
Session 2-2: Hydrogen production
Session Chairs: Xing L. Yan, Taehoon Lee

Seiji Kasahara, Nobuyuki Tanaka, Hiroki Noguchi, Jin Iwatsuki, Hiroaki Takegami, Shinji Kubo. JAEA, Japan

15:33-15:51 INET, China’s R&D on the thermochemical IS process for hydrogen production
Ping Zhang. INET, China

15:51-16:09 STATUS OF NUCLEAR HEAT AND HYDROGEN SYSTEMS CONCEPT STUDY. HTR2014-21339
Won Jae Lee, Yoon Ho Choi, Jae Mun Han, Jin Ki Ham, Su Jin Choi, Sang Ii Lee, Je Ho Park, Jae Sak Koo. KAERI, Korea

16:09-16:27 Bimetallic catalysts for HI decomposition in the iodine-sulfur thermochemical cycle. HTR2014-21295
Laijun WANG, Songzhi HU, Lufei Xu, Daocai LI, Qi HAN, Songzhe CHEN, Ping ZHANG, Jingming XU. INET, China

16:27-16:45 Study on in-situ electrochemical impedance spectroscopy measurement of anodic reaction in SO2 depolarized electrolysis process. HTR2014-21325
XUE Lulu, ZHANG Ping, CHEN Songzhe, WANG Laijun. INET, China
Track 8: Safety and Licensing
Session 8-1: Safety Design Issues
Session Chairs: H. J. Allelein, TONG Jiejuan

17:00-17:18  Safety Design Approach for the Development of Safety Requirements for Design of Commercial HTGR. HTR2014-81150
Hirofumi Ohashi, Hiroyuki Sato, Shigeaki Nakagawa, Yukio Tachibana, Kazuhiko Kunitomi. JAEE, Japan

17:18-17:36  Perspectives on Understanding and Verifying the Safety Terrain of Modular High Temperature Gas-Cooled Reactors. HTR2014-81367
Donald E. Carlson. NRC, USA

17:36-17:54  Is Tritium an Issue for High Temperature Reactors? HTR2014-81096
Michael A. Füttterer, Elio D’Agata, Xavier Raepsaet. JRC, Netherlands

17:54-18:12  Radiation Level and Occupational Exposure during the Helium Circulator Maintenance Of The 10 MW High Temperature Gas-cooled Reactor-test Module (HTR-10). HTR2014-81408
Sheng FANG, Hong LI, Zaizhe YIN, Chengxiang GUO. INET, China

Track 3: Fuel and Waste
Session 3-1: Overview and Fabrication
Session Chair: LIU Bing

13:30-13:48  Implications of Results from the Advanced Gas Reactor Fuel Development and Qualification Program on Licensing of Modular HTGRs. HTR2014-31252
David Petti. INL, USA

M. Rachmawati, Sarjono, Ridwan, R. Langenati. National Nuclear Energy Agency, Indonesia

14:06-14:24  Preparation of SiC and Ag/SiC coatings on TRISO surrogate particles by Pulsed Laser Deposition. HTR2014-31363
Martin Lustfeld, Anne-Maria Reinecke, Ana Ruiz-Moreno, Wolfgang Lippmann, Antonio Hurtado, JRC-ITU, Germany

14:24-14:42  Effect of Orientation on Microstructure and Hardness of Graphite Matrix for HTGR. HTR2014-31347
Sunghwan Yeo, Sungok Kim, Moon Sung Cho, Young-Woo Lee. KAERI, Korea
**Track 3: Fuel and Waste**

**Session 3-2: Fabrication**

Session Chair: TANG Chunhe

<table>
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<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Institution</th>
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<tbody>
<tr>
<td>15:51-16:09</td>
<td>Investigation of the fluidized bed-chemical vapor deposition (FB-CVD) process using CFD-DEM method.</td>
<td>HTR2014-31304</td>
<td>Malin Liu, Rongzheng Liu, Yuanyun Wen, Bing Liu, Youlin Shao. INET, China</td>
</tr>
<tr>
<td>16:09-16:27</td>
<td>Study on the efficient disintegration of HTGR fuel elements by electrochemical method.</td>
<td>HTR2014-31267</td>
<td>Piao Nan, Chen Ji, Xiao Cuiping, Wen Mingfen, Chen Jing. Liaoning Shihua Univ., China</td>
</tr>
</tbody>
</table>

**Track 5: Reactor physics analysis**

**Session 5-1: Modelling method and code**

Session Chairs: Hans D. Gougar, WEI Chunlin

<table>
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<th>Time</th>
<th>Title</th>
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<th>Institution</th>
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<tbody>
<tr>
<td>17:00-17:18</td>
<td>The IAEA Coordinated Research Program on HTGR Uncertainty Analysis: Phase I Status and Initial Results.</td>
<td>HTR2014-51106</td>
<td>Frederik Reitsma, Gerhard Strydom, Friederike Bostelmann, Kostadin Ivanov. IAEA</td>
</tr>
<tr>
<td>17:18-17:36</td>
<td>Research on Benchmark Calculation and Analysis of HTR-10 with RMC code.</td>
<td>HTR2014-51207</td>
<td>Wanlin Li, Ganglin Yu, Chunlin Wei. Tsinghua Univ., China</td>
</tr>
<tr>
<td>17:36-17:54</td>
<td>Development of a new nuclide generation and depletion code using a topological solver based on graph theory.</td>
<td>HTR2014-51209</td>
<td>S. Kasselmann, S. Scholthaus, C. Rössel, H.-J. Allelein. FZJ, Germany</td>
</tr>
<tr>
<td>17:54-18:12</td>
<td>Advancements in reactor physics modelling methodology of Monte Carlo Burnup Code MCB dedicated to higher simulation fidelity of HTR cores.</td>
<td>HTR2014-51291</td>
<td>Jerzy Cetnar. AGH Univ. of Science and Technology, Poland</td>
</tr>
</tbody>
</table>
OCTOBER 28, TUESDAY | ROOM 5

Track 1: National research programs and industrial projects
Session 1-1: National research programs and industrial projects - I
Session Chairs: Frederik Reitsma, Horst-Michael Prasser

   Nils Haneklaus, Frederik Reitsma, Harikrishnan Tulsidas. IAEA

   Farshid Shahrokhi, Lewis Lommers, John Mayer, Finis Southworth. AREVA, USA

14:06-14:24 The ARCHER Project. HTR2014-11234
   S. Knol, M.A. Fütterer, F. Roelofs, N. Kohtz, M. Laurie, D. Buckthorpe, W. Scheuermann. NRG, Netherlands

14:24-14:42 HTR studies at PSI. HTR2014-11377
   Horst-Michael Prasser. PSI, Switzerland

Track 1: National research programs and industrial projects
Session 1-2: National research programs and industrial projects - II
Session Chairs: Frederik Reitsma, Horst-Michael Prasser

