

WiNspire

An E -Newsletter of the
Association of Women in
Nuclear-India (WiN-India)

JANUARY 2024



Contents

01 Chairperson's Message

02 President's Message

03 Editor's Note

04 Board of Directors

05 Executive Council

Article Contributions

06 The Italian navigator has landed.....
Dr. Umasankari Kannan

07 Protecting Nuclear Power Plants in War Zones
Dr. Manpreet Sethi

**08 Medical uses of Nuclear Technology:
Radioiodine Therapy (I-131) a Saga of more
than 80 years**

Dr. Amrita Tiwary Vyas

**09 Harnessing the Atom: Nuclear Power's
Crucial Role in Tackling the Climate Crisis**

Zoya Akhter

Contents

10 **WiN-India Events 2022-2023**

Exploring the Myriad Facets of Nuclear Energy

12 March 2022

International Women's Day: Celebrating the Achievements of Women In Nuclear Science and Technology

15 March 2023

11 **Become a Member**

01

Chairperson's Message

Association of Women in Nuclear India (WiN-India) has been created with the specific purpose of providing a platform for women engaged in various fields of nuclear science and technology, security and strategy in India. Nuclear energy is recognized as a prime field of STEM. About 22% of the workforce in nuclear technology sector, encompassing aspects such as mining, fabrication, reactor operation, regulation, and other allied uses of radiation are women, and this figure has been steadily increasing.

Women are at the forefront of many major milestones of both nuclear energy generation and non-power applications. There have been pioneering efforts by women in nuclear science and technology in India in power production, fuel fabrication, reprocessing of spent fuel, production of radio isotopes for medical and other applications, control and instrumentation of nuclear power plants, design of innovative nuclear energy systems, development of electron based linear accelerators, cyclotrons, pioneering research in the use of radioactive ion beams and the list goes on. Skilled women are employed in several national and international labs, organisations, universities, strategic sciences, science journalism and corporate sectors across India. The role of women in decision making in the nuclear energy sector is also on the increase. While they have been contributing through their professional expertise, it is felt that their presence and contribution needs to be highlighted and accorded due attention.

As the role of nuclear energy expands to take up challenges for a net-zero carbon economy, women's contribution also will have to increase to realise this mandate and must make inroads into uncharted domains.

The mandate of WiN India is clearly laid out with an aim to showcase the presence of professional women experts, support them in their ventures, learn from each other's experiences, and thereby encourage other young women to join this field.

**Dr. Umashankari Kannan,
Chairperson, Board of Directors,
Association of Women in Nuclear - India (Win - India)**



02 President's Message

Greetings from Win-India!

It is heartening to see that WiN-India has finally taken shape, with professional women from all over the country coming together to establish new alliances and strengthen existing bonds. It is a great platform for mutual collaborations as well as mentoring promising young women in achieving their goals.

The concern about the role of nuclear in climate change is increasingly being propagated across the globe, as nuclear power offers a low-carbon energy option. Several new strategies and designs, including the Small Modular Reactors, are being discussed recognizing the near-zero-emission capabilities of nuclear power. The immense versatility of nuclear power, from deep sea propulsion of submarines to exploration of space, is being explored to the fullest. The success of the recent Indian space missions have also sparked the possibility of using Radioisotope Thermoelectric Generators as power sources for future missions. Amidst these developments, it is the endeavor of WiN-India to work towards increasing awareness and support for nuclear power and other societal applications of nuclear technology.

This Newsletter is conceived as an excellent medium for communicating about the role of nuclear applications in our daily lives and the benefits that have game-changing potential, specially in the field of healthcare and agriculture. It is a simple and effective means of reaching out to individuals, organisations and industries. Members are urged to give their contributions in terms of articles, snippets, news information etc. that will enhance the knowledge of the readers in this field and inculcate more confidence on safe use of nuclear technologies. The public perception of undue fears related to nuclear need to be scientifically and convincingly alleviated for its popular acceptance and we believe that this Newsletter will do its worthy bit in this direction.

Congratulations to the Editorial Team for this maiden issue and I hope that the subsequent issues will come at frequent intervals with good scientific content to satiate the curiosity of the readers.

**Dr. Balvinder K Sapra,
President, Executive Council,
Association of Women in Nuclear - India (Win - India)**



03 Editor's Note

Nuclear energy has come to play an imperative role for the future of clean energy as well as for the sustainability. Efforts are being made at the global and national levels towards recognizing nuclear as a part of decarbonized energy systems to achieve net zero carbon goals. The important contributions of the peaceful uses of nuclear technologies towards healthcare, food and agriculture and power generation are also being increasingly emphasized.

Against the background of today's nuclear-positive landscape, it gives us immense pleasure to bring out the first issue of **WiNspire**, the newsletter from the Association of Women in Nuclear - India (WiN-India). Conceptualised by women working in various sectors of nuclear science, including nuclear energy, radiation applications and nuclear strategy, WiN-India aims to raise awareness in the public about the substantial contributions of the peaceful uses of nuclear technologies. In that context, the first issue of WiNspire highlights essays from experts showcasing the spectrum of nuclear applications from energy generation to medicine and the climate crisis. We have also been organizing events and activities on the margins of our objectives to showcase the role of women in the development and application of nuclear science and technology, and some of those have been included in this issue.

This is just the beginning and we have a long journey ahead. We thank everyone for their dedicated efforts that have contributed towards the preparation and publication of this inaugural issue of WiNspire.

**Dr. Celin Acharya and Dr. Tanvi Kulkarni,
Co-Editors, WiNspire, and
Publication Managers, Association of
Women in Nuclear - India (Win - India)**



04 Board of Directors



Dr. Umasankari Kannan, Chairperson: Former Head of the Reactor Physics Design Division at Bhabha Atomic Research Centre (BARC). She led the physics design of several thermal reactors namely, Advanced Heavy Water Reactor(AHWR), Indian Pressurised Water Reactor (IPWR) and Molten Salt Reactors (MSR). Thorium utilization and nuclear data physics are her forte. She has been instrumental in several experimental and irradiation programmes for qualifying new reactor fuel. She has over 80 journal publications and is a senior professor of Homi Bhabha National Institute.



