INDIAN NUCLEAR SOCIETY NEWS

QUARTERLY BULLETIN OF
INDIAN NUCLEAR SOCIETY

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FROM PRESIDENT, INDIAN NUCLEAR SOCIETY

Dear Fellow Members

Very warm greetings. We are happy to bring to you this combined issue (Jan-June 2024) of our newsletter. This is also an appropriate time to take stock of the activities promoted by the present executive committee (EC) in the past one year or so. You are well aware that this EC took over in December 2022.

INS Outreach Program

I am happy to inform our esteemed life members that the incumbent EC has expanded and intensified the outreach program. INS organized over 12 outreach programmes by June 2024, namely, at Brijlal Biyani Science College Amravati, College of Engineering Kankavli, Vidya Niketan School Kasal, Nehru Science Centre Mumbai (in collaboration with INYAS), IIT-BHU, IIT-Jammu, NIT-Srinagar, Rani Laxmibai Memorial School (two branches), Pioneer Montessori School and Central Drug Research Institute at Lucknow, Karnataka University Dharwad and KLE Society's P.C. Jabin Science College, Hubballi. These outreach programs consisted of talks on Indian nuclear energy program, inevitability of nuclear energy to combat climate change, applications of radiation and isotopes in health, agriculture and industry, and further expanding the scope in laser and accelerator technologies.

INS Lecture Series

We introduced two new programs, namely, INS Lecture Series and INS Young Professional's Forum. The INS Lecture Series, started in January 2023, is aimed at bringing together INS life members for a lecture delivered by an expert speaker. The series has become quite popular among the life members. So far, we organized the following lectures under this series: (1) Relevance of small and modular reactors in Indian energy scenario: Challenges and opportunities, by Dr. A.K. Nayak, Head, NCPW, DAE, (2) Small and modular

reactors, by Shri G.R. Srinivasan, Former Vice-Chairman, AERB, (3) Physics of next generation energy systems: An overview, by Dr. K. Umasankari, Head, RPDD, BARC, (4) Indigenous electron accelerators for diverse applications, by Dr. Archana Sharma, Director, BTDG, BARC, (5) Safety-security interface at nuclear power plant, by Shri D.K. Shukla, Chairman AERB, (6) Nuclear hydrogen towards quest for next zero, by Shri K.T. Shenoy, Director, CEG, BARC, and (7) Nuclear non-proliferation and safeguards, by Dr. S. Gangotra, RRF-DAE and Member EC, INS. We hope to organize more lectures in the time to come. The objective of the INS Young Professional's Forum is to groom young generation scientists/engineers through lectures and interactions. We would like to build on this program so that newer talent will be made available to INS as well as to DAE in future.

Memorandum of Cooperation and WNE 2023

INS has signed memorandum of cooperation with French Nuclear Society (SFEN), American Nuclear Society, and Japanese Nuclear Society. These cooperation arrangements shall help INS to expand in its objectives in a long run. Consequent to our cooperation agreement with SFEN, INS was provided a special VIP Badge to participate in the 5th edition World Nuclear Exhibition (WNE 2023) held at Paris during November 28-30, 2023. I, as the INS President, represented INS at WNE 2023. I would like to inform INS life members a few salient features of this event.

The theme of WNE 2023 was, "Connecting Nuclear to the World: Rising to the energy and environment challenges". WNE 2023 was a grand exhibition with over 30 countries having their exhibits and with visitors from over 70 countries. India was listed as one of the 30 countries, however, the only stall from India was that of L&T. WNE 2023 had huge pavilions by France, China, USA, UK, and reasonably good pavilions by countries such as Poland, Czech Republic, Romania etc. WNE 2023 had over 130 keynote sessions, panel discussions and workshops with participation of over 200 nuclear experts.

The inaugural session of WNE 2023 was titled, "Nuclear Power, a Key Energy to a Worldwide Low-carbon Future". The speakers in this session were, Sylvie Bermann, President of WNE 2023, Rafael Mariano Grossi, DG, IAEA, Fatih Birol, Executive Director, International Energy Agency, Thierry Breton, European Commission and Agnes Pannier-Runacher, French Minister for Energy Transition. In

other high-level sessions, there were presentations by experts such as Sama Bilbao y Leon, Director General, World Nuclear Association. These speakers highlighted the nuclear renaissance that is in the offing owing to the low-carbon nature of nuclear power.

WNE 2023 emphasised on trade and commerce, and it was attended by ministers from various countries, some examples are, Agnes Pannier-Runacher, French Minister for Energy Transition, Mary Ng, Minister for Export Promotion Canada, Josef Sikela, Minister for Industry and Trade, Czech Republic, and Dan Dragos Draga, Secretary of State for Energy, Romania.

WNE 2023 consisted of a large number of parallel workshops and sessions on variety of topics such as SMR, nuclear new builds, regulation, security, healthcare, hydrogen, heat production, digitization, closing the fuel cycle and accelerating advanced nuclear technology programs. There was an emphasis on sensitizing younger generation to take up nuclear as a career option. Mr. Rafael Grossi, DG, IAEA said, "Communication is essential. Nobody wants to work in a dying sector that is not interesting. For the past 20 years, there has been constant communication that nuclear is bad, dangerous and dying. Against that background negativity, the industry could not expect young people to join it". Mr Grossi further said that he was encouraged to see that this trend is changing, "but this is going to take some time. We need to learn to communicate with a younger generation that gets its information in a different way". Mr Grossi added: "We do have a particular problem when it comes to gender. My observation is that, when it comes to gender, there is a lot of discourse, but very little in action". With this in mind, IAEA has created a channel that helps to finance the nuclear careers of 200 women. He appealed to the audience for help in developing this channel and expand it to cover 2000 women.

WNE 2023 had instituted 10 innovation awards; two each in the following 5 categories: (1) Societal and Sustainable Responsibility, (2) Nuclear Safety, (3) Operational Excellence, (4) Products and Services, and (5) Skills & Knowledge Management.

Finally, to conclude, the mood in the nuclear community was very upbeat and there was a general feeling that this is an extraordinary time for nuclear industry. It must also be mentioned here that the South Korean Nuclear Association has invited INS to participate in their annual event to be held around December 2024.

INSIC-2023

INS had its international conference (INSIC-2023) on the theme, "Nuclear for Clean Energy Transition" during December 12-15, 2023 at the DAE Convention Centre, Anushaktinagar, Mumbai. The conference was organized in collaboration with the Nuclear Power Corporation India Ltd. (NPCIL). It was an extraordinarily successful conference with participation of a large number of national and internation delegates. On behalf of INS, I would like to place on records our sincere thanks to NPCIL for their valuable participation in the organization of the conference. We have received several messages from the invited speakers and delegates describing the conference very informative and useful. The success of INSIC-2023 was due to three factors: Firstly, the theme itself conveyed the task ahead of the humanity to combat the climate change. Secondly, the timing of the conference was on the backdrop of the COP28 UN Climate Change Conference in Dubai during November 30 to December 13, 2023. An important event in COP28 was the declaration to triple nuclear energy. Thirdly, the untiring efforts of various committees of INSIC-2023 contributed immensely to the success of the conference. The video recordings of the invited talks are available on INS/INSIC-2023 website. In this combined issue we have carried two important aspects of INSIC-2023, namely, interviews of international nuclear experts and summary of panel discussions. We thank Shri S.K Malhotra and Dr. A. Ramarao for preparing respectively the transcripts of the interviews and panel discussions.

INSAC-2024

It appears that the world is heading towards 'Nuclear Renaissance', where nuclear is being seen as an inevitable solution to meet energy needs of the world with net zero emission. This renaissance has several dimensions including deployment of Gen-III and Gen-III+ nuclear reactors; innovative reactors such as SMRs, FBRs, MSBRs, CHTR and also nuclear hydrogen. In order to realize the full potential of nuclear power, significant efforts are required to design protocols that ensure highest safety and security standards. Considering the utmost importance of robust nuclear regulatory framework in harvesting nuclear energy and its applications in speedy manner, Indian Nuclear Society has embarked on its annual conference (INSAC-2024) on the topic, "Regulatory Framework for Nuclear Renaissance" to be held at the DAE Convention Centre, Anushaktinagar, Mumbai during November 19-21, 2024. The

conference is being organized in association with the Atomic Energy Regulatory Board (AERB) that plays a pivotal role in implementing the nuclear regulatory framework in India. We hope to receive enthusiastic participation of nuclear fraternity in this conference.

Looking forward

INS EC strongly believes that it has made a significant positive difference in the public appreciation and acceptance of nuclear power and its applications in the Indian context. To this end, we are engaging ourselves with all stakeholders of nuclear power. I would like to mention two initiatives here: (1) To bring together Indian industry and suppliers together on one platform and provide them opportunities in international nuclear events to display their products. A small beginning to this end was made during INSIC-2023. We are continuing to work on this idea. (2) To support foreign travel of students working in the area of nuclear energy and its applications. To this end we have already created a corpus of Rs. 60 lakhs to begin with. We propose to go to the General Body soon for approval of this travel grant scheme.

In conclusion, the current EC has consolidated the existing activities, added newer activities and is creating opportunities for future growth of INS. All this has been made possible by the untiring and selfless work of the members of the EC. I take this opportunity to thank them for their valuable contributions to the growth of INS.

Warm regards.

Yours sincerely

Prof. B.N. Jagatap
President, Indian Nuclear Society

01. INTERACTIONS WITH INSIC-2023 SPEAKERS

As a side-line activity of INSIC-2023, Shri S.K. Malhotra, Chairman, Publication and Media Committee had interactions with 5 of the invited speakers. Following are some excerpts from these interactions.

Ms. Valerie Faudon, Director General, French Nuclear Society (SFEN), France

SKM: Welcome Ms. Valerie. I will start the discussion by saying that the world today is trying to do what France had done 4 decades back i.e. Fast deployment of nuclear power in a short time. Your comments and suggestions.

VF: Yes, we had put up 58 reactors in 20 years. Our share of fossil fuels in electricity came down from more than 70% to less than 10% in that short time. This is what all countries in the world need to replicate today. There are two learnings from our experience. One, government policy and two, industry organization. For industry to be able to construct plant after plant, we need to have a vision. Important thing is, choose a design and go on making plant after plant. That saves time and money. It has to be done in a big national mission mode.

SKM: You will agree that nuclear power is going through a fresh renaissance. Are you going to add nuclear capacity in your country in new future?

VF: Yes, we are going to extend life gradually up to 60 years and beyond. Plus 14 large reactors (6 large EPRs and 8 additional ones will be built between 2035 and 2050. This may not be as fast as earlier. We have not built nuclear reactors for a long time, so we want to gear up to do it once again.

SKM: Do you think there is Chance of Germany coming back to nuclear power.

VF: Yes, unfortunately in last 10 years or so Germans shutdown many low carbon nuclear generation plants and kept running the high emission coal based plants. Now, no gas from Russia and many industry say they can't continue in Germany because of high prices of electricity. Main opposition party says they want to go back to nuclear and want Germany to restart the shutdown plants. They want Germany to be a big nuclear country once again. In fact, they have said Germany should had signed agreement at COP-28. I personally look forward to that as this will be a boost to the

nuclear industry.

SKM: In your presentation today, you mentioned about disruptive fuel cycle and disruptive technology. Can you tell exactly what you mean by that?

VF: For our SMRs, we will be using same fuel cycle as being pursued presently. For advanced SMRs, we don't have plants, so it is disruptive. For example, for Molten Salt Reactor there is no fuel yet. We are developing it.

SKM: So, what exactly is the plan?

VF: Idea is to have large reactors produce large amount of electricity. We will have SMRs to do hydrogen and heat for industrial sites. We will also have a fleet of advanced modular reactors which can either contribute for applications such as hydrogen. In addition to the 14 EPRs, we plan to put up two pairs of SMRs and a prototype advanced modular reactor. We will participate in development of multiple technologies and finally will choose one or two for commercial level AMR. One technology will be sodium cooled FBR and the second can be an advanced modular reactor for which we are yet to develop the technology.

SKM: What about the public acceptance?

VF: We in France have very good public acceptance. Particularly since 2018, it is very favourable because gas prices are high in Europe. My problem is, about half the population doesn't not know that nuclear is low carbon source of electricity. They generally feel industry is dirty and nuclear being industry, must be dirty. Ten years back people thought only renewables will be sufficient, but now they do understand that without nuclear we cannot mitigate climate change. We arrange lot of public debates on nuclear power where we carefully listen to their questions and address them People see white clouds, they feel nuclear plant is putting heat into the environment, thus causing climate change. In most public debates, mainly anti-nuclear people come and ask typical questions. General people do not come as they feel why to waste time. Another issue is mistakes in textbooks.

SKM: What are the objectives of the MoU you have signed on behalf of French Nuclear Society (SFEN) with INS?

VF: Firstly, to have science cooperation, second, to write joint white papers, third publish scientific papers together, fourth, work together on hydrogen, and fifth, cooperation in regulation. I will be consulting my technical experts to identify more areas of cooperation like desalination etc.

SKM: One aspect of nuclear power is to replace coal for generation of electricity. But

the second and equally important aspect is to use nuclear power in the industry as a source of heat and also to replace coal by hydrogen as the reducing agent. Are you working on this?

VF: Yes, France is working on that and it is equally important.

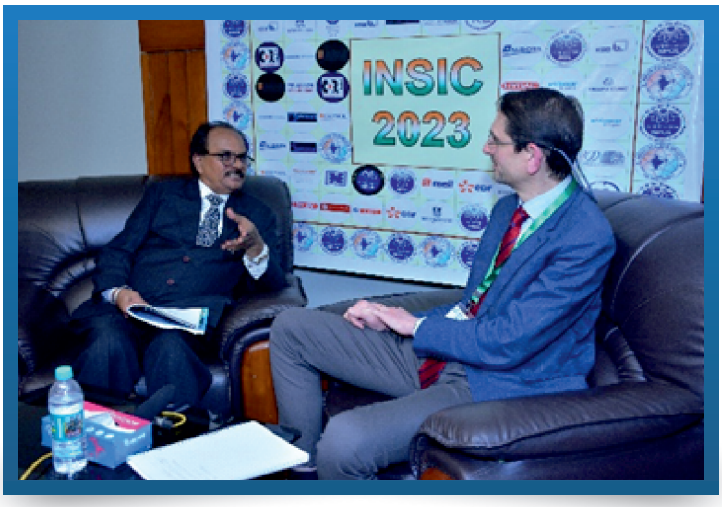
SKM: How about heat for home warming?

