

## GEN IV Education and Training Initiative via Public Webinars

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**Abstract.** An increasing number of countries are opting for new nuclear energy as an important step towards economic development and environmental protection. According to the IAEA, electricity from nuclear energy may triple by 2050 as evidenced in the report IAEA-RDS-1/33; therefore, the projected use of this carbon-free technology will require many new nuclear engineers and scientists. In addition, countries such as France, the United States, which are the world's largest producers of nuclear energy, are experiencing a decline in the nuclear energy workforce both in their national laboratories and in the private sector. The future vigor and prosperity of nuclear energy, and associated nuclear science, clearly depend on continued use of available nuclear reactors as well as the development of advanced nuclear reactor technologies. To maintain the know-how in this field, to increase the knowledge of new advanced concepts, and to avoid the loss of the knowledge and competences that could seriously and adversely affect the future of nuclear energy, the Generation IV International Forum (GIF) established the GIF Education and Training Task Force. The task force serves as a platform to enhance open education and training as well as communication and networking in support of GIF. Indeed, its first initiative is the organization of a webinar series on the next generation of nuclear energy systems (Sodium Fast Reactor, Supercritical Water Reactor, Molten Salt Reactor, Lead Fast Reactor, Very High Temperature Reactor, and Gas-cooled Fast Reactor) and other cross-cutting subjects such as the basics on nuclear reactor systems, thorium fuel cycle, and nuclear fuels and materials. By exploiting modern internet technologies, the GIF Education and Training Task Force is reaching out to a broad audience and is raising the interest and strengthening the knowledge of participants in topics related to advanced reactor systems and advanced nuclear fuel cycles. This achievement is the direct result of partnering with internationally recognized subject matter experts and leading scientists in the nuclear energy arena who conduct live webinars on a monthly basis (for more details on the webinar series please see <https://www.gen-4.org/>). Besides opening the classroom to everyone in the world, the webinars offer earlier opportunities for interdisciplinary networking and educational and research collaboration. The details and examples of the GIF webinar modules will be presented in our paper.

**Key Words:** Gen IIV Advanced Reactor Systems, Education, Training, Webinar.

## **1. Introduction**

Gen IV International Forum (GIF) is a co-operative international endeavour which was set up to carry out the research and development needed to establish the feasibility and performance capabilities of the next generation nuclear energy systems. The development of Gen IV reactors is aimed at making nuclear power sustainable by embedding proliferation resistance, minimizing nuclear wastes, assuring safety, broadening horizons to curtail climate change and improve energy economy. Within GIF, the Education and Training Task Force (ETTF) has been tasked to develop and provide quality nuclear education and services on Gen IV nuclear reactors and associated fuel cycles in a manner that fosters international engagement and opportunities. Essential to the success of GIF, considering long time needed to achieve the challenging goals of Gen IV reactor systems, is education and training of not only nuclear workforce, but also the general public, policy makers, and students. Considering the increase in nuclear activities around the world and the associated request from most interested countries to obtain up-to-date information on present status of the ongoing research, we have launched a series of webinars to widely spread educational information on Generation IV systems and associated cross-cutting subjects, which will promote the main Gen IV concepts, and stimulate people's interest.

## **2. GIF Education and Training Task Force Objectives and Goals**

GIF-Education and Training Task Force (ETTF) was launched in 2015 to serve as a platform to enhance open education and training (E&T) as well as communication and networking of people and organizations in support of Gen IV International Forum. The principal objective of the GIF-ETTF is focused on promoting E&T by 1) identifying and advertising current training courses, 2) identifying and engaging collaboration with other international E&T organizations, 3) developing webinar series dedicated to Gen IV systems and related cross-cutting topics and advertising these at the national and international level, and 4) creating and maintaining a modern social medium platform (- such as LinkedIn <https://www.linkedin.com/groups/8416234>) to exchange information and ideas on general Generation IV Research and Development (R&D) topics as well as related GIF E&T activities. The development of webinars is intended to inform and stimulate not only young scientists' interest, but also managers, key decision makers and the general public about advanced reactors introducing foreseen advantages but also key R&D to be developed, past experience, current research and existing projects.