Dr. Manpreet Sethi, Co-Chairperson: Distinguished Fellow, Centre for Air Power Studies, New Delhi, heads its programme on nuclear security. She is also a Senior Research Advisor, Asia -Pacific Leadership Network. Recipient of K Subrahmanyam award (2014); Commendation by Chief of Air Staff (2020) and C-in-C, Strategic Forces Command (2022). Since receiving doctorate in 1997, she has worked on nuclear issues ranging from energy to strategy. She is author/coauthor/editor of 9 books and over 120 papers. She lectures regularly at National Defence College and other establishments of Indian Armed Forces, Police, Foreign Services, and Universities.



Manju Gupta, Treasurer: She has diverse experience spanning over 35 years in global nuclear industry. She has contributed to the Nuclear Sector by serving organizations namely Nuclear Power Corporation of India, Areva and Atkins in India, UK and Finland.



Dr. Mary Mohankumar, Joint Treasurer: Dr Mohankumar retired as senior scientist from Indira Gandhi Centre for Atomic Research, Kalpakkam and has over 25 years of research experience on health effects of low dose ionizing radiation. She is also the country representative for Women in Nuclear-Global.



Dr. Alpana Goel: Director and Head of Amity Institute of Nuclear Science and Technology. She is also academy ambassador to WINS Austria. She did her Ph.D from IIT Roorkee in Nuclear Physics. She has more than 30 years teaching and research experience in Nuclear field. Recently she has published a book on Nuclear Isomers – A Premier published by Springer Nature (2021). During 2018-20 she was holding chair position of working group II of International Nuclear Security education network (INSEN), IAEA.

Board of Directors



Archana Yadav: Assistant Professor, Amity University with a history of working in the higher education industry.



Dr. Nitendra Singh: PhD from HBNI and is working as Project Associate at ITER, France. Responsible for Nuclear Safety and Accident Analyses for Test Blanket Module (TBM) of International Thermonuclear Energy Reactor (ITER).



Dr. Aakanksha Saxena, Secretary: Nuclear physicist with 10 years of experience working in both nuclear fission and fusion. She did her PhD thesis from CEA, France on thermal hydraulics of sodium cooled fast reactor. Currently she is working as Diagnostics integration engineer at International Thermonuclear Energy Reactor (ITER), France and is responsible officer for In Vessel Viewing system and Diagnostics Safety components.



Kritika Kaur, Joint Secretary: She is an AERB approved RSO and specializes in Radiation monitoring instruments. She is currently working with Thermofisher Scientific as Sales Manager for Radiation Measurement and Security instruments.

05 Executive Council



Dr. Balvinder Sapra, President: Head, Radiological Physics and Advisory Division, BARC and Chairperson of Women's Cell of BARC. Dr. Sapra has expertise in radiation dosimetry techniques. Her core area of expertise is aerosol studies in the context of nuclear and radiological facilities. She has more than 150 publications in peer reviewed journals and is a member of various regulatory and safety committees (national and international), and recipient of DAE Science and Technical Excellence Award (2011).



Dr. Amrita Tiwary Vyas, Vice President: Senior Specialist and HOD at Janakpuri Super-specialty Hospital, Govt of NCT Delhi. Nuclear Medicine Physician by profession, who was trained at Army Hospital Research & Referral, New Delhi. She has a Clinical fellowship from Royal Victoria hospital, Belfast, Northern Ireland (U.K) and Professional course by P.D. Hinduja Hospital and Medical Research Centre Mumbai, India. She also holds eMDPon healthcare management & analytics from IIM KOZHIKODE and is NABH MIS ASSESSOR.



Nita Singh, General Manager: Associate Director, (Control & Instrumentation) at NPCIL, Mumbai. Her core expertise is the design of Reactor Protection Systems of 220 MWe, 540 MWe and 700MWe Indian Pressurized Heavy Water Reactors and has been involved in the design & development of several First Of A Kind (FOAK) systems. She received the prestigious Indian Nuclear Society medal in 2007 for her contribution to NPP design.



Alpana Manwal, Deputy General Manager: Scientific Officer/D, (Control & Instrumentation) Kakrapar Atomic Power Project, Gujarat. Completed her B.Tech in Electronics & Instrumentation and is working as Scientific Officer/D at the first Indian 700MWe reactor site at Kakrapar Atomic Power Project-3&4, Gujarat. She handles activities related to Supply, Erection, Cabling and Commissioning of the operator panels of the Main Control Room.



Dr. Garima Sharma, Scientific Program Manager: Scientific Officer /G, Nuclear controls & Planning Wing, DAE. She has been involved in policy development under the legal and regulatory framework for nuclear energy, development of Nuclear Security framework, export controls of strategic items and nuclear energy technologies, management of disused radioactive sources, legal matters pertaining to the DAE and Nuclear Security School of GCNEP. She has vast experience in R&D and over 80 publications in international peer-reviewed journals.

Executive Council



Jalaja Madan Mohan, Public Awareness & Media Network Manager: Head, Technical Coordination and Public Awareness Section of IGCAR, Chennai. She has organized and conducted more than 200 public awareness programmes on behalf of the Centre at various levels. She was instrumental in setting up of an Information centre at Shastri Bhavan, Chennai.



Zoya Akhter, Public Awareness & Media Network Manager: Experienced researcher with a demonstrated history of working in the area of sustainability and geopolitics of climate change and international affairs. She was a Research Associate at the Centre for Air Power Studies, focusing on the emergence of nuclear energy in Asia post Fukushima. Previous work experiences include research on Chinese media studies and Public Diplomacy. She is the author of the book Nuclear Power in Asia Post Fukushima (2023).



