



INTERNATIONAL FRAMEWORK FOR NUCLEAR ENERGY COOPERATION

RELIABLE NUCLEAR FUEL SERVICES WORKING GROUP

WORKSHOP ON APPROACHES TO FINANCING A MULTINATIONAL REPOSITORY – CHALLENGES AND ALTERNATE APPROACHES

December 11, 2018
CC 10 - OECD Headquarters,
2, rue André Pascal
Paris, France

A geologic repository is recognized worldwide as the reference solution for the disposal of spent nuclear fuel, and high-level radioactive waste. A geologic repository is an expensive undertaking with high fixed costs that are largely independent of the size of the repository. This makes a multinational geologic repository (MNR) an interesting option for reducing overall costs for disposal. This Workshop will explore alternatives to building an innovative business model for future MNR.

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| 8:30 - 9:00 | Registration |
| 9:00 - 9:10 | Welcoming remarks
<i>Sama Bilbao y Leon - Head, Division of Nuclear Technology Development and Economics. OECD-NEA.</i> |
| 9:10 - 9:20 | Introduction to the workshop and recent activities of the Working Group
<i>Co-chairs Sean Tyson and Tomaž Žagar.</i> |
| 9:20 - 09:35 | Past approaches to financing an MNR and large projects
<i>Charles McCombie - President of Arius Association. Arius Association and ERDO working Group.</i> |
| 9:35 - 10:00 | What are the generally understood phases of any geological repository project and what is the spending profile for those phases?
<i>Alan Brownstein - Consultant.</i> |
| 10:00 - 10:25 | What is the cost of an MNR?
<i>Neil Chapman - Vice President of Arius Association.</i> |

- 10:25 - 10:50** **What are the risks that will have to be addressed in any financing arrangement for a MNR?**
Charles McCombie - President of Arius Association. Arius Association and ERDO working Group.
- 10:50 - 11:10** **Group photo and coffee break**
- 11:10 - 12:50** **Planning related to financing, past projects/lessons learned**
- 11:10 - 11:30 Costing methods for high level radioactive waste disposal programs
Stefan Joerg Mayer - Team Leader Disposal, Nuclear Energy. IAEA.
- 11:30 - 11:50 Finland's experience
Anne Väättäinen - Counsellor of Innovations and Enterprise Financing. Ministry of Economic Affairs and Employment - Finland.
Mika Pohjonen - Managing Director. Posiva Solutions Oy - Finland.
- 11:50 - 12:10 Russian approach to high level waste and spent fuel management
Anzhelika Khaperskaya - Leading manager, SNF management Project Office. State Corporation ROSATOM.
- 12:10 - 12:30 Approach to HLW disposal cost estimation
Katsumoto Yoshimura - Director of Technology Office for Radioactive Waste Management. Ministry of Economy, Trade and Industry - Japan.
- 12:30 - 12:50 National waste management approach on deep geological spent fuel disposal – costing and financial assurances
Dave McCauley - Director of the Uranium and Radioactive Waste Division. Energy Sector Natural Resources - Canada.
- 12:50 - 13:50** **Lunch hosted by NEA / IFNEC**
- 13:50 - 15:20** **Approaches to Financing an MNR in response to the Hypothetical Scenario**
- 13:50 - 14:00 Description of Hypothetical Scenario and introduction of panel
Robert Mussler, Consultant.
- 14:00 - 14:20 *George Borovas - Partner and Head of Nuclear. Shearman and Sterling LLP.*
- 14:20 - 14:40 *Robert Sloan - Senior Research Fellow, Energy Faculty. Tulane Law School Energy Centre.*
Elise N. Zoli – Partner. Jones Day.
- 14:40 - 15:00 *Elina Teplinsky - Partner, Nuclear Energy. Pillsbury Winthrop Shaw Pittman LLP.*
- 15:00 - 15:20 *Paul Murphy - Managing Director, Management Department. Murphy Energy & Infrastructure Consulting, LLC. Edward Kee, Xavier Rollat, Ted Fraiser.*

15:20 - 15:35

Coffee break

15:35 - 17:00

Moderated roundtable discussion to include participation by attendees

George Borovas - Partner and Head of Nuclear. Shearman and Sterling LLP.

