



International Conference on Future of Heavy Water Reactors (HWR-Future) 2011 October 2-5



Atucha I and II Power Plants (www.atucha2.com)



Qinshan Phase-III Power Plant (www.AECL.ca)



Rajasthan Atomic Power Station (www.thehindu.com)

**Ottawa Marriott Hotel
Ottawa, Ontario
Canada**



Our Sincere Appreciation to



Atomic Energy of Canada Limited



International Atomic Energy Agency

Co-Sponsoring Nuclear Societies



대한 원자력 학회
KOREAN NUCLEAR SOCIETY



Sunday 2011 October 02

16:30-18:00 Registration

18:30-20:30 Reception

DRAFT



Monday 2011 October 03

07:00-08:00 Continental Breakfast

08:00-10:20 Opening Plenary

Chairs:

- Romney Duffey (Atomic Energy of Canada Limited)

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08:00-08:10 WELCOMING ADDRESS

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08:10-08:35 PLENARY TALK 1

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08:35-09:00 PLENARY TALK 2

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09:00-09:25 PLENARY TALK 3

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09:25-09:50 PLENARY TALK 4

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09:50-10:15 PLENARY TALK 5

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10:15-10:40 BREAK



DRAFT

Monday 2011 October 03

10:40-12:20 **Reactor Design**

Room:

Chairs:

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10:40-11:05 **The EC6--An Enhanced Mid-Sized Reactor with Fuel Cycle Applications**

Mike Soulard, Stephen Yu, Jerry Hopwood and Ian Hastings

11:05-11:30 **Enhanced CANDU6: Reactor Core Design and Fuel Cycle Flexibility**

Michaela Ovanes, P. S.W. Chan, J. Mao and N. Alderson

11:30-11:55 **ROP Design for Enhanced CANDU 6 Reactor**

Jingliang Hu, Dasha Scherbakova, Doddy Kastanya and Michaela Ovanes

11:55-12:20 **I&C Design Changes to enhance CANDU**

John de Grosbois, Gilbert Raiskums and Mike Soulard

12:20-13:30 **LUNCH**

Monday 2011 October 03

10:40-12:20 **HWR Technology**

Room:

Chairs:

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10:40-11:05 **ACR Technology for CANDU Enhancements**

Stephen Yu, Michael Soulard and Ranjit Singh

11:05-11:30 **Roadmap for Human Resources for Expanded Indian Nuclear Industry**

R.K. Singh, G. R. Srinivasan and O. P. Goyal

11:30-11:55 **Some Aspects on Security and Safety in A Potential Transport of A CANDU Spent Nuclear Fuel Bundle in Romania**

Gheorghe Vieru

11:55-12:20 **Operational Transparency: An Advanced Safeguards Strategy for Future On-Load Refuelled Reactors**

Jeremy Whitlock and Dave Trask

12:20-13:30 **LUNCH**



Monday 2011 October 03

13:30-14:50 **Physics and Neutronics**

Room:

Chairs:

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13:30-13:55 **Status of Deuterium Nuclear Data for the Simulation of Heavy Water Reactors**

Ken Kozier, Dan Roubtsov, Raghu Rao, Juris Svenne, Luciano Canton, Arjan Plompen, Mihai Stanoiu, Nikolay Nankov and Chariklia Rouki

13:55-14:20 **Feasibility of the Nodal Equivalence Theory in the CANDU Reactor**

Yonghee Kim, J.H. Park and G.H. Roh

14:20-14:45 **Current Developments and Future Challenges in Physics Analyses of The NRU Heavy Water Research Reactor**

S. Nguyen, B. Wilkin and T. Leung

14:45-15:10 **Measurement and Simulation of Gamma Radiation Profile inside A CANDU Reactor**

S. Yue, C. Jewett, G. Jonkmans, B. Sur, D. Comeau and D. Taylor

15:10-15:40 **BREAK**

Monday 2011 October 03

13:30-14:50 **Thermalhydraulics (I)**

Room:

Chairs:

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13:30-13:55 **The Role of a Technology Demonstration Program for Future Reactors**

Alexandre Viktorov

13:55-14:20 **An Overview of Thermal Hydraulic Design Validation Studies for AHWR**

Ritesh Bagul, Manish Sharma, Darshan Pilkhwal, Pallippattu Vijayan, Dilip Saha and Ratan Sinha

14:20-14:45 **The BEPU (Best Estimate Plus Uncertainty) Challenge in Current Licensing of Nuclear Reactors**

Francesco D'Auria, Alessandro Petruzzi, Nikolaus Muellner and Oscar Mazzantini

14:45-15:10 **The Effect of a CANDU Fuel Bundle Geometric Variation on Thermal Hydraulic Performance**