VF: In Paris, 50% of the heat for warming the homes and offices comes from waste materials and 50% from gas. Currently nuclear power stations are far from city. That is why we are looking to SMRs.

SKM: It was really very interesting to talk to you. All the best to you and your country.

VF: Thank you very much Mr. Malhotra.

Mr. Serge Gorlin, Head, Membership and Business Development, World Nuclear Association, UK



SKM: Welcome Mr Gorlin. Today, you talked about net zero nuclear initiative of WNA. Can you tell us more about it?

SG: Yes, Mr Malhotra, thanks for inviting me. Net zero nuclear is initiative of WNA and Emirates Nuclear Energy Corporation (ENEC) based in UAE, the host country for COP 28. It is an advocacy initiative that recommends triplication of the global nuclear capacity by 2050 in order to achieve net zero emission.

SKM: What will be the role of WNA in achieving that goal?

SG: Our priority is enabling finance for nuclear projects which are capital intensive and take some time before you can payback. Facilitate finance on fair terms. Financial institutes should look at nuclear without any partisan.

SKM: Is WNA developing any financial models in collaboration with some banks and financial institutes?

SG: We have created a working group called environmental social group (ESG). Trillions of dollars invested in pension funds, companies etc. are looking at suitable criteria for investment. It is important to ensure that the money is being invested in a manner that it meets the criteria of climate change, carbon neutrality, etc. In the past, the criteria of investment was only earning. Today, it is how the investment meets environmental criteria. In the past nuclear has been neglected, but now it is recognised

that nuclear is very strong in terms of ESG. We can convince that nuclear is a sustainable energy source with low carbon footprint, low land footprint, no impact on climate.

SKM: Nuclear not only is suitable source of energy, but supports many sustainability goals of the UN.

SG: Absolutely true. Nuclear meets multiple SDG goals. There was a study published by an institute in Luxembourg according to which nuclear was found to be the most sustainable.

SKM: What in your view would be the global nuclear capacity by 2050 as compared to today's 400 GW?

SG: Target of triplication is about 1200 gigawatt. Latest fuel report of WNA looks up to 2040 and it has 3 scenarios. The upper scenario. With 930 GW Is consistent with reaching 1200 GW by 2050. In reality, it could be more than triplicating.

SKM: Another issue besides the 3M challenge is public acceptance. What are you doing about it?

SG: That is fundamentally true. We try to influence public debates. We have about 200 information papers that cover the topics people are concerned with e.g. nuclear waste. We have free news service. We are employing really good journalists for the newsletter. Not only positive news stories, various issues coming up are discussed in these newsletters.

SKM: In your presentation you talked about CORDEL. Can you elaborate on that?

SG: Working group of WNA where Industry members come together to share their experiences and come to a consolidate position on a particular issue. Typically, the licensing process in one country takes 4 to 5 years. Then while deploying in another country, it again takes more time. WNA's working group on Cooperation in Reactor Design, Evaluation and Licensing (CORDEL) has recommended that regulators cooperate with other regulators while maintaining their sovereignty and their jurisdiction.

SKM: It is a sensitive issue. There can be objections from some regulators and they may ask, "Do you mean that regulators are being bottlenecks for the growth of nuclear power?"

SG: I agree. Regulators set the rules and the industry is supposed to follow these rules. There are many regulators who agree with this type of benchmarking the regulatory process. It is possible to be reasonably independent while cooperating with others resulting in speeding up the process of licensing.

SKM: Well, I wish you all the best for that. Now please tell me about other general activities of WNA.

SG: We hold a symposium every year at London. Last September we were delighted to have the station manager of Kaiga NPP to speak at a session that we co-organised with WANO. He talked about managing the fleet of new construction. We have World Nuclear Fuel Cycle Co-organised with Nuclear Energy Institute. We do lot of online webinars. We were doing them earlier also but particularly during COVID period we did a large number of them and using the skills developed, we are continuing to do so. Online webinars are very convenient, low cost and effective.

SKM: What possibilities do you see about cooperation between WNA and the Indian Department of Atomic Energy, nuclear operators and industry and professional bodies like INS?

SG: Well, we would love to increase such cooperation. My coming to this conference is with hope of making connections and learn what is happening in India. WNA has global members in 40 countries, including some Indian companies. We certainly would like to bring more Indian industry on board. India has lot to offer. You hold records of operating for long periods without shutdowns. There is lot of research in India and you are developing closed fuel cycle. You have lot of young talent coming from universities that can support not only the Indian but the global nuclear industry. My Director General is hoping to come for the India Energy Week to be organised in February, 2024.

SKM: Well, Mr. Gorlin, it was really nice talking to you and I look forward to increased interactions between WNA and Indian nuclear industry and professional bodies like INS. I wish you a comfortable stay in India.

SG: Thank you very much Mr. Malhotra.

Ms. Elena Artemova, Deputy Director General, Back End of Nuclear Fuel Cycle, TENEX, Russia

SKM: Welcome Ms. Elena. Tell us, being a lawyer, how you got into nuclear field?

EA: My basic background is legal, and I was working in that profession. Now, the legal

background is assisting me in business development. At some point of time, it became interesting not only to assist but to lead the business development projects. My legal background helps me to structure the projects.

SKM: Both our countries follow close nuclear fuel cycle unlike some other countries that follow the open nuclear fuel cycle. What do you think about this approach and its advantages?

EA: It is true that there is much in common to our approach to the development of nuclear as a whole. India's three stage nuclear power program provides many elements which are present in the Russian program too. In Russia too, we are engaged in development of closed nuclear fuel cycle and are developing technologies in this respect. Spent fuel consists of many useful components which can be further reused, and it is a responsible approach for the humans not to treat it as a waste, but to allow the energy potential of the fuel to be further reused.

SKM: How many reprocessing facilities do you have in Russia?

EA: On commercial scale, there is our Mayak plant near Chelyabinsk operating since 1977 with a well-established technology with long operational experience. We are also constructing pilot scale demonstration facility in Siberia. It will be operational in couple of years.

SKM: So with this one plant that too of old vintage, are you able to take care of reprocessing of all the spent fuel generated in your country?

EA: Mayak plant has wide technical capability and it is able to deal with very different fuel types including submarine plant fuel. Presently, the capacity is not enough to reprocess the whole annual production of spent fuel, but we are working on it. So the strategic goal is to reprocess all the fuel that accumulates. That is why we are increasing the reprocessing facilities.

SKM: OK, but in your talk, you told that in addition to reprocessing your spent fuel, you are assisting more than a dozen other countries to reprocess their spent fuel also.

EA: Yes, it is true. Rosatom participates in large number of international projects connected with reprocessing of spent nuclear fuel management. Actually 18 countries have sent their spent fuel for reprocessing to Russia and currently we are having ongoing project with our foreign partners. Among these are both research reactors and commercial power reactors. So we are very happy to be part of this international cooperation.

SKM: That is really very good. Tell me what happens to the spent fuel post reprocessing - fuel materials like uranium, plutonium and some other useful materials and finally, the high level waste. Do they go back to the country of origin?

EA: The valuable materials can be consumed in the Consumer's fuel cycle or that of Russia. We discuss case to case with each customer that what is the best option. As per the current industry standards, high level waste should go back to the country of origin. Now, we are improving the reprocessing technology, including partitioning of high-level waste so that handling of each section of partitioned waste will be most effective with respect to the characteristic of each fraction. Doing this will make life of customer much easy as they will get the waste in a form which is very easy to handle.

SKM: Do you separate the actinides from the short-lived fission products?

EA: Actually, we make two fractions - one is hot but short lived. Most of its activity comes from caesium and strontium. In 300 years, its activity will become equivalent to that of uranium, the starting material. Once vitrified, this short-lived waste can be returned to the country of origin. This does not need final disposal in deep geological repository. Other fraction composed of minor actinides. This we plan to burn in fast breeder reactors.

SKM: So you will do it in the FBR. Many other countries including India plan to do it in the accelerator driven sub-critical systems.

EA: Yes, there are multiple options. We are comparing them. As Russia is developing commercial fast breeder reactor, our priority is to burn actinides in them.

SKM: Are you already having deep geological repository in your country?

EA: No, it is planned to be constructed. The site is already chosen near Norsk, and a scientific laboratory is being constructed there. By 2026 it will be made operational. It will be doing research of soil and all other research to prove that this site is suitable for deep geological repository.

SKM: What about the public acceptance there. Have you faced any challenges?

EA: Yes, of course. Public awareness is being given high priority by Rosatom. This is obligatory and part of the federal law to inform the public and conduct public hearings in all the stages of nuclear development. We are applying all the instruments like informing public and public hearing and open approach towards public opinion. It is a fact that areas in which nuclear is already operative, the public is more supportive, People understand that

there are no dangers but at the same time there are jobs and other benefits of development in this area. The geological repository will be established near a currently existing nuclear site and that helps to promote that area.

SKM: During your presentation, you compared in terms of economics the open and closed nuclear fuel cycle. In fact you presented that in reprocessing the nuclear fuel you are not spending but recovering some money. Can you elaborate that?

EA: We are doing thorough economic calculations and modelling, and it has actually been shown that traditional reprocessing without and with partitioning will be cheaper with latter being much cheaper, say by 20 to 25%. Of course, all such calculations are case specific.

SKM: For this partitioning, what kind of technology are you developing or already developed. Are you putting up a plant in near future?

EA: We have an established program for development of this technology. We have already done R&D with respect to different technological approaches to partitioning, and we have chosen the options on which to rely. This year, we have obtained samples of vitrified short lived fractions. By 2027, we plan to have a package filled with short lived fraction to be put into the reference storage and monitoring in order for all our partners to come and see the package and participate in monitoring this package.

SKM: You also talked about international cooperation in spent nuclear fuel management, basically the entire back end of the nuclear fuel cycle. Are these cooperations with individual countries, or are you involving international agencies like IAEA, etc.

EA: Of course, we are involving all possible forums to discuss and exchange opinions. We are part of the IAEA project INPRO and we are actively communicating with them. We are using all the opportunities and are thankful to all the international organizations to provide the ground for such discussions.

SKM: OK, Thank you Ms. Elena. I wish you all the best for your professional and personal life.

EA: Thank you very much, Mr. Malhotra.

Mr. Yoh-Shik Nam, Vice President, Korea Nuclear Association, S. Korea

SKM: Good morning! Mr Yoh-Shik Naam. So, by qualification, are you a nuclear engineer or a scientist?

YSN: By qualification, I'm a physicist. I joined KANP in 1984 for starting nuclear physics related work.

SKM: The story of nuclear power in Korea is a very interesting. You started in 1978 with one unit at Kori and today, can you tell where do you stand? How many reactors and how many gigawatts?

YSN: Presently we are operating 25 units in our country with installed capacity about 24 GW. We are constructing three units and two more are in the planning.

SKM: What about uranium? I understand, like many European countries, you too do not have uranium resources in your country.

YSN: No, we don't have any. Our nuclear fuel policy is long term. We have long term contracts with various companies from US, Canada, Russia. Final manufacturing is done by Korean Nuclear Fuel Company.

SKM: How have you managed such a large program? Do you always keep a stock of uranium?

YSN: KHNP, the only operator of nuclear power in Korea has long term contracts with major companies. We have reserves to supply fuel for all the 25 units in operation. Based on demand, KNF will manufacture fuel for KHNP. That is the strategy.

SKM: Are all the nuclear power plants you are operating and even exporting, based on a single technology or multiple technologies.

YSN: The only foreign project was for UAE and there we supplied APR 1400, the only technology in the market. In addition, we are trying to obtain projects in Czech Republic and Poland and any other country. New emerging market is SMR. So we are developing integrated pressurised water reactor (i-SMR).

SKM: What is its capacity? What is the status?

YSN: i-SMR is 170 MW. We have completed the conceptual design. Next year, we will begin the actual design. Our plan is that by 2027, we will complete the design and will apply for its approval from the Korean Regulatory Body.

SKM: When do you see your SMRs to be operational?

YSN: Hopefully by 2031-32.

SKM: Are the SMRs you are developing, based on the technology of your larger reactors or is it totally different?

YSN: Some portion of the i-SMR comes from the SMART technology (all-in-one type

nuclear reactor in which the reactor, steam generator, pressuriser and coolant pump are integrated in one vessel), but we are working on more operating systems and more safety features.

SKM: How about the instrumentation and control systems? Is it within your country or does it come from other countries?

YSN: We have our own self-reliant technology for instrumentation and all components of our nuclear power plants.

SKM: So everything used in Korean reactors is made in Korea itself.

YSN: Yes, everything is Korean.

SKM: How is the private industry there? Is everything done by the government owned companies or is it done by the private industry also?

YSN: Main equipment like steam generator are supplied by Doosan. For instrumentation, Doosan and some private industries do it together.

SKM: Now let us come to the back end of nuclear fuel cycle in your country. Do you follow open or closed fuel cycle?

YSN: It is open fuel cycle right now.

SKM: Have you already identified some sites for final disposal of your spent fuel?

YSN: Not yet, actually for choosing such a site, there is public opposition.

SKM: That is the common problem for the nuclear industry except in China.

YSN: So right now, for our PHWRs, we already have the storage at the site. For LWRs, we will have similar facility at the site. These are interim storage sites. Later we will put up interim storage site outside the plant.