15:15-15:33 HTR System Integration in Europe and South Africa. HTR2014-11220

15:33-15:51 Nuclear power more profitable than coal if funded with low cost capital: A South-African case study. HTR2014-11183
   Dawid E. Serfontein. North West Univ., South Africa

   Li Yanrui, Xin Pingping, Yao Ruiquan, Guo Huifang. Institute of Nuclear Information & Economics, China
Track 4: Materials and Components
Session 4-1: Research on Metallic Materials I
Session Chairs: SHI Zhengang, Manuel A. Pouchon

17:00-17:18  High Temperature Test of 800HT Printed Circuit Heat Exchanger in HELP.  HTR2014-41170
Chan Soo Kim, Sung-Deok Hong, Jaesool Shim, Min Hwan Kim.  KAERI, Korea

17:18-17:36  Evaluation of the Control Rod Super Alloy Material of HTR-PM.  HTR2014-41199
Li Pengjun, Yan He, Diao Xingzhong.  INET, China

17:36-17:54  Corrosion tests of high temperature alloys in impure helium.  HTR2014-41235
Jan Berka, Jana Kalivodova, Monika Vilemova, Zuzana Skoumalova, Petr Brabec.  Research Centre Rez & Institute of Chemical Technology in Prague, Czech

R. N. Wright, L. J. Carroll, J. K. Benz, J. K. Wright, T. M. Lillo, N. J. Lybeck.  INL, USA
October 29, Wednesday

PLENARY SESSION 1
National & International Status & Progress
08:30-09:30

PLENARY SESSION 2
Safety, Licensing and Technology
10:10-11:40

TECHNICAL SESSIONS
13:30-18:30

OCTOBER 29, WEDNESDAY | CONFERENCE HALL

Plenary Session 1:
National & International Status & Progress
Chairs: Tom O’Connor, Frederik Reitsma

08:30-08:45  The GEMINI Initiative
             Finis Southworth. AREVA, USA;
             Vincent Chauvet. LGI-Consulting Paris, France

08:45-09:00  Present Status of HTTR Project in JAEA
             Kunitomi Kazuhiko. JAEA, Japan

09:00-09:15  Nuclear Hydrogen and VHTR Technology Development in Korea
             Yong Wan KIM. KAERI, Korea

09:15-09:30  Generation IV Reactors: Continued Progress toward the Future
             Carl Sink. DOE, USA
Plenary session 2:  
Safety, Licensing and Technology  
Chairs: H. J. Allelein, Kunitomi Kazuhiko

10:10-10:25  Initial Start-up and Testing of the Fort St. Vrain HTGR - Lessons Learned which may be Useful to the HTR-PM  
H. Larry Brey.  Public Service Company of Colorado, USA

10:25-10:40  Post Fukushima Action – A Perspective from the IAEA  
Frederik Reitsma.  IAEA

10:40-10:55  Guideline for HTR-PM Safety Review  
ZHU Lixin.  NNSA, China

Fred Silady.  Technology Insights, USA

11:10-11:25  HTR-PM Safety Requirement and Licensing Experience  
LI Fu.  INET, China

Michael A. Fütterer  JRC, Netherlands

OCTOBER 29, WEDNESDAY  |  ROOM 1

Track 6: Thermal-hydraulics and Coupled Code Analyses  
Session 6-4: Reactor transient and accident analysis  
Session Chairs: SHI Lei, Malwina Gradecka

Zheng Yanhua, Xia Bing, Shi Lei, Chen Fubing.  INET, China

13:48-14:06  Discussion on Design Transients of Pebble-bed High Temperature Gas-cooled Reactor HTR2014-61144  
Wang Yan,  Li Fu, Zheng Yanhua.  INET, China

14:06-14:24  Study on the Break Accidents of the HTR-PM Primary Loop. HTR2014-61155  
Lang Minggang, Sun Ximing, Zheng Yanhua.  INET, China

Hao Haoran, Frank Wols, Jan Leen Kloosterman.  INET, China

14:42-15:00  Examination of rapid depressurization phenomena modeling problems in VHTR following sudden DLOFC event. HTR2014-61238  
Izabela Gutowska, Brian G. Woods.  Warsaw Tech. Univ., Poland
Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-5: Fission products, graphite dust and hydrogen production
Session Chairs: Karl Verfondern, CHEN Zhipeng

15:15-15:33 Chemical Mechanism of Graphite Dust Migration in the Primary Loop of HTGR. HTR2014-61188
Bo Yuan, Huaqiang Yin. INET, China

M.M. Stempniewicz, D. Wessels. NRG Arnhem, Netherlands

15:51-16:09 Sorption Coefficients for Iodine, Silver, and Cesium on Dust Particles. HTR2014-61289
M.M. Stempniewicz, P. Goede. NRG Arnhem, Netherlands

Tae-hoon Lee, Ki-young Lee, Young-joon Shin. KAERI, Korea

Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-6: Fluid dynamic simulation and experiment
Session Chairs: Michael Laufer, SUN Ximing

17:00-17:18 Predictions of the Bypass Flows in the HTR-PM Reactor Core. HTR2014-61130
Sun Jun, Chen Zhipeng, Zheng Yanhua, Shi Lei, Li Fu. INET, China

17:18-17:36 Thermodynamics Properties of Binary Gas Mixtures for Brayton Space Nuclear Power System. HTR2014-61286
Ersheng YOU, Lei SHI, Zuoyi ZHANG. INET, China

17:36-17:54 Experimental Study of the Twin Turbulent Water Jets Using Laser Doppler Anemometry for Validating Numerical Models. HTR2014-61328
Huhu Wang, Saya Lee, Yassin A. Hassan, Arthur E. Ruggles. Texas A&M Univ., USA

17:54-18:12 Effect of Crossflow on Hot Spot Fuel Temperature in Prismatic VHTR. HTR2014-61206
Sung Nam Lee, Nam-il Tak, Min Hwan Kim, Jae Man Noh, Goon-Cherl Park. KAERI, Korea
Track 7: Development, Design and Engineering
Session 7-4: Research on pebble bed behaviour
Session Chairs: ZHOU Yangping, Wolfgang Steinwarz

Du Yuwei. China Nuclear Power Engineering, China

ZHOU Shuyong, WANG Junsan, Wang Yuding, CAI Ruizhong, Zhang Xuan, Cao Jianting. CNPSC, China

14:06-14:24 The Design of the Radioactive Graphite Dust Experimental System in the Primary Circuit of HTR-PM. HTR2014-71239
Feng Xie, Yongnan Liang, Yue Pi, Hong Li, Jingyuan Qu. INET, China

14:24-14:42 The cross-flow mixing analysis of quasi-static pebble flow in pebble bed reactor. HTR2014-71421
Xiang Fang, Zhiyong Liu, Yanfei Sun, Xingtuan Yang, Shengyao Jiang. INET, China