Dr. Ritu Singh, Manager (Finance): Scientific Officer /G, Nuclear Safety Analysis and Research Group, Atomic Energy Regulatory Board. She is working since then in the field of nuclear safety analysis and research in AERB. She has completed her PhD from IIT Bombay, Mechanical Engineering Department. She is involved in structural integrity assessments related to components in NPPs. She has coordinated research projects in collaboration with academic institutes like IITs and CSIR Laboratories.



Dr. Celin Acharya, Publications Manager: Scientific Officer/G, Molecular Biology Division, BARC, Mumbai & Associate Professor, Homi Bhabha National Institute, Mumbai. She received her postdoctoral training in chemical biology from University of Warwick, UK. Her research primarily focuses on cellular and molecular mechanisms of metal resistance and metal detoxification in microbial systems. Her special interest is in microbial interactions with uranium. She has 50 peer-reviewed publications and 2 patents. She is a recipient of DAE Scientific and Technical Excellence (STA) award and DBT-CREST award.



Dr. Tanvi Kulkarni, Publications Manager: Policy Fellow at Asia-Pacific Leadership Network (APLN) and a Visiting Fellow at the Institute of Peace and Conflict Studies, New Delhi. She has a PhD in Diplomacy and Disarmament studies from the JNU, New Delhi. Formerly, she taught at the Department of Defence and Strategic Studies at the Savitribai Phule Pune University.

Executive Council



Dr. Kanica Rakhra, Academic/Universities Liason Manager: Assistant Professor, Kautilya School of Public Policy. Former Consultant with the Disarmament and International Security Affairs Division of the Indian MEA. She completed her PhD on India and Iran's Nuclear Programmes from JNU in 2016 and has undertaken research fellowships such as the Visiting Fellowship at Middlebury Institute in Monterrey (2019) and the Harvard led- Arms Control Academy (ACONA) Fellows (2020).



Dr. Urvashi Gaur, IT Manager: Faculty of Advanced Operating Systems of BARC training school and an MTech guide of Homi Bhabha National Institute. She is working in the Supercomputing Section of Computer Division, at BARC. Since 2008, she is involved in R&D in High-Performance Computing, Storage Area Network based systems, Cloud based storage, Distributed Filesystems and Web Technologies. She is a recipient of Homi Bhabha Award- Gold Medal (2008) and DAE group achievement award for MACE Telescope Project(2020).

06 Article Contributions

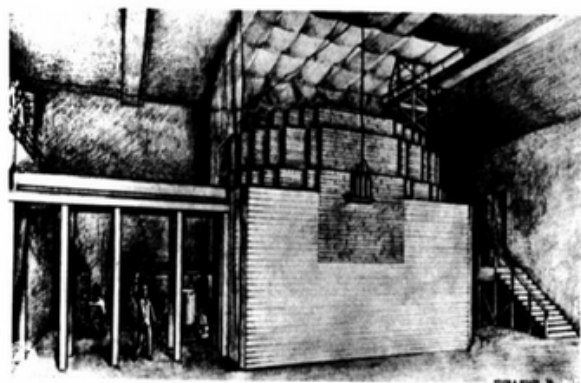
THE ITALIAN NAVIGATOR HAS LANDED.....

DR. UMASANKARI KANNAN

Otto Hahn and Fritz Strassmann had discovered the splitting of Uranium 235 atom and the subsequent release of energy in 1938. It was well known that when lighter atoms fuse or when heavy atoms break, energy is released due to the interplay of bound nucleons in the nucleus. It was Professor Lise Meitner who explained the fission chain reaction. The potential of the neutral particle - neutron was discovered.

Then on December 2, 1942, when the world witnessed the first sustained and controlled nuclear chain reaction in a squash court in Chicago, it was an advent of a new era. The Manhattan Project came to light.

The Chicago Pile, as it was called, was a reactor containing 45,000 graphite blocks weighing 400 short tons (360 t) used as neutron moderators, and was fueled by 6 short tons (5.4 t) of uranium metal and 50 short tons (45 t) of uranium oxide. The team included Fermi, Leo Szilard, discoverer of the chain reaction, Lise Meitner and Herbert L. Anderson, Walter Zinn, Martin D. Whitaker, and George Weil.



The Chicago Pile-1- A crude pile of black bricks and wooden timbers

Radium- Be source was used for initiating the chain reaction. It had no radiation shielding or cooling system as it only operated at very low power.

In a nuclear reactor, a sustained chain reaction is measured by a critical condition where the production and loss mechanism are balanced. The process is called criticality and the reactor is maintained in this state where the balance is constantly monitored.

The shape of the first pile was intended to be roughly spherical, but as work proceeded, Fermi calculated that critical mass could be achieved without finishing the entire pile as planned. The genius Enrico Fermi's notes are ample evidence of how he systematically worked out the critical configuration and how he was aware of the neutronic characteristics of uranium, neutron scatterer Graphite and neutron absorbers like Cadmium.

They also fabricated the control rods, which were cadmium sheets nailed to flat wooden strips, cadmium being a potent neutron absorber, and the scram line, a Manila rope that when cut would drop a control rod into the pile and stop the reaction. Such was the ingenuity in this maiden reactor design.

It was described as a 'crude pile of black bricks and wooden timbers.'

It is another beautiful story how the success of the event was communicated. In the war-torn age, this maiden scientific path breaking achievement had to be kept cryptic. The Military General, Arthur Compton conveyed the message to James Conant, chairman, the National Defense Research Committee, that the 'Italian navigator has landed in the new world.' And when Conant asked how were the natives, the achievement of sustained chain reaction was announced in a more elegant way that the natives were very friendly. The excitement was recorded and celebrated many times over.

