

Brief Report On Engineer's Conclave 2015

7-9 September 2015
Mumbai

RECOMMENDATIONS



Organized by:

Bhabha Atomic Research Centre, Mumbai

in association with

Indian National Academy of Engineering

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1. INTRODUCTION

- 1.1.** INAE has taken an initiative of organizing an annual mega event of engineers called “Engineers’ Conclave” starting from the year 2013, jointly with one of the major Scientific Organizations of the Country. The objective of the Engineers’ Conclave is to provide a platform for engineers from allied fields to meet, deliberate and recommend engineering solutions to some of the pertinent issues of national importance. The first “Engineers’ Conclave 2013” was jointly organized with DRDO at New Delhi and the themes of the Conclave were “Production and Manufacturing in Aerospace” and “Engineering Interventions in Sunderbans”. Shri Pranab Mukherjee, Hon’ble President of India, inaugurated the Conclave. The second Engineers’ Conclave 2014 was organized jointly with Indian Space Research Organization (ISRO) at Bangalore and the two themes of the Conclave were “Emerging Space Applications” and “Technologies for Hill Regions”.
- 1.2.** This year, the third Engineers’ Conclave 2015 (EC-2015) was jointly organized with Department of Atomic Energy (DAE) from September 7-9, 2015 at BARC, Mumbai. The two themes selected for EC-2015 were:
 - Theme -1: Green Energy Options for Sustainable Development.
 - Theme-2: Clean India Technologies.
- 1.3.** The focus of the two themes was on finding engineering solutions to the problems faced by the people of India and to come up with implementable recommendations for concerned departments and agencies. Eminent experts, senior functionaries from various government departments, Academia, Industry, NGO, DAE and INAE Fellows participated in large numbers to deliberate upon the two themes of EC-2015. Details about the participation are given in Appendix I.

2. EC-2015 OVERVIEW

- 2.1.** As per the INAE laid down norms for Engineers’ Conclave, Dr. R K Sinha, Chairman, Atomic Energy Commission was the Chair and Dr. B.N. Suresh, President, INAE was the Co-Chair of Engineers’ Conclave 2015. Dr. Sekhar Basu, Director, BARC chaired the programme committee and Shri R.C. Sharma, Director, Reactor Group, BARC chaired the organizing committee.
- 2.2.** Theme-1 technical programme was coordinated by Shri R.C. Sharma. Theme-2 technical programme was coordinated by Dr. P.K. Tewari, RRF, BARC.
- 2.3.** The conference included an inaugural session, a keynote address, four plenary talks and technical sessions in EC 2015 covering important aspects of both the themes. Programme details of the EC 2015 are given in Appendix II.

- 2.4.** Under the theme ‘Green Energy Options for Sustainable Development’, deliberations were organized in the following five technical sessions:
- a. Strategy for multifold increase in installed nuclear capacity in India chaired by Dr. S.K. Jain.
 - b. Green energy options chaired by Shri S.G. Ghadge.
 - c. Industry support for nuclear energy chaired by Shri S.S. Bajaj.
 - d. Policy intervention for sustainable development chaired by Shri S.K. Mehta and
 - e. Renewable energy prospects chaired by Shri A. K. Anand.
- 2.5.** Under the theme “Clean India Technologies”, deliberations were organized in the following five technical sessions:
- a. Cleaning of Rivers and Water Resource Management chaired by Dr. P.S. Goel.
 - b. Industrial Waste Water Management chaired by Dr. (Ms) Lakshmi Raghupathy.
 - c. Solid Waste Management chaired by Shri Vijay Kumar.
 - d. Clean Fuel Technologies chaired by Shri R.K. Garg and
 - e. Environment Pollution Control & Carbon Sequestration chaired by Prof. Mani A.
- 2.6.** EC-2015 was inaugurated by Hon’ble Raksha Mantri Shri Manohar Parrikar. He mentioned that both the themes are in line with Clean India Technologies inspired by the ‘Swachh Bharat Abhiyan’ or ‘Clean India Mission’ which was officially launched by the Hon’ble Prime Minister Shri Narendra Modi on 2nd October 2014 and it was directly linked to the socio-economic activity of the nation. He reiterated that these topics are indeed timely and relevant to Indian scenario wherein 130 Crore Indians are aspiring for rapid economic growth. He emphasised that our energy production has to keep pace with increasing demand and grow many fold in order to achieve double digit growth envisaged by the Prime Minister and hence we have to explore every energy option.
- 2.7.** Dr. M. R. Srinivasan, Former Chairman, AEC and Member, AEC delivered the keynote address on the topic “Green Energy Options for Sustainable Development”. He reiterated that electric power production in India was 2 GW in

1950 and the same has grown to 250 GW now. He further informed that rapid increase in power generating capacity is a must for building essential infrastructure of high speed trains, steel plants, cement plants as a part of “Make in India” concept initiated by Hon’ble Prime Minister Shri Narendra Modi. He reiterated that the strategic planning group of the Department of Atomic Energy makes a projection of the likely demand for electricity in the time horizon up to 2052. This study revealed that on the realistic front the installed capacity might have to go up to 750-810 GW by 2052, of this the contribution from nuclear component is estimated to be 275 GW by year 2052. To achieve the same, we must build nuclear reactors in different categories in the years to come.