14:42-15:00 Introduction to the Chinese HTR-PM heat transfer test facility. HTR2014-71422
Zhiyong Liu, Cheng Ren, Yanfei Sun, Xingtuan Yang, Shengyao Jiang. INET, China

Track 7: Development, Design and Engineering
Session 7-5: Heat transform and hydrodynamics studies in HTGR
Session Chairs: WANG Jinhua, LI Tianjing

15:15-15:33 Study on cryogenic adsorption capability of trace nitrogen and methane by activated carbon for coolant helium purification. HTR2014-71141
Hua Chang, Zong-Xin Wu. INET, China

Hao Haoran, Yang Xiaoyong, Wang Jie, Ye Ping, Yu Xiaoli, Zhao Gang, INET, China

15:51-16:09 Research and Measure of Tritium and Carbon-14 in HTR-10. HTR2014-71190
Pi Yue, Cao Jianzhua, Xie Feng. China Nuclear Power Engineering, China

Zhou Yangping, Hao Pengefei, Li Fu, Shi Lei, He Heng. INET, China

16:27-16:45 Experimental and numerical study of granular flow characteristics of absorber sphere pneumatic conveying process. HTR2014-71435
He Zhang, Tianjin Li, Weiwei Qi, Zhiyong Huang, Hanliang Bo. INET, China
Track 7: Development, Design and Engineering
Session 7-6: Construction of nuclear power plant
Session Chairs: WANG Jinhua, LI Tianjing

17:00-17:18 Digital Distributed Control System Design: Control Policy for Shared Objects in HTR-PM. HTR2014-71138
Shuqiao ZHOU, Xiaojin HUANG. INET, China

17:18-17:36 Preliminary Study on New Design and Construction of HTR-PM Steam Generator Compartment Modules. HTR2014-71201
Zhu Longyun, Wang Haijun. HSNPC, China

17:36-17:54 Applications and Prospects of Modularization Technology in HTR Project Starting from Primary Loop Cavity Construction. HTR2014-71433
Guokang Yang, Jing Chen, Wen Huang, Lizhi Lin, Yunlun Sun, Yan Chen, Jiaxin Mao, Yougang wang, Jinwen Wang, Mingfeng Lin, Mingshan Yang. Chinergy, China

17:54-18:12 Research and tests of Steel-concrete-steel sandwich composite shear wall in reactor containment of HTR-PM. HTR2014-71434
Yunlun Sun, Wen Huang, Ran Zhang, Pei Zhang, Chunyu Tian. Chinergy, China

OCTOBER 29, WEDNESDAY | ROOM 3

Track 5: Reactor physics analysis
Session 5-2: Operation and fuel management
Session Chairs: Frederik Reitsma, XIA Bing

Samukelisiwe N. Khoza, Dawid E. Serfontein, Frederik Reitsma. North-West Univ., South Africa

13:48-14:06 Improvement of Discontinuity Factor for Strong Absorber Region. HTR2014-51276
Guo Jiong, Li Fu, Hao Chen, Zhang Han, Zhou Xiaofeng, Fan kai, Wang lidong, Lu Jiana. INET, China

14:06-14:24 Calculation of the Fission Product Release for the HTR-10 based on its Operation History. HTR2014-51181
A. Xhonneux, C. Druska, S. Struth, H.-J. Allelein. FZJ, Germany

14:24-14:42 Conception of Experimental Studies of Modular HTGR Neutronics at Astra Critical Facility with Heating of the Assembly. HTR2014-51323
Track 2: Industrial application and markets
Session 2-3: Application and hydrogen
Session Chairs: ZHANG Ping, Seiji Kasahara

15:15-15:33  GTHTR300 cost reduction through design upgrade and cogeneration.  
HTR2014-21436  
   Xing L. Yan, Hiroyuki Sato, Yu Kamiij, Atsuhiko Terada, Yoshiyuki Imai,  
   Yukio Tachibana, Kazuhiko Kunitomi.  JAEE, Japan

15:33-15:51  INET, China’s R&D on high temperature electrolysis for hydrogen production  
   Bo Yu.  INET, China

15:51-16:09  Monitoring of the AMB rotor and electrical fault diagnosis in HTR.  
HTR2014-21320  
   Zhao Jingjing, Sun Zhe, Yan Xunshi, Shi Zhengang.  INET, China

   L.Lommers, J.Geschwindt, F.Southworth, F.Shahrokhi.  AREVA, USA

16:27-16:45  Viscosity of HI-I2-H2O solution at atmosphere pressure.  
HTR2014-21329  
   Songzhe Chen, Mengxue Gao, Ping Zhang, Laijun Wang, Jingming Xu.  
   INET, China

Track 8: Safety and Licensing
Session 8-2: Safety Analysis
Session Chairs: CHAI Guohan, TONG Jiejuan

17:00-17:18  Comparative Study on the Method of Uncertainty Analysis in the Maximum Fuel Temperature of HTR-PM.  HTR2014-81282  
   Hao Chen, Li Fu, Zheng Yanhua.  INET, China

17:18-17:36  Plant Operation Station for HTR-PM Low Power and Shutdown Operation Probabilistic Safety Analysis.  HTR2014-81332  
   Liu Tao, Tong Jiejuan.  INET, China

17:36-17:54  Phenomena Identification and Ranking Tables Related to the HTR-PM Accident Analysis.  HTR2014-81296  
   Fubing CHEN, Yanhua ZHENG, Lei SHI, Fu LI, Yujie DONG,  
   Zuoyi ZHANG.  INET, China

   LIU Yusheng, TANG Jilin, WEN Lijing, ZHANG Chunming, ZHANG Pan.  
   Ministry of Environment Protection, China
Track 3: Fuel and Waste
Session 3-3: Irradiation
Session Chair: Steven Knol

Nadia Rohbeck, Ping Xiao. Univ. of Manchester, UK

13:48-14:06 Comparative Study of Laboratory-Scale and Prototypic Production-Scale Fuel Fabrication Processes and Product Characteristics. HTR2014-31093
Douglas W. Marshall. INL, USA

14:06-14:24 Test Results of PBMR Fuel Spheres. HTR2014-31418
Konstantin Koschcheev, Alexander Diakov, Igor Beltyukov, Andrey Barybin, Mikhail Chernetsov. Institute of Nuclear Materials, Russia

Shohei Ueta, Asset Shaimerdenov, Shamil Gizatulin, Lyudmila Chekushina, Masaki Honda, Masashi Takahashi, Kenichi Kitagawa, Petr Chakrov, Nariaki Sakaba. JAEA, Japan

Track 3: Fuel and Waste
Session 3-4: Irradiation and PIE
Session Chair: David Petti

Bong Goo Kim, Sunghwan Yeo, Kyung-Chai Jeong, Sung-Ho Eom, Yeon-Ku Kim, Woong Ki Kim, Young Woo Lee, Moon Sung Cho, Yong Wan Kim. KAERI, Korea

