

# **Whether Ordinance on Self-Denial of Nuclear Power Harmful To India?**

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On May 16, 2012, the Indian Parliament in New Delhi looked for lessons in the nuclear crisis created from the March 11, 2011 earthquake and tsunami effect on the Fukushima Daiichi nuclear power plant in Japan.

A question was raised by a Member of the Parliament Mr. Anant Geete of Shiv Sena (regional political party from Maharashtra State) whether India would do a re-think on nuclear power in the post-Fukushima scenario in which Germany and Japan have announced that they would give up atomic energy.

Indian Prime Minister Dr. Manmohan Singh who holds direct charge of the Department of Atomic Energy (DAE) of the Central Government answered the question inside the Parliament on May 16, 2012, during the Question Hour in Lok Sabha, the Lower House of the Indian Parliament.

In his reply, Dr. Manmohan Singh asserted, "*it would be harmful for the country's interest to pass an ordinance in the self-denial that we shall give up the option of having nuclear power,*" [1]. Pre or Post Fukushima, there has never been an informed debate in the Indian Parliament on the pros and cons of investing heavily on nuclear electricity.

The assertion of the Indian Prime Minister inside the Parliament that an Ordinance on denial of nuclear power is harmful to India calls for an informed debate inside and outside the parliament. The discussion here is to help in taking forward such a debate and as a guide to the Members of Indian Parliament and Indian Public.

## **What Kind of Harm?**

What kind of harm would come to India if India gives up its pursuit of nuclear electricity? Prime Minister Dr. Manmohan Singh did not spell out the type and extent of harm that would come upon India if India like Germany makes a policy decision to give up the pursuit of nuclear electricity and fixes a timeframe for phasing out all its nuclear reactors.

The truth is, India would reap enormous harm not by giving up further investment in nuclear power plants but by climbing more on the curve of nuclear power growth. It is so because the huge investment for nuclear electricity would starve funds for other sources of power – hydro, solar, wind, bio and for energy saving schemes. India has to adopt its own energy policy based on its natural resources.

It is not easy for the Members of Parliament as well as the Indian Public to realise that the debate on nuclear matters in India proceeds from premises which are as real and true as the water in an entrancing mirage. Therefore, any debate on the need or otherwise of nuclear electricity in India requires firstly the clearing of some prevailing misconceptions and secondly a clear understanding of the factors that would ensure the energy security of India.

One weighty misconception is, nuclear power plants are needed to make nuclear weapons. This misconception is helping the self-serving senior scientists of the Department of Atomic Energy (DAE) to push all the mismanagement in DAE under the carpet by invoking national security.

The plutonium that was used in Pokhran-I (1974) and Pokhran-II (1998) nuclear tests conducted by India was derived not from nuclear power reactors but from Research Reactors. But the scientists of DAE filed affidavits in Public Interest Petitions WP Nos. 1785/96 & 1792/96 before Bombay High Court and made the High Court believe that the nuclear power plants are needed to make nuclear weapons. Believing thus, the High Court declined to pass orders for the disclosure of the 90 nuclear issues listed by the Atomic Energy Regulatory Board (AERB) in

its Report prepared in November 1995 under the Chairmanship of the then Chairman of AERB Dr.A.Gopalakrishnan.

The argument that the nuclear power plants are in the civilian sector and not in the defence sector and therefore the disclosure of the issues in the nuclear power plants is necessary under the International Convention on Nuclear Safety signed by India, also did not cut ice with the High Court because the High Court was made to believe that there is an intricate intersection between the technology involved in nuclear power plants and nuclear weapons. However, the High Court was kind enough to record in its speaking orders, *"Merely because we have rejected the claim of the petitioners to have access to the AERB Report, it does not mean that we have concluded that no information for all times need be disclosed by AERB and/or the AEC (Atomic Energy Commission) or the Government of India in respect of the safety aspects of the Nuclear Power Plants. The doors of the Court are always open if the situation so warrants in a proper case."*

Another misconception firmly lodged in the minds of Indian politicians in power is - all is well with the DAE and the competency of DAE is of world class. There are three factors which caused and sustained this blind belief.

First factor is the composition and powers of Atomic Energy Commission (AEC) as the highest policy making body on nuclear matters in the country. The very senior scientists whose performance is to be adjudged by the AEC are the persons who head and man the AEC. There is little scope for the policies of the Central Government in nuclear matters to be different from what the senior scientists of DAE desire them to be. There is little scope to judge objectively the performance of DAE.

Second factor is the legacy coming from the days of Homi Bhabha and Prime Minister Jawaharlal Nehru wherein the Secretary to the Department of Atomic Energy of the Central Government and Chairman of AEC is one and the same person. With such an arrangement where one person holds two important key posts and wields enormous powers to appraise and advise the Central Government in nuclear matters, only those ideas and concepts which are conducive to serve the self-interests of the top nuclear scientists would be welcomed and others would be prevented from receiving consideration by the concerned quarters of the Central Government.