- 2.8. A brainstorming luncheon session was organized on ‘the future energy needs and constraints’ with participation of senior functionaries of GOI, scientific communities and academicians, soon after the inaugural session. Deliberations of this session are elaborated in subsection 3.2.
- 2.9. An exhibition was arranged in EC-2015 where the products developed by the various units of DAE and that from other supporting industries were displayed.
- 2.10. Following four plenary talks were delivered during EC 2015.
 - a. The first talk was by Shri Rajendra Singh, founder of Tarun Bharat Sangh (NGO), who is particularly working in the rural areas on “**River rejuvenation through community driven decentralized water management**”. Shri Rajendra Singh informed the audience about the efforts taken by the villagers in Alwar region under his guidance, to rejuvenate the seven lost rivers and the socio economic benefits the region derived subsequently.
 - b. The second talk was by Dr. S. Banerjee, Former Chairman AEC on “**Energy, Environment and Sustainability**”. He emphasized that the most important aspect of nuclear energy lies in its potential in supplying energy for centuries to come and this aspect is an integral part of sustainability. The adoption of closed fuel cycle, the growth of nuclear power by use of plutonium in fast reactors and the deployment of thorium fuel cycle will eventually fulfill the cherished goal of energy independence for the country.
 - c. The third talk was by Shri S.K. Mehta; Former Director, Reactor Group, BARC on “**Development of Small and Medium Size Reactors**”. He emphasised that in India with the growing need of power for industrial and social development, particularly in the remote areas, Small & Medium Size Reactors (SMRs) could be very attractive option. SMRs can be deployed in remote areas not connected to national grid and can be utilized to replace

ageing conventional power plants (coal, oil or gas based) and also for desalination in specific coastal areas.

- d. The fourth talk was by Dr. R. K. Sinha; Chairman, AEC on **Nuclear Energy “Clean & Sustainable Option”**. He informed that the present scenario of global energy demand and supply warrants focussing on harnessing renewable and green energy sources in order to mitigate, and as far as possible prevent the global warming and concomitant climate change. Nuclear energy has a central role in this endeavour, besides other renewable energy sources like solar, wind, geothermal, biomass, hydropower, etc. Nuclear energy, being the only green energy source that is highly concentrated and capable of providing sustainable base load, is poised for rapid growth.

3. LUNCHEON MEETING

- 3.1. The topic for the luncheon meeting was to focus on issues related to create the capacity needed for accelerated growth of the Nuclear Energy. It was emphasised that the presence of engineering and scientific community, academicians, researchers, policymakers and industry is an appropriate forum to articulate the way forward in bringing out specific recommendations for various government agencies.
- 3.2. During the discussion it was noted that growth of nuclear power is important as a green energy option for sustainable development and also for ensuring clean environment which is essentially required. Indian nuclear power programme had matured over the years with indigenous effort. It has overcome technology denial regime and has incorporated lessons learnt from major accidents in nuclear industry elsewhere. For the growth of nuclear power in India, the emphasis was made that the country (GOI and people) should realise the necessity of the expansion along with other green and clean energy options which should be taken up on priority.
- 3.3. Issues highlighted in the meeting are summarized below.
 - a. Technology is no more an impediment for growth of nuclear energy and we have gained full expertise with pressurised heavy water reactor technology. Also, fuel now could be imported easily for safeguarded reactors. Once land and technology are available, fuel issues are solved, for accelerated growth through this route; though finance is the main constraint. Concerns related to civil nuclear liabilities are being worked upon.
 - b. It is envisaged to add nuclear power generation capacity by importing larger size light water reactors to meet the quick capacity building up, in line with

the targets specified in integrated energy policy. Here also, the issues are finance and civil nuclear liability.

- c. The other countries, like France, while going for rapid expansion in nuclear power programme, adopted for funding from the market based; on their credibility. We could also adopt a similar approach and with our proven track record of PHWR based technology and we can explore national government fund as well as world market.
- d. Any foreign country establishing business in India should be providing full support to Indian nuclear power programme without any restriction.
- e. Government Development fund for industry to develop critical equipment to be used in nuclear power plants needs to be created.
- f. Post Fukushima, the concerns of public perception needs to be addressed with support of third parties like INAE.