SKM: Lot of spent fuel must be piling up at your sites as you have 25 reactors with installed capacity close to 24 gigawatts.

YSN: The problem is, currently the Korean National Assembly is reviewing our acts. But you know, there are two big parties. They have different views about the act. So we are waiting for finalisation of the act.

SKM: OK. In general, how is the public attitude about nuclear energy in your country?

YSN: Recently, Korean Atomic Energy Forum did public survey on nuclear energy. My understanding is that more than half the public recognised the need for atomic energy for future and they want Atomic Energy in Korea.

SKM: How was the public mood immediately after Fukushima happened?

YSN: Fukushima process water release was a big issue politically in Korea. Big parties were very much against it. Right now, some process water has been released into the sea and there is no impact on the water.

SKM: When was the last nuclear reactor

made critical in Korea and whenever you started construction, was there opposition?

YSN: Actually right, but we are explaining to the people about need and safety of nuclear power plant, we also have a compensation policy. So, whenever we start construction of a nuclear power plant, the local people understand the importance of nuclear power. This, combined with our compensation policy, results in no opposition to nuclear power by them. So far so good.

SKM: Like India, do you need to conduct public hearing and obtain environmental clearance before starting the construction of the nuclear power plant?

YSN: Yes, we too have to do that. We submit the EIA report and after public hearing, get clearance from our environment ministry.

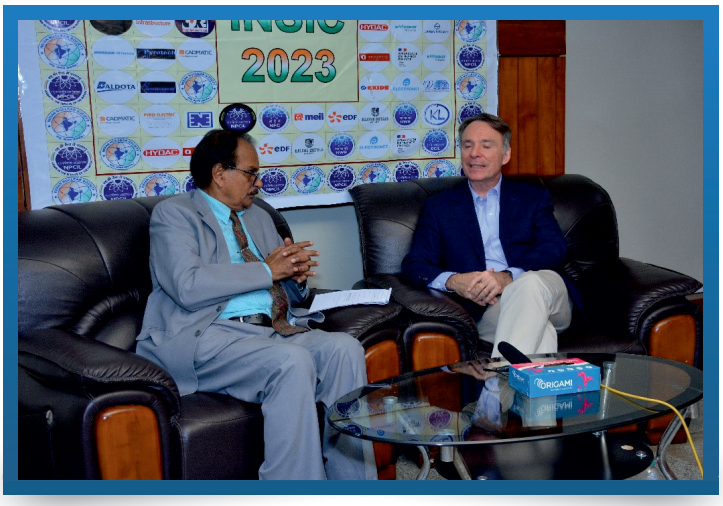
SKM: So, I think your country is doing very well in nuclear sector. Starting from scratch in 1978, you have already reached an enviable position. I wish you all the best, particularly for your global expansion activities. Any plans for doing something in India?

YSN: I understand, Indian government wants more nuclear units to meet the climate requirement. We hope we can get some project. Now Russia is already participating in the Indian market. Foreign technologies are very competitive. So based on that we can appeal to the Indian people and Indian nuclear industry. We hope we will get a chance.

SKM: Thank you very much, Mr. Nam for this interaction. I wish you, KNA and all the nuclear organizations of your country all the best for your future endeavours.

YSN: Thank you!

Franklin Servan-Schreiber, CEO & Co-founder, Transmutex S.A., Switzerland



SKM: Welcome, Mr Franklin. Tell me a bit about yourself, your early life and education.

FSS: I was born in France, did my electrical engineering from Carnegie Mellon University, Pittsburgh, USA. I did my Masters in Political Science, studying how government interacts with industry for high-tech incentives. Then I moved to Japan and studied Japanese. Came back to New York, where I established a research centre for Sony Corporation. Then, after few years, I

moved to Switzerland and became Director of Communication for International Olympic Committee which is the headquarter for Olympic Games and after that I became a self-consultant before I became Advisor to Chairman, World Economy Forum. Then I had the realisation that life is very important to be engaged in environmental causes and I went round the world to fight against plastic pollution of the ocean. That's how I got interested in environment and in nuclear. I realised that nuclear is the only way to make decarbonised power generation. Now this has been realised at COP 28. It may be a bit late. That is why I am here talking about nuclear energy.

SKM: Very interesting indeed. The most interesting fact about you is that you are a very rare commodity. Most of the people who claim to be environmentalists, tend to be anti-nuclear.

FSS: Thanks for the compliment. Because I was engaged in environmental issues, fighting against plastic pollution, I made friends with some anti-nuclear movements and they love thorium. They think that thorium is new nuclear. That is very interesting to them. We were able to reach some dialogues with them and they are favourable to us. That is a very big achievement.

SKM: As you know, India is very rich in thorium. So what you are doing, is of great interest to us. For many years, India is engaged in how to use these thorium resources. As you must be aware, India is pursuing a 3 stage nuclear power programme that was formulated way back in 1955. It has Uranium 235 as the fissile material for the first stage, Pu 239 as the fissile material for the second stage and we have the 3rd stage with Uranium 233 derived from thorium as the fissile material. So our interests are common. So the field you are working in is ADS. Can you tell briefly what is the global status of this technology and what is the status in your company?

FSS: First, I would like to say that Dr. Bhabha's vision was very well in advance and his idea was excellent. When you look at thorium fuel cycle, the one key element is how you produce U 233. As per me, fast breeder reactors are very difficult to manipulate and also, you need lot of plutonium. Of course, India has lot of experience, but if you need to reinvent the whole fuel cycle, you need many many technologies to come together. We have partnership with Argonne National Laboratory, CERN, Paul Scherrer Institute (Switzerland), etc. We can bring all these technologies together with your leadership

and expertise. One of the technologies is the accelerator technology. Particularly the high energy proton accelerator technology. We have based our design on the Paul Scherrer Institute's machine which is working for last 50 years. We think we can deliver the machine quite efficiently. We need India's help to work on the fuel itself and the pyro-processing together with America who invented the pyro-processing and that is why we are here. We really hope that we can establish this partnership.

SKM: You are proposing to convert thorium into uranium-233 in the ADS. How exactly it is done?

FSS: Right now, in second stage of India, thorium is in the blanket. So you produce lot of uranium waste. We propose to use thorium directly with plutonium in the core and then we have blanket on the top of it. We can have very optimised breeding because we use thorium everywhere in the reactor. That is thanks to the sub-criticality of the reactor. Everybody imagined the ADS as a burner, but we can change the burner into breeder. It will still burn but will breed too. We can optimise the whole thing. As we have our own simulation code, we are able to do simulation quickly. Simulations show that we can breed between 3 to 5 times more efficiently per unit of energy than a fast critical reactor.

SKM: That is very interesting. The reactor proposed by you will have Th - Pu metallic fuel and by the way, we in India are also working on metallic fuel.

FSS: Exactly, that is why we have come to you.

SKM: Is any such reactor system working anywhere in the world?

FSS: No, not really. It is under proposition only. An Italian company has been financed to develop a lead cooled reactor for the last 15 years and we have partnered with them to use their design which has been reviewed by IAEA and has been determined as very safe. So, we are working with them to customise it. Also. Thanks to India's vision, we want to now create a way to take the fuel out like a PHWR. I believe that both 220 MW and 700 MW could be redesigned to use thorium.

SKM: May be it is too early to ask if you could throw some light, at least qualitatively on the cost of such a reactor?

FSS: That is another reason we want to work with India, because India could make it much cheaper. Right now, our estimate is that for the first of a kind, the cost will be around 2 billion USD, which is not extraordinary number. We have some very serious estimate from European suppliers that when made in series, it will cost 1.5 billion USD for 220 MW reactor. We believe

that in India, we could lower the price maybe to one third. We believe, India can do extraordinary things at low costs. You have proven it by reaching the moon at such a low cost.

SKM: Oh yes, we are very proud of that. You know, when we reached the moon for the first time, it was found to be cheaper than it would have costed to go there by an auto rickshaw a very cheap means of transport for middle class in India.

FSS: It is a great new measure of cost, say auto rickshaw mile cost.

SKM: What is the status of collaboration in India? Has its reached somewhere?

FSS: We have had strong discussions. Since that Thorium conference you had here at the same venue in June, we hope we have prepared letter of intent and I think it is going through different approvals. Of course, as an environmentalist, I have strong urgency, but I am learning that in India you have this little bit of bureaucracy and checks.

SKM: Of course, every country has its own way of working.

FSS: In Switzerland or France, I know how to go about, but here we are learning to go about.

SKM: So, maybe you have to make more trips to India and learn the tricks.

FSS: That is what I will do. I definitely hope we can convince people that we need expertise of India, not just for the energy security of India but that of the whole world. We have a number of countries very interested in thorium and in India's leadership in making it happen. I am very hopeful that we can move quickly and will be very thankful to anybody who could push this approval quickly.

SKM: On that note, I thank you very much and before I end this, I would say that nothing is going to happen to the Earth. Whatever happens will happen to us and our future generations. If you talk of the worst scenario, we all may not be there, but the Earth will still be there. If we do not take the right actions now, the Earth will become a planet like Mars or Venus. No life, no water, no air.

FSS: Probably life will continue, but not human life. I think we should stop complaining. Action is most important. I believe in fighting for environment.

SKM: Any message for the environmentalists in India.

FSS: I came to nuclear power as an environmentalist because it is the most efficient, least costly, least carbon footprint, least land footprint least everything energy source. I was never in nuclear. I had never done anything nuclear. Every technology will

have some problem, but the nuclear has the least. It is very important that we move forward and as per me the best technology would be thorium energy and that is why it is so important that we move together on developing this new technology not just for India but for the world.

SKM: So, thank you very much and wish you all the best for your passion for thorium and your passion for environment. Hopefully we shall meet sometime in future.

FSS: Certainly, and thanks a lot.

02. PANEL DISCUSSIONS IN INSIC-2023: A SUMMARY

Panel Discussion 1: Role of Nuclear and Renewables in Clean Energy Transition

Panellists:

1. Dr R B Grover; Emeritus Professor, HBNI, Member, AEC
2. Dr D P Srivastava; Retired as Indian Ambassador to Iran
3. Prof R Srikanth; Dean, Prof & Dean NIAS, Bengaluru, India
4. Prof Suneet Singh; Prof, IIT Bombay
5. Shri A K Balasubramanian; Former Director (Technical), NPCIL

R B Grover, Chairman of the panel discussion welcomed co-panellists. In his opening remarks he highlighted the following key observations on energy transition in India and world over.

1. Net Zero needs nuclear, which I think has been highlighted by all the speakers in INSIC-2023.

2. India has made formal announcements regarding the evolution of energy mix but they are still to be firmed up. Even in the academic domain there is a dearth of studies for the energy mix in 2070 to achieve an economy-wise Net Zero target.

3. Other countries like in UK, have analysed cases which go beyond 2050 before they have announced Net Zero by 2050 and we are trying to catch up now, and I think some studies have been done but many more studies are needed.

4. This gap needs to be filled up and has to be addressed by integrating several perspectives namely the development need of the country, indigenous energy resource, availability of technologies and their supply chain, trained human resources and further evolution of policies and associated social impacts of energy transition.

5. Introduction of CBAM, which is Carbon Border Adjustment Mechanism, by the EU is one important development. It is EU's tool to put fair price on the carbon emitted during production of carbon intensive goods like cement, iron and steel, aluminium, fertilisers, electricity and hydrogen that are entering EU and to encourage cleaner industrial production in non-EU countries. In Rio declaration, the UK and the USA also are working on similar lines ostensibly in retaliation to the EU on evolution of CBAM. Now this decision is totally outside and how it will influence a country like India I think has been talked about earlier. The developed world could come up with some other tools as well to retain its position in global economy. The Finance Minister Nirmala

Sitharaman on 7th December 2023 in a statement called CBAM as not morally correct.

6. These developments lend urgency to evolve an energy mix that is predominantly based on low carbon energy technologies that are mature today and whose supply-chain lies by and large within the country. Research of course has to continue to develop technologies for the future.

7. This panel discussion we'll be focusing on nuclear and renewable technologies. By nuclear we essentially mean fission technologies. Hydrogen will have to play a key role in decarbonizing. For sectors like steel and cement industries estimates for the final energy consumption that is FPC have been made in some academic studies including one done by my PhD students to have HDI of 0.9.

8. In an economy-wise Net Zero scenario, the final energy consumption in India in 2070 will be about three times or above as compared to what it is today. About 60% that is about 14 to 15,000 Terawatt hour will be used as electricity and the rest will be in the form of hydrogen.

9. India will be tripling installed nuclear capacity much before 2050. May be by 2030-32. In that time frame there are enough academic studies that bring out the role of base load electricity generating technology from the point of view of grid stability.

10. Central Electricity Authority has formulated resource adequacy norms first time in the country. It has highlighted the importance of storage and all the studies have made statements that with storage per unit electricity will cost Rs 10, which will be add to the tariff from solar or wind. The cost of storage is now coming out high and this kind of remarks are coming now from all policy makers.

11. NPCIL has formulated a very ambitious plan but only for one decade. It is time for them to have a second plan for second Fleet of 10 reactors which can come up between 2030 and 2040 because there is a lot of pre-planning needed in site acquisition taking various clearances so it is the time to start thinking about it. Not thinking but getting approval for a fleet of 10 more reactors which will come up after this current fleet is over or may be concurrently with this current fleet of 10 reactors. I think NPCIL has also ideas about 200 MWe design which can even have a steel line containment that will need a smaller exclusion zone.

12. On SMRs, well I think, I will like to make a statement here considering the 220

MWe design of NPCIL. So we have our own SMR.

13. Both existing and new reactors are necessary for India and the world. To achieve economy wise net zero we should rely more on indigenous technologies as our energy needs are very large and we should think about deploying reactors whose economics is already proven. For small and micro reactor, economics is going to be challenging.