Alan Brownstein - Consultant.

Neil Chapman - Vice President of Arius Association.

Charles McCombie - President of Arius Association. Arius Association and ERDO working Group.

Paul Murphy - Managing Director, Management Department. Murphy Energy & Infrastructure Consulting, LLC.

Robert Sloan - Senior Research Fellow, Energy Faculty. Tulane Law School Energy Centre.

Elina Teplinsky - Partner, Nuclear Energy. Pillsbury Winthrop Shaw Pittman LLP.

17:00 - 17:15

Closing Remarks

Co-chairs Sean Tyson and Tomaz Žagar.

SPEAKERS



Sama Bilbao y León – Head of Division of Nuclear Technology Development and Economics at the Nuclear Energy Agency / OECD.

In her role at the NEA, she helps provide Member Countries with authoritative studies in support of their energy policy decision-making. Sama has a very diverse professional experience having worked in the nuclear industry (Nuclear Safety Analysis Engineer, Dominion Energy, USA), in academia (Director of Nuclear Engineering Programs and Associate Professor at the Department of Mechanical and Nuclear Engineering, Virginia Commonwealth University (VCU), USA) and in international organizations (Technical Head of Water Cooled Reactors Technology Development Unit, International Atomic Energy Agency (IAEA)). Sama, who is originally from Spain, holds a bachelor's degree in Mechanical Engineering and a master's degree in Energy Technologies from the Polytechnic University of Madrid; a master's degree and PhD in Nuclear Engineering and Engineering Physics from the University of Wisconsin – Madison; and an MBA from Averett University. Sama's areas of expertise are nuclear thermal-hydraulics for both light water reactors and sodium cooled reactors, nuclear reactor design, nuclear safety, energy and environment policy, and complex decision making.



Sean Tyson - Office of Nuclear Energy, U.S. Department of Energy

Sean Tyson graduated in 1992 from the Monterey Institute of International Studies with a Master's degree in International Policy Studies, with an emphasis on arms control and non-proliferation. He has since served with the United States Department of Energy in a variety of international programs focused on international cooperation on non-proliferation.

In the late 90s, Mr. Tyson provided direct oversight of the cleaning, conditioning and storage activities in Nyongbyon, North Korea under the U.S.-North Korea Agreed Framework. He then transitioned to the U.S.-Russia Materials Protection, Control and Accounting program, where he managed activities focused on increasing nuclear materials security at nuclear facilities in Russia. Most recently, Mr. Tyson has supported the Office of Nuclear Energy bilateral and multilateral exploration of multinational options for the disposal of spent nuclear fuel and high level radioactive waste.



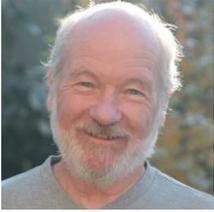
Tomaž Žagar - Head of Planning and Control in GEN energija.

He received B.Sc. degree in Physics from the University of Ljubljana and Ph.D. degree in Nuclear Engineering from the University of Maribor. He is first generation fellow of World Nuclear University in Idaho, USA and alumni of IEDC – Bled School of Management, Slovenia. Previously, he was appointed Director of Radioactive Waste Management Agency. He was a researcher at Jožef Stefan Institute in Ljubljana, Slovenia and at Institute for Transuranium Elements in Karlsruhe, Germany. He has been working in the nuclear sector for the past 20 years.

He is a Slovenian representative in the Nuclear Development Committee at the Nuclear Energy Agency in Paris and a member of Council for Nuclear and Radiation Safety at Ministry of Environment of Republic of Slovenia; in addition, he was a member of the Council of the Energy Agency of Slovenia.

He is an author of several papers on nuclear engineering, spent fuel, and radioactive waste management.

SPEAKERS



Charles McCombie - President of Arius Association. Arius Association and ERDO working Group.

Dr McCombie is an independent strategic and technical advisor to numerous national and international radioactive waste management programmes. For 20 years, he was scientific and technical director of the Swiss national disposal program. For 8 years he served on the U.S. National Research Council's Board on Radioactive Waste Management, latterly as Vice-Chairman. Currently his chief responsibilities are as President of the Arius Association and Secretary of the European Repository Working Group; both organisations focus on enhancing multinational cooperation at the back-end of the fuel cycle.