4. TECHNICAL MEETINGS

4.1. Green Energy Options for Sustainable Development

- a. The capabilities of industry should be utilised in understanding and supporting other reactor technologies like PWR and BWR to augment rapid capacity addition required in stage-1 of the Indian Nuclear Power Programme. Also, a long term budgetary support by government is necessary to augment stage-1 programme with other reactor technologies. Further, for the benefit of industry and prolonged active use of technology, it is necessary to ensure a continuous and consistent scaling up, by way of new project in every 3-4 years, instead of a bulk set-up approach. It ensures that skilled manpower and supply chain is kept live for longer duration.
- b. There is a need for protection of interests of local industry by way of favourable contract terms & conditions. Further, the criteria of awarding contracts should be relaxed, so as to invite wider participation of capable local industry to support nuclear energy programme, rather than only on the basis of “proven track record”. In addition, federal support to research activities in areas like materials and technology is required for self-reliance and a national blueprint must be prepared for long term solutions for self-reliance and to foster innovation & excellence all across industries in the country.
- c. There should be increased support of R&D activities involving industries, in order to develop better materials and technologies in renewable sector

(nuclear, wind and solar), like photovoltaic cells, light weight composites, super conducting power cables, batteries, radiation resistant and proliferation resistant materials, etc.

- d. In order to minimize the waste and reduce the doubling time (DB) to less than 10 years, a closed metallic fuel cycle with multiple recycling is recommended along with burning of MA (Minor Actinides) to minimise the waste. The growth of FBRs with U and Pu fuel is essential for launch of 3rd stage. Beyond that Pu-Th based FBRs as well as Molten Salt Reactors should be used for effective conversion of Thorium. In addition, there is a need to develop Nuclear Mega parks in coastal areas, where it is possible to manufacture the entire Reactor Auxiliary (RA) components as a factory-made single package item. Also there should be enough funds provided by the Govt. to support the active development of FBR technologies in such industrial installations.
- e. There is a need for accelerating the integrated approach towards Fuel Reprocessing and Waste Management, especially to cater to the fuel reprocessing in closed fuel cycle, which is an immediate requirement for accelerated growth.
- f. It is possible to extend the operating life of a nuclear reactor beyond its design life by identifying critical components and understanding degradation mechanisms. An effective life assessment plan helps in upgrading/maintaining these components at appropriate intervals. Hence, ageing and plant life management approach should be used for plant life extension. This will also ensure that the plant life gets extended without compromising safety and reliability.
- g. For industry, there is a need for assurance of continuous business and also provisions of fiscal concessions, incentives and benefits. Further, (i) *irregular inflow of projects*, adversely impacts the investment in dedicated infrastructure and skilled resources; (ii) *lack of dedicated skill development programme*, impedes the programme for development of nuclear components & associated manufacturing processes; (iii) the *development of indigenous vendor base*, provides expeditious development required for supply of raw materials and services and (iv) *delay avoidance*, in project execution ensures better economy.
- h. International cooperation flows out of properly drafted IGA's and proper budget allocation and human resource management for such collaborations may be envisaged with good foresight. A clear policy document may be

formulated, identifying the area of scientific collaboration with a long term vision.

- i. LCOE (Levelized Cost of Electricity) is higher for renewable energy system as compared to conventional fossil based systems. Only Solar Cell technology has matured to the extent of commercialization after 60-70 years of continued R&D. On top of it, there is uncertainty on the front of availability. These pose as a challenge for renewable energy system development. Also development of newer technologies like super critical CO₂ Brayton cycle power plant (esp. supercritical turbine), improving the reliability and performance of printed solar cell using flexible glass substrate have potential to have a disruptive impact on the energy availability of the country.
- j. Wave Energy potential is rather limited in this part of the world and the initial cost is high due to civil construction of caisson. However it is still viable if done along with port – breakwater. Further, smaller power modules based on Backward Bent Ducted Buoy (BBDB) are more viable. For Ocean Thermal Energy Conversion, the areas to be addressed include underwater operation (shallow water, up to 20 m depth); endurance of bearings, seals, etc.; generator design, deployment and maintenance and survival in sea storms. In addition, bio-fuel from algae in mineral rich sea water and technologies to use methane gas trapped as hydrates in sea-bed should also be worked upon.
- k. Solar thermal systems are considered to be unviable presently for power generation, but can provide for energy storage for mitigating high demands during peak period. These technologies (parabolic trough, power towers, Linear Fresnel Reflectors etc.) can be easily indigenized except for a few imported components like white glass. Indian industry has some experience of fabricating and using variety of solar concentrator technologies. Solar thermal concentrators may also be suitable for high temperature storage leading to 24 x 7 electrical power generation and comparatively high efficiency. Efforts are needed to design and test systems with solar concentrators integrated with storage for the purpose. Challenges in this respect are on the reliability and availability issues. Standardization of components is the way forward to improve industry participation and confidence.
- l. In India, with the growing need of power for industrial and social development, particularly in the remote areas, Small & Medium Size Reactors (SMRs) are a very attractive option. SMRs can be deployed in remote areas not connected to national grid and these can be utilized to