Sumeet Singh

1. Nuclear has to be a significant part of energy mix to meet the net zero targets.
2. 10 years back power from renewables was expensive but today it is the cheapest alternate however, if it has to support base-loads, then storage needs to be factored. Today batteries are the main energy storage device. Presently they are expensive but like in the case of PV could become cheaper in the future but then question is will solar + battery be clean. In the light of this, nuclear is the only base load power that can boost the economy.

Balasubramanian

1. Listening to the inevitability of nuclear power in realizing the dream of energy transition in the future and also hearing the overwhelming targets in terms of 100s of GWe of power generation in short span of time, the call for nuclear fraternity must be to execute, execute and execute. To this I want to add plan, plan and plan. That's what the real need in this context is.
2. Standardization of design and efficient implementation at the site need more attention. There is lot of interrelation between site selections and site evaluation for adequacy. For implementation of a nuclear power plant these two have a greater ramification on the detail engineering. An enveloping parameter applicable to all the sites will go a long way in avoiding reengineering system and component design. A lot of efforts go in evaluating site specific parameters before factoring them in specific design.
3. Plant life management and life extension need focused strategy. Today we are talking about 40 years. Definitely I believe the kind of robustness the kind of margins which are built in the designs we can go up to 60 years. For this additional efforts streamlined to firm up the strategies are required. With large amount of data that is available from the operating reactors, there is a need to

analyse these data to arrive at optimum life extension strategies along with safety upgrades to meet the required safety standards. These measures will go in a long way in running all the 23 plants continuously for record breaking duration as a base load power which is needed for speedy growth of economy.

Questions from Audience:

1. We have been talking always about energy in form of electricity in the decarbonisation process. Lot of Industries requires only thermal energy for example in the chemical industry sector.

Response (Grover):

The total energy requirement on the average is 40% thermal and 18% electrical. There is lot of experience in supplying steam to chemical plants as in the heavy water plant. This kind of a model will be able to utilize the nuclear energy for a whole cluster of chemical plants.

2. The question is related to deployment of SMR or other reactors because morning onwards we are discussing that by 2031 we are planning to increase more than 15 GWe and also by 2050 and 2070 we have lot of plans now what should be the timeline where we can put our 220 MWe SMR if at all.

Response (Grover and Balasubramanian):

We should plan for one more fleet of 10 reactors of 700 MWe immediately so that we can take it up in parallel to the current fleet. With regard to 220 MWe as SMR I understand that there have been some requests from certain industry, steel and aluminium Industries. They want to think in terms of setting up 220 MWe reactor and this dialogue at the moment is at preliminary stage and it will as we proceed further we'll know because this dialogue has just started so it is difficult to make a comment as to what timeline it will need but industry is showing interest.

With regard to advanced reactors while we currently Implementing 220 MWe we must develop advanced modular reactors so that we can have Gen IV Technologies and BARC already has a plan to develop molten salt breeder reactor and at Kalpakkam you are working on Fast reactors and I'm sure after PFBR goes critical you will have further plans and you will be able to move on.

3. It is well known that to meet the Net Zero requirement, we must have lot of nuclear. It is good but, what about the sites what about the site where we are going to locate the thing that is one question what is the thought process going on and second question there

was a webinar earlier that many thermal power plants are getting retired those sites are available what is the thought process that those reactors can be put into those sites.

Response (Srikanth):

The study that we (NIAS) have done for BRNS very clearly indicates that there is enough land for nuclear plants. We are very sure that there is 40 GWe of capacity available in vacated thermal power plant sites at various parts of the country. If the exclusion zone can be reduced to 500 m the envelop sites further increases and we will be able to get another 30 GWe. Sites are available but those sites require a completely different level of skills in handling the media, in handling Civil Society, in handling the state governments, that's a completely different ball game which will take many many years if NPCIL has to do everything on its own. Today India requires 20 NPCs but all these NPCs need not be government. They can also be privately owned, they can also be state owned. I think we need to be open to that idea.

The most fundamental issue facing India is ramping up generation capacity because we are at a very low point of our development trajectory now. Ramping up generation capacity at such pace requires huge resources and for that we have to have an open mind. One idea which NIAS has suggested is amendment of atomic energy act. We have to be careful as AERB, NPCIL and DAE will have to have to have an overarching role. Private sector has dynamism but of course there are safety issues, but we have to bear in mind the kind of resources needed.

4. Regarding 220 MWe technology, it's a very interesting technology and PHWR is quite interesting in the sense that in terms of safety as well as cost because whatever accidents have happened world over, they not attributable to PHWR and then in terms of cost it's multiple times, you know, lower than other nuclear technologies. So as far as you were mentioning about 220 MWe reactors, will the design be the old 220 MWe one or will there be some element of 700 MWe as far as safety systems are concerned.

Response (Balasubramanian):

If I understood correctly you are asking if we adopt this 220 MWe as an SMR whether we will go for some changes, yes something changes in line with the some of the advanced features of 700 MWe absolutely. By this you know passivity increase and you know the CDF level goes down so that we

can have wider number of sites to locate this SMR. I think I mentioned this, the 220 MWe design as such is a very robust design and we will not like to change the fundamental features of that because as I said any changes you start it has got a cascading effect in detail engineering so we will in my personal view, of course NPCIL will have a separate view, we can look at certain features for example the containment liner which is very vital in the leak tightness of the containment and thereby it helps in reducing the exclusion zone radius. We can look at the manufacturing and some kind of modularization without actually changing the engineering part of it. So I gave an example of reactor vessel. Certain amount of assembly can be done outside and it can be brought inside. Having said that again I'm repeating this, the detail engineering will have to be qualified for a wider spectrum of site parameters so that you can go on implementing very easily when you get a site.

5. 220 MWe will be used for export purpose.

Response (Grover):

Export issue is a little complicated. Whenever any country exports to other country particularly developing country they always look for loan or debt at very low interest rate. Now this is a something there are two aspects here, technical issues, yes NPCIL can handle along with vendors in India but when it comes to financing providing debt at low interest rates that is a decision which government of India has to take. So I don't think anyone of us here are in a position to answer that in detail for example when we have purchased reactor from Russia interest rate has been negotiated at government to government level. Those issues are I think beyond anyone of us here. Technically yes Indian industry and NPC together have that technical capability now.

6. We are having three models with us like 220 540 and 700 MWe PHWRs. These are well demonstrated models. Keeping in view issues of grid stability in India, lack of complete public acceptance of nuclear, not enough land availability for the expansion of nuclear which model should we adopt. Second question, is there studies carried out on the energy mix taking huge expansion of solar and other renewable mix with the nuclear.

Response (Grover and Sunit Singh):

As on today grid stability is not an issue in India and so we must go for building 700 MWe PHWR which will be our future work horse. Land requirement for 220, 540 and 700 MWe do not look to be too different and so again 700 MWe is preferred which adds to capacity build-up at a faster phase.

Smaller reactors like modular 220 MWe can be built at vacated sites with lower exclusion zone of 500 m. With regard to load following how do we take care? We need hydrogen for industrial use and at the current level of technology this hydrogen has to come only from electrolysers. We don't have high temperature reactors at this stage. So one can do an optimization study where we have nuclear reactors, renewables, hydrogen electrolysers and battery storage. So design a system such that whenever there's a mismatch between demand and supply, the extra supply can go to electrolyser for production of hydrogen. Hydrogen electrolyser can be located at locations where hydrogen is needed so that transport and the storage can be easily handled. Optimization studies have been done and it is possible to integrate and optimize this kind of a system where you don't have to flex nuclear reactors.

Three issues which were raised are: 1. Accommodating more 220 MWe PHWR at existing sites of NPCIL where land have been acquired considering 1.6 km exclusion zone. This idea is already under consideration by NPC. 2. The remark that integrated energy policy published in 2006 talked about 63 GWe by 2032 with certain indigenous components is achievable and the remaining component be acquired under collaboration with foreign vendors

7. What is India`s position on liability?

Response (Grover):

Let me explain it in detail on the liability. On nuclear liability front, we have Paris convention we have Vienna convention and since our position was not compatible with both the conventions they advocated Convention for Supplementary Compensation (CSC) which India also has later on joined. Now there is difference between these three conventions. You use the word harmonized with IAEA. IAEA has harmonized with CSC. IAEA has already accepted what we have presented to them and no objections have been raised.

People in legal expertise on nuclear ability have called objections raised by us as oxynomics because their own law has several differences from laws in all other countries. I have myself quoting from that paper the first it was written by Mr Evelyn and I have quoted that in my own commentary "Population progressed in nuclear energy in 2017" so essential. Issue with regard to foreign reactors is viability. After dialogue, dialogue, dialogue and dialogue we are not able to ensure viability of those reactors.

Panel Discussion 2: Emerging Nuclear Technologies

Panellists

1. Shri P A Suresh Babu; Director (HR), NPCIL
2. Ms Valerie Faudon; Director General, French Nuclear Society, France
3. Mr G R Srinivasan, Former Vice Chairman, AERB & Advisor, Nuclear Power Business
4. Dr Ganapati Myenini; President & CEO, BSCE Systems, Inc USA
5. Mr Serge Gorlin Head; Business Development, World Nuclear Association, UK

Shri Suresh Babu,

Chairman of the Panel welcomed the co-panellists. In his opening remarks he mentioned about SMR, fast neutron reactors, high temperature reactors, thorium utilisation, accident tolerant fuel and other key topics under emerging nuclear technologies. He made the following key observations:

1. The consensus is to increase the nuclear energy by threefold to meet decarbonisation target and there is another challenge which is very important to take care of growing population.
2. Reactor safety, economy of nuclear energy and early deployment of reactor for speedy capacity addition are key issues in the advanced and emerging nuclear technologies. SMR technology looks promising. Many speakers in this conference have talked about SMR and its current status worldwide.

Ganapati Myneni

The problem with the current technology is of three-fold. One, it takes too long to build, two, it costs too much and three, the spent nuclear fuel is a hazard for the humanity and I think this is putting the goals of reaching zero carbon really into jeopardy. I think there are ways to circumvent all these issues. That can be done by implementing Dr Homi Baba's vision of thorium usage. That can be done in fact right away in-lieu of this three-stage program not able to meet. We can convert thorium which is a fertile material using Advanced Accelerator Technologies. So you add one neutron to thorium which will transition finally to Uranium-233 which is fissionable and the final products of this reaction are really radiotoxic for less than 300 years. So we are reducing radio toxicity from hundreds of thousands to less than 300 years. Also subcritical reactors can be built within 3 to 4 years and all the existing components need to be integrated together to make them operational.

Valerie Faudon

I presented this morning that there are really two fields of innovations. I think are really fruitful right now it's the new applications and also the new fuel cycle with the advanced modular reactor so on. The new applications we've been working a lot in the French Nuclear Society on hydrogen. We published two white papers and we're going to publish a third one too to actually show how competitive is hydrogen produced with nuclear and we are right now working on heat and also working on special application. So that's really very new you know how we can use nuclear power to power deep exploration or future lunar bases or trips to Mars so that's really we're all very excited about. And on the fuel cycle side and I talked about this morning actually used fuels for us are not waste there's a lot of material in it and good things that we can recycle and that I talked about plutonium this morning but we have also in France a lot of depleted uranium that can power the country for several thousand years should we have the right reactor technology and be able to scale it up in an industrial manner. So I think that these are two things that we're working on right now thank you.

Srinivasan

I see two main reasons why the emerging technologies are emerging about two to three decades ago the only role assigned for nuclear power plants was power production may be a little bit desalination was there but once the seriousness of climate change was realized and further it was realized that power sector is a junior partner as far as CO2 emission is concerned to other sectors then the world thought that we have to tackle this issue. That's one reason. The other reason is nuclear industry is not static. It wants to learn from operational experience, accidents and try to design so that accidents are either prevented or mitigated; in fact, I told the safety even during severe accidents in my presentation. Additional things which retarded its growth are high level radioactive waste management, construction delay, capital economics, proliferation, public acceptance, societal, nuclear security, low physical footprint, compatibility with renewables, locating in urban areas, high seismic isolation, multiple applications like H2 production, burning actinide, transmutation and so on. Special reactors were designed to solve these issues thus the advancements in innovative reactors and SMR were born. One thing which we have to notice is it's not only the reactor it's the fuel cycle technologies which somebody

mentioned because we need accident tolerant fuel and all those things and even economics. Trying to have a 24 month cycle we can't generate 10 to 30,000 GWe required much later with the present day nuclear cycle. In fact these technologies are rebirth for them. Many of them are operated earlier but the operation was not enough even to find out the bugs leave alone solving them in addition the objectives of the present reactors is much higher so they have to go back to drawing board anyway and that's what they are doing now. I have talked about challenges I don't want to repeat because of lack of time.

Gorlin

I probably am approaching this from a different angle. I'm not an engineer or a scientist but I've worked in the industry for over 25 years so I've observed a few things. There are brilliant scientists and engineers within this industry. We sometimes get accused of being not Innovative but that's I think is far from the truth. You know at the moment there are nearly 100 different SMR designs that are trying to be developed. There are new approaches being researched in terms of accident tolerant fuel, in terms of improving the back end just to name some examples. I think the problem will come from is how we get the fundamentals to enable these reaching the market. A lot of the SMR designers say that their business model is based on the perception that once it's been licensed in one country it'll be possible to deploy in other. You may have to spend hundreds of millions in each jurisdiction or you're those great designs are never going to reach the light of day. There's an issue with codes and standards as well that needs to be addressed. So digital innovation which is essential there are two different approaches in the world and they have different definitions of things like defence in depth. So this is I think holding back emerging technology and the final point I'd say in introduction is you see a lot of the main companies marketing themselves as non-innovative so if you look at we had a presentation from Westinghouse about its SMR design and they were emphasizing the fact we've done this and is based on existing technology that's been licensed and you know the emphasis is on deploy ability how to deliver it.