His responsibilities throughout his career have covered reactor safety, performance assessment for disposal, repository engineering and geological investigations and overall programme direction. He has chaired the International Technical Advisory Committee and the International Board of Counsellors of NUMO (the HLW organisation of Japan) and also the Nuclear Advisory Committee of the Swiss Paul Scherrer Institute. For 8 years he served on the U.S. National Research Council's Board on Radioactive Waste Management, latterly as Vice-Chairman.

He received a B.Sc. degree in physics from the University of Aberdeen, Scotland, and a Ph.D. degree in physics from the University of Bristol, England.



Alan Brownstein – Consultant

He completed his nearly 40 year career in Federal service retiring in 2017 as the Associate Deputy Assistant Secretary in the U.S. Department of Energy's Office of Nuclear Energy. During his 10 years with the Office of Nuclear Energy, Mr. Brownstein was instrumental in supporting and guiding the International Frameworks for Nuclear Energy Cooperation's Reliable Nuclear Fuel Services Working Group including serving as the Co-Chair.

Mr. Brownstein also served 25 years with the Yucca Mountain Project in many leadership positions including serving as the Chief Operating Officer. Mr. Brownstein began his career on the research faculty of the Pennsylvania State University supporting the Governor's energy office and worked for General Public Utilities before, during, and after the accident at Three Mile Island.

Mr. Brownstein currently serves as a consultant to the Department of Energy's Office of Nuclear Energy.



Neil Chapman - Vice President of Arius Association.

Professor Neil Chapman is among the leading experts worldwide in the geological disposal of radioactive wastes, with four decades experience in environmental, strategic and waste management aspects of the international nuclear industry. He acts as principal adviser and consultant to government organisations and international agencies worldwide on regulatory and safety issues and on structuring scientific research and strategic development programmes.

Key scientific achievements include the first UK experimental studies of the effects of high pressures and temperatures on radioactive wastes, pioneering internationally the use of natural geochemical analogues of materials and processes in deep geological repositories, integration of complex geological data into forecasts of far future evolution of deep systems and, most recently, leading high-profile evaluations of the impacts of natural geological hazards on nuclear facilities.

Professor Chapman has a broad working experience encompassing business, academia and government agencies, and has managed both applied research and consulting groups. He has a keen interest in training and education, as well as acting as chairman of many project teams and advisory groups internationally. He is the author/co-author of 9 books and over 200 scientific papers, mainly on geological disposal of radioactive wastes. He is holder of the James Watt Medal of the UK Institution of Civil Engineers.

SPEAKERS



Stefan Mayer - Team Leader Disposal, Nuclear Energy. IAEA.

Dr Mayer is the team leader for radioactive waste disposal (2012-present) in the Waste Technology Section of the Nuclear Energy Department of the International Atomic Energy Agency (IAEA). His work is focused on supporting Member States' implementation of disposal solutions providing for permanent, safe containment and isolation of radioactive waste. Information, cooperation and other support requested by Member States are delivered through the development of IAEA reports and eLearning modules, the deployment of disposal network activities, the organization of workshops and training courses, expert missions, scientific visits and fellowships. Some of the recent projects aim at developing Agency documents on a Roadmap for a generic deep geological disposal programme; the management of site investigations; disposal concepts and the design process as implemented around the world; communication and stakeholder involvement in radioactive waste disposal; cost estimation method and funding approaches for disposal programmes; and disposal concepts for small inventories.

Coming from a research and engineering background, prior experience in the waste disposal field was gained during ten years spent working for Andra (2002-2012), the French radioactive waste management organization, in various responsibilities for geological disposal developments.

A first experience was gained during two years spent as a research engineer at the Center for Nuclear Waste Regulatory Analysis (2000-2002), an organization providing technical and scientific support to the US NRC.



