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Facts on Kudankulam Nuclear Power Project

There are some vested interest groups, who are spreading unscientific and incorrect information, fuelling apprehensions and fears about nuclear power among the masses. Recently there has been a lot of misinformation spread about Kudankulam site, earthquakes and tsunamis at the site, possible displacement of people, safety of the reactors set up, effect on fisheries etc.

Nuclear, radiation and environmental safety is of paramount importance and it has been given top-most priority at Indian nuclear power plants, including at Kudankudam Nuclear Power Project (KKNPP). The facts on various aspects of KKNPP are attached herewith.
Facts on Kudankulam Nuclear Power Project

1. Site Clearance for Kudankulam-1&2 (KK-1&2)

The sites offered by the states for setting up nuclear power projects are evaluated by the Site Selection Committee (SSC) of the Government. The SSC evaluates the sites in line with the criteria laid down in the AERB Code of Practice on Safety in Nuclear Power Plant Siting, which inter alia, gives the mandatory and desirable requirements of the site from safety considerations. These include assessment of seismicity, location of faults, geology, foundation conditions, meteorology, potential of flooding (from tsunami, storm surge, etc. at coastal sites and from rain, upstream dam break, etc. at inland sites), proximity to airports, military installations, facilities storing explosive and toxic substances, etc. The environmental setting comprising of bio-diversity, including flora and fauna, marine ecology etc. in the region is also evaluated. In addition, availability of land, water, electricity demand in the region and the availability of other energy options also form the basis for evaluation. The SSC submits its recommendations to the Government. The Government after due process, accords ‘in principle’ approval for the site.

*Kudankulam site was also evaluated by the then Site Selection Committee and approved after due process then prevalent.*

Ministry of Environment & Forest (MoEF) and other statutory Clearances

On receipt of ‘in principle’ approval, pre-project activities including obtaining environmental clearance from MoEF and site clearance from AERB are taken up, in parallel with preparation of detailed project report.
The Environmental Clearance for KK-1&2 was obtained after following the due process then prescribed by the MoEF. An Environment Impact Assessment (EIA) had been carried out. The MoEF notification for environmental clearance process then in force did not envisage public hearing. However, subsequently, while obtaining the environmental clearance for KK 3&4, Environment Impact Assessment (EIA) as per EIA notification, public hearing including the responses to stakeholders, review by expert appraisal committee of MoEF as per the prevalent notification of 2006 was carried out. Detailed studies comprising Geo-technical examination, Seismo-tectonic, Safe grade level, meteorological and other studies were carried out by the expert agencies of organizations specializing in these. Based on these studies, the detailed site evaluation report was submitted to Atomic Energy Regulatory Board (AERB), who after a detailed review, accorded site clearance for Kudankulam site. The project financial sanction based on the Detailed Project Report (DPR) prepared was obtained in February 2001 and the work on the project was started after obtaining necessary clearances by following the due processes in place at that time.

**Exclusion Zone and Sterilized Zone**

According to the AERB code an area in the radius of 1.5 km, called *exclusion zone*, around the reactors is established, where no human habitation is permitted. This area forms the part of the project and is included in the land acquired. The AERB Code of Practice on Safety in Nuclear Power Plant Siting states:

*An exclusion area of appropriate size (at least 1.5 km radius from the reactor centre) shall be established around the reactor and entry to this is to be restricted to authorized personnel only.*
Thus the population falling within the exclusion zone, if any, is only resettled.

The sterilized zone is the annulus between the exclusion zone and an area up to 5 km from the plant. The AERB code states in this regard:

“A sterilised area up to 5 km around the plant shall be established by administrative measures where the growth of population will be restricted for effective implementation of emergency measures. Natural growth, however, is allowed in this zone”.

Thus, there is no displacement involved in the sterilized zone. In fact, there are no restrictions on natural growth of population in the sterilized zone. The administrative measures are put in place to ensure that there is no large increase in the population due to say setting up of an industry involving large labour force, etc.

3 Population Distribution

The AERB Code of Practice on Safety in Nuclear Power Plant Siting lays down desirable criteria for population for selection of a site as follows:

“Other desirable population distribution characteristics in plain terrain are:

i) Population centers greater than 10000 should not be within 10 km of the plant.

ii) The population density within a radius of 10 km of the plant should be less than 2/3 of the state average.

iii) There should be no population centres more than 100000 within 30 km from the plant.

iv) The total population in the sterilised area should be small, preferably less than 20000.”
It may be reiterated that these are only desirable criteria and are prescribed to enable easy emergency planning.