On thorium Utilisation

Ganapati Myneni

I am aware of at least two systems that can actually be implemented. Thorium reactors, one is by the Copenhagen atomics based in Denmark; they are hoping to build

a truck-based reactors but the issue there is they have to start with a plutonium material to start the reactions but I think they have some agreement with United Kingdom which has a lot of plutonium sitting somewhere. I'm not sure where they are hoping to build it there. They actually producing supply chains for molten salt thorium fluoride and lithium-7 required for these kind of molten salt reactors that can be walkway safe in principle since these are molten salt you do not need the containment domes and all the associated security systems which make them time consuming to build and also very expensive. So I think Thorcon is another company based in United States and I presented that system to be implemented in India at International thorium energy conference 2015 hosted in this site but there are no takers and the current situation is that Indonesia has signed an agreement with Thorcon and to build these kind of a modular reactors the basic unit will be 250 MW but the economics makes it to combine two of them in the basic unit that will be 500 MW electric and these are based on again molten salt technology and they can be built very rapidly and we are expecting that Thorcon 500 MW unit first one will be built something around 2028 and it will come to the final operations within year of that and the capacity building of this will be constructed like in a shipyard fashion so they can build 20 GWe plants in one year. So that is based on one Shipyard basis type so if you can establish many of those production facilities you can ramp up this type of technology very rapidly and the cost of these systems are really very low. One GW plant that can be built in a year would cost about a billion dollars. Think about that and they are walk-away safe so these are the two systems that the companies are working but, my corporation BC systems is developing Advanced Subcritical Micro reactors (ASMR) and the capacity of that is 10 MW thermal energy and which can be converted into other forms as required and they can also be built by 2028 Prototype. All the existing components can be assembled together. The neutronics of the design is done it is going to be published shortly. So the details will be available to you as soon as the publication is out. It's under review and we have done some economics of this ASMR. We call this Advanced Sub Critical micro reactor and it can replace in the United States industries that are using fissile fuel based heat sources. We can replace them and there are about 235,000 of those can be replaced with this technology very rapidly and they can be produced pretty quickly as

well so this is where the status of this is. I will give further details in my Friday talk.

Valerie Faudon

The proposal from our government for new companies to propose new designs and we have three companies that have proposed molten salt designs but as I think the gentleman was saying in India you have thorium and in Saudi Arabia they have oil and in France we have a lot of depleted uranium and plutonium. So for us we probably will use if we use salt technology with plutonium and with chloride salt that's really where the research goes and there's investment in research from Orano and from on CA on fuel basically plutonium fuel to go into the molten salt reactor we see that as less mature than the sodium fast reactor because we had in the past sodium fast reactor so we do have the fuel design and which is authorized by the Safety Authority we just don't have any more the fuel the facility to build the fuel. So that's why I said in my slides this morning I said its different from a Gen IV reactor because in our Gen IV reactor we will use the fuel the same fuel fabrication and the same plants from that we currently using for the EPRs and from the current Fleet but if we build the fleet of sodium fast reactors we have the fuel technology but we need to build back the facility to make the fuel for molten salt fuel. It's more in the R&D process now we don't have yet an agreed fuel with the safety proven fuel and with a Safety Authority so it will be more a prototype work like the one they're building in the United States McCrae they building you know a machine in the United States it's more a research machine yet than a first off a State kind so if we start building that it will be around 2030.

Srinivasan

We talk about the bottleneck for AHWR something which is within our control. There are accelerated driven systems to convert fertile thorium to file U-233. Of course if you put it in a reactor you generate power. This will at least make it faster would have been a wonderful one. It will be a jump straight to stage three. Now some of the foreign developments which we have to consider one are a Dupic cycle which is tried in some PHWR but there's some fuel fabrication problems if that can be solved. This is one news item. Then I think Copenhagen atomics have come up with HALEU and thorium and the problem with this is if we import them we have to put our reactors into safeguards so some sort of a policy issue also will be involved and there are the use of thorium is being recognized world all over now a lot of developments. I think as time

goes by we should start our research. We have a lot of research scientists doing together with France for example in their Julich research reactor, so I think we should have a lookout. Ultimately it looks as if only we may be worried about thorium. Remaining people are not bothered too much so we have to be the, what do you call sheet anchors or beginners or the emerging technology will be in doldrums.

Gorlin

I've to confess this was the kind of question I was worried might come up in the panel because it's not an area I've studied in depth I've learned about it of course and I suppose all I can do is emphasize that you know think in a business-minded way all those that are looking I know there are a lot of technologies developing that are the thorium based and it has and I know of its advantages so don't underestimate. I think the SMR some of the SMR manufacturers are surprised that they are subject to the same regulatory rigor that you know some of the standard GW reactors are even though they feel the technologies they're developing are more safer more intrinsically safer. So I think that just needs to be really thought about not to lose sight of the deliverability of those designs and raising the finance.

On High temperature gas cooled reactors

Valerie Faudon

The advanced Rea gas reactors they already have operated and we have one in China right now and so there is experience running them so they're really a proven reactor. We have also the technologies available to make the fuel so they are promising technology, so out of the 15 companies I mentioned in France one is called Jimy and they have one contract award from the government to develop a high temperature gas reactor and they already have a they're soon going to announce the first industrial client. One of the things we've been working on is that we have these companies that are very dynamic because they're really young you know entrepreneurs and so and one other thing we've been working on with them is the issue of how they talk to the general public. It's very important because they're going to arrive into new cities new sites not areas where we have existing nuclear facilities so of course we have to prepare what is the process to engage with the local communities beyond their customer right because you have an industrial site who is interested in buying the solution but then we have to engage with the local authorities with the population and so far the Safety Authority hasn't yet developed the process for that so whole program that

we have to put which is not only a technology program but which is a really how we what is our process to go to new sites. One thing that we've learned because these are all private companies so they have government support but they're private companies it's not something we are used to because in France everything which is nuclear is public and is government driven and so we feel some reluctance about seeing private companies arriving in this area is to really engage. The government puts in place a program with a master plan so that we have a national program of where it is that we need this new resources and there is a process with a general public with a Safety Authority for this is absolutely critical and we must not overlook that because we can fail the arrival of these new technologies if we're not able to talk to the general public well so that's something we're working on. I wanted to say also because we have all these Technologies everybody's asking for fuel and we have to think about the fuel because I think that's really what happened in the United States because you have like at some point 50 start-up companies all developing exciting technology and everybody was focused on the reactor and at some point in time people were like well what about the fuel and actually the fuel is a very important part of this technology. So that's also something that we should be really aware.

Srinivasan

High temperature gas cool reactors one of the best reactors one of the two best reactors for decarbonizing hard-to-abate industries like steel. They can attain the good temperature for process heat it's not that they were not there earlier they were earlier like pebble reactor in South Africa and many others but as I mentioned in my presentation they didn't operate enough to even to unearth all the bugs. Right now of course it's one of the six reactors chosen by Generation 4 group and so it's going to have a very strong rebirth. China is already put one high temperature gas cool reactor in the commercial domain so that's a good beginning for world to do the other reactor. I would like to repeat what I read; molten salt reactors are worth their salt so these are also high temperature reactors and they have so many advantages and they are simpler (and) give high temperature good nuclear cycle facilities (with) high level radioactive. So of course India is also developing one now so these are the two reactors which I see will be there for years from now for decarbonizing non-power sectors mainly supplying process heat and other things.

Gorlin

It has struck me as slightly strange that this high temperature Gas cooled reactor is Gen-4 and at the same time was being developed back in the 1960s and I had the privilege of interviewing a gentleman who was involved in the Program the dragon project at Winfrith, UK and a lot of those I just suppose I like make the obvious point that when we develop nuclear to that we should be leveraging the research that was done in that period. If you look at the Investments that were made relatively speaking there was so much more up until the sort of' 70s 80s and so we can you know it but it's very good to see that still being utilized. South Africans obviously put a lot of money into developing Pebble bed reactor and didn't get off the ground unfortunately. South Africans used a lot of the German scientists that had been developing that carried forward the silicon carbide fuel concept and then I think in turn the South Africans have been cooperated with the Chinese and as you say there is this plant now at Shidao which I know it was delayed but you know I believe it is operating now and I'm interested to hear.

On Accident tolerant fuel

Valerie Faudon

The companies in France have been very active with a new design of accident tolerant fuel which is actually tested in the United States. It has become a very strong topic for us because we have in Europe something called the taxonomy, green finance and it was decided that the nuclear would be included in green finance which was a great victory for the nuclear industry. Years ago took a lot of reports from expert to see that we were satisfying all the criteria but actually in the decision from European commission we have the fact that we have to use accident tolerate fuel so for two years we've been discussing what is it what is the definition so some argue that the latest fuels are accident tolerant exactly because they are better than the previous generation but there are lot of discussion on do they exist have they been agreed licensed what is the situation. So I think it's still not resolved but it's true that's really a great moment of innovation so it's also so it brings a lot of benefits it brings new issues because for instance new fuel for us to recycle typically in France we recycle and could you continue with Advanced fuel cycle management also if you mean the fuel cycle the way we recycle in France we have a plant in La Hague so where we take all the used fuel in France all the used fuel is recycled and so what we do is that we separate in a used fuel we

separate plutonium which is 1% in the used fuel. Reprocessed uranium which is 95% and 4% which is a final waste so the final waste is vitrified is right now stored in La Hague and we'll building the geological deep geological repository which will be a clay repository which will take this vitrified the high level waste and right now we are in a process of getting the licensing from the Safety Authority on the design of the final repository. So the 1% uranium is today recycled. We've we mix it up with a depleted uranium and this MOX fuel today produces 10% of our nuclear electricity in France. So it's pretty good and for a while we had stopped the use of reprocessed uranium because uranium was cheap but natural uranium was cheap but now we have decided to start again. So we have the Cruas plant in France which this year has loaded I think is loading right now a new batch of reprocessed uranium and so we plan to extend the use of pre-processed uranium to other plants so that means that we reach the number of 25% that mean 25% of the electricity produced in France will be produced with a recycled material. So we're very proud of that because we have this objective of circular economy in our Fleet but of course we can go further than that. We could also start we have now a lot of used MOX so we're building a big new pool to actually store this used MOX but we looking at solutions not to recycle the used MOX so first we need to know how to basically separate used MOX but we have two options one option is to do a MOX it would be a solution that would go into the future EPR Fleet and the other option of course is to go to fast reactors so these two options are on the table right now and being looked at.

Srinivasan

Many countries in the world are developing accident tolerant fuel. I think the Russians call it by some other name but the final purpose is the same. If you analyse the three accidents that have taken place, it's mostly due to metal water reaction which has augmented the seriousness of the things so one is to go away from this metal water reaction or zirconium water reaction. So they're testing many materials which did not have this reaction the main objective is in case of severe accidents or design extension conditions there should not be any problem in the public domain. Of course if you try to if you write up the reactor something else it's an economic penalty but there should be nothing which requires any countermeasures to be taken in the public domain of course one would have liked faster development of these things many

times. I read somewhere that we trying to solve a 20th century problem in 21st century with a 22nd century solution so we would like things to be fast but nuclear engineers realize that it has to be going to R & D development research deployment and commercial domain so it takes time but some of the things like for example EU taxonomy TR that ATF is a must which only make the people to hurry up but they may lose quality and this is one the other thing asked about the thing is fuel management the fuel cycle development. There are many issues with fuel cycle of course important is non-proliferation and also how much high level radioactive waste it produces and then of course MW days per ton burn-up uh then again for LWR unlike PHWR which is on-power fuelling. What the fuel cycle is like is it 18 months or 24 months and all this. So I think these are all being addressed of course high level radioactivity is being separately addressed also and these are the things so the research is on the whole fuel cycle not just fresh fuel.

Gorlin

What we were talking in the last question about silicon carbide fuel which of course is very accident tolerant. But when we comes to vast majority of fuel of course it is described with zirconium cladding and it's really encouraging to see the developments and I think what we understand there's a need for some of the utilities to step up and offer their reactors to for the leaders assemblies and I think that's really an area where the industry as a whole can collaborate because I'm not sure what advantage the utility utilities always want to run their reactors round the clock they don't want to risk averse so I think it's great that generators of nuclear are willing and stepping forward to say yes. We will test out those lead reactors that have been developed by the fuel manufacturers that have an enhanced safety features. Another question looking at is the sort of the full cycle. I mean the question is been raised about recycling accident tolerant fuel that has some sort of coating or how does that is that going to work and I was encouraged I know our colleagues at Rosatom have started to do research on that. I believe they may even have done a recycling batch with it and the results were quite positive. It's good news for the whole industry. That you know we're thinking not just about running them in the reactor in a safe safer way but that the whole fuel cycle you know. Last point I noted down here is that in our organization we look at the once through cycle as a valid option. You know that there are countries that are

decided for their reasons such as Finland Sweden and I think Sweden may be looking again at it. Finland certainly has developed their deep geological repository on the basis of fuel once through and one potential option for the countries to deploy nuclear energy so we quite sure of neutral about the different technologies. What we do say is you have to have a plan you have to develop a plan whether it's once through or recycling but otherwise it's there are different approaches.

Yeah well again it depends on the policy of respective country. United States has planned to do the deep geological storage years ago around 1995 there was a big news article in New York Times. A friend of mine who is known as Charlie Bowman is responsible for creating hurdle that otherwise they could have started the underground storage of but that's the reason why it failed in the United States one single guy could interrupt the whole planning.