How very true, Enrico Fermi led the team which made the world's first nuclear reactor and it was indeed landing into a new world.

Lise Mietner, a woman scientist par excellence, a pioneer particle physicist, explained the process of nuclear fission. Over these eight decades, nuclear reactors have been designed which cater to different applications from small research reactors of a few watts to power reactors of several giga watts. Nuclear reactors are also being designed based on the energy of the neutrons- thermal, intermediate or fast neutrons. The temperature and physical conditions of the fuel and coolant are also so varied and oriented towards the requirements in the different operating regimes. On the fuel utilization front, there are designs ranging from natural uranium fuel to enriched uranium to more efficient thorium-based reactors.

There have been variety of coolant and moderating materials used for different applications namely water cooled, gas cooled, liquid sodium cooled to molten salt cooled reactors.

Several new reactor designs have been developed using innovative concepts as high temperature reactors, nuclear power packs and compact reactors for special purposes. The design challenges are many, from modest designs to complicated hybrid reactors.

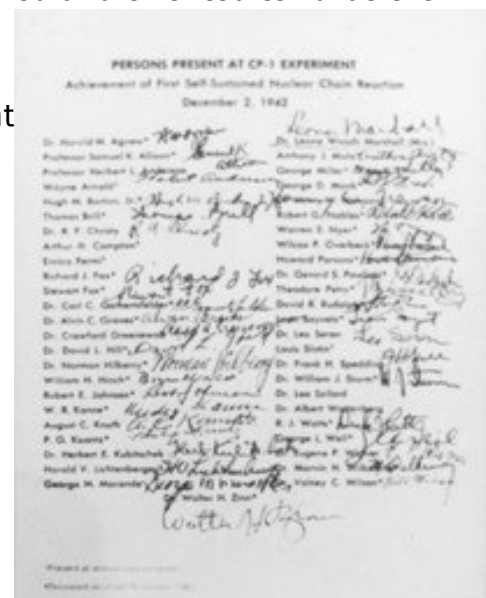
Nuclear reactor design is an exciting and highly skilled multi-disciplinary field. And we have to navigate through many more lands!

The Announcement

Compton: "The Italian navigator has landed in the New World".

Conant: How were the natives?

Compton: Very friendly.



The people who witnessed the first criticality

07 Article Contributions

PROTECTING NUCLEAR POWER PLANTS IN WAR ZONES

DR. MANPREET SETHI

Interest in nuclear energy as a low carbon source of electricity is on the rise in the face of growing climate change concerns. Energy transition is the buzzword as nations struggle to meet their goals of net zero emissions. Worldwide, the focus is on renewable energy as a viable option, but the limitations of these sources, particularly with respect to baseload electricity, is bringing nuclear energy into sharper focus.

However, concerns about safety and security of nuclear energy continue to cloud public perception. Even as concerns raised by the accident at Fukushima in 2011 were beginning to fade, the ongoing Russia - Ukraine conflict, now in its second year and showing no sign of resolution, has brought attention to the risks faced by nuclear facilities in war zones.

Ukraine has 15 nuclear reactors in four nuclear power plants and was deriving 50% of its total electricity from them before the start of conflict. Thereafter, reactor operations have suffered disruptions. This has not only impacted electricity availability, but also generated anxiety around the safety and security of the plants. Both sides, in fact, have used nuclear plants to score tactical victories, ignoring the strategic risks being caused by their actions. Ukraine has reported that after taking over the sites, Russian troops have used them as safe havens for themselves and their ammunition. Russia, on the other hand, has accused Ukraine of attacks on the Russian-occupied plants to create a disaster. Though physical security of nuclear facilities is a national responsibility, in this particular case, the IAEA has assumed a proactive role. Since 17 Jan. 2023, IAEA teams have been stationed at Ukrainian nuclear plants. At this moment, the situation seems to have settled into an uneasy stability, but the danger has certainly not receded.

Many lessons will be drawn from this episode, and these should be of particular interest to India for two reasons. One, it has several civilian nuclear facilities across the country. Secondly, it has unresolved territorial disputes with its neighbours in the East and the West which have erupted into conflicts in the past. While these have been limited in geographical and operational scope, the triggers have not been resolved. Meanwhile, exploitation of civilian nuclear energy is growing in India, China and Pakistan.

Fortunately, at least in the context of India and Pakistan, there is a bilateral agreement on non-attack of each other's civilian nuclear facilities that was concluded in 1988. Both exchange a list of such facilities on the 1st of January every year and this practice has been followed since the early 1990s. While this agreement has no verification mechanisms, one cannot discount the normative pressures and frictions that such instruments bring to the fore.

In fact, even the noteworthy provisions in international law suffer from lacuna. For instance, Article 56 of Additional Protocol I to the Geneva Conventions of 1979 mentions that only "nuclear power plants" should not be attacked, but it leaves out other nuclear facilities such as research reactors, nuclear material in transit, enrichment and reprocessing facilities, and spent fuel pools. Meanwhile, Paragraph 2 of the same Convention removes protection to nuclear power plants if they are providing electric power in regular, significant, and direct support of military operations. Customary international humanitarian law too only instructs states to take "particular care" of nuclear electrical generating stations, to avoid "release of dangerous forces and consequent severe losses among the civilian population."

In the absence of any legally binding instruments that nations may acquiesce to in these times of stressed inter-state relations, the best that can be expected is to encourage nations to follow codes of responsible conduct to ensure that all types of nuclear facilities are treated with the respect they deserve since disasters at such sites could be unforgiving. Expansion of bilateral or multilateral non-attack agreements could be a viable solution. It is certainly something that India and China should conclude since it is in the best interests of both. Averting a disaster at a nuclear facility is indeed a shared interest.