replace ageing conventional power plants (coal, oil or gas based) and also for desalination in specific coastal areas.

- m. If certain issues like CLNDA, assurance of continuous business and fiscal benefit are given to Indian industry, they would be willing to put additional investments, so as to meet new demands of Indian Nuclear Power Programme. The right to recourse in case of nuclear damage due to defect in component by any supplier and applicability of other laws in the country have been addressed/resolved through a process of intense international engagement culminating in an understanding reached in January 2015, as well as through the creation of the India Nuclear Insurance Pool (INIP), which was launched in July 2015. This insurance pool will provide cover to the operator, as well as the suppliers as per the understanding arrived at. This has removed a major hurdle in the involvement of international suppliers and vendors in the Indian nuclear energy market.
- n. AERB also should have plans in place to enhance its human resources, for catering to the additional workload, in view of the envisaged significant expansion of nuclear industry.

4.2. Clean India Technologies

- a. In our country, large population lives in rural areas and remote locations. There is need for technology innovations that are simple, repairable by local technicians and sustainable in a rural context.
- b. Our achievements are yet to adequately percolate down to the bottom of the pyramid. The potential to impact the common man's life is yet to be fully exploited particularly in remote areas.
- c. The proven strategy to recharge water bodies in Himalayan regions through isotope hydrology may be adopted at large scale.
- d. There is urgent need to control the untreated effluent and sewage discharge to Ganga River throughout its length.
- e. Toilets for all to make open-defecation-free India, is an important step towards Clean India. However, this by itself is not adequate. We need to implement solutions to deal with the human waste, as integral part of the toilet. Necessary technologies exist.
- f. Waterless toilets technology is now near maturity and its implementation all across the country is to be rigorously pursued.

- g. Waste generated from the treatment of industrial waste should be suitably managed and disposed depending on its hazardous or non-hazardous nature for comprehensive and holistic solution. The technology exists; however, implementation has to be strengthened through strict rules and follow-up.
- h. Technologies required for Clean India mission are generally 'high volume low value' technologies. It requires increase in R&D investment to reduce cost and wider outreach for public adoptability.
- i. The Waste management in cities has become a huge problem. The current model of complete funding of the plant by the contractors & recovering the investment by generating revenue through sale of recyclables, electricity & compost has not been successful. The financial model needs to be relooked. One of the models suggested is that the Government funds the capital expense. The facility is operated and maintained by the contractor with the income from the sale of recyclables, compost & electricity. Each municipality should actively pursue this even at the cost of some of the tax collection.
- j. It is recommended that the concept of Reduce, Reuse and Recycle (RRR) should be promoted. Policies and programmes should be framed to facilitate community participation and make the stakeholders accountable for management of waste.
- k. Conclave is happy to note that a mechanism for e-waste management is in place. However, the informal system through small operator is not letting this happen. More awareness for existence of such a system is needed.
- l. Sludge Hygenisation Research Irradiator (SHRI) and NISARGRUNA technologies developed by Department of Atomic Energy (DAE) for treatment of solid municipal and kitchen wastes may be deployed over a large scale. Conclave recommends corporate sector to adopt a few cities for effective demonstration of their system.
- m. Among the various applications of solar energy, solar refrigeration has potential to mitigate spoilage of agricultural produce, marine food products etc. However, the issues related to design and development of simple compact system and cost reduction need to be addressed for sustainability and commercialization.
- n. Low cost indigenous water purification units for clean drinking water, developed by DAE, are very effective technology solutions for providing good quality drinking water to society. However, to spread its outreach at

quick pace, it is recommended that it may be distributed to household in rural and remote areas through CSR schemes.

- o. Wastes, which have potential for value added utilization, should be reused to solve environmental pollution problems as well as leading to savings in cost, material and energy. Most of the technology already exists.
- p. There exist parallel opportunities in the carbon market. The benefit of going green is two-fold as resulted reduced emission is complimented by opportunity of carbon trading.