These first and second factors were responsible for misleading the then Prime Minister Shri. Atal Behari Vajpayee as well as the Indian nation to believe that the first hydrogen bomb test of India in 1998 was a success even though it was fully known to be a failure. The top brass of the Department of Atomic Energy (DAE) including the then Chairman AEC & Secretary DAE Dr.R.Chidambaram and also the Head of the Defence Research and Development Organisation (DRDO) Dr. A.P.J. Abdul Kalam knew the hydrogen bomb test failed. But systematically and repeatedly they both had claimed that the hydrogen bomb test was a success. A thorough examination of this failure would show the need for injecting new blood into DAE and DRDO.

This writer was the first person to do mathematical calculations based on the seismic recordings in Pokhran-II and to conclude that the first hydrogen bomb test was a failure. His findings were reported in The Hindu in its nation page on May 20, 1998. Thereafter, in June 1998, the Frontline carried a cover story by this writer giving more details on the failure of hydrogen bomb test. The cover story was titled, "H-Bomb issue is crucial". Based on these two articles in The Hindu and Frontline, there were questions in the Parliament on the claims made about the first Hydrogen Bomb Test of India.

The then Minister of State for External Affairs, Ms. Vasundhara Raje, referred to this writer's name and told the Lok Sabha, *"the scientist Dr B.K. Subbarao, had based his claim [that there was no success of hydrogen bomb test] on his interpretation of the seismic data issued by India and foreign seismic stations and the conclusion drawn by the scientist that the Pokhran*

*nuclear tests did not comprise a hydrogen bomb was erroneous and it was not possible to determine the nature of an explosive device by looking into seismic data.*" (PTI news item in *The Hindu*, dated July 27, 1998). The Minister missed the point in that the search from calculations based on the seismic data was for the yield of the Pokhran-II nuclear test and the search showed that the total yield was very much less than the yield claimed for the Hydrogen Bomb (Thermo nuclear device).

Minister Vasundhara Raje also stated in the Parliament that the scientists of DAE and DRDO rigged Instruments at the Pokhran-II site and the recordings of those instruments showed that the Hydrogen Bomb Test succeeded.

However, eleven years after Pokhran-II, Dr.K.Santhanam a senior scientist of DRDO and Project Leader of the Pokhran-II nuclear tests of 1998, who had rigged those Instruments at the test site in 1998 revealed in 2009 that the thermonuclear test (hydrogen bomb test) of 1998 was a "fizzle".[1a].

Dr.Santhanam's version in detail was carried by the media where referring to the shaft into which the hydrogen bomb device was lowered he had clearly stated, "*shaft remained totally undamaged.*" [1aa]. It confirmed that the Hydrogen Bomb Test was a failure. It also confirmed that Dr.R.Chidambaram and Dr.Abdul Kalam misled the then Prime Minister Atal Bihari Vajpayee and the Parliament and also misled the nation. Both these scientists climbed well in their careers based on their make believe achievements. It has been possible only because of the two factors mentioned above.

The third factor is once again the legacy coming from the time of Prime Minister Nehru, whereby the DAE has been under the direct charge of the successive Prime Ministers. With the type of decision making process coupled with the secrecy surrounding the DAE, there has been all along a question mark. What kind of nexus could develop when the Prime Minister holds direct charge of the Department of Atomic Energy (DAE) and a senior atomic scientist commencing with Dr.Homi Bhabha functions as the Chairman of Atomic Energy Commission (AEC) the highest policy making body in the atomic field and also works as the Secretary DAE of the Central Government?. Only in the aftermath of the Indo-US nuclear deal jointly signed by US President G.W.Bush and Indian Prime Minister Dr.Manmohan Singh some things came to surface to reveal the way the Prime Minister could use the Chairman AEC and the way the Chairman AEC also could use the Prime Minister for their mutual benefit. Prime Minister Dr. Manmohan Singh was keen to accommodate the wishes of President Bush to promote nuclear power business in India and Chairman AEC & Secretary DAE Dr. Anil Kakodkar for self-promotion was ready to fall in line even though in the beginning he was not in favour of the Indo-US nuclear deal.

The real strain to the nation from this third factor whereby the Prime Minister holds direct charge of DAE can be noticed from what Anil Kakodkar told Marathi daily Sakaal (January 5, 2011), "*We also have to keep in mind the commercial interests of foreign countries and of the companies there ... America, Russia and France were the countries that we made mediators in these efforts to lift sanctions, and hence, for the nurturing of their business interests, we made deals with them for nuclear projects.*"

This statement of Anil Kakodkar has several revelations. Mediocre scientists who climbed career ladders in DAE by cultivating the politicians in power cannot deliver results without foreign collaborations. But sanctions come in the way of foreign collaborations. To help India to get rid of the controls and sanctions, some countries including America, Russia and France wanted their pound of flesh in the form of sale of their nuclear reactors to India. With their respective positions of power, the self-serving Manmohan Singh and Anil Kakodkar joined hands to formally position the Indo-US nuclear deal and to cause India to sign deals for nuclear projects. A great deal of media spin is created to show all these foreign collaborations for nuclear projects are necessary to improve the energy security of India.