On Fast Neutron Reactors

Srinivasan

Again fast reactor it's a rebirth again. They were operating in 1947 or something. If I remember in and for many reasons I know the reason it just faded off but now it's gaining importance. I think four of the generation four reactors lead cooled and sodium cooled and so it looks as if you want to have nuclear power until fusion comes or even after fusion comes for a long time to come, the present day cycles will not sustain so you have to use thorium. You have to use probably even mined uranium from the sea. In fact large amount of it is in the sea but it's not commercial. Now so there are a lot of things which can be done of course once fusion reactors come then maybe these reactors will fad so I think the fast access will be the in-thing now and of course we have front runners. One day I hope with available thorium also that can be sent to countries that do not have fuel we may be for runners in export of reactors and before that to establish itself in a very strong manner in the home ground

Valerie Faudon

Several fast reactors in France including a Super Phoenix which stopped in 1997 and that was a big disappointment for everyone in the nuclear industry at that time. So in last year's we've been working on a project called Astrid but the government has decided to delay the construction of prototypes on Fast reactors because the priority right now is to replace the existing Fleet because I showed this morning we have 56 reactors but we still have no vision of whether they can go beyond 60 years so if

they cannot go beyond 60 years we'll have to really accelerate the building of new EPRs and so the priority is really on this capability for the security of Supply on electricity. I mean the industrial priority so as I said the government has taken another approach which is said we have some time now before we restart building a prototype so let's open up to new IDs and that's what they have decided but among these IDs we have at least three sodium fast reactor designs and one lead fast reactor design so right now they some of them have already received support from the government to develop the IDS but they are really innovative for instance the Anna design they're using molten salt to store the energy so it's a little bit like the Natrium design in the in Wyoming from what's the name Terra power except that it's going to be a fast reactor so there because we have some time they exploring new and innovative ideas and but we hope that we'll have to start building prototype by 2030 and that will be based on this prototyping to make an industrial decision for a fleet later in the 2030s. That's a dream we have at least as a French Nuclear Society.

Srinivasan

I want to take this opportunity to thank France for giving FBTR to us. I think 40 years ago and it's operating very nicely now and in fact it gave the impetus and laid the foundation stone for our first breeder reactor program. I am only little bit upset that they themselves shut down Phoenix and super Phoenix but I'm sure they're going to regain.

On Application of nuclear technology

Valerie Faudon

One of the applications of our technology that we are developing I think that's very useful medical purposes. Yes so we also we have some believe it or not we have stocks of thorium in France and Orano has developed a process to extract Pb-212 from the stocks of thorium and these are being tested for Alpha therapy in the United States and they already have gone through stage two to cure some cancers. I forgot the name of neuro whatever cancers but I can't find it and so it's true that we have found a medical application for the stocks of thorium and they're starting they hope to commercialize this new Alpha therapy really soon.

Srinivasan

There are people I know especially people from BARC who know various applications almost in any field. You say nuclear energy is there in fact I was just wondering in this Cave I mean tunnel they could have easily used some tracer technology to find out the best way to have

reached them and in fact people say that nuclear causes cancer but 60% of accidents treatment in Chicago hospital is by nuclear isotopes. So it is both creator of the problem and solution to the problem. Innumerable uses in fact if a line gets plugged by something they can know earlier days you had to really do lot of navigation now they know exactly where the problem is. In fact I think a BARC man can talk almost a whole day on various applications.

Gorlin

There seems to be a lot of innovation in the medical area and the development of new sort of Molecular Health Care. I think they are talking about it now as opposed to nuclear medicine at least in Europe and just also perhaps to make the point that I think it's really useful for nuclear power sector to collaborate with other nuclear technology sectors. We've actually set up a forum recently for different nuclear technology sectors and we want because they face the same challenges that nuclear power does in terms of radiological protection rules in terms of Waste Management. Sometimes obviously not exactly the same in terms of waste but there are definite synergies there. So we should be working across having a dialogue to see how we can collaborate better.

Panel Discussion 3:
Topic: Reduction in Cost and Gestation time for Nuclear Expansion: Various Industry Models

Panellists

1. Shri V Rajesh Director; Director Technical (PHWR), NPCIL
2. Shri Anil Parab: Director & Sr. EVP, L&T, India
3. Dr Vakisasai Ramany: Senior Vice President, EDF, France
4. Mr Alexandre Volgin: Project Director, Rosatom Energy, Russia
5. Shri M.K. Srivastava: Executive Director (Engineering)

Shri Rajesh,

Chairman of the Panel welcomed the co-panellists. In his opening remarks he made the following statements.

We are all set to begin panel discussion number 3 and the topic of the panel discussion is "Reduction in cost and gestation time for nuclear expansion: Various industry models". In the last 3 days of discussion, we have listened to various available reactors and different technologies world over and we take up the issue of how fast we can deploy them. Now you know this particular topic is a topic of high relevance on many accounts. I will welcome the panellists one by one so that we can start the panel discussion. I welcome Mr Anil Parab, whole time Director L&T, then Mr V Ramany, EDF, then then Mr Alexandre Volgin and Mr M K Srivastava ED, NTPC. One speaker, before this panel discussion, Mr Nadaph who represents Walchandnagar Industries, projected a target of 200 GW in 40 years which has to be added in India alone. That is a target set for nuclear. That means we have to add 5 GW per year. World over, in COP28 meeting, some 17 countries joined together for tripling the nuclear capacity. Now 5 GW per year in India means let us assume that 50% we add by PHWR of 700 MWe maximum capacity that we have a standardised model and 50% through import routes. That means per year four units of 700 MW have to be added in India per year. Four units mean one unit is having one Calandria, two End Shields, 4 Stream Generators, 4 recirculating pumps and all other things. In the case for imported reactors if you add two or four of 1,000 or 1650 MW of EDF design, then that many RPVs are required per year. So that is with respect to Industrial capability. How we will be able to deliver. Other than this, SMR is a construction intensive, capital intensive and requires a lot many skilled manpower at site. So to address this, primarily how fast we can go ahead for plant deployment? Panellists will express their views one by one and then we can take questions from the audience.

Srivastava

First of all I thank the organizers for inviting me to give my opinion on this very important critical subject and be a part of this elite panel speaking to this learned audience. Rightfully said by you Sir now we are speaking of a target date so once the date is fixed time is fixed and today the start date as we know, so now we are working under a time constraint. Now going with this time constraint and as you just shared 5 GW per year that is a herculean task and to build this capacity in nuclear it's not single or two three dimension but multi-dimensional. I have rightly picked that it is not only from component manufacturing, it is from the manpower, from the resources, from the finance and since it is a nuclear the people of India the Common Man of India also should be ready to accept this power mentally ready yes it's a clean power, it's a safe power, it's a green power; so I think this is a very important discussion so with those opening remark I'll pass on to the next panellist.

Ramany

Thank you very much Mr Chairman. May be to add on to the challenge because you've been throwing big numbers and we also in Europe have big numbers and so I have to mention them because basically at EDF obviously we want to support India's growth and developing its nuclear industry and we also have to address European needs and so for you to have an idea when all the energy ministers in Europe met and those who are like-minded related to nuclear they collectively aimed for a target of 150 GW additional installed capacity in Europe by 2050. When you look at what is currently in the energy plans of the different countries in Europe what we account for is a minimum of 27 reactors to be added in Europe when including United Kingdom still in the geographical Europe and the number with the different optional and potential additions goes up to 49 reactors to be added by 2050. So you can see that clearly the challenges we are facing are very similar. In a market which has to essentially renew its capacity but also add and grow because of the doubling of electricity demand, in that period now on the face of that I think what we should recognize as well is if we are to build all these nuclear reactors and a number of those programs we hope will be under way and under construction in the 2030s. We can imagine that around the globe there will be significant tension on capacity both starting from engineering, going through manufacturing and project management capabilities because these are mega projects we're talking about and we have to

acknowledge that these tensions in resources are in front of us. On one side we need to grow the capacity and the volumes the other we know it will not be growing fast enough and we will be facing tension. So I think two ideas may be to add to the topic of this discussion and see how to effectively mean for reduction of cost and gestation time. Number one is it will be extremely difficult if we do not foster cooperation and regional cooperation because clearly it wouldn't make sense for India to build up so much capacity than at some point in the future it would be sitting idle and likewise in Europe and at the same time neither India nor Europe will be able to build up such capacity as quickly as needed and so cooperation is I think a very important element. The other aspect related to that I think is related to how we can define areas of may be specialization which will allow one country supporting another through the means of specialization and therefore being more cost efficient in doing so in our approach when we factor in India and cooperation with India we also have in mind our ability to leverage the Indian industrial capabilities to support our programs in Europe. Jaitapur is an entry point into that so allowing the Indian industry together and meet the EPR requirement and standards for Jaitapur is a gateway for markets and that's the way we see it. This is true for engineering manufacturing and also project management capabilities.

Parab

I would say for achieving such ambitious target on fast track basis four most important things are important. First the current methodology which is more conventional method of procurement we'll have to change to program management approach because unless you have that long-term vision where you will approach in a program management. Second one I would say is standardization. Industry after industry if you see or even in infrastructure when there is a standardization of technology, standardization of design, standardization of quality and assurance plan you will get productivity speed and reliable quality so second factor will be extremely important is the standardization. Third is the long-term engagement of the stakeholders; not transaction by transaction. Supply chain whatever you want to make a choice after that actually engage them on a long-term basis that will bring digitalization Industry for modularization because everybody is planning for that continuity long-term basis. The talent pool is very crucial critical when they see that okay next 10 to 15 years you are

going to do same thing again and again actually obviously the challenges of retaining. They simply will disappear and the fourth important part when such large ambitious program is full kit. Now you can't have start stops that means you launch then you have difficulty in securing full land, you have difficulty in overcoming local public related issues, funding availability etc. Once you launch, this entire requirement must be in place. There is no stop if that is there. Then I would say even such ambitious target can be achieved.

Volgin

Thank you everybody I thank the organizing committee for inviting me. I'm really pleased to be here among such brilliant people that I've met numerous times this year. I guess the recipe is already here because we have good examples of friends of Russia constructing a series of reactors for example 900 MW it was a perfect example 300 MW in France as well. In Russia the reactors of series 320 have been constructed in numerous countries with good cost so the recipe is already here what we are missing is a commitment of the government to achieve these goals because government often fixing something so we will get the net zero emissions by 2070 you do whatever you want. So what we need is a clear road map and now when we get it, the vendors the suppliers will enter this game. It will allow lowering the costs. It will allow people training more efficient. There will be more personnel; the recipe is here just let's use it.

Rajesh

So may be in the first round of discussion what has emerged from this side is the need for total global cooperation so that the resources in our country are utilized. The brains available over there and the technology available over there is also shared with us so that it increases the pace and in addition to that we should have a standardization of design and optimization so that we move ahead fast. This is with respect to, let us say, supply chain management or something, but if you think about the site work you know like we ultimately (have) nuclear plant as bulk additional of power. SMR anyway we can build in the factory that is what is being told now, but for bulk addition of power we require large capacity plants and let us say for in Kudankulam, we have 2 units of 1,000 MW set up with Russia and in Jaitapur 1650 MW may come up, and we have 700 MW (PHWR). On an average, you know for a twin unit, the peak manpower required for around 3 years will be around 8000 persons. It's not

like a thermal plant. 8000 persons required all the time for 3 years continuously. What happens in Indian conditions, I can say there are festivals like Diwali and Holi. This manpower will suddenly will go away, so for 8,000 you know we have to have a backup of two-fold more. 16,000 should be in the backup to this 8,000. Around 40% has to be skilled in the form of cable pullers or welders or fitters or something like that. Rest will be unskilled manpower. So imagine a case of around 3000 skilled manpower means backup of 6000 additional. And some multiple units coming all over. How do we think that we'll be able to manage the skilled manpower requirements?

Srivastava

See I am from a thermal background so I will share my experience. You rightly said that manpower and with the Indian context the festivals the other important they just sway away and which is not under the control of the developer not at all. Regarding the backup the condition is it is a real life practical condition. At least from NTPC experience there's no backup that is the true fact and projects do suffer because whatever we do in a momentum as per schedule and if it takes a X amount of time but if the schedules are fragmented with disruptions whether it is 2x, 3x or Nx it can be anything. Manpower has no substitute. With respect to the plant machineries, tools and tackles we can bring more we can have sufficient backup but manpower yes there is a real problem. Just to add further to that there's a distinct difference the way we do the construction in India as compared to the developed countries. NTPC has the opportunity to work with almost all the global suppliers who have taken various contracts and during the execution phase they had deployed. One distinct difference what we have observed that is with respect to the safety which is important aspect. Safety impact is unpredictable although we know as per the statistical figures that we can predict but it is a real life situation that with the quality of manpower what we have and what we get and the safety standards that is one more problem which is very critical for in the construction phase and which effectively affects the gestation period of a project of this magnitude. One more important aspect is there although we speak of quality we understand quality but when it comes to the grass root implementation of quality perhaps more needs to be done because we have the firm opinion and we believe that if safety and quality during the project construction phase is ensured not through systems and practices but by the each and

every stakeholder who is directly or indirectly involved in the construction of the project, he may be sitting somewhere in the other part of the globe but whatever the material he's supplying whatever the logistics that has been planned both safety and quality if it is not put in the proper way that affects the construction time and finally what we result into overrun time, overrun cost, overrun gestation period. So this is the context I think why we are here and this context these problems we need to find solutions. While we do the capacity addition in whatever way, you are doing just now from here onwards because if you don't change I repeat if you don't change the way we have done our earlier projects whatever we are discussing we'll never achieve we cannot achieve because last 50 years approaching 50 years I have seen that problems and surprises come which just affects time and cost so we have to overcome these surprises we have to see in the Indian context particularly how we can control such disruptions and it is only then whatever target we are aspiring with the help of the regional cooperation what Mr Ramany said we will definitely achieve it.

Rajesh

Thank you. I have just one question to you. You internationally see the shortage of skilled manpower working at site because your 1650 project also is a manpower intensive project which has a site and you have constructed in various countries. I don't want a China example but I want an example in your country.