## **3. GIF Education and Training Task Force Initiative in Education and Training**

As the worldwide nuclear capacity continues to grow in 2016 with 391.4 GWe net, up from 382.2 GWe at the end of 2015 [1], and in order to deploy advanced light water technology, and in the longer term other advanced systems, a strong, skilled workforce is needed to develop and maintain the technologies and infrastructure. In the past several years, there has been a growing recognition of the nuclear workforce challenges that several countries are facing with the need to inform the public and attract a new generation of professional engineers into the nuclear energy sector. The U.S. nuclear electric power industry employs more than 400,000 people to generate, transmit and distribute the nation's electricity. As of 2008, more than half of all workers in the industry were over the age of 45 and were eligible to retire within the next decade. This means that as many as 200,000 workers will be needed

by 2018 to fill the gap in the U.S. electricity sector [2]. Given that the current nuclear energy workforce is approaching the age for retirement, as shown in FIG.1 and that a limited number of universities in the world provides advanced reactor systems curriculum, we are faced with a growing demand for the training and education in the Gen IV system arena. Numerous initiatives are being developed which address workforce challenges, and those efforts are starting to bear fruit. Nuclear-related programs are filling to capacity, and university nuclear engineering programs are attracting students again after years of declining enrollments.

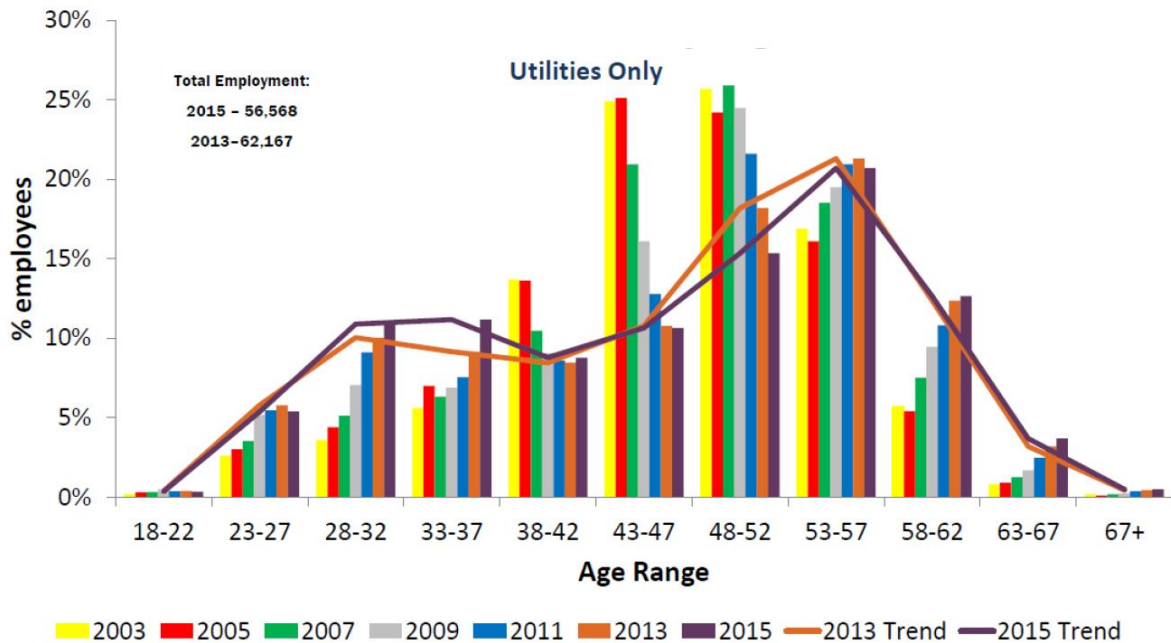


FIG.1. U.S. Workforce for Nuclear Generation Operations – Distribution by Age [3]

Highly trained and exceptionally talented workforce in the advanced reactors field is needed to maintain the actual level of expertise and avoid a gap in the near future. As shown in FIG. 2, several Gen IV systems are expected to enter either performance development or demonstration in the next decade [4].