For the purpose of planning for serious accidents, if any, an area of 16 km around the plant is considered as the Emergency Planning Zone. The AERB Code of Practice on Safety in Nuclear Power Plant Siting states:

_During emergency, availability of transportation network means of communication, etc. which are of significance during emergency condition shall be checked. A radial distance of 16 km from the plant may be considered for this purpose._

It may be, however, noted that in the KK reactors design, many advanced safety features are deployed. These include the passive heat removal system (PHRS), which will ensure cooling of the fuel under the most stressed condition of non-availability of power supply and cooling water and further also there is the provision of core catcher to contain the molten material and the radioactivity within the reactor, even under the most severe accident resulting into the fuelmeltdown. Such and other safety provisions strengthen the plant such that the intervention in the public domain beyond exclusion zone will not be required even in case of a severe accident.

4 **Effect on Fishing**

Requirement of cooling water is not unique to nuclear power plants. The generation of electricity using heat in the form of steam from fossil fuels like coal, gas, oil, etc. involves condensing of steam in a power condenser, which requires cooling water. In a similar manner, the generation of electricity from nuclear source also uses steam and thus needs cooling water. Ships, submarines and motorboats also use the seawater for cooling their engines.
The cooling water temperature observed at the outlet of the power plant condenser is slightly higher than the ambient temperature of the water, which is, in fact, lowered at the discharge point by employing systems/engineering solutions so as to be within the limit stipulated by the Ministry of Environment & Forests (MoEF). The effect of this discharge water on the marine life has been studied extensively and validated.

Based on these thermo-ecological studies, Ministry of Environment & Forests (MoEF) has stipulated as follows:

Quote:

“The thermal power plants using sea water should adopt suitable system to reduce water temperature at the final discharge point so that the resultant rise in temperature of receiving water does not exceed 7°C over and above the ambient temperature of the receiving water bodies.”

Unquote:

The operation of nuclear power plants in the country at the coastal locations at TAPS, Tarapur in Maharashtra and MAPS at Kalapakkam in Tamil Nadu has also not shown any adverse effects on marine life including the fish.

At Department of Atomic Energy-Board of Research in Nuclear Sciences (DAE-BRNS) Thermo-ecology study was carried out at Kalpakkam and Kaiga stations with several experts from institutions like National Institute of Oceanography (NIO), Central Electro Chemical Research Institute (CECRI)
and several universities of the country. These studies have not found any adverse effect on marine ecology around the nuclear power plant sites.

Kudankulam nuclear power project cooling water system also provides for fish protection, which ensures fish are not sucked into the intake.

5. **Radiation in the Surrounding Area**

Utmost attention is given to safety of the environment and the public in all aspects of nuclear power from siting, design, construction, commissioning, and operation and up to decommissioning. The entire effort is to ensure that release of any radioactivity or radiation in the public domain affecting the public and the environment is minimized to be well within the prescribed regulatory limits. A principle of “As Low As Reasonably Achievable (ALARA)” is adopted in this regard. The radiation dose from nuclear power plants in operation in India has been found to be a negligible fraction of the naturally existing background radiation. The details are:
An Environmental Survey Laboratory (ESL) is set up at the site before the start of operation of the reactors, which collects data of several environmental matrices like air, water, soil, vegetation, crops, fish, meat, etc. It establishes a baseline. Subsequent to start of operation of the station, the ESL monitors the environmental matrices even beyond emergency planning zone of 16 km (usually up to 30 km of the site) for radioactivity (elements like Iodine-131/133 Strontium-90 etc) and radiation levels. The experience over the last 40 years has been that at such distances no significant increase in radiation levels above the baseline data is found at Indian nuclear power plant sites.

6. Assurance of Quality

The Assurance of Quality is accorded highest attention in all activities of nuclear power plants from design, construction, commissioning and operation. The construction works are carried out in accordance with a Quality Assurance Manual. The quality assurance plans in line with the manual are prepared for each activity. In respect of civil construction, the materials used are tested for every batch at the concrete testing laboratory at the site. The construction QA personnel inspect the works as per the QA plan and the works carried out after approval of the QA staff. The records of testing and inspections, which are extensive, are well documented. The regular reviews of the quality are carried out by internal audit teams within NPCIL.