5. PANEL DISCUSSION AND VALEDICTORY SESSION

The two panels of theme-1 and theme-2, chaired by Shri R.C. Sharma and Dr. P. K. Tewari met separately and consolidated the recommendations (Refer section 5) of the technical sessions. The recommendations were presented and discussed in the valedictory session by a panel comprising of Dr. R K Sinha, Chairman, AEC, Dr. B N Suresh, President INAE and Dr. S K Jain, Former CMD, NPCIL.

6. RECOMMENDATIONS

6.1. Recommendations : Luncheon meeting of EC-2015

- a. India should advocate rapid expansion of nuclear energy as a solution for reducing the carbon footprint during the forthcoming meet on climate change.
- b. Commitment from Government for the sustained nuclear power programme and requisite funding for early addition of nuclear power plants to implement the policy of carbon footprint. Industry can bank upon the orders resulting in long term utilisation of infrastructure and retention of experts and skilled manpower.
- c. Defining a financial model (including government funding and funds from domestic and world market based on proven credibility of the programme) matching the projected growth of nuclear power.
- d. Defining a policy for generating and sustaining expertise by placement of students specialising in nuclear technology.
- e. Professional bodies like INAE should support to address public perception on nuclear power.

- f. DAE to take further initiative to organise a meeting of stake holders (DAE units, industry representatives, academicians and media) to formulate a base paper for the government.

6.2. Recommendations from Theme-1

- a. In order to realise the target of 63000 MWe of installed nuclear power capacity by 2032 as per the integrated energy policy of GOI, the ongoing 700 MWe PHWR programme should be further accelerated. In addition, to achieve the target of nuclear power, it is necessary to augment the program by addition of LWRs, PFBRs & IPWRs in the total energy mix. A roadmap to achieve 63000 MW by 2032 should be prepared.
- b. As envisaged, in line with the three stage nuclear power programme, the growth of FBRs with U and Pu fuel can be continued up to 2045 as required to achieve sustainability of third stage, beyond which Pu-Th based FBRs as well as Molten Salt Reactors will be utilized for effective conversion of Thorium.
- c. In order to accelerate the growth of other reactor technologies, viz. IPWR, LWRs, etc. there is a need to establish long term commitments with Industry.
- d. The procurement policy, contracting methodology and policy of awarding fiscal concessions, incentives and benefits to industry by GOI, should be suitably reviewed, so as to ensure preferential participation of Indian industry along with its long term sustenance, continuity in manufacturing, and effective resource management for maintaining the supply chain.
- e. There is a need for time-bound GOI supported research activities in areas like materials and technology for self-reliance and a national blueprint must be prepared for long term solutions and to foster innovation & excellence all across industries in the country.
- f. In order to promote development of better materials and technologies in renewable sector, effective policy changes need to be carried out so as to encourage the concerned industries to invest more in R&D.
- g. There is a need to develop industrial mega parks in coastal areas for manufacture of factory made single package together with entire Reactor ancillaries for ease of optimized supply chain management.
- h. The integrated approach to Fuel Reprocessing and Waste Management should be accelerated to cater to fuel reprocessing in closed fuel cycle.

- i. The plant owners should institute effective ageing management and life extension plans right at the inception, for maximizing the plant life and its effective utilization.
- j. A clear policy document may be formulated by identifying the areas of international scientific collaboration for advanced research in thrust areas of nuclear energy which in long term would serve as a catalyst for accelerated growth in nuclear energy sector.
- k. Development of Small & Medium Size Reactors (SMRs) may be taken up for deployment in remote areas not connected to national grid, and also in specific coastal regions for desalination.
- l. GOI should quickly implement all aspects of CLNDA (including right to recourse), along with the operationalization of the Indian Nuclear Insurance Pool (INIP).

6.3. Recommendations from Theme-2

- a. The proven strategy to recharge water bodies in Himalayan regions through isotope hydrology should be adopted at a large scale.
- b. Sufficient nos. of Sewage Treatment Plants (STPs) and Effluent Treatment Plants (ETPs) should be constructed to minimize the untreated industrial effluent and sewage discharge to Ganga River.
- c. Policies to install toilets based on modern technologies for integrated waste management, on larger scale should be framed. Waterless toilet technology is now near maturity and its implementation all across the country is to be rigorously pursued.
- d. In order to reduce cost and wider outreach for public adaptability, the investment in R&D for high volume and low cost technologies for achieving Clean India mission should be enhanced.
- e. A policy should be framed to ensure that the Waste management in cities should follow a model of capital expenditure by Government fund and facility operation & maintenance by contractor. The income from the sale of recyclables, compost & electricity will be a source of revenue generation for the contractor.
- f. Policies and programme should be framed to facilitate community participation and make the stakeholders accountable for management of waste through the concept of Reduce, Reuse and Recycle (RRR). Wastes,

which have potential for value added utilization, should be reused to solve environmental pollution problems as well as leading to savings in cost, material and energy.