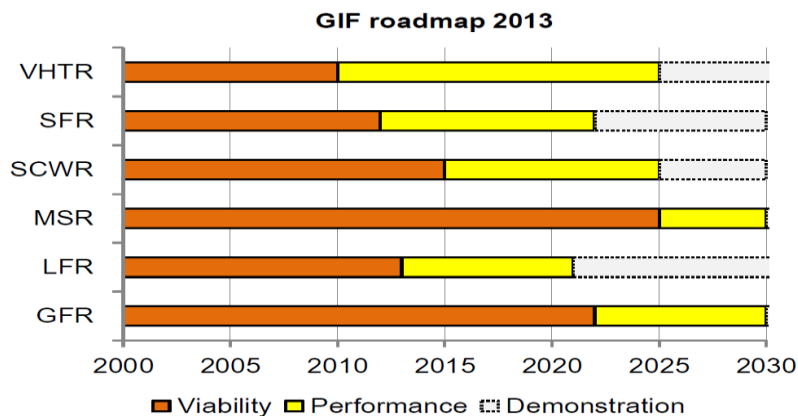


FIG.2. GEN IV Systems Development Timeline [4]

Despite increases in the graduation rate of specialized nuclear engineers through the traditional university curriculum, a decrease in advanced reactor systems experts is observed. It is obvious that a decrease in opportunities for training in advanced reactor systems may in turn affect the future of this field. To ensure a steady supply of nuclear workers, several options have been identified to educate and train the future nuclear engineers. Continuing education as an example offers a large spectrum of post-secondary learning, but the associated cost and/or needed time to learn the material could be a drawback. Distance learning is also used at different universities and is accomplished by different technological media where the training course can be delivered simultaneously to students off campus. This teaching and learning capability is a mode of delivering education and instruction to students who currently pursue formal education in universities which offer similar classes, but do not have necessarily enough professors to deliver the materials to the interested students. New available tools such as webinars prompted the GIF Education and Training Task Force to choose to exploit this modern internet technology and reach interest of a broader audience. Therefore, to promote training in Gen IV systems and to ensure a knowledgeable workforce exists, the GIF-ETTF is creating and making available to the public a series of webinars on topics specific to advanced reactor systems and cross-cutting subjects. These webinars are intended to be of interest not only to students currently pursuing formal education in universities but also to those already in the workforce who may need a refresher course or a better understanding of a specific topic, and most importantly to a more general public. We are seeking to develop world class webinars that will also be useful to people like quality assurance officers, data validators, technicians, managers, regulators, and others who may benefit from an enhanced understanding of advanced reactor concepts in their work. The GIF-ETTF has established collaborative associations with universities and nuclear organizations (Table I) actively involved in Gen IV systems to foster the exchange of scientific and technical information for the development of webinars.

TABLE I: ORGANIZATIONS INVOLVED WITH THE DEVELOPMENT OF GIF WEBINARS.

<b>Name of University/Organization</b>	<b>Abbreviation</b>
U.S. Department of Energy – Office of Nuclear Energy	DOE, U.S.A.
Institute of Energy and Environment Youngsan University	Youngsan University, R.O.K.
Commissariat à l’Energie Atomique et aux Energies Alternatives	CEA, France
Argonne National Laboratory	ANL, U.S.A.
Canadian Nuclear Laboratories	CNL, Canada
University of California, Berkeley	UC Berkeley, U.S.A.
US Naval Postgraduate School	NPS, U.S.A.
Nuclear Energy Agency	NEA/OECD
Idaho National Laboratory	INL, U.S.A.
Nuclear National Laboratory	NNL, U.K.

Short (60 to 90 minutes) webinar presentations on specific Gen IV systems and related topics are being developed in cooperation with our universities and organizations partners. The webinars are recorded and archived to become a library or collection of information for on-line access from the Gen IV website ([www.gen-4.org](http://www.gen-4.org)). The first series of a total of 13 webinars addresses various topics, and is described in FIG 3.