The quality of construction of civil works and piping has been proven at Kudankulam. The reactor building containment has withstood the structural integrity and leak rate test at the test pressure, which is much higher than the design pressure. The pressure test of various piping systems and the hot run has also established the excellent quality of construction at the site.

7. Coastal Zone Regulation
The coastal zone regulations as applicable have been meticulously followed by NPCIL. In case of KK-1&2, the approval for CRZ was under the Prime Minister Office (PMO). Due diligence studies were carried out and clearance obtained. In respect of KK-3&4 CRZ clearance, the required data and information, as required by the expert appraisal committee of the MoEF, have been submitted.

8. Safety Features of KK-1&2

The Kudankulam project consists of two units of advanced model of Russian VVER-1000 MW Pressurised Water Reactor, which is a leading type of reactor worldwide. The design has been evolved from serial design of VVER plant, of which 15 units are under operation for last 25 years. These reactors fall in the category of advanced Light Water Reactors being developed by various West European countries and Japan. The salient safety features incorporated in plant at Kudankulam are:

- Passive heat removal system to provide cooling for removal of decay heat
- Higher redundancy for safety systems
- Double containment
- Larger numbers of control rods
- Additional shutdown systems for the reactor like second quick-acting shutdown system and quick boron-injection system
- Advanced instrumentation systems of advanced technology for Reactor Systems and Balance of Plant as well as for Plant Computer System

The design of KK reactors also incorporates features such as core catcher, Hydrogen management system to mitigate severe accident scenario as witnessed at Fukushima in Japan.
Safety review on setting up this project is carried out by AERB over and above the regulatory review carried out for these reactors in the Russian Federation.

The safety features of Kudankulam project have been comprehensively reviewed by a task force of NPCIL in the context of the recent Fukushima accident and it has been found that the safety features of the reactor are adequate to withstand such extreme natural events. The report of the task force is available on websites of NPCIL and DAE.

9. Seismic Considerations

Kudankulam site is located in the lowest seismic hazard zone of the country, Zone-II. The nearest epicenter of a recorded earthquake was located near Trivandrum, which is situated at a distance of 88 km north-northwest of the Kudankulam site, where two earthquakes corresponding to 4.3 magnitudes on Richter scale, were recorded. The Kudankulam site has a much lower seismic hazard when compared to Fukushima in Japan.
The Kudankulam plant buildings have been designed for much larger earthquakes. The structures, systems and equipment of plant are designed for an earthquake magnitude of 6.0 on Richter scale with a peak ground acceleration of 0.15 g. An evaluation of the plant based on allowable stress values of materials has indicated that it can withstand significantly higher peak ground acceleration (of up to 0.6g).

**Tsunami**

Kudankulam site is located far off (about 1500 km) from the tsunamigenic fault (where tsunamis originate). Thus a tsunami would take time and lose some of its energy by the time it strikes Kudankulam site.
As against this, the tsunamigenic fault was only about 130 km away at Fukushima.

The Kudankulam site was not affected by the 2004 Indian Ocean tsunami due to its design of higher finished floor level. The water level experienced at the site due to December 26, 2004 tsunami triggered by a 9.2 magnitude earthquake was 2.2 m above mean sea level.

There is also a shore protection wall and important buildings are located higher than the flood level arising out of tsunami, storm surge, wave run up and tides. The buildings housing emergency power supplies are located further higher.

The sketch below shows the levels of important buildings and the design flood levels
In addition to location at higher elevations, all the safety related buildings are closed with double gasket leak-tight doors. Hence, water entry into these buildings is extremely remote even in case of sea water level surge reaching upto their elevations.

These aspects have been comprehensively reviewed by a task force of NPCIL in the context of the recent Fukushima accident. The report of the task force is available on websites of NPCIL and DAE.

10. Cost of the Project
The approved cost of the project is Rs. 13171 crore. The expenditure figures are submitted to the various monitoring agencies of the project like DAE, MOSPI and Parliamentary Committees and are thus in the public domain.

The tariff of electricity generated by the project will be competitive with other sources in the region and expected to be around Rs 2.50 per unit.