08 Article Contributions

MEDICAL USES OF NUCLEAR TECHNOLOGY: RADIOIODINE THERAPY (I-131) A SAGA OF MORE THAN 80 YEARS

DR. AMRITA TIWARY VYAS

When Dr. Saul Hertz, MD [1] administered Radioactive iodine (^{131}I) to the first human patient at Massachusetts General Hospital in Boston in January of 1941, it marked a new era in medical science and thus nuclear medicine was born that was hailed as one of the remarkable peaceful uses of Nuclear technology. We are now in 80th year of this discovery and Radioiodine is still the drug of choice for Hyperthyroidism and Differentiated Carcinoma Thyroid.



Dr. Saul Hertz, MD

In the November of 1936, Dr. Saul Hertz, the director of the Thyroid Clinic (1931 – 1934) at Massachusetts General Hospital in Boston, at Harvard Medical School, heard a discussion of Karl Compton, President, Massachusetts Institute of Technology on “What Physics Can Do for Biology and Medicine.” Hertz, who was studying iodine’s effects on the thyroid, enquired with Compton whether iodine could be made radioactive so that the radioactive iodine could be used to treat hyperthyroidism. Compton responded that iodine could indeed be made radioactive. That was a landmark discovery. The study was published by Hertz and Roberts in the first issue of the Journal of the American Medical Association in May 1946 [2].



**Dr. Hertz treating patient,
published in May 1946 issue of
the Journal of the American
Medical Association.**

Nuclear Medicine is a branch of medical science which deals with “unsealed sources of Radioactive Isotopes” for diagnosis and therapy of diseases. It comprises of technologies of nuclear physics to treat biology. The SPECT/ CT and PET /CT scanners are state of art machines used for diagnosis of various diseases in cardiology, neurology, oncology, nephrology, and urology to name a few. The “unsealed source” i.e. radio pharmaceutical is injected/ ingested to the patient and molecular imaging is done, as per protocol. Scanning is done and then the diagnosis is made following the principles of ALARA (as low as reasonably achievable).

Radionuclide therapy includes radionuclides, such as iodine-131, phosphorous-32, strontium-90 and yttrium-90, Lutetium-177 that have been used successfully for the treatment of many benign and malignant disorders. The radioactive iodine-131 (RAI) labelled with sodium iodide is given in capsule or liquid form to treat thyroid-related diseases such as Graves' disease, solitary hyper-functioning nodule, and toxic multinodular goitre. RAI benefits in subclinical hyperthyroidism, at risk of cardiac / systemic complications. The American Thyroid Association (ATA), European Thyroid Association (ETA), and Japanese Thyroid Association (JTA) guidelines named RAI as the therapy of choice for patients with Grave's disease [3]. The predictive value for 10-year relapse-free survival of one negative ¹³¹I thyroid scan is about 90% after RAI therapy, whereas two consecutive negative scans have a predictive value greater than 95% [4].

Till now RAI is the treatment of choice for Hyperthyroidism and Differentiated Carcinoma Thyroid. It also paved a way to use radioactive targeted molecular therapies in many cancers and opened new doors in medical science, for collaborations in nuclear energy and medicine.

References

1. Hertz, Barbara (2019). "A Tribute to Dr. Saul Hertz: The Discovery of the Medical Uses of Radioiodine," *World Journal of Nuclear Medicine*, 18 (1): pp: 8–12.
2. Hertz S, Roberts A (1946). "Radioactive iodine in the study of thyroid physiology. VII the use of radioactive iodine therapy in hyperthyroidism," *JAMA*, 131, pp:81–86.
3. Janet FE, Winfried B (2007). *Nuclear Medicine Therapy*, New York: Informa Healthcare USA.
4. Donald WK, Raphael EP, Ralph RW, et al (2003). *Holland-Frei Cancer Medicine*, Hamilton: BCDecker.

09 Article Contributions

HARNESSING THE ATOM: NUCLEAR POWER'S CRUCIAL ROLE IN TACKLING THE CLIMATE CRISIS

ZOYA AKHTER

Nucleonics Week popularly remarked [1], "Nuclear needs climate change more than climate change needs nuclear". Many such indictments have been made by nuclear power naysayers to imply that the nuclear energy industry has a vested interest in the urgency surrounding the climate change crisis. While nuclear power is not a panacea to the climate crisis, an objective evaluation indicates that it holds tremendous potential in reducing global carbon footprints.

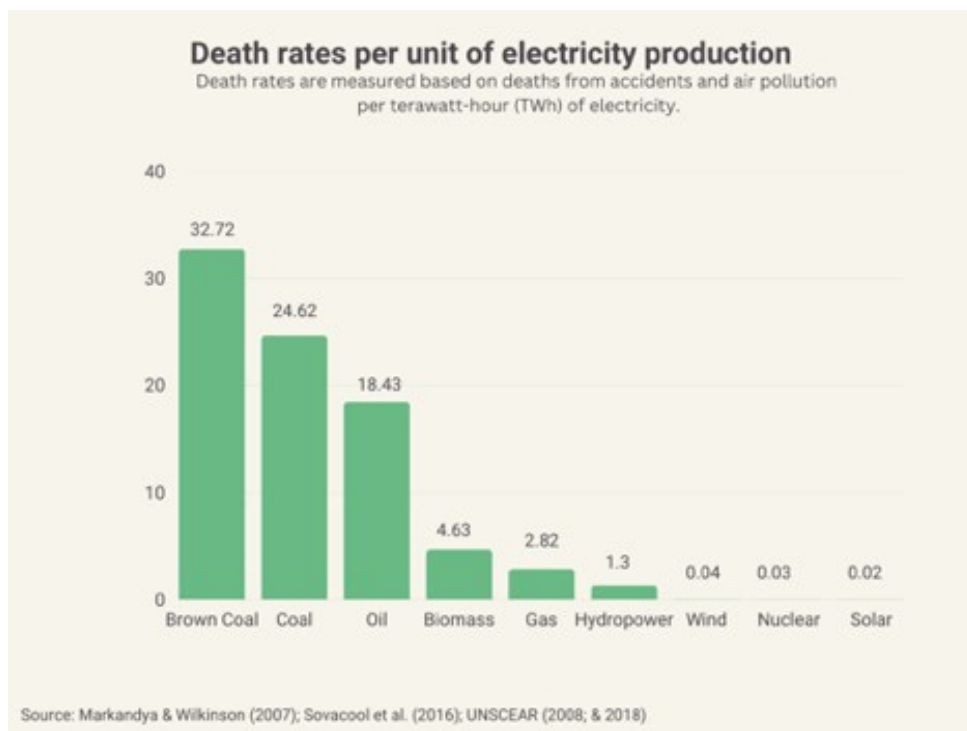
With global CO₂ concentrations surpassing 400 parts per million [2], a 50% rise in the past 25 years, the impacts of it are being felt across the world. A litany of weather extremes [3], for instance, are wreaking havoc globally and radically altering ecosystems, eerily resembling images from climate apocalypse movies. The stakes thus could not be higher. In this worsening climate landscape, we must utilise all the tools in the box- especially the ones as impactful as nuclear power.