- g. Adequate policies for training the small operator working in the e-waste management sector should be instituted for carrying out effective segregation and disposal resulting in better e-waste management.
- h. Sludge Hygenisation Research Irradiator (SHRI) and NISARGRUNA technologies developed by Department of Atomic Energy (DAE) for treatment of solid municipal and kitchen wastes needs to be deployed over a large scale.
- i. R&D related to design and development of simple compact solar refrigeration system and its techno-economic feasibility need to be pursued for sustainability and commercialization.
- j. Distribution of DAE developed low cost indigenous water purification units for use in rural and remote areas should be promoted through CSR schemes.

Details of Participation

About 484 participants attended EC2015. This includes participants from INAE, BARC, NPCIL and AERB. There was participation from different units of DAE also viz. IGCAR, BHAVINI, RRCAT, DCSEM, IPR, NRB, HWB, VECC, ECIL, AMD, IREL, BARCF Vizag, NFC, BRIT and UCIL. Eminent experts, senior functionaries from various government departments, Academia, Industry, NGO, DAE and INAE Fellows participated in large numbers as speakers. Industries like Areva, Westinghouse, KBL, L & T, RCF, HCC, UBM, Springer and Kaybouviet engineering have also participated. Students participated from universities like ICT, HBNI, Rajasthan, Austrade, TISS and NIAS, Bangalore. Media persons were also invited for the comprehensive coverage of the entire event. Auxiliary staff was involved from NPCIL and BARC without whom the event could not have become a great success.

S.No.	Participation	Nos.
1	INAE	65
2	BARC	83
3	NPCIL	39
4	AERB	15
5	Other DAE Units	80
6	Speakers	39
7	Senior DAE Officials	5
8	Industry	25
9	Organizers	8
10	Sub Committee Members	43
11	Students	10
12	Media Persons	30
13	NPCIL Auxiliary Staff	17
14	BARC Auxiliary Staff	25
Total no. of participants		484



Engineers' Conclave (EC 2015)

Theme-I : Green Energy Options for Sustainable Development

Theme-II : Clean India Technologies



Jointly Organized by Indian National Academy of Engineering (INAE) and Bhabha Atomic Research Centre (BARC)

PROGRAMME

7th September, 2015 - Day 1

Time (Hrs.)	Inaugural Session at NUB, NPCIL	
10.00 – 10.05	Welcome Address	Director BARC
10.05 – 10.10	Aim of the Conference	INAE Chair
10.10 – 10.15	Need for Accelerated Growth	CMD, NPCIL
10.15– 10.25	Presidential Address	Chairman, AEC
10.25– 10.55	Address by the Chief Guest	Hon. Raksha Mantri
10.55 – 11.00	Vote of Thanks	Convener, EC2015
11:00 - 11:30	High Tea	
11:30 - 12:15	Key note address by Dr. M.R. Srinivasan; Former Chairman, AEC	
	Venue : NUB, NPCIL	Venue : NUB, NPCIL
1215 -1300	Plenary Talk-I: River Rejuvenation through community driven decentralized water management Shri Rajendra Singh; Tarun Bharat Sangh	Luncheon Meeting with stake holders and policy makers
13.00 – 14.00	Lunch break	
14:00 - 14:45	Inauguration of exhibition at NUB, NPCIL	

	Venue : NUB, NPCIL	
	Technical Session I	
	Venue : NPCIL Auditorium Strategy for Multifold Increase in Installed Nuclear Capacity in India Session Chairman: Dr. S K Jain Rapportier: Shri S K Sen	Venue : NPCIL Seminar Hall Cleaning of Rivers & Water Resource management Session Chairman: Dr. P. S. Goel Rapportier: Dr. Soumitra Kar
14:45 - 15:15	<i>Road-map for Accelerated Growth of Nuclear Power in India</i> Shri K C Purohit; CMD, NPCIL	<i>Water Management: Nature Based Approach</i> Dr. Anil Joshi; Founder & Director, Himalayan Environmental Studies & Conservation Organization (HESCO), Dehradun
15:15 - 15:45	<i>Industry Support for Accelerated Growth of Nuclear Capacity of India</i> Shri. Sanjay C. Kirloskar; CMD, M/s Kirloskar Brothers Limited.	<i>Identification of Issues and Priority Actions for Ganga Restoration</i> Prof. Vinod Tare, IIT Kanpur
15:45 – 16:15	<i>Energy Security: Foresight and Technologies:</i> Dr. Baldev Raj, Director, NIAS	<i>Water Quality Management: Practical Issues and Possibilities.</i> Dr Nitin Labhsetwar, National Environmental Engineering Research Institute (NEERI), Nagpur
16:15 - 16:30 Hrs. Tea Break		
	Technical Session II	
	Venue : NPCIL Auditorium Green Energy Options Session Chairman: Shri S. G. Ghadge	Venue : NPCIL Seminar Hall Industrial Waste Water Management Session Chairman: Dr (Ms) Lakshmi Raghupathy