Michael E. Davenport, A. Joseph Palmer, David A. Petti. INL, USA

15:51-16:09 Determination of the Quantity of I-135 Released from the AGR Experiment Series. HTR2014-31103
Dawn M. Scates, John B. Walter, Edward L. Reber, James W. Sterbentz, David A. Petti. INL, USA

16:09-16:27 Analysis of Fission Gas Release-to-Birth Ratio Data from the AGR Irradiations. HTR2014-31102
Jeffrey J. Einerson, Binh T. Pham, Dawn M. Scates, John T. Maki, David A. Petti. INL, USA
Track 3: Fuel and Waste
Session 3-5: PIE
Session Chair: John Hunn

17:00-17:18 Progress in Solving the Elusive Ag Transport Mechanism in TRISO Coated Particles: “What is new?” . HTR2014-31261
I. J. van Rooyen, H. Nabilek, J. H Neethling, M. J. Kania, D. A. Pettig . INL, USA

17:18-17:36 Investigation of the Fission Products Silver, Palladium and Cadmium in Neutron Irradiated SiC using a Cs-Corrected HRTEM. HTR2014-31255
I. J. van Rooyen, E. J. Olivier, J. H Neethling . INL, USA

17:36-17:54 Irradiation Performance of AGR-1 High Temperature Reactor Fuel. HTR2014-31182
Paul A. Demkowicz, John D. Hunn, Scott A. Ploger, Robert N. Morris, Charles A. Baldwin, Jason M. Harp, Philip L. Winston, Tyler J. Gerczak, Isabella J. van Rooyen, Fred C. Montgomery, Chinthaka M. Silva . INL, USA


Jana Kalivodová, Jan Berka, Jozef Dámer, Ivan Viden, Jaroslav Burda, Markéta Zychová . Centrum výzkumu Úžhorod, Husinec-Rez, Czech

Track 4: Materials and Components
Session 4-2: Research on Metallic Materials II & Summarization
Session Chairs: SHI Zhengang, Manuel A. Pouchon

D.E. Buckthorpe . Manchester Univ., UK

13:48-14:06 Discussion of High-Temperature Performance of Alloy 625 for HTR Steam Generator. HTR2014-41298
Sun Guohui, Yang Song, Cao Xinjie, Ou Xinze, Wang Xinjuan . HARBIN ELECTRIC CORPORATION, China

14:06-14:24 Ten years of high temperature materials research at PSI - an overview paper. HTR2014-41361
Manuel A. Pouchon, Jiachao Chen . PSI, Switzerland

14:24-14:42 Investigation of Creep Rupture Properties in Air and He Environments of Alloy 617 at 800°C . HTR2014-41376
Woo-Gon Kim, I.M.W. Ekaputra, Jae-Young Park, Min-Hwan Kim, Yong-Wan Kim . KAERI, Korea

14:42-15:00 Corrosion behaviour of metallic materials in the experimental helium loop (HTHIL-1). HTR2014-41349
Jana Kalivodová, Jan Berka, Jozef Dámer, Ivan Viden, Jaroslav Burda, Markéta Zychová . Centrum výzkumu Úžhorod, Husinec-Rez, Czech
Track 4: Materials and Components
Session 4-3: Research on Nom-Metallic Materials 1
Session Chairs: SUN Libin, Samuel Baylis

15:15-15:33  AGR core models and their application to HTRs and RBMKs.  
HTR2014-41171  
Samuel Baylis.  EDF Energy, UK

15:33-15:51  Irradiation test plan of oxidation-resistant graphite in WWR-K Research 
Reactors.  HTR2014-41236  
Junya Sumita, Taiju Shibata, Nariaki Sakaba.  JAEA, Japan

15:51-16:09  Investigation on wear behavior of graphite ball under different 
pneumatic conveying environments.  HTR2014-41275  
Chen Zhipeng, Zheng Yanhua, Shi Lei, Yu Suyuan.  INET, China

16:09-16:27  Research on Moisture Absorption Performance of Carbon Material Used 
in HTGR.  HTR2014-41277  
WEI Liqiang, LU Zhenming, CHEN Xiaotong, LIU Ling, CHEN Xiaoming.  
INET, China

Track 4: Materials and Components
Session 4-4: Research on Nom-Metallic Materials 2
Session Chairs: SUN Libin, Samuel Baylis

17:00-17:18  A Simulation Model for Tensile Fracture Procedure Analysis of Graphite 
Material based on Damage Evolution.  HTR2014-41330  
Erqiang Zhao, Hongtao Wang, Shaopeng Ma.  Beijing Institute of 
Technology, China

17:18-17:36  Experimental research of the yielding behavior of a graphite cylinder 
subjected to line loading.  HTR2014-41331  
Hetong Liu, Qinwei Ma, Hongtao Wang, Shaopeng Ma.  Beijing Institute 
of Technology, China

17:36-17:54  Oxidation Protective SiC Coating on Graphite for VHTR Core Support 
Structure.  HTR2014-41334  
Jae-Won Park, Eung-Seon Kim, Jae-Un Kim, William E. Windes.  
KAERI, Korea

17:54-18:12  A TDS Study of High-Temperature N2 Adsorbed and N+ Ion Implanted 
Nuclear Carbon Materials.  HTR2014-41336  
Mingyang Li, Zhengcao Li, Zhen Hu, Hong Li, Jianzhu Cao.  
Tsinghua Univ., China
October 30, Thursday

PLENARY SESSION 3
Equipment, Supply and Project Implementation
08:30-09:30

PLENARY SESSION 3
Equipment, Supply and Project Implementation
09:50-10:50

TECHNICAL SESSIONS
13:30-18:30

HTR INTERNATIONAL ORGANIZING COMMITTEE MEETING
20:00-21:00

OCTOBER 30, THURSDAY | CONFERENCE HALL

Plenary Session 3:
Equipment, Supply and Project Implementation
Chairs: WU Yulong, DONG Yujie

08:30-08:45 Introduction to Progress of HTR-PM Demonstration Project
GONG Bing. HSNPC, China

08:45-09:00 EPC Experiences of HTR-PM Project
WU Yulong. Chinergy, China

09:00-09:15 Technologies of HTR-PM
DONG Yujie. INET, China

09:15-09:30 The Introduction of HTR-PM Fuel Production Line
ZHANG Jie. China North Nuclear Fuel Co., LTD, China

09:50-10:05 The Design and Research of HTR-PM Steam Generator
WU Xinxin. INET, China

10:05-10:20 HTR, the New Challenge and Improvement for Equipment Manufacturers
ZHU Genfu. Shanghai Electric Group Co., Ltd, China

SHI Guilian. China Techenergy Co. Ltd, China

10:35-10:50 The Technical Solution of Full Scope Training Simulator of HTR-PM
WANG Junsan. CNPSC, China
Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-7: Thermal hydraulics of key components
Session Chairs: Stempniewicz, CHEN Fubing