Assessing the Factors that Make Nuclear Power an Essential Tool in the Fight against Climate Change

Nuclear power generation boasts an impressively low carbon footprint, to the extent that some argue it has played a role in averting deaths related to air pollution. A study [4] in this regard conducted by the Goddard Institute for Space Studies and Columbia University found that substituting coal plants with nuclear power plants has prevented approximately 1.8 million deaths from air pollution since 2009. Furthermore, the utilisation of nuclear energy for electricity generation is estimated to reduce CO₂ emissions to an extent equivalent to removing over 400 million cars [5] from the roads annually.

Second, the efficiency of nuclear energy generation differentiates it from most traditional energy sources. Nuclear energy in the United States, for example, had an average capacity factor of 92.7 [6] per cent in comparison to hydroelectric power (37.1 per cent), wind energy (34.6 per cent) and solar energy (24.6 per cent %).

Even with regard to land use, nuclear energy requires much less land than wind or solar power. A study made by the Nuclear Energy Institute revealed that a 1000-megawatt nuclear facility requires one square mile worth of land. In comparison, wind farms require 360 times more land, and solar photovoltaic facilities require 75 times [7] the land area than a nuclear energy facility.



Further, contrary to popular belief, strongly influenced by the Chernobyl and Fukushima accidents, nuclear energy is a safer form of energy in comparison to other electricity-producing technologies. It is interesting to note that nuclear energy has resulted in one of the least numbers of deaths per unit of electricity [8] (including deaths from air pollution and accidents in the supply chain). This is because nuclear accidents are "low probability, high consequence" events. Moreover, highly stringent regulations, robust plant designs, effective safety culture and training, and emergency preparedness are all cumulatively helping in developing high safety standards. Furthermore, advancements in new reactor technologies, such as smaller modular reactors, address existing safety concerns associated with traditional plants, thus providing us with enough impetus to rethink staunch anti-nuclear stances.

In addition, other factors such as its high fuel density, lack of requirement for storage or backup like in the case of intermittent energy sources such as solar or wind energy and high grid reliability make it capable of meaningfully contributing towards a greener and more sustainable future.

In an email interview while discussing the economics of nuclear power, Mycle Shneider, Founding Board Member and Spokesperson of the International Energy Advisory Council (IEAC) stated, "Nuclear energy went from the myth of 'too cheap to meter' to 'too expensive to matter'". While unfavourable economics has been a barrier for the longest time, it is worth considering that high price is a small trade-off, taking into account all the benefits nuclear energy offers. Moreover, as nuclear technology has been developing at a rapid pace, it is found to be cost-competitive [9] with other forms of electricity generation, except where there is direct access to low-cost fossil fuels.

All of these factors have helped build the credibility of nuclear power over the years, as evidenced in the recurring discussions regarding a "nuclear renaissance". While the industry does appear to be witnessing a revival, it still requires significantly more support to be able to meet its potential to create an impactful difference.

Conclusion

When it comes to electricity-generating technologies, there is no silver bullet. For example, natural gas may be the cleanest burning hydrocarbon, but it also faces the problem of methane leakages; Solar energy is effective, but the disposal of solar panels is a hazardous problem that is yet to be satisfactorily resolved. Similarly, nuclear energy is efficient but also has its own shortcomings. Assessment cannot only be made by comparing one source of energy-generating technology versus others. Rather, a diverse and mixed approach is needed.

In a world where the pathways to a 1.5° outcome are limited, scientifically feasible solutions with substantial co-benefits cannot be ignored. The nuclear solution offers a sustainable bridge to the future that warrants serious consideration and support.

References

- [1] https://www.academia.edu/3152935/Nuclear_or_Not_TASM_pdf_
- [2] <https://www.mottmac.com/views/asset-management-and-climate-change-the-urgency-responsibility-and-ability-to-act>
- [3] <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world/>
- [4] <https://blogs.scientificamerican.com/the-curious-wavefunction/nuclear-power-may-have-saved-1-8-million-lives-otherwise-lost-to-fossil-fuels-may-save-up-to-7-million-more/>
- [5] <https://www.iaea.org/newscenter/statements/%20nuclear-technology-for-climate-mitigation-monitoring-and-adaptation>.
- [6] <https://www.energy.gov/ne/articles/what-generation-capacity>
- [7] <https://www.nei.org/news/2015/land-needs-for-wind-solar-dwarf-nuclear-plants>
- [8] <https://ourworldindata.org/safest-sources-of-energy>
- [9] <https://world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx>

10 WiN-India Events 2022-2023

EXPLORING THE MYRIAD FACETS OF NUCLEAR ENERGY

12 MARCH 2022

On 12 March 2022, marking the occasion of **International Women's Day**, WiN-India organised its **first national webinar** on 'Exploring the Myriad Facets on Nuclear Energy.'