16:30 – 17:00	<i>Fast Breeder Reactors : Indian Ingenuity</i> Dr. P. Chellapandi; CMD, BHAVINI	<i>Industrial Waste Water Management</i> Shri Ajay Popat; President - Corporate Diversification & Marketing, Ion Exchange (India) Limited, Mumbai.
17:00 – 17:30	<i>Fusion- A Clean Source of Energy</i> Prof. Dhiraj Bora; Director, IPR	<i>Australian Waste Water Management Expertise</i> Shri. Vijay Kumar; Water & Environment-South Asia; Australian Trade Commission (Austrade), Delhi
17:30 – 18:00	<i>Back End of Indian Nuclear Programme -Key to sustainability</i> Shri P.K. Wattal; Former Director, NRG, BARC	<i>Industrial Water Management: Challenges & Opportunities</i> Shri Sriram Kulkarni; Director, Technochem Pvt. Ltd., Mumbai.
18:00 --18:30		<i>City Waste Management: A Model Suitable for Big Cities</i> Shri Sandeep Asolkar; Managing Director, SFC Environmental Technologies Pvt. Ltd., Mumbai
18:30 – 19:00	Tea Break	
19:00 - 21:30 Hrs. – Cultural Programme & Dinner		
8th September, 2015 - Day 2		
09:30 – 10:15	Venue : NPCIL Auditorium Plenary Talk-II: <i>Energy, Environment and Sustainability</i> Dr. S. Banerjee; Former Chairman, AEC	
10:15 - 10:30 Hrs. Tea Break		
Technical Session III		
	Venue : NPCIL Auditorium Industry Support for Nuclear Energy Session Chairman: Shri S. S. Bajaj	Venue : NPCIL Seminar Hall Solid Waste Management Session Chairman: Shri Vijay Kumar

10:30 – 11:00	<i>Aging Management Concept and Nuclear Plant Component Testing Facilities.</i> Shri. Helmut Nopper, Areva <i>Industry Support for Accelerated</i>	<i>City Solid Waste Management</i> Shri. P.U. Asnani, Chairman, Urban Management Consultants (Global), Ahmedabad
11:00 – 11:30	<i>Growth of Nuclear Capacity in India</i> Shri. G. K. Pillai MD & CEO, M/s. Walchandnagar Industry Limited.	<i>Sustainable Solutions for E-waste Management in India</i> Dr (Ms) Lakshmi Raghupathy; Ex-Director, MOEF, Gurgaon
11:30 – 12:00	<i>Industry Support for Accelerated Growth of Nuclear Capacity in India</i> Shri G K Hedao, GM, In-Charge of Power Sector Marketing, BHEL	<i>Radiation Hygienisation of Municipal Dry Sewage Sludge for Agricultural Applications: An Urban-Rural Alliance for Sustainable Development</i> Dr. Lalit Varshney; Head, RTDD, BARC
12:00 – 12:30	<i>Industry Support for Accelerated Growth of Nuclear Capacity in India</i> Shri Neeraj Borwankar; Larsen & Toubro	<i>Nisargruna - Coimbatore Experience, Village Sustainability Project Based On BARC Nisargruna Technology</i> Dr. S.P. Kale, Associate Director, BSG, BARC
12:30 – 13:30 Hrs. Lunch Break		
Technical Session IV		
	Venue : NPCIL Auditorium Policy Intervention for Sustainable Development Session Chairman: Shri S. K. Mehta	Venue : NPCIL Seminar Hall Clean Fuel Technologies Session Chairman: Shri R.K.Garg
13:30 – 14:00	<i>Civil Liability for Nuclear Damage</i> – Shri. Amandeep Singh Gill; Joint Secretary, Disarmament & International Security Affairs Division, Govt. of India	<i>Clean Coal Technology</i> Shri. D. P. Misra; FNAE & Senior Advisor Development Consultants