12. CSR Activities

With an objective of inclusive growth of the surrounding population and community development in the neighboring villages around the Kudankulam project, through well-structured CSR programs, NPCIL has taken several initiatives:

**Infrastructure Development:**

Some of these initiatives include, construction of class room buildings, compound Walls of schools, providing the drinking water facilities like bore wells with pump & low level Sintex water tanks, water pipeline scheme for providing water from Rukandurai village to Panchal village (about 3.5 km), providing computers with accessories to a large number of village schools/Panchayat Offices, providing fire extinguishers to schools, providing electrification and tiled flooring to the Mercy Home for Disabled persons, providing solar street lights and sodium street lights to the villages, construction of Lavatory for the use of schoolchildren, construction of two bus shelters at Perumanal & Kuttapuli Village, providing furniture & other items for the community hall constructed by the Panchayat Union, improvement of building for mentally retarded children and Panchayat Office building in Chettikulam Panchayat, etc.

About 17.6 km of road leading from Levinchipuram to Kudankulam was also developed by NPCIL.

**Health Care:**
Several medical Camps have been organized in the surrounding villages. Hepatitis 'B' Vaccine was administered to the school/village children, hearing aids to the schools for hearing-impaired have also been provided.

**Education Support:**

Provided laboratory items at Govt. Higher Secondary School, Kudankulam, ceiling fans to Govt. Higher Sec. School, Chettikulam, and provided uniforms to School Children.

A Talent Nurture Program to provide quality education to the bright and talented children of the rural/ economically backward class living in the vicinity of KKNPP has been instituted. Atomic Energy Education Society (AEES) has offered to admit the students from the nearby areas. Under this programme, economically backward children from the neighbouring villages with rural background will be selected based on merit for admission to Standard - I in AEC School, Anuvijay Township.

**Support to Community at Coastal Villages:**

Tsunami Relief Activities were carried out in the year 2004-05 in the nearby coastal villages such as Idinthakarai, Perumanal, Kuthenkuzhi and Kutapuzhi such as distribution of Dress Materials, Bed Sheets, Biscuits, Sugar, Milk Powders, Food Pockets, Soaps and Garments, Mobilization of Local to safe places & financial assistance to Purchase of Land for Re-Construction of Houses.

The neighbourhood welfare activities are continuing and will be further enhanced in future in line with the objective of inclusive growth.

**12. Public Awareness Activities**
A public awareness programme regarding various safety features of Kudankulam Nuclear Power Project to the nearby villages was started in the early 1990s. Many schools and colleges have been visited by KKNPP officials and explained the various features of the Kudankulam Project.

In addition, around 200 villagers from the nearby villages like Kudankulam, Chettikulam, Idinthakarai, Vijayapathy, Erukkanthurai villages, etc., were taken to Madras Atomic Power Station, Kalpakkam, to have a realistic understanding of the benefits of the Nuclear Power Station, followed by interaction with MS Swaminathan Foundation on Marine Life.

Since the project started in 2001, the Public Awareness Campaign has been taken up in an elaborate way. The details are enclosed at annexure-1.
Brief details of Publication Awareness and Communications Initiatives

Press and Media Relations:

- In 2001, two Journalists Workshops were conducted for around 150 Journalists and Media Personnel from Tirunelveli and Kanyakumari Districts.

- Organised an interactive workshop for Journalists at Tirunelveli followed by site visit to KKNPP on December 2007. About 50 journalists, both print and electronic media, including state-owned press like PIB and AIR have participated.

- Regular interaction with the local/national press and media persons.

Public Communication:

- Technical Debate with Nature Trust Members at Nagercoil with participation of more than 100 professionals including students. It was organized by one Mr. Lal Mohan, who is one of the anti-nuke activists in Nagercoil.

- A Fishermen Workshop at Vallioor was arranged in coordination with Rotary Club, Vallioor in the year 2001, wherein fishermen from Idinthakarai, Vijayapathy, Perumanal, Kuttapuli, Kuthenkuzhi, Thomayarpuram etc., have taken part.

- In the year 2002, a Public Awareness Seminar was conducted at Radhapuram Panchayat Union Office wherein the Panchayat Union Chairman/Vice-Chairman, Block Development Officer (BDO), Panchayat Presidents and Union Councillors from Radhapuram Panchayat Union have participated.