Jung Hoon Ha, Jin Ki Ham, Min-Hwan Ki, Won Jae Lee. Hyundai Heavy Industries, Korea

13:48-14:06  Supercritical Steam Generator Design in Modular High-Temperature Gas-Cooled Reactor. HTR2014-61414
ZHANG Zhen, YANG Xing-tuan, JU Huai-ming. INET, China

14:06-14:24  Thermal Hydraulic Analysis of RPV Support Cooling System for HTGR. HTR2014-61438
Qi Min, Xinxin Wu, Xiaowei Li, Li Zhang, Shuyan He. INET, China

14:24-14:42  The Helium Test Facility (HTL) – Description and Operational Experiences. HTR2014-61192
Zuoyi Zhang, Mingde Yang, HanLiang Bo, Riqiang Duan, Hongye Zhu. INET, China

14:42-15:00  The Thermohydraulics and Dynamics Study of the HTR-10 High Temperature Helium Experimental Loop. HTR2014-61185
Chen Yang, Chao Fang, Jianzhu Cao. INET, China

Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-8: Natural circulation flow analysis
Session Chairs: ZHENG Yanhua, Shumpei Funatani

Tetsuaki Takeda, Hirofumi Hatori, Shumpei Funatani. Univ. of Yamanashi, Japan

Shumpei Funatani, Tetsuaki Takeda. Univ. of Yamanashi, Japan

15:51-16:09  Experimental Observations of Natural Circulation Flow in the NSTF at Steady-State Conditions. HTR2014-61430
Darius D. Lisowski, Mitch T. Farmer. ANL, USA

16:09-16:27  Separate Effect Experiment on Density Gradient Driven Flow in VHTR Small Break Air Ingress Accident. HTR2014-60148
Jae Soon Kim, Jin Seok Hwang, Eung Soo Kim. Seoul National Univ., orea
Seoul National Univ., Korea
Track 6: Thermal-hydraulics and Coupled Code Analyses
Session 6-9: Fuel element flow and porosity influence
Session Chairs: Lang Minggang, Heikki Suikkanen

17:00-17:18 The X-Ray Pebble Recirculation Experiment (X-PREX): Facility Description, Preliminary Discrete Element Method Simulation Validation Studies, and Future Test Program. HTR2014-61259
Michael R. Laufer, Jeffrey E. Bickel, Grant C. Buster, David L. Krumwiede, Per F. Peterson. Univ. of California, Berkeley, USA

17:18-17:36 Experiment Study of Fuel Element Motion in HTR-PM Conveying Pipelines. HTR2014-61248
WANG Xin, ZHANG Haiquan, NIE Junfeng, LI Hongke, LIU Jiguo, HE ayada. INET, China

17:36-17:54 Numerical Simulation of Flow Patterns of Fuel Spheres in Pebble Bed Reactors. HTR2014-61426
Sun Ximing, Li Fu. INET, China

17:54-18:12 Influence of Local Porosity Maxima on High Temperature Pebble - Bed Reactor Safety. HTR2014-61424
J. Bader. Univ. of Stuttgart, Germany

Track 7: Development, Design and Engineering
Session 7-7: Structural analysis in HTGR
Session Chairs: ZHOU Yangping, Wolfgang Steinwarz

Xu xiong guo, Shen ru guo, Ge chun xin, Fei dong dong, Yue xi han. Shanghai Turbine Plant, China

13:48-14:06 Drop analysis of the canister for spent fuel storage in HTR-PM. HTR2014-71271
Li Yue, Wang Jinhua, Wu bin. INET, China

14:06-14:24 Seismic Study of TMSR Graphite Core Structure. HTR2014-71351
Derek Tsang, Chao Chao Huang. Shanghai Institute of Applied Physics, China

14:24-14:42 Nonlinear finite element analysis of a test on the mechanical mechanism of the half-steel-concrete composite beam in HTR-PM. HTR2014-71379
SUN Feng, PAN Rong. Ministry of Environment Protection, China
Track 7: Development, Design and Engineering
Session 7-8: System and component design - I
Session Chairs: SHI Qi, SUN Yunlun

               HTR2014-71437
               Qi Shi, Xiaojing Kang. Chinergy, China

15:33-15:51    DESIGN OF THE HTR-PM SPENT FUEL STORAGE FACILITY.
               HTR2014-71237
               WANG Jinhua, ZHANG Zuoyi, WU Bin, LI Yue. INET, China

15:51-16:09    Research status on hydrodynamics and particle motion behavior of
               absorber sphere pneumatic conveying system in HTR-PM.
               HTR2014-71287
               Tianjin Li, He Zhang, Zhiyong Huang, Weiwei Qi, Hanliang Bo. INET,
               China

16:09-16:27    SHIDAOWAN HTR EX-CORE NEUTRON FLUX MONITORING SYSTEMS.
               HTR2014-71390
               Clark J. Artaud. Thermo Fisher Scientific (China), USA

Track 7: Development, Design and Engineering
Session 7-9: System and component design -II
Session Chairs: XIE Feng, LIU Dan

17:00-17:18    Concept of a Prestressed Cast Iron Pressure Vessel for a Modular High
               Temperature Reactor. HTR2014-71392
               Wolfgang Steinwarz, Dieter Bounin. Siempelkamp Nukleartechnik
               GmbH, Germany

17:18-17:36    The Design of High Reliability Magnetic Bearing Systems for Helium
               Cooled Reactor Machinery. HTR2014-71378
               N. Davies, R. Gao, Z. Guo, R. Jayawant, R. Leung, R. Shultz, M.
               Swann. Waukesha Magnetic Bearings, USA

17:36-17:54    Reliability Analysis on the Speed Measurement Redundant System of
               AMB Based on Markov Process. HTR2014-71402
               Zhou Yan, Shi Zhengang, Mo Ni, Yang Guojun. INET, China
Track 5: Reactor physics analysis
Session 5-3: Core analysis and design
Session Chairs: Frederik Reitsma, GUO Jiong

Wei Chunlin, Zhao Jing, Zhang Jian, Xia Bing. INET, China

Hwanyeal Yu, Donny Hartanto, Yonghee Kim. KAIST, Korea

14:06-14:24 ON THE EVALUATION OF PEBBLE BEAD REACTOR CRITICAL EXPERIMENTS USING THE PEBBED CODE. HTR2014-51253
Hans D. Gougar, R. Sonat Sen. INL, USA

14:24-14:42 The influence of thorium on the temperature reactivity coefficient in a 400 MWth pebble bed high temperature plutonium incinerating reactor. HTR2014-51384
Guy A. Richards, Dawid E. Serfontein. North-West Univ., South Africa

14:42-15:00 Neutronics Analysis of A 100 kWe Pebble Bed Space Reactor Concept. HTR2014-51403
Zeguang LI, Lei SHI, Zuoyi ZHANG. INET, China