14:00 – 14:30	<i>International collaborations: their Inevitability and Indispensability</i> Dr. K.L. Ramakumar; Director, RC&IG, BARC	<i>Solar Thermal Energy Refrigeration Technologies: Current Issues and Future Trends</i> Prof. A. Mani; IIT Madras, Chennai
14:30 – 15:00	<i>Regulatory Aspects</i> Shri S A Bhardwaj; Chairman, AERB	<i>Indigenous Water Technologies based on Clean Fuel</i> Dr. P.K. Tewari; Former Associate Director, ChEG, BARC
15:00 - 15:30 Hrs. Tea Break		
Technical Session V		
	Venue : NPCIL Auditorium Renewable Energy Prospects Session Chairman: Shri A. K. Anand	Venue : NPCIL Seminar Hall Environment Pollution Control & Carbon Sequestration Session Chairman: Prof. Mani A
15:30 – 16:00	<i>Engineering Challenges of Sustainable Energy: SERIUS and Beyond</i> Prof. K. Chattopadhyay; Director, SERIUS	<i>Like Cures Like: Waste Treatment Solutions Utilizing Industrial wastes</i> Dr. Malini Balakrishnan; The Energy & Resources Institute (TERI), New Delhi.
16:00 – 16:30	<i>Solar Thermal Energy Technologies and Issues</i> Prof Shireesh Kedare, IIT, Bombay	<i>Clean Energy Technologies and Parallel Opportunities in Carbon Market</i> Ms Meenakshi Jain; CMD, Positive Climate Care, Jaipur
16:30 – 17:00	<i>Utilization of Ocean Energy,</i> Dr. Atmanand, National Institute of Ocean Technology (NIOT), Chennai	<i>Clean Drinking Water for Rural & Remote Areas</i> Shri Pradeep Lalla, Managing Director, Sonadka, Mumbai.
17:00 – 17:30	<i>Hydrogen Economy: Challenges and Opportunities</i> Prof. G.D. Yadav, Vice Chancellor, Institute of Chemical Technology, Mumbai	<i>Discussion meet on Low Cost Affordable Technologies</i> Chair Person: Commodore. R.B. Verma
17.30 hrs. - 18.00 hrs. : Tea Break		

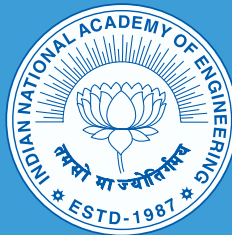
18.00 – 18.45	<p style="text-align: center;">Venue : NPCIL Auditorium</p> <p style="text-align: center;">Plenary Talk-III: Development of Small and Medium Size Reactors Shri S.K Mehta; Former Director, Reactor Group, BARC</p>		
9th September, 2015 – Day 3			
10:00 – 10:45	<p style="text-align: center;">Plenary Talk-IV: Nuclear Energy; Clean & Sustainable Option Dr. R K Sinha; Chairman, AEC</p>		
10:45 - 11:45	Panel Discussion	<p style="text-align: center;">Venue : NPCIL Auditorium</p> <p style="text-align: center;">Coordinator of Theme-I, Shri R.C. Sharma Chairman of all Technical Sessions</p>	<p style="text-align: center;">Venue : NPCIL Seminar Hall</p> <p style="text-align: center;">Coordinator of Theme-II, Dr. P.K. Tewari Chairman of all Technical Sessions</p>
11:45- 12:15 hrs. Tea Break			
12:15- 13:00	Valedictory Session	<p style="text-align: center;">The Vision for INAE-DAE Initiatives Dr. R. K. Sinha, Chairman, AEC & Dr. B. N. Suresh, President, INAE Shri S.K. Jain, Former CMD,NPCIL</p>	
13:00 – 14:00 Lunch			

INDIAN NATIONAL ACADEMY OF ENGINEERING

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. The aims and objects of the Academy are to promote and advance the practice of engineering and technology, related sciences and disciplines and their applications to problems of national importance. INAE also encourages inventions, investigations, and research in pursuit of excellence in the field of "Engineering".

INAE had taken an initiative of organizing an annual mega event of engineers as "Engineers Conclave" starting from year 2013, essentially to provide a platform for all engineers/scientists to deliberate and address major engineering challenges and opportunities of vital concern and relevance to the country and society. The "Engineers Conclave" is organized by INAE jointly with one of the premier engineering organizations/institutions of the country each year. There are two themes for the Conclave, both focusing on the issues relevant to the Country. While the theme-1 will be decided by the host department, the theme-2 specific to some social problem where engineering intervention is desired, will be decided by INAE. The discussions in the two themes will be focused in finding engineering solutions to the challenges with specific recommendations which would be forwarded to the concerned Departments/Industry for consideration.

For more details, please visit INAE website www.inae.in



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