**WEBINAR SERIES**

<p style="text-align: center;"><b>September 29, 2016</b> Atoms for peace - The Next Generation Dr. John Kelly, Department of Energy, USA</p> <p style="text-align: center;"><b>October 19, 2016</b> Closing the Fuel Cycle Prof. Myung Seung Yang, Institute of Energy and Environment Yongsan University South Korea</p> <p style="text-align: center;"><b>November 22, 2016</b> Introduction to nuclear reactor design Dr. Claude Renault, CEA, France</p> <p style="text-align: center;"><b>December 15, 2016</b> Sodium Cooled Fast Reactors Dr. Bob Hill, ANL, USA</p> <p style="text-align: center;"><b>January 25, 2017</b> Very High Temperature Reactors Dr. Carl Sink, DOE, USA</p> <p style="text-align: center;"><b>February 22, 2017</b> Gas Cooled Fast Reactor Dr. Alfredo Vasile, CEA, France</p>	<p style="text-align: center;"><b>March 28, 2017</b> Supercritical Water Reactors (SCWR) Dr. Laurence Leung, CNL, Canada</p> <p style="text-align: center;"><b>April 25, 2017</b> Molten Salt Reactors (MSR) Dr. Elsa Merle, CEA, France</p> <p style="text-align: center;"><b>May 23, 2017</b> Fluoride-Cooled High-Temperature reactors (FHR) Prof. Per Peterson, UC Berkeley, USA</p> <p style="text-align: center;"><b>June 20, 2017</b> Lead Fast Reactor (LFR) Prof. Craig Smith, US Naval Graduate School, USA</p> <p style="text-align: center;"><b>July 18, 2017</b> Thorium fuel cycle Franco Michel-Sendis, NEA/OECD, Paris, France</p> <p style="text-align: center;"><b>August 22, 2017</b> Nuclear Fuel and Materials Dr. Steven Hayes, INL, USA</p> <p style="text-align: center;"><b>September 21, 2017</b> Energy Conversion Dr. Richard Stainsby, NNL, UK</p>
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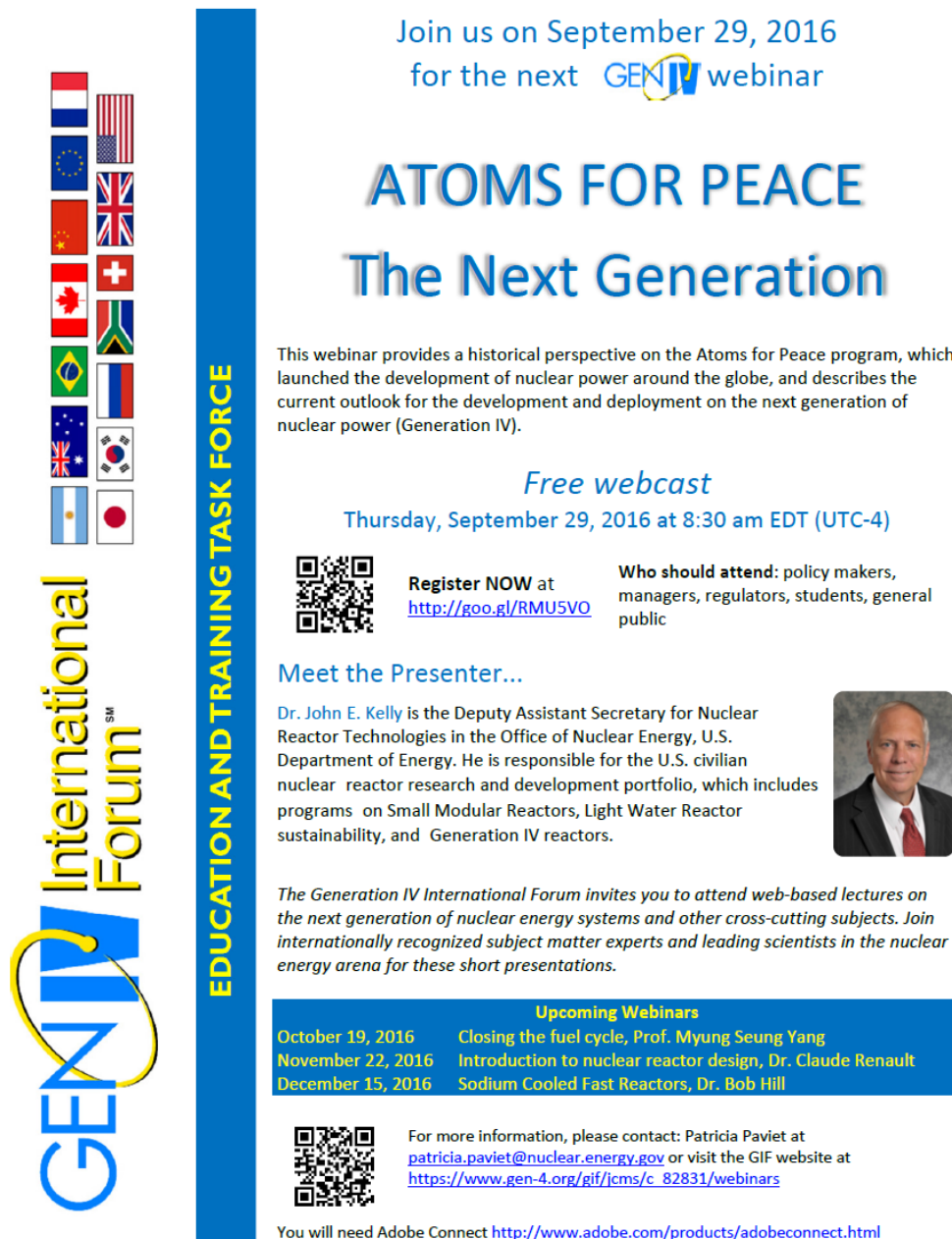
*FIG. 3. GIF Webinar Series (September 2016 to September 2017)*