- Around 45 Village Representatives, including Panchayat Union Chairman, Vice-Chairman, Village Presidents, Councilors and other members have
been taken to RAPS on Nuclear Plant familiarization programme in the year 2002, followed by the second batch of 30 people, including District Chairman, Tirunelveli District, Panchayat Union Chairman/Vice-Chairman, Village Presidents and Councilors from Radhapuram and Vallioor Panchayat Unions were taken to Rajasthan Atomic Power Station (RAPS) in 2005.

- Around 2000 nos. of Villagers/School children from the nearby villages like Chettikulam, Kudankulam, Idinthakarai, Erulkandurai, Perumanal, Kuttapuli Radhapuram villages etc., have been brought to site either for a site visit followed with the Public Awareness Programme or on an interactive programme to understand the welfare requirement and creating awareness at various stages of the Project.

- A presentation and detailed discussion was arranged with the Arch Bishop of Tuticorin and the Diocese team along with the Priest/Father of Coastal Villages around 30 visitors such as Idinthakarai, Perumanal, Kuttapuli, Kuthenkuzhi, Thomayarpuram, Ovari etc. During this meeting they have been explained about various safety features of the project and taken them to the site and clarified various doubts to their satisfaction.

- A discussion and Site Visit was also arranged in the year 2007 with the Anti Nuclear Activists like Shri S.P. Udayakumar, Shri Lal Mohan etc. They have been explained in detail about the various advanced safety features incorporated taking care of the post Chernobyl requirement and the tsunami events.

- The Project has allowed 350 students from various Universities to undertake the In-Plant Training/Project Work as a part of the Public Awareness Programme with main focus to give a detailed brief about the art of technology and the safety aspects of the Nuclear Power Plants.

- The officers at various levels have visited the various colleges (about 20) in Tirunelveli, Nagercoil, Tuticorin and Madurai Districts with an intention give brief about the salient features and safety aspects of KKNPP.

- A permanent Exhibition Hall has been set up at District Science Centre, Tirunelveli as a part of Public Awareness Programme.
• Around 500 Tirunelveli District Officials from various Departments like Revenue, Health, Fisheries, Agriculture, Animal Husbandry, Forest, Electricity Board, Transport, Irrigation and Fire and Rescue Personnel etc., have been given Public Awareness Programme and Emergency Preparedness Training Programme in the year 2011.

• A Self Help Group (SHG) and a local body of around 100 people have been trained on Public Awareness Programme.

Publications:

• A comprehensive booklet “From Volga to Ganga, the story of Kudankulam” has been published to highlight technical and general aspects of KKNPP
• A publication “Metamorphosis – the changing skyline of Kudankulam” has been made based on the CSR activities done by the KKNPP management.
• Published “Thiruvallar Muthu – Story of a Prosperous Village” in Tamil to clear the apprehensions of village people.
• Published several technical articles in Nu-Power and other journals about KKNPP.

Multimedia/Short Film:

• Produced an infotainment film “Thiruvallar Muthu” in Tamil using animated and cartoon characters to provide true picture of radiation and other aspects of nuclear power for general public, particularly pre-literate.
• Produced a short film (English) on the bio-diversity richness of Indian nuclear power plants, including KKNPP.

‘Environmental Stewardship Programme”:

NPCIL has taken up a voluntary programme, ‘Environmental Stewardship Programme (ESP)” for the study of flora and fauna in and around the exclusive zones of Indian nuclear power stations. Under the ESP, a nature club “Pelican Nature Club” has been formed at KK site to carry out the nature conservation activities regularly. Following are some of the activities carried out at KKNPP:
• A workshop on nature conservation has been conducted at KKNPP during September 25 – 27, 2006. About 60 persons including forest department officials, college students and professors, local NGO members, volunteers of KKNPP, etc.

• A survey of wetlands and water birds has been conducted during February 2008 and September 2011 in and around KKNPP to study wetlands and wetland birds.

• The volunteers of Pelican Nature Club have been regularly monitoring the birds and its habitats in and around KKNPP.

• Published several articles in Nu-Power and other journals about the environment of KKNPP.
### List of Statutory Clearances of Kudankulam Nuclear Power Project Unit-1&2

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