Ramany

I am very happy to contribute to the issue of manpower. May be to give you a few numbers so typically the on-going construction project that we have in the UK today, which is Helsinki point C at Peak, we see 8000 people on site effectively. So I acknowledge the numbers that you mentioned earlier; now for as we said look at it from an industry wide perspective. What we need is to add an addition of one lakh people to the industry. The French nuclear industry or say I should say is round about 2.2 lakh people okay and our estimate is that we need to get it to above 3 lakh people to make sure that we have enough people to you know to deliver the 6 EPR programs in France. Now clearly human capability building capacity is at the heart of whether we can succeed or not. Exactly as you mentioned and this is an area where the industry cannot manage on its own. It absolutely needs the support of the government that's absolutely essential. Why is it so, because typically when we talk about a 6 EPR program in France or if we talk about

Jaitapur or the PHWR programs, we are talking about programs for a span of 20-25 yrs; meaning that those people who will be effectively on the ground building the plans and performing the engineering studies they're probably today in high school or you know not even in high school may be still lower class. You know and so this requires a significant input support from government with specific policies not only to direct the pupils towards technical areas and then outside of the technical areas they need to be attracted by the industry by the nuclear industry so we get a fraction of a fraction actually and that is definitely a big challenge. Now if you think about it and we have seen this happening in Europe and in France especially there has been quite some time especially after Fukushima where we we've seen depletion of you know of people. The number of people in our nuclear reduced and we struggled keeping the numbers because there were more attractive areas elsewhere. We can have a debate on whether the SMR can effectively grow and be successful in the future. One very positive thing that the SMR has done is that it has for sure provided some attractiveness to the industry and the young talent have been looking at that as an object where they can relate to it and say yes this is the kind of nuclear I would like to work into and we have seen interest coming back and new talents joining us again. Since we have been you know working on the SMR and plans for SMR now from governments to ensure that basically industry on one side with our plans and government work hand in hand and we need basically three things from governments. Number one we need government to put these programs in high visibility which is absolutely needed. At last now we have reached high visibility worldwide. I think progressively we're reaching high visibility but visibility is needed visibility in its own right is not enough because that's essentially communication the second thing that is needed is legitimacy is needed and we have to clearly explain why is it why it is needed and why nuclear currently is absolutely essential for us to deliver. You know on the different objectives we would have and that would combine climate change goals as well as energy Independence or security of Supply. The third aspect is credibility. There is only one way you can address credibility is by making decisions because we can talk about plans that is visibility we can explain why we have plans that is legitimacy but until you make decisions you don't have any job to give to people and so we need these three coming

from the government and this is how we in our partnership approach with the UK government with the French government do effectively try and move things forward and we're very glad to share that experience with NPCIL as needed.

Rajesh

Mr Volgin, now, may be, you have plenty of plans coming up in Bangladesh as well as in Turkey. Have you faced the shortage of manpower? You know our topic is gestation time and we approximately calculate in 5 or 6 years plan will become commercial from the start of first pour of concrete but overall there has been a slippage and many of the reasons are attributable to the local site delays you know as Mr SAS was telling because of no manpower so how do you feel this has affected in upcoming Bangladesh or in Turkey. What's your experience in this?

Volgin

Thank you for this challenging question. The thing is that I guess it's common for all the vendors and specifically for Satam who is constructing more units outside of the country than inside the country. The resources remain a critical and challenging option. So I know that for nuclear power plant it's hard to find the personnel. The project is on-going and it's on time as well but it's always difficult to attract people in unknown foreign countries and specifically experienced people because we cannot find them easily. We involve local population, we make trainings we have engineering schools we make co-operations and through these common programs we attract new persons and new brilliant people as well. This is for the large scale NPPs. For the SMRs I guess it will be another challenge because it's starting somehow from the scratch. Globally NPPs are using modular reactors probably skilled Personnel will need it less because of the concept itself and probably we will solve this issue but let's see the future if it will show.

Rajesh

L&T has always been a part NPCIL's program other than your regular supplies of critical equipment. In all our construction, you have been deploying massive manpower and in many projects. As I told initially that this manpower swaying is there because of local festivals, elections and other things so how do you address these challenges and what do you foresee in the near future for large capacity addition.

Parab

I think first of all what you highlighted challenges of vacations then turnover of manpower these are realities and more so post pandemic because there is a change in behaviour of labourers. One issue what

Ramany talked about visibility, credibility which is a fact which I had articulated basically that is one very important issue and numbers what you said 8000 required for one plant at a peak. Actually I have a different view over there because like what you said to mobilize large labourers which is a fact. At this moment we have deployed 3,00,000 labourers in the country. Where is 8,000 and where is 3,00,000 and if it is required to be scaled up to 4,00,000 in a country like India it is not an issue. The issue is of a different kind. The issue is the skill level because you talked about 40% of that is a high skill. What I told you, we do see a shift because now projects are going across the country and large infrastructure projects are being launched whether it is roads whether it is ports, water you name it; all kinds of projects are there all over country. So, post pandemic there is a preference to work closer to my native origin; this is one shift which is there. Second when there is a very complex, demanding work, there is a tendency to try up to a certain level and then give up because there are easy options available. Now I would say that for this what I had talked; I was not talking only manufacturing, I had shown examples of construction, modularization will reduce your requirement of manpower significantly at the site. So by modular, I'm not only talking of small modular reactor, I'm even talking of nuclear plant modularization because obviously if you go with rebar and concrete then no modularization is possible. There partly I talked about pre-cast and those liners modular but L&T is actually building full plants in our modular fabrication yards and shipping to Singapore for Lind, Germany, compressor modules completely made in the yard and shipped to Singapore, CO2 capture plant completely made in India shipped to Netherlands. Now there is a fertilizer plant being built. It will go in modular way directly to Australia. Now this is enhancing safety and enhancing quality. At site the requirement of manpower which is especially the high skilled manpower will go down significantly so I would say numbers is not an issue; training now is running across the country. 16 skill training institutes are there only for work. There the infrastructures continuously train the labourers. So, I would say the challenges more than number is the long-term visibility and continuity. Second, we must look at modularization and third is to keep training the labourers and also one more thing which we had to ramp up the living conditions of the labour camps at the site because today if you see what we were doing before pandemic and today I would

say significant difference; better conditions and they should feel like staying there and working there.

Rajesh

These are the things; we have addressed some issues with respect to our topic because ultimately how fast we deploy this nuclear with high affordability is a crux of this issue as of now.

Compiled by Dr. A Rama Rao

03. REPORT ON INS-YOUNG NUCLEAR PROFESSIONAL'S FORUM

Indian Nuclear Society under "Young Nuclear Professional Forum" organized the following lectures at INS office Hall, Project Square, Anushaktinagar, Mumbai - 400094. The intention of organizing these lectures is to create awareness among young engineers of DAE and talks are preferably delivered by Young Professionals.

- Seismic design of nuclear power plant on 19 January 2024 by Shri S.D. Bhavsar, Associate Director (Stress analysis and seismology), NPCIL
- Thermal Hydraulics in Nuclear Power Plant on February 28, 2024 by Shri R.R. Sahay, Associate Director (LWR), NPCIL
- AERB: its mandate, regulatory framework and regulatory processes" on 14 May 2024 by Shri Parikshat Bansal, Senior Scientific Officer, AERB.

Dr Nitin S More, EC member, INS is the Course Coordinator for this lecture series under "Young Nuclear Professional Forum".

All the above lectures were well received and highly appreciated especially due to the hall ambience facilitating cordial interaction among the audience and the speaker. Audience and the speaker find it very convenient to raise the queries and responding to the queries respectively during the talk and afterwards. All the participants in these lectures benefitted immensely by gaining knowledge in the respective talks.

All the speakers were felicitated by handing over mementos as tokens of appreciation by INS officials / EC members.

04. INS LECTURE ON "NUCLEAR NON-PROLIFERATION AND SAFEGUARDS"

Dr. Suresh Gangotra, delivered a technical talk on "Nuclear Non-Proliferation and Safeguards" on March 30, 2024. Details of non-proliferation were explained and how they are implemented globally. The role of IAEA safeguards in ensuring the world order was covered in detail. These measures are technical and administrative.

India has an impeccable record of nuclear non-proliferation, and has a unique position. India has a separation plan, whereby there are Indian nuclear facilities, which are designated as civil and are subject to IAEA safeguards. These include Pressurised Heavy Water Reactors, Boiling Water Reactors, fuel fabrication facilities and nuclear material storage facilities. The talk covered in detail, how IAEA safeguards are implemented in these facilities.

Like any other field related to nuclear, the subject of nuclear safeguards is also keeping up with the new technical developments, like use of drones for safeguards. Dr. Gangotra discussed in detail several of these measures. An important aspect of these measures were the original methods developed by the design team of BARC.

The three S's, namely the Safety, Security and Safeguards are closely related. However, there are basic differences between the three. At times they have converging goals and at other times competing requirements while designing and implementing in nuclear facilities. These differences and similarities were also discussed.

In negotiations of international agreement for civil nuclear cooperation, the measures of implementing safeguards and reporting of exchange of nuclear material and equipment is extensively documented. A flavour of these measures were also part of the presentation.

The talk was well attended. Presence of eminent experts like Dr. R. Chidambaram, Dr. R.B. Grover, Shri Anil Anand and many others added to the rich discussions, as several questions were fielded by the audience.

The talk is available for view on the youtube channel of Indian Nuclear Society at https://www.youtube.com/watch?v=tMhjOz4odn8.

05. OUTREACH PROGRAM AT IIT-JAMMU AND NIT-SRINAGAR

A team of experts from INS, BARC and AERB visited IIT Jammu and NIT Srinagar and delivered talks.

The event at IIT Jammu was a one day program, titled 'Nuclear Engineering Science & Technology (NEST-24)', organised by Student Section ANS – IIT Jammu and INS. It was held on 13 April 2024 and attended by students and teachers.

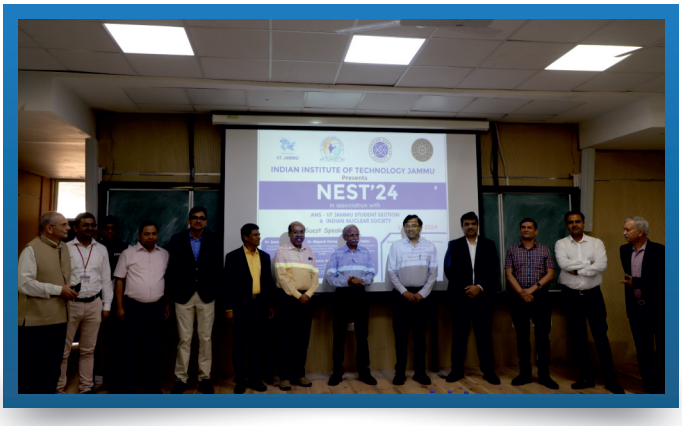
The event at Srinagar was also a one day event, titled, Indian Nuclear Power Program: Evolution, Present and the Way Forward. It was organised by Indian Nuclear Society in collaboration with NIT Srinagar on 15 April 2024.

The events at both places were lively with participants posing queries and engaging in interesting discussion with the experts.

The topics of the talks delivered at both the institutes were as follows.

1. Safety in Design, Commissioning & Operation of the Indian Nuclear Power Plants – Dr. Mayank Verma, AERB and INS
2. Current and the future programs of the Department of Atomic Energy – Dr. Suresh Gangotra, INS
3. Nuclear materials and application of the rare earth elements – Dr. K.K. Yadav, BARC
4. DAE vision towards the Indian Nuclear Power Program – Mr. P.K. Mishra, NPCIL and INS
5. Civil & Structural Engineering Safety in Indian Nuclear Power Plants: from Siting to Decommissioning. – Mr. Sourav Acharya, AERB
6. Current and the evolutionary designs of Nuclear Power Plants – Mr. Neeraj Jain, NPCIL

Both the events were well received and have helped in opening up collaborations with IIT Jammu and NIT Srinagar.



06. OUTREACH PROGRAM AT LUCKNOW

INS conducted an outreach program on the above main topic in Lucknow at four different places, which included three schools viz., two branches of Rani Laxmi Bai (RLB) Memorial School, Pioneer Montessori School and Central Drug Research Institute (CDRI-CSIR), Lucknow.

Members of INS Executive Committee and NPCIL senior officers participated and delivered lectures on various aspects of nuclear energy, societal applications of radiation and role of nuclear in clean energy transition.

On the evening of 24th April a press meet was organised with special efforts of Shri Amritesh Shrivastava of NPCIL along with INS officials UP Press Club. All visiting officers from INS and NPCIL interacted with media persons and clarified the doubts and myths among the public on nuclear energy and other related issues. The same was covered widely by news and print media.

On 25th April two outreach programs were conducted at RLB Memorial Schools. More than 800 school students attended each of the programmes. The programs were inaugurated by Dr B N Jagatap, President, INS who gave an introductory lecture on the need and role of nuclear energy for clean energy transition in future. This was followed by lectures on fundamentals of nuclear energy and nuclear radiation and its societal applications by Shri Satyawan Bansal, Dr K.I. Priyadarsini, Shri K.U. Agarwal and Dr A. Ramarao. At the end Shri Amritesh Srivastava of NPCIL gave a detailed awareness lecture on Indian Nuclear Energy programme followed by a quiz competition and screening of a documentary film. Prizes were distributed to the winners of the quiz competition. The programmes at both branches of the RLB schools were highly appreciated both by the management and also by the students.

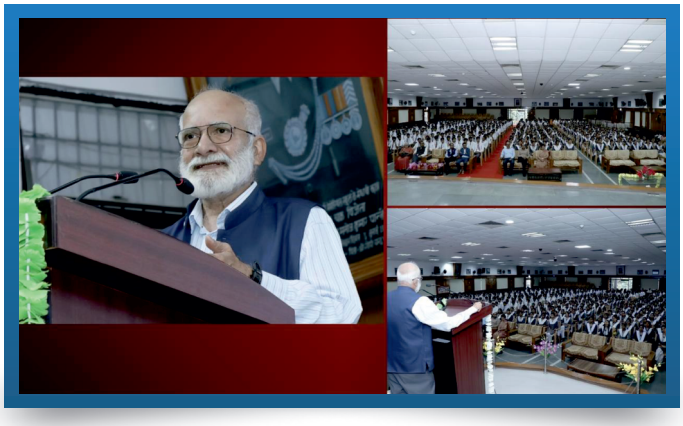
The program on 26th April at Pioneer Montessori School was inaugurated by Shri V. Rajesh, Director (Technical), NPCIL, who gave an introductory lecture and highlighted the need for nuclear energy. This was followed by lectures on fundamentals of nuclear energy and nuclear radiation and its societal applications by Shri Satyawan Bansal and Dr K.I. Priyadarsini. Shri A Srivastava of NPCIL gave a detailed awareness lecture on Indian Nuclear Energy programme followed by a quiz program. Here also nearly 700 students attended the outreach program. A few other retired scientists from Lucknow also attended the program.