The webinars consist of lectures and provide an opportunity for the audience to comment or ask questions at the end of each presentation. The system is designed for web conferencing and includes many features such as:

- Attendee registration
- Attendee questionnaires about the webinar they followed

- Scheduled reminders for the registered participants and follow up questionnaires, if desired.
- Conferencing capabilities for 200 attendees at one time.

In connection with this activity, flyers are developed to advertise the webinars (e.g., FIG.4), on the Gen IV website and on LinkedIn as well.




Join us on September 29, 2016  
for the next **GEN IV** webinar

## ATOMS FOR PEACE The Next Generation

This webinar provides a historical perspective on the Atoms for Peace program, which launched the development of nuclear power around the globe, and describes the current outlook for the development and deployment on the next generation of nuclear power (Generation IV).


*Free webcast*  
Thursday, September 29, 2016 at 8:30 am EDT (UTC-4)

 Register NOW at <http://goo.gl/RMU5VO>

**Who should attend:** policy makers, managers, regulators, students, general public


**Meet the Presenter...**

Dr. John E. Kelly is the Deputy Assistant Secretary for Nuclear Reactor Technologies in the Office of Nuclear Energy, U.S. Department of Energy. He is responsible for the U.S. civilian nuclear reactor research and development portfolio, which includes programs on Small Modular Reactors, Light Water Reactor sustainability, and Generation IV reactors.



*The Generation IV International Forum invites you to attend web-based lectures on the next generation of nuclear energy systems and other cross-cutting subjects. Join internationally recognized subject matter experts and leading scientists in the nuclear energy arena for these short presentations.*

Upcoming Webinars	
October 19, 2016	Closing the fuel cycle, Prof. Myung Seung Yang
November 22, 2016	Introduction to nuclear reactor design, Dr. Claude Renault
December 15, 2016	Sodium Cooled Fast Reactors, Dr. Bob Hill

 For more information, please contact: Patricia Paviet at [patricia.paviet@nuclear.energy.gov](mailto:patricia.paviet@nuclear.energy.gov) or visit the GIF website at [https://www.gen-4.org/gif/jcms/c\\_82831/webinars](https://www.gen-4.org/gif/jcms/c_82831/webinars)