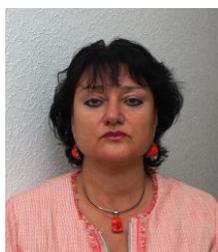
Anne Väätäinen - Counsellor of Innovations and Enterprise Financing. Ministry of Economic Affairs and Employment - Finland

Counsellor in the Ministry of Economic Affairs and Employment. Experience: more than 20 years in administration and research in the energy, nuclear energy and nuclear waste management sectors. That includes 2 years in Vienna (IAEA related work in the Embassy of Finland), and 4 years in Paris in Permanent Delegation of Finland to the OECD (IEA and NEA related work). Responsible for the administrative preparation and presentation of the decision-in-principle on the final disposal facility of spent nuclear fuel to the Government and the Parliament of Finland.



Mika Pohjonen - Managing Director. Posiva Solutions Oy - Finland

Mr. Pohjonen has over 25 years of international experience in the energy sector. He has previously held various sales and management positions in the engineering and management consulting business, e.g. in Fortum Oyj and Pöyry. Moreover, Mr. Pohjonen has broad expertise in the nuclear energy business acquired in numerous projects in Finland and in most European countries that utilize nuclear energy, as well as in the Middle East and China. He has also worked as an invited expert in the International Atomic Energy Agency (IAEA) on several occasions.



Anzhelika Khaperskaya - Leading manager, SNF management Project Office. State Corporation ROSATOM

She has been working in the nuclear industry for about 30 years, all her professional activities are related to the nuclear fuel cycle advance technologies development and implementation (SNF management and recycling of nuclear materials).

She is a PHD in physical chemistry. Under her leadership a number of NFC innovative infrastructure projects have been successfully implemented.

She is widely involved in international activity in sharing experience in the nuclear fuel cycle technologies development: in IAEA (TWG NFCO, SNF network etc.), Joint Convention (a vice- chair of the Country group for the 6 review Meeting), in NEA OECD (WG on the strategy on the NFC, on the separation chemistry etc.), Nuclear Innovation -2050 forum (a member of the advisory board).

SPEAKERS



Katsumoto Yoshimura - Director of Technology Office for Radioactive Waste Management. Ministry of Economy, Trade and Industry - Japan

Katsumoto YOSHIMURA is the Director, Technology Office for Radioactive Waste Management and Director, Public Relations Office for Radioactive Waste Management Development. He manages the national projects of technical development, also engages to fulfil resources for R&D such as human resource development. And he promotes dialog activities that deepen the understanding of geological disposal in Japan.



Dave McCauley - Director of the Uranium and Radioactive Waste Division, Energy Sector. Natural Resources - Canada

His responsibilities include the development and implementation of federal policies in the areas of uranium, radioactive wastes, and nuclear liability. With over twenty years of experience on nuclear policy issues, he represents Canada on a number of international committees of the International Atomic Energy Agency and the OECD Nuclear Energy Agency. He holds a Master's Degree in Environmental Studies from York University in Toronto, Ontario, Canada.



Robert Mussler – Consultant. International Framework for Nuclear Energy Cooperation (IFNEC)

Robert Mussler currently supports the Nuclear Energy Agency in its work as the Secretariat for the International Framework for Nuclear Energy Cooperation (IFNEC). His experience includes serving as legal counsel in the U. S. Department of Energy, Office of General Counsel, for the U. S. geologic disposal program. After that program closed he worked for Booz Allen Hamilton on international nuclear policy issues that included financing of nuclear projects, emerging technologies, and the back-end of the fuel cycle. He began supporting the activities of IFNEC in 2012 and continues that work as a consultant to the IFNEC Secretariat.



George Borovas - Global Head of Shearman & Sterling's nuclear group

Mr Borovas advises governments, lenders and sponsors on the development of nuclear power programs and the financing and construction of nuclear projects. He has worked on projects and transactions in the U.K., the U.S., Russia, Europe, the Middle East, North Africa, Japan, South Korea, Southeast Asia, China, Australia and South Africa. Mr Borovas is a Board Member of the World Nuclear Association (WNA) and is recognized as a nuclear industry expert by the International Atomic Energy Agency (IAEA), and the International Framework for Nuclear Energy Cooperation (IFNEC). Before becoming a nuclear energy lawyer, Mr Borovas worked as an engineer for a nuclear power plant engineering firm.



Robert Sloan - Senior Research Fellow, Energy Faculty

Former executive vice president and general counsel at Entergy Corp., has broad-ranging experience in the energy industry in the United States and across the globe. He is currently senior research fellow at Tulane Law School's Energy Center and he has been a senior fellow at the University of Chicago's Energy Policy Institute at Chicago.