Jun Ho Bae and Joo Hwan Park

15:10-15:40 **BREAK**



Monday 2011 October 03

15:40-17:20 **Advanced Fuel Cycle**

Room:

Chairs:

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15:40-16:05 **Fuel Cycles--A Key to Future CANDU Success**

Sermet Kuran, Jerry Hopwood and Ian Hastings

16:05-16:30 **Advanced Fuel Cycle Development at Chalk River Laboratories**

Mark Floyd

16:30-16:55 **A Step Towards Closing the CANDU Fuel Cycle – an Innovative Scheme for Reprocessing Used CANDU Fuel**

Frank Collins and Derek Lister

16:55-17:20 **Use of Recycled Uranium in CANDU Reactors**

Catherine Cottrell, Zhenhua Zhang, Mingjun Chen, Mustapha Boubcher and Sermet Kuran

17:20 **END OF DAY 1**

Monday 2011 October 03

15:40-17:20 **Refurbishment**

Room:

Chairs:

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15:40-16:05 **Designing and Operating New Nuclear Power Plants for Future Refurbishment – Regulatory Perspective**

Al Omar, Hatem Khouaja, Blair Carroll and Ken Kirkhope

16:05-16:30 **Safety Benefits from CANDU reactor replacement-- A Case study**

Ron MOTTRAM, Julian Millard and Peter Purdy

16:30-16:55 **Development of advanced techniques for life management and inspection of AHWR coolant channel components**

K Madhusoodanan, S.K. Sinha, Kundan Kumar, T.V. Shyam, Sanjay Panwar, B.S.V.G. Sharma and J.N. Kayal

16:55-17:20 **Safety Analysis Methodology with Assessment of the Impact of the Prediction Errors of Relevant Parameters**

Andrés Galia

17:20 **END OF DAY 1**



Tuesday 2011 October 04

07:30-08:30 Continental Breakfast

08:30-10:10 Thorium Fuel

Room:

Chairs:

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8:30-8:55 Thorium Fuelled CANDU Reactors

Yang Ruan, Catherine Cottrell, Robert Bodner, Ian Hastings and Sermet Kuran

8:55-9:20 Fuel cycle flexibility in Advanced Heavy Water Reactor (AHWR) with the use of Th-LEU fuel

Amit Thakur, Baltej Singh, Neelima Prasad Pushpam, Vishal Bharti, Umasankari Kannan, P. D. Krishnani and R. K. Sinha

9:20-9:45 Benefits of The Transition to A Thorium Fuel Cycle

Geoffrey Edwards and Bronwyn Hyland

9:45-10:10 Moving Towards Sustainable Thorium Fuel Cycles

Bronwyn Hyland and Holly Hamilton

10:10-10:40 BREAK

Tuesday 2011 October 04

07:30-08:30 Continental Breakfast

08:30-10:10 Thermalhydraulics (II)

Room:

Chairs:

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8:30-8:55 Modelling of Critical Heat Flux in Light-Water Flow with Heavy-Water-Based Correlation

Laurence Leung

8:55-9:20 Experimental and Computational Thermalhydraulics Research Related to CANDU Reactor Operation and Safety.

Stavros Tavoularis, Dongil Chang, Elad Rind, George Choueiri, Liu Yuan, Hassan Shaban and Etienne Lessard

9:20-9:45 Experimental Verification of CFD & Thermal Hydraulics Codes by Quantitative Flow Visualization

R.K. Singh, A.K. Kansal, N.K. Maheshwari, P.K. Vijayan and V.M. Joshi

9:45-10:10 Design of an R-134a Loop for Subcritical and Supercritical Forced-Convection Heat Transfer Studies

Masih Balouch and Metin Yaras

10:10-10:40 BREAK



Tuesday 2011 October 04

10:40-12:20 **Transmutation**

Room:

Chairs:

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10:40-11:05 **Reducing The Impact of Used Fuel by Transmuting Actinides in A CANDU Reactor**

Bronwyn Hyland and Geoffrey Edwards

11:05-11:30 **Super-Deep-Burn with the FCM (Fully Ceramic Microencapsulated) TRU Fuel in CANDU**

Yonghee Kim, Francesco Venneri and Donny Hartanto

11:30-11:55 **Transuranic Mixed Oxide Fuel use in CANDU**

Andrew Morreale, David Novog and John Luxat

11:55-12:20 **Transmutation Rates in Annulus Gas of Pressure Tube Nuclear Reactor**

Mohammad Mateen Ahmad, Rachid Machrafi and Igor Pioro

12:20-13:30 **LUNCH**

Tuesday 2011 October 04

10:40-12:20 **Safety Analyses**

Room:

Chairs:

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10:40-11:05 **A Composite Analytical Solution for Large Break LOCA**

Peter Purdy, Rene Girard, John Marczak, Dean Taylor, Raidis Zemdegs, Tefvik Kapaklili, Gabe Balog, Mike Kozluk and Antonino Oliva

11:05-11:30 **Safety Assessment of Passive features of Advance Heavy Water Reactor(AHWR)**

Hemant Lele, Ankur Contractor, Mithilesh Kumar, Abhishek Srivastava, Prasanna Majumdar, Deb Mukhopadhyay, Rajesh kumar, Avinash Gaikwad, Barun Chatterjee, Keshav Vaze and Ratan Sinha

11:30-11:55 **PSA-Oriented Analysis of Transients in Atucha Unit II PHWR with A RELAP Model**

J. González, P. Zanocco, M. Giménez, M. Schivo, O. Mazzantini, M. Caputo, G. Bedrossian, P. Serrano And A. Vertullo

11:55-12:20 **MARS-KS Assessment on B9802 SBLOCA test in RD-14M Test Facility**

Joosung Kim, Kap Kim and Kwangwon Seul

12:20-13:30 **LUNCH**



Tuesday 2011 October 04

13:30-14:50 **Panel Discussion on "Current Developments and Challenges In Heavy Water Reactor Physics Analyses"**

Room:

Chair:

- Parvaiz Akhtar (CNS)
- ()

Panelists:

P.J. Turinsky (NCSU, USA)
F. Rahnema (Georgia Tech., USA)
T. Downar (University of Michigan, USA)
P.D. Krishnani (Homi Bhabha National Institute, India)
J.V. Donnelly (AMEC-NSS, Canada)
A. Buijs (MacMaster University, Canada)

Topics:

- Present neutronics computational schemes for heavy water reactors and challenges related to optimization of operational and licensing needs for life extension
- Full core transport methods in HWR : drivers and trends
- Coupled neutronics-thermalhydraulics codes
- Developmental needs pertaining to advanced HWR designs and new fuel cycles
- Verification and validation activities and related qualification of uncertainties
- Developmental needs to address evolution of regulatory and licensing requirements

15:10-15:40 **BREAK**

Tuesday 2011 October 04

13:30-14:50 **Panel Discussion on "Fuel CHF Enhancement – Technologies to improve safety margin, enhance power output, and mitigate ageing effect"**

Room:

Moderator:

- Laurence Leung (AECL)
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Panelists:

Michel Couture (CNSC)
Gord Hadaller (Stern Lab.)
Matt Krause (AECL)
Yuksel Parlatan (OPG)
Ab Tahir (AMEC-NSS)

Topics:

- Past experience
- Current developments
- Analytical support
- Experimental support
- Future trends
- Regulatory and licensing requirements

15:10-15:40 **BREAK**



Tuesday 2011 October 04

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Topics:

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- Full core transport methods in HWR : drivers and trends
- Coupled neutronics-thermalhydraulics codes
- Developmental needs pertaining to advanced HWR designs and new fuel cycles
- Verification and validation activities and related qualification of uncertainties
- Developmental needs to address evolution of regulatory and licensing requirements

17:20

END OF DAY 2

18:00-18:30

PRE-BANQUET GATHERING FOR GROUP PHOTO

18:30-21:00

CONFERENCE BANQUET

- **Speaker:**

Tuesday 2011 October 04

15:40-17:20 **Panel Discussion on "Fuel CHF Enhancement – Technologies to improve safety margin, enhance power output, and mitigate ageing effect"**

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17:20

END OF DAY 2

18:00-18:30

PRE-BANQUET GATHERING FOR GROUP PHOTO

18:30-21:00

CONFERENCE BANQUET

- **Speaker:**



Wednesday 2011 October 05

- 07:30-08:30 Continental Breakfast**
- 08:30-10:10 Tritium and Moderator-Related Studies**
Room:
Chairs:
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- 8:30-8:55 Tritium Emission Reduction Initiatives at CANDU Stations**
L. Rodrigo, D. Williams and F. Fusca
- 8:55-9:20 Removal of Tritiated Light Water from Fuel Bays using Thermal Stratification**
I. Castillo, K. Kutchcoskie, D. Baker and H. Boniface
- 9:20-9:45 Heavy Water Reactor Moderator – are changes to design requirements necessary?**
John G. Roberts
- 9:45-10:10 A Moderator Ion Exchange Model to Predict Carbon-14 Behaviour during Operations**
D.K Ryland, L. Rodrigo and D.H. Barber
- 10:10-10:40 BREAK**

