Centre for Air Power Studies (CAPS)

Forum for National Security Studies (FNSS)

NATIONAL Seminar on

NUCLEAR POWER

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Venue: Conference Hall, Subroto Park, New Delhi.

Session I: Nuclear Power Today

The Global Nuclear Energy Picture - Dr.Stuti Banerjee, Research Fellow, Indian Council of World Affairs

- Nuclear energy has become an important aspect of the strategy/policy to achieve 'Green Growth'. These policies reflect the understanding that economic growth and environmental protection can be compatible rather than conflictingactivities.
- Nuclear power plants provide stable and predictable generating costs over a long time. However, constructing of the plants have high upfront capital costs. Delays in construction further add to cost.
- Furthermore, the existing problems associated with nuclear energy are:
    - Security Issues
    - Nuclear Safety
    - Nuclear Waste
    - Decommissioning, whichis an expensive affair.
- Presently, there are 449 nuclear power reactors in operation, globally, with 3, 92,171 MWe total net installed capacity.
- Asia is the driver of nuclear energy in the present scenario.
    - China and India are leading the world in their attempt to ensure a considerable percentage of their energy is sourced from nuclear. Japan has also restarted some of its nuclear power reactors, while South Korea is another key player in the industry and its nuclear reactors provide about one-third of the country's electricity.

  - Bangladesh is developing its capability with Russianassistance, while the Philippines is looking into operating its only nuclear power plant built four decades ago but never used, to ensure a long-term supply of clean and cheap electricity.
- The United States of America and Canada are also looking to add a few reactors to their already extensive networks.
- Nuclear power plants generate almost 30% of the electricity produced in Europe. However, based on individual country decisions,Each country decides alone whether to include nuclear power in its energy mix or not. Belgium, Germany and Switzerland have plans to phase out nuclear power over time.

Nuclear Future: Possible Prospects:

- The UAE is perhaps the only country among the GCC States that has made progress in its endeavour to establish a nuclear power programme. Other states of the GCC have halted their programmes as the option is not viable for their current limited needs.
- Africa's inability to generate enough electricity has curtailed economic growth, shaving two to four percent off GDP every year, according to the Africa Progress Panel. South Africa is the only country on the continent operating nuclear power plants providing about five percent of the country's energy needs.
- In Latin America, nuclear power is not a prevalent source of energy with only three countries having seven nuclear power plants-Brazil (2), Mexico (2) and Argentina (3).
  - Countries that have expressed interest in nuclear energy are Bolivia, Chile and Peru. The political- economic environment in the region is not conducive for large scale projects, for the moment.
- Despite a turbulent history, the appeal of nuclear energy—electricity production on a massive scale with minimal emissions—remains. Its low emission rate remains the key reason for the United Nations International Panel on Climate Change to recommend doubling of the world's nuclear capacity by 2050.
- It is likely that nuclear energy will compete with fossil fuel sources as well as renewable energy sources in the future.

Japan's Nuclear Energy Programme Six Years After Fukushima – Mr. Miyake Yasujiro, Counsellor, Embassy of Japan in India

- The earthquake in 2011 transformed Japan's power generation composition, replacing nuclear with LNG, oil and coal. In response to nuclear difficulties, coal capacity is planned to increase 21% to 47 GWe by early 2020s.

- The current shut down of nuclear reactors in Japan's energy mix does not imply a nuclear energy phase-out. In fact, there has been a slow growth in trying to make nuclear energy as a baseload source of power yet again as indicated by policymakers.
- Presently, contribution by nuclear power in Japan stands at 3 per cent, while oil, which has to be imported contributes 43 per cent to Japan's energy basket. Renewable sources of energy contribute a mere 4 per cent to Japan's energy security mix.
- With increased imports of energy sources over the last five years, the rising costs of power in Japan have been inevitable. The average electricity price has risen by around 25% for households and around 40% for industry because of increasing fuel costs and so on.
- Nuclear power in Japan will continue as an important base-load power source as a low carbon and quasi-domestic energy source, contributing to stability of energy supply-demand structure, on the major premise of ensuring of its safety, because of the following perspectives: (a) Superiority in stability of energy supply and efficiency, (b) Low and stable operational cost, and, (c). Free from GHG emissions during operation.
- Safety is the top priority for Japan, and the government has initiated several policies to clean up the mess left behind after the Fukushima accident. These include
    - Specific Measures toward decommissioning
    - Fuel Debris Retrieval through identification of the location or amount of fuel debris in each unit. R&D on optimal method for retrieving fuel debris from each unit is being conducted.
    - Overview of Water Management

      1. Measures are taken to reduce the generation of contaminated water by "isolating" groundwater from the contamination source.