Track 8: Safety and Licensing
Session 8-3: Source Term
Session Chairs: H. J. Allelein, CHAI Guohan

15:15-15:33 Influence of high temperature treatment on graphite dust remobilization in a HTR primary coolant circuit. HTR2014-81355
C. Stöckel, T. Barth, J. Zhao, H. Großmann, W. Lippmann, U. Hampel, A. Hurtado. TU Dresden, Germany

Matt Richards. Ultra Safe Nuclear, USA

T. Barth, J. Zhao, J. Kulenkampff, U. Hampel. Institute of Fluid Dynamics, Germany
OCTOBER 30, THURSDAY | ROOM 4

Track 3: Fuel and Waste
Session 3-6: Modelling
Session Chair: Paul Demkowicz


Robert N. Morris, Charles A. Baldwin, Paul A. Demkowicz, John D. Hunn, Edward L. Reber. ORNL, USA


Jason M. Harp, Paul A. Demkowicz. INL, USA

14:06-14:24 Detection and Analysis of Particles with Failed SiC in AGR-1 Fuel Compacts. HTR2014-31254

John D. Hunn, Charles A. Baldwin, Tyler J. Gerczak, Fred C. Montgomery, Robert N. Morris, Chinthaka M. Silva, Paul A. Demkowicz, Jason M. Harp, Scott A. Ploger. ORNL, USA

14:24-14:42 Comparison of fission product release predictions using PARFUME with results from the AGR-1 irradiation experiment. HTR2014-31382

Blaise P. Collin, David A. Petti, Paul A. Demkowicz, John T. Maki. INL, USA

Track 3: Fuel and Waste
Session 3-7: Modelling and Waste
Session Chair: Mathias Laurie


Yang Lin, Liu Bing, Tang Chunhe. State Nuclear Power Technology R&D Centre, China

15:33-15:51 Comparison of fission product release predictions using PARFUME with results from the AGR-1 safety tests. HTR2014-30264

Blaise P. Collin, David A. Petti, Paul A. Demkowicz, John T. Maki. INL, USA


D. Shi, A. Xhonneux, S. Ueta, K. Verfondern, H.-J. Allelein. FZJ, Germany


A. S. Ivanov, A. A. Rusinkevich. Kurchatov, Russia
Track 3: Fuel and Waste
Session 3-8: Waste
Session Chair: Karl Verfondern

17:00-17:18 Carbon Dust Filtration in Three Different Nuclear Process Environments: A comparison the challenges Carbon Dust Filtration Presents Under Different Process Conditions. HTR2014-31411

Chris Chadwick. Porvair Filtration Group

17:18-17:36 Advances in HTGR Wastewater Treatment System Design. HTR2014-31399

Li Junfeng, Qiu Yu, Wang Jianlong, Jia Fei. INET, China

17:36-17:54 Strategy Study on Treatment and Disposal of the Radioactive Graphite Waste of HTR. HTR2014-31398

Li Junfeng, Ma Tao, Wang Jianlong. INET, China


Wenqian Li, Hong Li, Jianzhu Cao, Jiejuan Tong. INET, China


Sida Sun, Sheng Fang, Tao Liu, Jianzhu Cao, Hong Li. INET, China

Track 4: Materials and Components
Session 4-5: Research on Nom-Metallic Materials 3
Session Chairs: SUN Libin, Samuel Baylis


Xu Wei, Shi Lei, Zheng Yanhua. INET, China


Xiaoyu GUO, Zhengcao LI, Zhen HU, Hong LI, Jianzhu CAO. Tsinghua Univ., China

14:06-14:24 Temperature programmed desorption (TPD) studies on nuclear carbon materials charged with hydrogen at elevated temperatures. HTR2014-41342

Zhengcao Li, Mingyang Li, Zhen Hu, Hong Li, Jianzhu Cao. Tsinghua Univ., China

14:24-14:42 Joining technology - A challenge for the use of SiC components in HTRs. HTR2014-41439

M. Herrmann, P. Meisel, W. Lippmann, A. Hurtado. TU Dresden, Germany

14:42-15:00 Relationship between the Toyo Tanso Group and HTR-PM. HTR2014-41450

Takashi KONISHI, Masatoshi YAMAJI, Eiji KUNIMOTO, GuoBin Zhan, Dalei Yuan. TOYO TANSO, Japan
### Track 4: Materials and Components

#### Session 4-6: Manufacture and Maintenance of Components

**Session Chairs:** SUN Yanfei, SHI Zhengang

  
  Gong Tong Hao, Ge Chun Xin, Wang Min, Yao Jian Fang. Shanghai Turbine Plant, China

  
  ZHENG Tianchang, WANG Min, XU Xiongguo. Shanghai Turbine Plant, China

- **15:51-16:09** HTGR Metallic Reactor Internals Core Shell Cutting & Machining Anti-deformation Technique Study. HTR2014-41198
  
  Xing Huiping, Xue Song. Shanghai No.1 Machine Tools Work, China

- **16:09-16:27** The Research and Development for 12Cr2Mo1 Heavy Steel Forgings Used for RVI of HTR. HTR2014-41395
  
  Shi Yu, Xue Song, Gong Hongwei. Shanghai No.1 Machine Tool Works, China

### Track 4: Materials and Components

#### Session 4-7: Design and Experiment of Components

**Session Chairs:** SUN Yanfei, SHI Zhengang

- **17:00-17:18** Design and Experiment of Auxiliary Bearing for Helium Blower of HTR-PM. HTR2014-41129
  
  YANG Guojun, SHI Zhengang, LIU Xingnan, ZHAO Jingjing. INET, China

- **17:18-17:36** Flow characteristics of helium gas going through a 90° elbow for flow measurement. HTR2014-41152
  
  Beibei Feng, Shiming Wang, Xingtuan Yang, Shengyao Jiang. INET, China

- **17:36-17:54** Design on Hygrometry System of Primary Coolant Circuit of HTR-PM. HTR2014-41243
  
  Sun Yanfei, Zhong Shuoping, Huang Xiaojin. INET, China

- **17:54-18:12** Thermal Analysis and Structural Design of Deposition Test Section of 10MW High Temperature Gas-cooled reactor-test Module (HTR-10). HTR2014-41311
  
  Wang Xiaoding, Liu Yanfang. DongFang Electric, China
Plenary Session 4: Application and Market
Chairs: N.G. Kodochigov, Yong Wan Kim

08:30-08:45  Nuclear Cogeneration for Industrial Applications
             Karl Verforndern, FZJ, Germany

08:45-09:00  Advancing the Commercialization of HTR: The Potential Applications, Market and Challenges
             CUI Shaozhang, Huaneng Group, China

09:00-09:15  TBD
             N.G. Kodochigov, OKBM, Russia

09:15-09:30  HTR Technology Industrialization Progress
             ZU Bin, CNEC, China

09:50-10:05  Progresses in Hydrogen Production and Application for Establishment of Low-carbon Society in Japan
             Yukitaka Kato, Tokyo Institute of Technology, Japan

10:05-11:20  Closing remarks
             ZHANG Zuoyi, Micheal Fuetterer

Closing Session
Chair: SUN Yuliang

10:50-11:20  Closing remarks
             ZHANG Zuoyi, Micheal Fuetterer
Technical Tour

HTR-PM (High Temperature Reactor-Pebble-bed Module)

HTR-PM, consisting of two 250 MWth reactor-steam generator modules and one steam turbine-generator set, is a 200 MWe industrial demonstration nuclear power plant of the modular pebble-bed high temperature gas-cooled reactor. The plant is located at Shida Bay, Weihai, China, which is close to the conference venue. The first concrete of HTR-PM was poured in December 2012.