The national webinar opened with introductory remarks by the Chairperson of the Board of Directors, Dr. Umasankari Kannan.

Dr. Meera Venkatesh, former director of the Division of Physical and Chemical Sciences at the IAEA and former head of the Radiopharmaceuticals Division at the Bhabha Atomic Research Centre (BARC) delivered the **keynote address** on the topic '**Beneficial Radiations for Better Health.**'

WOMEN IN NUCLEAR - INDIA (WIN-INDIA)
Celebrate International Women's Day with a National Webinar on
Exploring the Myriad Facets of Nuclear Energy
Saturday 12 March 2022 15:00 - 17:00 hrs

DR UMASANKARI KANNAN
Head, RPDD, BARC
Chairperson, BOO WIN - India
Introduction to WIN-India
Programme Anchor :: Ms. Archana Yadav

KEYNOTE ADDRESS
DR MEERA VENKATESH
Ex Director Division of Physical and Chemical Sciences, IAEA &
Ex Head, Radiopharmaceuticals Division, BARC &
Ex Senior General Manager, BRIT, DAE
Beneficial radiations for better health

PANEL DISCUSSION
Chair :: Prof. Alpna Goel

MS MANJU GUPTA Ex NPCIL & EX Head AREVA India Treasurer BOO WIN India <i>Nuclear Power in India - Now and the Future</i>	DR BALVINDER SAPRA Head, RPAD, BARC President, EC WIN India <i>Radiations in everyday life</i>
DR MANPREET SETHI Distinguished Fellow, CAPS Co-Chairperson BOO WIN India <i>Nuclear Security and India</i>	MS JALAJA MADAN Head, TCPAS, IGCAR Public Awareness Manager, EC WIN India <i>Public perception of atomic energy</i>

DR MARY MOHANKUMAR
Former Senior Scientist, IGCAR
Jt Treasurer, BOO WIN-India
Concluding remarks

JOIN US
ON YouTube
<https://youtu.be/nsAzzWzzZ3Y>
ON ZOOM
MEETING ID: 856 9808 6920
PASSCODE: 738828
<https://us02web.zoom.us/j/85698086920?pwd=eE1TNDhoaHk3IuaGQzMUlSUUxzUT09>

Diagnostic Nuclear Medicine

• Radiotracers – for diagnosis

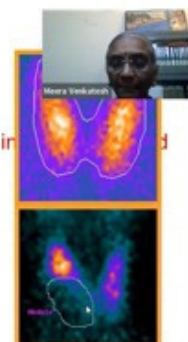
- Administration of a radiolabelled molecule (Radiopharmaceutical) in imaging
- Radiation emitted – imageable photons such as gamma rays
- Gamma emitting RNs and Positron emitters (annihilation photons)
 - Tc-99m; I-131; Tl-201; F-18; Ga-68 + ...
- Organs – anatomy & function - Static and Dynamic
- Tumours - shape, position
- Cancer-diagnosis; treatment monitoring; regular follow-up

Cardiology, Oncology– most NM studies;

+ several other areas (Neurology, infections, Liver, Kidneys etc.) + Drug research

WHO (2021 Fact sheet)-CardioVascularDiseases-17.9M deaths/y -31% of deaths

Global Cancer ~ 19 M annual new cases; 10 M deaths



EXPLORING THE MYRIAD FACETS OF NUCLEAR ENERGY

12 MARCH 2022

Following presentations were made as part of the panel discussion on Exploring the Myriad Facets of Nuclear Energy:

Nuclear Power in India - Now and Future by *Manju Gupta*

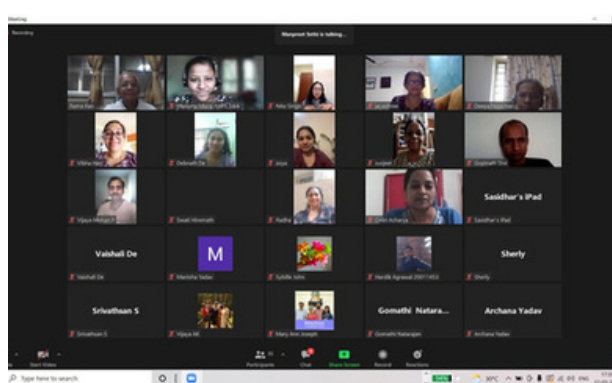
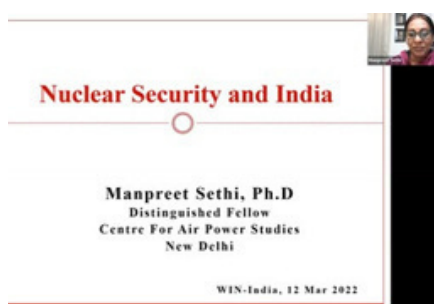
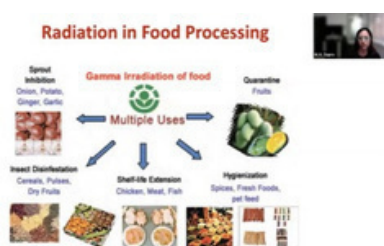
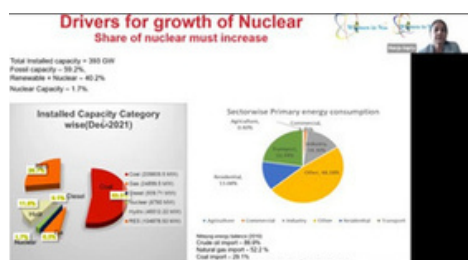
Nuclear Security in India by *Dr. Manpreet Sethi*

Radiations in Everyday Life by *Dr. Balvinder Sapra*

Public Perception of Atomic Energy by *Jalaja Madan Mohan*

The panel discussion was chaired by **Dr. Mary Mohankumar.**

Photo Gallery:



INTERNATIONAL WOMEN'S DAY: CELEBRATING THE ACHIEVEMENTS OF WOMEN IN NUCLEAR SCIENCE AND TECHNOLOGY

15 MARCH 2023

On 15 March 2023, WiN-India organised an in-person seminar to celebrate the **Achievements of Women in Nuclear Science and Technology**, at the AERB Auditorium in Mumbai. The seminar was held in celebration of International Women's Day. **Dr. Balvinder Sapra**, President of the WiN-India Executive Council, delivered the welcome address.