      2. Measures are taken for preventing leakage of contaminated water to the sea by "preventing leakage" of contaminated water.

      3. "Removing" the contamination source
- Lessons learned from the Fukushima accident has forced the industry to improve three aspects of nuclear power generation, namely: Safety Measures, Severe Accident Measures and Nuclear Emergency Preparedness Measures.
- Japan is keen to provide support on human resource development toward the safe operation and management of nuclear power stations to other countries. With close cooperation with relevant domestic and international organizations such as IAEA, programmes are carried out by dispatching or hosting nuclear power experts..

The Current State of India's Nuclear Power Programme - Ranajit Kumar, Head, Nuclear Control and Planning Wing of DAE

- India's projected energy requirements by 2032 from all the major sources combined which includes thermal, hydro, solar, wind and nuclear is estimated to be 700 GW.
- This is required in order to meet India's 7 to 9 percent GDP growth along with the need to have a green source of energy which in turn would support its sustainable development.
- India has a closed fuel cycle which ensures that the spent fuel gets reprocessed and reused while at the same time its radiotoxicity is further reduced before getting it ready for geological disposal.
- India's PFBR is set to reach criticality in this year. Currently R&D is underway for the development of multi-purpose reactors.
- Currently, India has 22 functioning reactors which includes two Boiling Water Reactors (BWR), 18 Pressurised Heavy-Water Reactors (PHWR) and two Light-Water Reactors (LWR); all having a combined capacity of 6780 MW. And by adding the ones under construction – eight PHWR of roughly 700 MW each – the overall capacity is set to increase to 13400 MW.
- There is a strong institutional support from the Government of India in terms of budgetary as well as legislative, such as the amendment to the Atomic Energy Act that provides Nuclear Power Cooperation of India Limited (NPCIL) to have partnerships through joint ventures with other Indian Public Sector Undertakings (PSUs). Further, there are talks with Russia for the VVER or Water-Water Energetic Reactors, the Westinghouse and Toshiba, and the French company AREVA/EDF.

Session II: Addressing Public Concern*s*

Comparative Evaluation of Economics of Different Electricity Generating Technologies - Prof RB Grover, DAE HomiBhabha Chair professor, HomiBhabha national Institute

- The four factors that determine the economics of various electricity generations are *capital cost* – the cost of setting up the plants, in this there is also the system

integration cost which often does not get included in the capital cost, such as the grid that connects plants. The *generation cost* – cost of capital that includes debt plus equity – followed by *cost of fuel* including transportation; and finally there is the operations and maintenance cost.

- There also exists the external cost and net energy gain which needs to be considered while understanding the economics of electricity generating technologies. External cost denotes the cost that is not accounted for during production and at the same time is not imposed on the receiver. But, this is a cost imposed on the third party that has to bear with the negative externalities. For instance emissions from a thermal plant results in a negative health impact for the people around the area costing them in the form of increasing health care bills.
- Nuclear power with its lowest level of GHG emissions has the smallest level of direct health effects and thus, the lowest amount of external cost. Yet it still faces the lowest level of acceptability due to the fears of accidents, weaponisation and the use of fissionable materials.
- Another factor which needs to be taken into account is the efficiency of energy production since there exist energy loss during the extraction of energy resources. The EROI or Energy Return on Energy Invested provides the net energy gains by dividing the energy produced or returned by energy invested in production. For instance the EROI for 100 MJ of oil extraction after going through various stages of production account to about 20.5 MJ of oil that goes into the final supply to consumers.
- The Energy Cliff indicates that the higher the EROI the higher would be the energy gains. In this regard, coal, nuclear and hydro energy has high energy gains. Nuclear energy has high EROI implying efficiency of energy production along with a low external cost.
- R&D becomes a prerequisite for technological evolution in order to develop and built new reactors that ensure zero release of radiological substance and to address the prevailing apprehensions on the safe use of nuclear for energy production.