You will need Adobe Connect <http://www.adobe.com/products/adobeconnect.html>

FIG. 4. Example of GIF Webinar Flyer

Outreach and informational meetings are organized by NEA/OECD. Brochures to advertise the GIF-ETTF webinars activities are being developed, and participation at several national and international conferences is planned. Information is accessible without restrictions via the Gen IV website. The first webinar which provided a historical perspective of the

“Atoms for Peace” program and described the current outlook for the development and deployment on the next generation of nuclear power (Generation IV) was presented by Dr. John Kelly from the Department of Energy on 29<sup>th</sup> of September 2016. The GIF webinar attendance distribution for the first three webinars is presented in FIG.5. with a total of 315 attendees from diverse organizations, federal agencies, state agencies, universities and national laboratories.

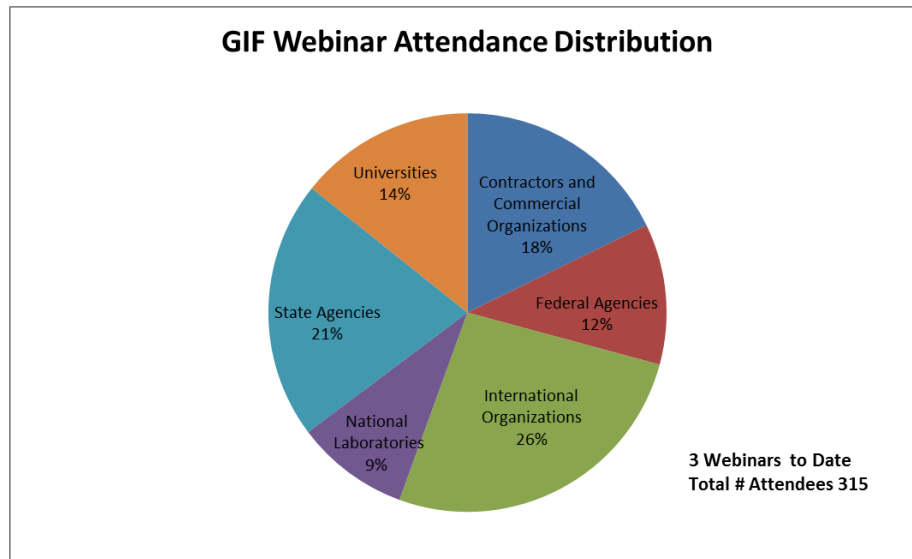


FIG. 5. GIF Webinar Attendance Distribution as of 14 December 2016.

These webinars are presented and recorded live and are an efficient way to reach new audiences as well as to retain previously engaged audiences. The live webinars include slides presentation, and engage the attendees by giving them the opportunity to ask questions during the live event through the webcast interface. At the end of the live presentation, questions are answered as they arrive by the presenter. All these webinars are archived and serve as an in-depth resource in Gen IV advanced reactor systems. There are no fees associated with these webinars, which make the webinars very attractive. The success of these webinars relies on the presenters who are internationally recognized experts.

The attendees thus far have been extremely positive about the quality and content of these webinars as reflected by the following statements:

*“I thought it was very interesting. The material is not often presented in other than a graduate school setting so many of us don't have access to it; other than from books. Thank you for making it possible.”*

*“Excellent introduction. I look forward to the ongoing program.”*

*“These webinars will benefit a vast audience, keep up the great work!!”*

*“Very good format. Great outreach. Please continue.”*

*“Excellent, clear and well organized presentation that covered central issues on the topic.”*

*“The technical content of the slides for this webinar were EXCELLENT.”*

*“I like the link to the GIF webinars on the Gen-4 webpage. This makes it very convenient to watch the webcasts and/or download the presentations.”*



#### 4. Conclusion

The GIF webinars are very successful and demonstrate a strong need of such resource for informing the general public, but also the scientific community about advances in the Gen IV systems. In addition, because of the passion and grass root efforts from professionals and educators, the GIF-ETTF goal of creating an archive of online webinars has become a reality. The webinars are accessible online in two formats: audio-video recording as well as pdf slides. This is a free public access, which makes it even more attractive to the scientific community.

#### 5. Acknowledgements

The authors would like thank Berta Oates from Portage Inc., for her invaluable support.

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