Dr. Umasankari Kannan, Chairperson of the WiN-India Board of Directors introduced Association of Women in Nuclear - India and its objectives. Presentations were given by:

Dr. Sarbini Ghosh Laskar, *Professor and Radiation Oncologist, TMC* on **Radiation Oncology for Head and Neck Cancer: the travel so far and miles to go.**

Ajita Shrivastava, *Chief Engineer, (R&D-ES) & CISO, NPCIL* on **DigiEmpowerment of Women**

Dr. Alpana Goel, *Director & Head, Amity Institute of Nuclear Science and Technology* on **An Institute's Accession to Excellence under woman leadership.**

Nita Singh, *General Manager of the WiN-India Executive Council and Associate Director (C&I), NPCIL* gave the vote of thanks.



International Women's Day

March 15, 2023, 2.30 PM onwards
AERB Auditorium, Anushaktinagar, Mumbai

Join us to celebrate the
**Achievements of Women In
Nuclear Science and Technology**

For Registration:
Kindly send an email to winiwd.2023@gmail.com by 14th March 2023. Limited seats only.

Program Schedule

2.30 -3.00 pm	Registration
3.00-3.15 pm	Welcome Address Dr. Balvinder Sapra President EC (WiN India) & Head, Radiological Physics & Advisory Division, BARC
3.15-3.30 pm	Objectives of WiN India Dr. Umasankari K. Chairperson BoD (WiN India) & Head, Reactor Physics Design Division, BARC
3.30-3.50 pm	Talk 1: Radiation Oncology for Head and Neck cancer: the travel so far and miles to go Dr. Sarbini Ghosh Laskar Professor & Radiation Oncologist, TMC
3.50-4.10 pm	Talk 2: DigiEmpowerment of Women Ms. Ajita Shrivastava Chief Engineer (R&D-ES) & CISO, NPCIL
4.10-4.30 pm	Talk 3: An Institute's Accession to excellence under woman leadership Dr. Alpana Goel Director & Head, Amity Institute of Nuclear Science and Technology
4.30-5.00 pm	Interactive session
5.00 -5.05 pm	Vote of Thanks Ms Nita Singh General Manager EC (WiN India) & Associate Director (C & I), NPCIL
5.00-5.30 pm	Tea and on-the-spot membership registration

INTERNATIONAL WOMEN'S DAY: CELEBRATING THE ACHIEVEMENTS OF WOMEN IN NUCLEAR SCIENCE AND TECHNOLOGY

15 MARCH 2023 PHOTO GALLERY



11 Become a Member

Call for
Membership!!



Association of Women in Nuclear in India (WiN-India)

www.win-india.org

Objectives:

- To spread the awareness and encourage participation of women in the field of nuclear science/technology/industry;
- To prepare, develop and disseminate information on nuclear technology awareness by way of public events, seminars, reports, flyers, videos, social media, performing arts etc.

Governing Bodies:

Board of Directors

Dr. Umasankari BARC	Chairperson
Dr. Manpreet Sethi CAPS	Co-Chairperson
Ms. Manju Gupta Ex-NPCIL	Treasurer
Dr. Aakanksha Saxena ITER	Secretary
Ms Kritika Kaur Thermofisher Scientific	Jt. Secretary
Dr. Jyoti Gupta	IT Manager
Dr. Alpana Goel, Amity Univ. Dr. Mary Mohankumar, Ex-IGCAR Dr. Nitendra Singh, ITER Ms Archana Yadav, Amity University	Members

Executive Committee

Dr. B.K. Sapra, BARC	President
Dr. Amrita Tiwary Vyas Janakpuri Superspeciality Hospital	Vice-President
Ms. Nita Singh, NPCIL	General Manager
Ms. Alpana Manwal KAPP	Jt. Secretary
Dr. Garima Sharma, DAE	Manager (Programmes)
Ms. Jalaja Madan Mohan, IGCAR & Zoya Akhtar, Blue Sky Analytics	Manager (Public Relations)
Dr. Ritu Singh, AERB	Manager (Finance)
Dr. Celin Acharya, BARC & Dr. Tanvi Kulkarni, Asia-Pacific Leadership Network	Manager (Publication)
Dr. Kanika Rakhra Kautilya School of Public Policy	Manager(Academic/ Universities Liaison)

Membership:

Membership is open to any individual having genuine interest in the society's objectives, without any discrimination on the basis of gender, race, creed, etc.

Please fill the Registration form <https://forms.gle/arMZbd6Kjse1Mq697> or download it and send the manually filled up form by email to : contact.winindia@gmail.com

After receipt of confirmatory email regarding your membership, please make the payment as per details provided

Annual Membership fees:	INR 1000
Lifetime membership Fees:	INR 5000 (Discounted price of INR 2500 till 30 June 2024)
Student Annual membership:	INR 200
Payment Details:	Bank: State Bank of India Account Name: Win India Association Account no. 40969531352 IFSC code: SBIN0010124

Hurry up to avail
the discounted
membership fees!!