Response Strategies for Handling Nuclear Emergencies – Dr. Manpreet Sethi, Senior Fellow, Centre for Air Power Studies

- Emergency preparedness and response are important to gain public confidence in nuclear power along with theemphasis on safety and security - safe designs and physical defences.
- Nuclear emergencies must be handled carefully as they can impact public life, health and property. It is a national responsibility to handle these effectively through a national regulatory body.
- In order to prevent and prepare for a nuclear emergency, it is imperative to understand the difference between a nuclear incident and accident. The International Nuclear and Radiological Event Scale provides a distinction between the two, making it easier to come about effective response strategies for various circumstances.
- Effective handling of nuclear EPR requires organisational capabilities and standard operating procedures.
- The organisation must have well defined categories of hazard assessment criteria, relevant tools and equipment along with proper training and public communication strategies. This will help to make the public feel more involved so as to not let things escalate in the media, as they often do.
- As far as the international framework on nuclear emergency response is concerned, there are two legally binding conventions that India is a part of. These are –
    - The Convention on Early Notification of Nuclear Accidents (1986) – relates to information on emergencies and their potential to impact beyond territorial boundaries.
    - The Convention on Assistance (1987) – extends cooperation through IAEA on request by the concerned state, including radiation monitoring, medical help, waste management and mitigation of consequences.
    - Further, the IAEA Code of Conduct is another document which is advisory in nature and not legally binding. It lays down guidelines for preparedness and response for a nuclear or radiological emergency.
- The potential challenges in nuclear EPR would arise in:
    - Inter-agency coordination as well as a level of understanding and cooperation from agencies that are outside the nuclear realm;
    - The relevance of joint drills and exercises can be enhanced if feedback and peer reviews are considered. One reason for hesitation towards peer reviews may be due to the fact that it runs the risk of exposing weaknesses of an organisation, generating negative publicity and hurting credibility;
    - Adequate thought to succession planning must be made in order to successfully establish nuclear EPR;

- This could add to a careful balance of international guidelines and national cultures to help maintain safety and security

Effectiveness of a Nuclear Safety Regulator – S.A. Bhardwaj, Chairman, AERB

- The fundamental objective of national nuclear safety regulatory body is to ensure that activities related to use of nuclear & radiation energy are carried out in a safe manner.
- Regulatory supervision is an iterative and dynamic process that uses combinations of approaches as tools to address the inherent complexity of the facilities/activity being regulated.
- The Atomic Energy Regulatory Board (AERB) was established in 1983 through Presidential notification in order to control radioactive substances and ensure safety in nuclear and radiation installations. The mission of the Board is to ensure that the use of ionising radiation and nuclear energy in India does not cause undue risk to health and the environment.
- The principles for an effective nuclear regulator are the following:
  1. Focus on safety bringing about a safety culture encompassing individual staff members, leaders and the organisation as a whole.
  2. A sense of independence, wherein it can take decisions without bias or coercion, at the same time not operating in isolation.
  3. Competence based on experienced, skilled and well trained organisational and human factors.
  4. Openness and transparency in order to facilitate stakeholder involvement and allow for public access to information regarding regulatory processes.
- Essentially, there are six attributes of an effective nuclear regulator:
  1. Clear and consistent regulation of the body, issuing regulatory guidelines, clearly defining objectives etc.
  2. Consistent and balanced decision making is required for stable regulatory control and prevention of subjectivity by individual staff members.
  3. Accountability to national governments and the public, wherein the regulator can justify and explain their actions and decisions as well as withstand challengers to those decisions.
  4. Strong organisational capability with an effective management system, leadership and recruitment of competent staff.
  5. Continuous improvement through peer reviews and international involvement in order to monitor performance and effectiveness of regulatory strategies and embrace a culture of continuous improvement.
  6. Credibility, trust and respect that result from the actions of its effectiveness itself.