HTR-PM is a key project listed in the national long-term science & technology development program of China. With the successful construction and operation and safety tests of HTR-10, the robust safety features of modular pebble-bed reactors have been well demonstrated and recognized. The demand for nuclear power and safety has been pushing the further development of HTGR technology in China.
Sightseeing/Spouse Program

Sightseeing/spouse programs will be arranged on 28, 29 and 30 Oct. as shown below. Participants who wish to join these programs should inform the conference reception desk and pay correspondingly in advance (Participants registered as spouses are exempted from payment).

<table>
<thead>
<tr>
<th>Route No.</th>
<th>Trip</th>
<th>Date</th>
<th>Visiting Time</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weihai Liugong Island, Shidao Chishan</td>
<td>10/28</td>
<td>7:30-17:00</td>
<td>60USD/Person</td>
</tr>
<tr>
<td>2</td>
<td>Weihai Huaxia Town, Shenyou Seaworld</td>
<td>10/29</td>
<td>7:30-16:00</td>
<td>50USD/Person</td>
</tr>
<tr>
<td>3</td>
<td>Rongcheng Chengshan Cape, Shendiaoshan Wildlife Park</td>
<td>10/30</td>
<td>7:30-18:00</td>
<td>65USD/Person</td>
</tr>
</tbody>
</table>

Brief instruction for three routes:

Route 1: Weihai Liugong Island, Shidao Chishan One-day Tour (60USD/person)

09:00 Visit the Liugong Island (The national 5A scenic spot)
14:00 Visit the Shidao Chishan (The natural forest park, the Buddhist shrines, the national 4A scenic spot)

Route 2: Weihai Huaxia Town, Shenyou Seaworld One-day Tour (50USD/person)

08:30 Visit the Huaxia Town (The grand ecological cultural scenic spot showing oriental classical culture, the national 4A scenic area)
12:30 Visit the Shenyou Seaworld in Weihai

Route 3: Rongcheng Chengshan Cape, Animal Parks One-day Tour (65USD/person)

09:00 Visit the Chengshan Cape (National key scenic spot)
13:30 Visit the Shendiaoshan wildlife park (The largest grazing seaside animal park in China)

The Quotation Includes:

1. The air-conditioned tour bus
2. Lunch
3. Scenic spot entrance ticket
4. Tour guide service
5. The travel agency liability insurance
6. Travel accident insurance

Charge for extra services and facilities, such as the battery car, cableway, etc., is not included and tourists must provide information including names, passport numbers, birth dates in advance when registering.
Since its foundation, HSNPC has continuously improved its management in line with national nuclear safety laws and regulations during the construction of HTR-PM Demonstration Project, with experiences of construction and operation management from NPP's home and abroad and CHNG power plants. Having a team of nuclear power workforce with high proficiencies, HSNPC has built a scientific and standard management system and excellent nuclear safety oriented enterprise culture, laying a solid foundation for construction of the HTR-PM Demonstration Project and development of Shidao Bay nuclear power base.
III. Progress of HTR-PM Demonstration Project

On August 17, 2004, the National Development and Reform Commission approved to launch the preliminary works on HTR-PM project.

At the beginning of 2006, HTR-PM Demonstration Project and PWR Demonstration Project were included in the sixteen major projects listed in the National Guideline on Medium Term and Long Term Program for Science and Technology Development (2006-2020).

On February 15, 2008, the State Council approved the overall implementation plan of HTR-PM Demonstration Project.

On March 1, 2011, the State Council executive meeting approved the feasibility report of HTR-PM Demonstration Project.

On December 9, 2012, the first concrete for the Nuclear Island foundation plate was poured, marking the official start of the construction of HTR-PM Demonstration Project.

On September 7, 2014, the first concrete for the Conventional Island was poured, marking the official start of the construction of the main buildings in Conventional Island.

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IV. Highlights of HTR-PM Demonstration Project

The Demonstration Project was officially initiated for construction at the end of year 2012. The civil works has reached to level 0m. Major components such as reactor pressure vessel, main helium circulator and steam generator are in the stage of R&D tests and manufacturing. As the first demonstration project for HTR-PM NPP in the world, significant breakthroughs have been made on project construction and equipment manufacturing.

With respect to construction, as the nuclear island foundation plate of the HTR-PM Demonstration Project is 3m thick, unique construction technologies have been adopted, including layer by layer concrete pouring, heating of aggregate for concrete and real time monitoring by integrated concrete temperature monitoring system. These technologies have helped realization of the first practice of big volume concreteing for nuclear island foundation plate in winter period in the history of nuclear power construction, winning high praise from domestic experts for nuclear safety inspection. The adoption of modular design and construction for civil works and installation addresses the crucial issues on simultaneous and staggered constructions between embedment and steel bars and save a lot of time on the critical path.

In the area of equipment manufacturing, the sample of main helium circulator, the heart of an HTR NPP, has finished the 100-hour continuous hot functional operation test in full power. It’s a breakthrough of key technical issue on advanced technology R&D for HTR and a significant achievement in self reliance and innovation in crucial component technology for advanced nuclear power in China. For the lower cylinder of RPV – another core component in the nuclear island, the class I forging piece is the heaviest and biggest one in all the domestic NPP projects and it’s also a nuclear safety class 1 forging piece most difficult in casting and forging. It weighs 110t each and the casting ingot is 460t. The ultimate verification by magnetic particle testing and ultrasonic test is the sign of breakthrough on the most difficult problem constraining the manufacturing progress of the reactor pressure vessel for a long time, filling the gap in nuclear power components fabrication, and marking a new era of native capability in super-large scale forging fabrication. The spiral tubes of steam generator heat exchanger are designed with high parameters and complicate structure. And there is no similar experience in fabrication. Organizations involved in the R&D have overcome difficulties in super-long heat exchange tube rolling, spiral pipe bending, welding of dissimilar materials, inlet and outlet bending and high temperature resistance test, and completed the installation of the first set of spiral tube assembly, marking the breakthrough of the main fabrication process bottleneck for HTR steam generator and laying a solid foundation for steam generator production. The above-mentioned breakthroughs on key technologies have laid a solid foundation for safety verification and commercialization of HTR.
**Introduction**

Founded in 2003, CHINERGY Co., Ltd. (hereinafter referred to as CHINERGY) is an AE company jointly invested by China Nuclear Engineering Group Co. (CNEC), Tsinghua Holding Co., Ltd. (THHC) and China General Nuclear Power Group (CNG). Dedicated to the research, development, demonstration and deployment of High Temperature Gas-cooled Reactor (HTGR) and the integrated vessel type Nuclear Heating Reactor (NHR), CHINERGY is the supplier of the nuclear application system of HTGR & NHR, and the EPC contractor of NI of the HTR-PM.