Wednesday 2011 October 05

- 07:30-08:30 Continental Breakfast**
- 08:30-10:10 Canadian Supercritical Water-Cooled Reactor**
Room:
Chairs:
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- 8:30-8:55 A Next Generation Heavy Water Nuclear Reactor with Supercritical Water As Coolant**
Laurence Leung, Metin Yetisir, William Diamond, Martin Dan, Pencer Jeremy, Bronwyn Hyland, Holly Hamilton, Dave Guzonas and Romney Duffey
- 8:55-9:20 Physics Aspects of The Pressure Tube Type SCWR Preconceptual Design**
Jeremy Pencer and Bronwyn Hyland
- 9:20-9:45 Optimization of Thorium-Uranium Content in a 54-Element Fuel Bundle for use in a CANDU-SCWR**
David Hummel and David Novog
- 9:45-10:10 Review of Research on CANDU-SCWR in XJTU**
Jianqiang Shan, Liangzhi Cao, Qincheng Bi and Junli Gou
- 10:10-10:40 BREAK**



Wednesday 2011 October 05

10:40-12:20 **Heavy Water Technology**

Room:

Chairs:

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10:40-11:05 **A new Approach to Heavy Water Upgrading Technology**

Peter Ozemoyah, John Robinson, Touraj Manifar, Vince Robinson, Sam Suppiah and Hugh Boniface

11:05-11:30 **Combined Electrolysis and Catalytic Exchange (CECE) Upgraders – An Alternative to Water Distillation (DW) Heavy Water Upgraders**

D. Ryland, H. Boniface, I. Castillo and S. Suppiah

11:30-11:55 **Future Trends for Electrolysers in Nuclear Industry**

Touraj Manifar, John Robinson, Vince Robinson, Peter Ozemoyah, Hugh Boniface and Sam Suppiah

11:55-12:20

12:20-13:30 **LUNCH**

Wednesday 2011 October 05

10:40-12:20 **Fuel and Fuel Safety**

Room:

Chairs:

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10:40-11:05 **Design and Fabrication of Remote Welding System for the Fuel Bundle Assembly**

Soo-Sung Kim, Jung-Won Lee and Geun-II Park

11:05-11:30 **Modelling CANDU Fuel Element and Bundle Behaviour for Performance of Intact and Defective Fuel**

Khaled Shaheen, John Stuart Bell, Andrew Prudil and Brent J. Lewis

11:30-11:55 **Evaluation of Fission Product Release Following Single Channel Accidents for Refurbished Wolsong-1**

Jong Yeob Jung and Joo Hwan Park

11:55-12:20 **Potential Use of Enhanced-Thermal Conductivity Fuels in Advanced Heavy-Water Moderated Reactors**

W. Peiman, I. Piro, and K. Gabriel

12:20-13:30 **LUNCH**



Wednesday 2011 October 05

13:30-14:50 **Steam Generators and Pump Seal**

Room:

Chairs:

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13:30-13:55 **Performance Indicators Of CANDU And PWR Steam Generators**

Jovica Riznic and Sanja Simic

13:55-14:20 **Steam Generator and Preheater Tube ID Fouling and the Impacts on Reactor**

Inlet Header Temperature and Inspections

Ken Chuong and Ken Sedman

14:20-14:45 **The role of AECL's Pump Seals Program for Heavy Water Reactors**

Dave Rhodes, Tim Sykes and Jintong Li

14:45-15:10

15:10 **END OF INT. CONF. HWR-FUTURE**

Wednesday 2011 October 05

13:30-14:50 **Pressure Tubes and Passive Autocatalytic Recombiners**

Room:

Chairs:

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13:30-13:55 **Governing factors for in-reactor creep of Zr-2.5Nb tubes and their improvement**

Young Suk Kim

13:55-14:20 **Improved Zr-2.5Nb Pressure Tubing for Future HW Reactors**

G.A. Bickel, L.Walters and M. Griffiths

14:20-14:45 **AECL Passive Autocatalytic Recombiners**

Lee Gardner and Krystyna Marcinkowska

14:45-15:10

15:10 **END OF INT. CONF. HWR-FUTURE**



Thursday 2011 October 06

Int. Conf. HWR-Future Technical Tour (Registered Participants Only)

07:30 Departure from Ottawa Marriott Hotel (Shuttle bus)

07:30-09:30 Travel from Ottawa to Chalk River Laboratories

09:30-10:30 Welcoming address and Introduction

10:30-12:30 Tour of Chalk River Laboratories Facilities

12:30-13:30 Lunch

13:30-16:00 Tour of Chalk River Laboratories Facilities

16:00-18:00 Travel from Chalk River Laboratories to Ottawa Marriott Hotel (Shuttle bus)



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