During the second half of 26th April, similar outreach programme was arranged at

CDRI-CSIR, Lucknow. Dr. B.N. Jagatap, President, INS gave keynote lecture on various aspects of nuclear energy programme with special emphasis on its role in the energy mix as a clean source. Shri V Rajesh, Director (Technical) gave his address on Energy transition in carbon constrained world, which was followed by lectures on important aspects of nuclear energy and nuclear radiation and safety respectively by Shri K.U. Agarwal and Dr A. Ramarao.

All the programmes concluded with singing of the National Anthem.

Overall the events gave an excellent outreach on Nuclear energy to students, teachers, scientists and media persons. Many young students were inspired and showed keen interest in Atomic Energy programmes for their future career.



मनुष्यता व पर्यावरण की मित्र है परमाणु ऊर्ज

प्रेसवार्ता के दौरान मौजूद इंडियन न्यूक्लियर सोसाइटी के वैज्ञानिक। स्रोत

संवाद न्यूज एजेंसी

लखनऊ। पर्यावरण प्रदूषण और क्लाइमेट चेंज की दुश्वारियों से जूझ रही दुनिया के लिए परमाणु ऊर्जा ही भविष्य है। इसके विषय में फैली भ्रांतियों को दूर करने और जागरूकता को लेकर मुंबई स्थित इंडियन न्यूक्लियर सोसाइटी के वैज्ञानिकों ने बुधवार को प्रेस क्लब में पत्रकारों संग वार्ता की।

भाभा परमाणु अनुसंधान केंद्र से सेवानिवृत्त प्रसिद्ध परमाणु वैज्ञानिक डॉ. बीएन जगताप ने बताया कि परमाणु ऊर्जा मनुष्यता की मदद के लिए है। रेडियो एक्टिविटी व रेडिएशन को लेकर लोगों में बेवजह डर है। इसे लेकर लोगों जानकारी कम और भ्रांतियां ज्यादा जिन्हें हम दूर करने की कोशिश कर हैं। परमाणु संयंत्रों में बिजली बनाने लेकर, चिकित्सा, कृषि व अन्य क्षेत्रों में परमाणु ऊर्जा का सकारात्म इस्तेमाल है।

दो दिन तक इंडियन न्यूक्लिय सोसाइटी के वैज्ञानिक रानी लक्ष्मी बा मेमोरियल स्कूल, पायनियर मॉन्टेस स्कूल और सीडीआरआई में विद्यार्थियों शिक्षकों संग संवाद करेंगे। प्रेसवार्ता वरिष्ठ वैज्ञानिकों में डॉ. रामाराव, डॉ इंदिरा, डॉ. बंसल, डॉ. केयू अग्रवाल, डॉ केपीटी बालाकृष्णन मौजूद रहे।

लखनऊ, शुक्रवार, 26 अप्रैल 2024 06

कैम्पस 30 S

देश में परमाणु ऊर्जा के प्रति लोगों में जागरूकता लाने के उद्देश्य से इंडियन न्यूक्लियर सोसाइटी द्वारा रानी लक्ष्मी बाई मेमोरियल स्कूल में आयोजन हुआ।

विद्यार्थी परमाणु ऊर्जा में शोध करें

लखनऊ। छात्रों को परमाणु ऊर्जा में शोध करना चाहिए। इसके बारे में जाने और समझें। पढ़ाई में परमाणु ऊर्जा के पाठ्यक्रम को चुनें। आने वाले दिनों में इस क्षेत्र में करियर के बहुत अवसर आएंगे। यह बातें इंडियन न्यूक्लियर सोसाइटी (आईनएस) के अध्यक्ष व भाभा परमाणु अनुसंधान केंद्र के पूर्व वैज्ञानिक डॉ. बीएन जगताप ने शुक्रवार को आरएलबी स्कूल में कहीं। इस अवसर पर अन्य वक्ताओं ने भी विचार रखे।

07. OUTREACH PROGRAM AT DHARWAD-HUBBALI

Indian Nuclear Society organized two one-day workshops at Dharwad and Hubballi on 12th and 13th June 2024 respectively. The theme for the workshops was, 'Nuclear, Laser and Accelerator Technologies'. The programmes at Dharwad and Hubballi were organized at the Karnataka University, Dharwad and KLE Society's P.C. Jabin Science College, Hubballi. Shri P.K. Rao, Member, INS-EC coordinated with Prof. S.R. Inamdar of the Department of Physics, Karnataka University and Dr. Lingraj Horakeri, Principal of the Jabin Science College for successful conduct of the workshops. From INS, there were three speakers: Shri P.K. Mishra, Dr. A. Ramarao and Prof. B.N. Jagatap. They were joined by Prof. S.R. Inamdar of Karnataka University and Prof. Santosh Chidangil of Manipal Academy of Higher Education.

The workshop at Dharwad on June 12, was inaugurated by Prof. B.G. Mullimani, Former Vice Chancellor of Gulbarga University and BLDE University, Vijayapur. The workshop had 7 talks; namely, Overview of Indian Nuclear Energy Program (P.K. Mishra), Applications of Nuclear Technology (A. Ramarao), Lasers and their Applications in Nuclear Energy Program (B.N. Jagatap), Lasers in communication (S.R. Inamdar), Lasers in Medicine (Santosh Chidangil), Research Reactors (A. Ramarao) and Ultra-intense Lasers, Accelerators and Fusion (B.N. Jagatap). The workshop at Hubballi on June 13, was inaugurated by Prof. B.N. Jagatap and Dr. Lingraj Horakeri. The scientific program was essentially the same as that at Dharwad.

The student community at both places was keen to understand the advanced technologies. Students found the concept of small modular reactor (SMR) very interesting. They were also interested in the applications of radiation in agriculture and food preservation. Overall, the workshops were successful in sensitizing students as well as faculty members in the areas of nuclear, laser and accelerator technologies.

Students and faculty members attending the workshop at Karnataka University, Dharwad.

Prof. B.N. Jagatap delivering the inaugural address in the workshop at Hubballi. Sitting on the dias from left to right are: Dr. Jagadeesha Angadi, Prof. Santosh Chidagil, Shri P.K. Mishra, Dr. A. Ramarao, Prof. S.R. Inamdar and Dr. Lingraj Horakeri.

08. SPRINGER NATURE AND DAE AGREEMENT

Springer Nature has agreed a landmark transformative agreement (TA) with the Department of Atomic Energy (DAE), India. The agreement marks the first TA by any publicly funded department in India, which is a significant leap forward for India's research and academic community. The deal will allow all 50+ centres affiliated to the DAE to read and publish Gold Open Access (OA) - an article is published immediately as OA in an online journal of book and is available for all to use and reuse from the moment it is published - in Springer Nature's 2,000+ hybrid journals across all disciplines. This agreement marks a significant milestone in the journey towards universal access to research findings and represents a collaborative effort to accelerate the transition to open science.

The deal is the latest development in Springer Nature's longstanding partnership with the DAE. As part of this collaboration, both Springer Nature and DAE will work together to promote open access principles and remove barriers to the dissemination of scholarly research. The agreement encompasses a range of initiatives designed to foster innovation, transparency, research integrity and accessibility in academic publishing. As part of Gold OA, the visibility and impact of Indian research will be enhanced, and its global reach will foster greater international collaboration and knowledge exchange. Commenting on the agreement, Carolyn Honour, Chief Commercial Officer of Springer Nature Group, said, "I am delighted that the DAE has chosen to extend its partnership with Springer Nature on their Open Science journey. This is the first time DAE has consolidated all its member subscriptions as a consortium and we are thrilled to embark on this transformative journey to advance scientific discovery, increase publishing options and reach for Indian researchers. This deal is a testament not only to our strong partnerships and experience in delivering sustainable transformative deals, but also to our commitment to drive positive change in the scholarly communication landscape and ensure that research findings are accessible to all."

Echoing these sentiments, Dr Arun Kumar Nayak, Head of Nuclear Controls and Planning Wing (NPCW) at the DAE, who also led this project in the department said, "Our chairman was instrumental in taking these decisions and this is a historic moment for all the scientists and research scholars in the DAE family and the country. This deal also lays the foundation for many more such

agreements in the future which will be instrumental in ensuring that our country's scientific temperament is known to the world." Commenting further Dr Deepali Kuberkar, Head of the Department of Library Sciences, TMC & Coordinator, One DAE One Subscription (ODOS) said, "ODOS is an important turning point for DAE and its scientific community. We look forward to our collaboration with Springer Nature to help advance and spread the culture of knowledge and learning to better the world. Here on, our focus will be on publishing world class literature." The deal will benefit 5,000+ researchers across DAE with simplified workflows and easy author journey. The partnership between Springer Nature and the DAE exemplifies a collaborative approach to advancing open access publishing and promoting the free exchange of knowledge.

This transformative agreement will have a lasting impact on the academic publishing landscape in India and pave way for discussions for a potential national or regional agreement. What is a Transformative Agreement (TA)? TAs enable participating institutions to combine journal subscription (read) access along with open access (OA) publication costs (APCs). In addition to managing the cost and administration of OA, TAs offer authors an easy way to comply with funders' OA requirements. Under a TA subscription access and OA publishing are brought together into one reading and publishing contract across a consortium of institutions. This means that researchers in those institutions can publish under the "gold" open access model, while also gaining access to research in subscription journals. Spearheaded by Springer Nature with the first such agreement signed with the Association of Dutch Universities, VSNU, Netherlands in 2014, these agreements make the administration of OA simpler for both the institutions participating and their researchers. In addition, these agreements enable a wider group of researchers to benefit from the enhanced discoverability, increased citation and increased usage of OA content, help to solve the problem that some academic disciplines lack OA funding (a centralized APC allows any researcher from the participating institution, regardless of academic discipline, to publish OA), and also provide researchers with an easy way to comply with funders' OA requirements.

The DAE was set up under the direct charge of the Prime Minister through a Presidential Order on August 3, 1954. DAE encompasses all the areas related to power

and non-power applications of atomic energy. The Department has the mandate of development of nuclear power technology which includes exploration, identification and processing of uranium resources and atomic minerals, fabrication of nuclear fuel, production of heavy water, construction and operation of nuclear power plants, nuclear fuel reprocessing and waste management. DAE is also responsible for R&D of fast reactor and fusion technologies, accelerator and LASER technology, advanced electronics and instrumentation, materials science, biological sciences, etc. As part of non-power applications of atomic energy, the Department carries out cutting-edge R&D for application of isotopes and radiation technologies for health care, food & agriculture, industry and environment. For over 180 years Springer Nature has been advancing discovery by providing the best possible service to the whole research community. We help researchers uncover new ideas, make sure all the research we publish is significant, robust and stands up to objective scrutiny, that it reaches all relevant audiences in the best possible format, and can be discovered, accessed, used, re-used and shared. We support librarians and institutions with innovations in technology and data; and provide quality publishing support to societies. As a research publisher, Springer Nature is home to trusted brands including Springer, Nature Portfolio, BMC, Palgrave Macmillan and Scientific American.

Source website link :

https://www.aninews.in/news/business/springer-nature-and-department-of-atomic-energy-india-sign-landmarktransformative-agreement-to-drive-forward-open-research20240508132944

by Dr. A Rama Rao

INDIAN NUCLEAR SOCIETY'S ANNUAL CONFERENCE (INSAC)

in association with

ATOMIC ENERGY REGULATORY BOARD

November 19-21, 2024

DAE Convention Centre, Anushaktinagar, Mumbai-400094

www.ins-india.org

www.aerb.gov.in

First Announcement

INSAC-2024

Indian Nuclear Society (INS), in association with Atomic Energy Regulatory Board (AERB), is delighted to announce its Annual Conference INSAC-2024 on the theme

"Regulatory Framework for Nuclear Renaissance"

Nuclear power is a key element in global energy demands and net-zero emissions. Many countries have committed to increase the share of nuclear in the energy mix by 2050. A nuclear renaissance is, thus, in the offing. Additionally, the use of radiation in medical and industrial sectors is expanding continuously. To fully realize the potential of nuclear power with utmost safety, it is crucial to develop and implement regulations that ensure the highest standards of safety and security. Given the need and importance of a robust nuclear regulatory framework in accelerating the adoption and applications of nuclear energy, INS is organizing this conference to address these pivotal issues.

Conference topics

- Regulatory framework in India
- Challenges in the three-stage Indian nuclear program
- Challenges in the quick deployment of nuclear energy and new technologies
- The regulator's role in building public trust and encouraging industry excellence
- Development of Regulatory framework for imminent nuclear expansion
- Development of regulations and stakeholders participation
- Safety and security interface challenges
- Safety research for regulatory decision making
- Resources and competence development in regulatory body
- Leadership and management for safety

We invite professionals, researchers and stakeholders in nuclear safety to join us in this significant event, as we work together to advance the nuclear regulatory framework essential for the safe and efficient delivery of nuclear power in the era of nuclear renaissance. Conference will consist of invited talks, panel discussions and contributory papers.

For more details please contact

Garg A.P. , Convener INSAC-2024, Outstanding Scientist and Director, DRA&ER, AERB
Bansal S. , Co-Convener INSAC-2024, Vice President, INS and Executive Officer (T), AERB
Agrawal K.U. , Co-Convener INSAC-2024, Joint Secretary, INS and GM, NPCIL
Verma Mayank , Secretary INSAC-2024, Member, INS EC and Sr. Scientific Officer, AERB
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