**Qualifications**

- NUCLEAR ENGINEERING DESIGN QUALIFICATION CLASS-A
- NUCLEAR ENGINEERING CONSULTING QUALIFICATION CLASS-A

**Main Business**

- Research, development, demonstration and deployment of nuclear energy and other nuclear applied technologies
- EPC of nuclear energy project
- Engineering consultancy for nuclear energy project
- Project investment in nuclear energy

**Project**

- High Temperature Gas-cooled Reactor Demonstration Plant (HTR-PM)
3D Engineering Design

3D design is an advanced method of engineering design and the development trend of engineering design. 3D design technology applied by CHINERGY in HTR-PM can greatly reduce design period and improve design efficiency.

Modular Construction Solutions of HTR-PM

The idea and method of Modular design & construction have been applied by CHINERGY in the construction of HTR-PM. Modular construction solutions of Shield Cooling Water System for Reactor Cavity & Steam Generator Cavity of HTR-PM have been achieved. Modular construction application in HTR-PM can shorten the construction period so as to reduce the construction cost.

HTR Simulation Test Center

HTR SIMULATION TEST CENTER has been established by CHINERGY, dedicated to R&D for simulator and simulation technology applicable to HTR.
上海自动化仪表股份有限公司是一家以自动化产品制造、系统集成和工程服务为主业务的大型企业。自仪的历史可以追溯到1925年，拥有众多优秀企业，包括中国历史上海首个仪表制造企业——大华仪表厂。国家级企业技术中心，投资控股、参股10多家企业。公司1993年10月8日改制上市，简称“自仪股份”，是一家同时发行A、B股的上市公司。

公司作为中国自动化产业发展的典型代表，已成为中国工业自动化领域中同时具有系统、仪表和执行器，结构设计、仪表与系统集成综合制造能力最强的工业IT企业，获高新技术企业称号，长期为火电、核电、轨道交通、环保、石化、化工、冶金、水等业务领域，提供自动化系统集成和解决方案，提供仪器仪表产品、培养。

造就了一批产品设计、产品工艺、系统集成、仪表制造和工程服务、培训等方面的专业人才队伍，坚持以科学管理求持续改进；以上仪品牌使顾客满意；以卓越的品质，卓越的产品，卓越的服务搏击市场，奉献用户。
China North Nuclear Co., Ltd (202 Plant), was built in 1958, is one of the most important members of China National Nuclear Corporation. CNNFC is located in Baotou, Inner Mongolia, is the main research and production base of nuclear material, nuclear fuel elements in China, and made important contribution to peaceful use of atomic energy.

CNNFC is a leading nuclear fuel manufacturer which produces the most kinds of nuclear fuel in China and provides relevant service. CNNFC nuclear fuel R&D facilities consists of a research institute of nuclear materials and nuclear fuel, four nuclear fuel elements production lines, an uranium conversion production line and an independent inspection center. CNNFC supplies nuclear fuel elements for PWR and PHWR power plant and most research reactors in China now and will supply nuclear fuel for AP1000 PWR power plant and HTGR nuclear power plant recently. In the past years, the nuclear fuel elements supplied by CNNFC run stably in the reactors and received high recognition from all the customers.

After nearly sixty years of development, CNNFC has made brilliant achievements in the fields of nuclear materials and nuclear fuel research and fabrication. With the rapid and large-scale development of nuclear power industry, the production, R&D and human resources system made great progress. The R&D capabilities and production capacity of nuclear fuel elements increased continuously. CNNFC provides reliable and high quality nuclear fuel support for the nuclear power development.

CNNFC is willing to make joint efforts with our customers to build a low-carbon, clean, safe, stable new situation of energy supply.

R&D achievements

CNNFC developed and produced many kinds of fuel elements for power reactor and research reactor, has accumulated abundant technology and rich experience in the development of nuclear fuel elements.

Medical neutron irradiator nuclear fuel element. The element is produced for the first medical small reactor in China, treats the brain glioma by neutron capture technology. It is the successful model of nuclear technology exploring in the medical field.

PHWR nuclear power plant cobalt adjustment rod assembly independently developed by CNNFC which replaced the stainless steel adjustment rod assembly, realized cobalt-60 radionuclide production while regulating the reactor neutron energy. By of the end of 2013, seven batches of 151 groups cobalt regulating rod assemblies had been produced, 147 groups were put into the reactor, 105 groups got out of the reactor and the quality of the assemblies are recognized highly by customer.

Vision

At present, with the rapid development of China’s nuclear power industry and the continuous progress of the world nuclear industry, under the leadership of CNNC, CNNFC will continue to improve the industrial R & D capabilities and manufacturing capacity, continue to improve the product quality and optimize the services. The company will always be committed to creating value for customers, achieving the nuclear fuel industry scale, independent, international development, by 2020, CNNFC should be the top-ranking base of nuclear materials research and nuclear fuel elements production, one of best nuclear fuel fabrication company around world.

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Wechat No.: CNNFC202
Shaanxi WeiFeng Nuclear Instrument Inc. was founded in 2003, focusing on the field of radiation monitoring and protection, integrating R&D, production research and development, production, sales and engineering services. Shaanxi WeiFeng also supplies famous foreign products and professional maintenance services for nuclear power plants. WeiFeng products have been exported to more than 60 countries in the world.

Shaanxi WeiFeng has highly experienced professional staff and adopts most up-to-date management system. The company has established an excellent quality assurance system, certified by ISO9001:2008, private science and technology enterprise, high technology enterprise, software enterprise, granted a number of patented technologies as a qualified supplier of China's National Nuclear Corporation.

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- Nuclear Engineering Monitoring System
- Surface Contamination Monitor
- Portable Instrument
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- Lab Equipment
- Environmental and Emergency Radiation Monitoring System
- Portal Monitor
- Monitoring Instrument for Irradiation sites
- Vibration Monitoring System and Seismic Monitoring System
- Maintenance Services

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Conference Center Floor Plan

3rd Floor Plan of International Conference Center

Zhuhai Building Floor Plan

1st Floor Plan of Zhuhai Building
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