Before joining Entergy, Sloan was the managing partner of the Brussels office of a large American law firm and then vice president and general counsel for the world-wide General Electric Industrial Systems subsidiary. He has also worked on nuclear energy issues, at Entergy (the second-largest nuclear power generator in the United States) and on nonproliferation law and policy question earlier in his career in the Office of the Legal Adviser at the U.S. State Department.

Sloan also has handled international corporate, financial, and project-finance transactions in the U.S., Western Europe and Asia, as well as complex contract negotiations in French-speaking developing countries. In addition to energy law, he has taught courses on both European Union law and law, literature and the legal profession.

SPEAKERS



Elise N. Zoli – Partner. Jones Day

Elise Zoli provides strategic direction and advice to the nation's leading public and private enterprises. Her experience focuses on the development, financing (impact investment, hedge fund, private equity, governmental grant, and alternative funding), and operation of clean energy, water, and related infrastructure projects and services. In conjunction with her transactional work, Elise also has pioneered the use of risk-mitigation instruments, including insurance, designed to facilitate new market entrants.

Elise has extensive first-chair experience in large-scale energy- and water-related arbitration and litigation, including on behalf of renewables component manufacturers, energy purchasers, and energy facility owners and operators. Elise has experience that extends beyond transactional work to the use and release of radioisotopes, as well as the operation, decommissioning, and redevelopment of nuclear power plants, former defense sites, laboratories, and industrial facilities that employ radioisotopes.

Elise is a periodic lecturer at MIT's Sloan School and a member of the clean energy committee for the New England Clean Energy Council.



Elina Teplinsky – Partner, Nuclear Energy. Pillsbury Winthrop Shaw Pittman LLP.

She advises clients worldwide on a variety of complex transactional and regulatory issues, including advising on multi-billion dollar nuclear project contracts, structuring nuclear new build projects for bankability, understanding and mitigating nuclear liability risks, developing and implementing nuclear legal and regulatory infrastructure, negotiation and implementation of bilateral nuclear cooperation agreements, and drafting, negotiation and implementation of intergovernmental and host government agreements for the development, construction and operation of nuclear facilities.

Ms. Teplinsky was part of the core Pillsbury team advising Brookfield Asset Management on the \$4.6B acquisition of Westinghouse Electric Company LLC. She has lead since 2013 Pillsbury's 360 degree advice to Akkuyu Nukleer, the company developing the first nuclear power project in Turkey and is also advising a state-owned enterprise with respect to another new nuclear project in Turkey. She was heavily involved in the firm's advice to K.A.CARE in the development of a peaceful nuclear program in Saud Arabia and to Emirates Nuclear Energy Corporation with respect to the Barakah NPP project. She is also the relationship partner for the firm's assistance to a vendor with respect to that company's nuclear projects in South America, Africa and Asia.



Paul Murphy - Managing Director, Management Department. Murphy Energy & Infrastructure Consulting, LLC

Paul is recognized as an expert in the development and financing of nuclear power programs by the International Atomic Energy Agency (IAEA), the OECD's Nuclear Energy Agency (NEA), the International Framework for Nuclear Energy Cooperation (IFNEC), and the U.S. Government.



Edward Kee – CEO & Principal Consultant. Nuclear Economics Consulting Group (NECG)

Mr. Kee is an expert on nuclear power economics providing strategic and economic advice to companies and governments on nuclear industry issues.

SPEAKERS



Xavier Rollat - Alet Business Services Limited

Xavier Rollat is a seasoned senior financier with a comprehensive experience developed during his 29-year career in emerged and emerging countries, primarily in banking and financial advisory services. Xavier has built a solid track record in originating, structuring and arranging single- and multi-source long-term funding solutions to finance capital-intensive investments in the power industry, with a focus on the nuclear power sector.



Timothy A. (Tim) Frazier - Nuclear Economics Consulting Group (NECG) Affiliate

Tim Frazier is a recognized international expert on the back end of the nuclear fuel cycle and has spoken internationally on the subject. He managed the President's Blue Ribbon Commission on America's Nuclear Future for the Department of Energy.