It shows conclusively that the deals for the nuclear power parks like the proposed nuclear power park at Jaitapur in Maharashtra from France, and the proposed nuclear power park at Kovvada in Andhra Pradesh from the United States and the proposed four more reactors at Koodankulam in Tamilnadu from Russia and such other nuclear power plants elsewhere in India are all as a consequence of the compulsion to sign nuclear power plant deals with those countries for getting the sanctions lifted and not because India needs those nuclear power plants. Therefore, to say that those nuclear power plants are needed to achieve energy security for India is a deliberate attempt to mislead the Indian Parliament and Indian Nation.

Thus it is clear, Prime Minister Dr.Manmohan Singh misinformed and misrepresented to the Parliament on May 16, 2012 and caused ill-founded fear in the minds of the Members of Parliament that there would be harm for the country by giving up the pursuit of nuclear electricity. It appears, he is more keen in preventing the Indo-US nuclear deal from falling into disrepute with an ordinance on denial of nuclear power than positioning limited funds of India for the alternate sources of renewable energy like hydro, solar, wind, biofuels, etc., and for energy saving measures. He did all that only with an idea to save the Indo-US nuclear deal, knowing fully well that the interests of the nation will be gravely affected from the consequences of the Indo-US nuclear deal. [1b].

If there has been benefit to the nation by investigating into the 2G scam which purportedly involves rupees over one lakh crore, there is a bigger benefit to the nation if investigation into the Indo-US nuclear deal could be carried out since it has rendered the nation helpless and placed it on a path to commit more than rupees 5.5 lakh crores for deals with foreign countries to install nuclear power plants at Jaitapur in Maharashtra, Kovvada in Andhra Pradesh, Haripur in West Bengal, Mithi Viridi (or Chayamithi Viridi) in Gujarat, Kumharia or Gorakhpur in Haryana, Bargi or Chuttka in Madhya Pradesh, Markandi (Pati Sonapur) in Orissa and also four more additional nuclear plants at Koodankulam in Tamil Nadu from Russia.

### **Completely Safe?**

People of India hear repeatedly from the Prime Minister who holds direct charge of the Department of Atomic Energy (DAE) and from the nuclear scientists of DAE that the nuclear power plants in India are completely safe and there are no accidents in the long years of operation of those plants right from the late sixties.

Majority of the Indian people do not have time and expertise to subject such routine assurances on nuclear safety to critical examination. The media in India, print and electronic, is yet to gain in the nuclear field the type of investigative skills it has been displaying in other areas of public interest including corruption matters.

Consequently, the DAE and its primary research establishment Bhabha Atomic Research Centre (BARC) have grown layers upon layers of complacency and intellectual dishonesty took roots. Politics and science became indistinguishable. It is difficult to know whether the Prime Minister is a pawn or a King in the decision making in nuclear matters.

Post Fukushima, when opportunity came to the Members of Parliament to know the type of safety in our nuclear installations and to debate on it, Prime Minister Dr.Manmohan Singh assured the Parliament, on May 16, 2012, "*We have 19 functional reactors and there has never been any accident. After Fukushima, I ordered a complete revisit to all the reactors and those reports are on the [Nuclear Power Corporation of India Limited \(NPCIL\) website.](#)" [1]. Thereby, the Prime Minister lulled the Members of Parliament and the nation to believe that the nuclear safety in our country is sound and secure. However, the truth is different.*

Examination of nuclear safety is on two counts. First is about the radiation pollution in the environment and its impact on all living forms due to periodic nuclear discharges from normal operation of nuclear installations. Second is about the accidents in the nuclear installations and consequences thereof. On both these counts, Prime Minister Manmohan Singh avoided informing the Parliament fully and faithfully.

There are admitted facts, admitted by DAE about the radiation pollution in the environment which remained undisclosed to the public due to fear of public reaction.

Then there were accidents in our nuclear installations and the Reports rendered by formally constituted Committees to investigate into those accidents are kept away from public access.

The oath of office taken by the Prime Minister requires him to discharge his Constitutional duty to inform the Parliament fully and faithfully. From the contents of his reply in the Parliament on May 16, 2012, it is possible to say, Prime Minister Dr. Manmohan Singh failed in his Constitutional duty.

The Members of Parliament should drop their respective Party Shackles and examine the facts in national interest and discuss threadbare the nuclear safety issues inside and outside Parliament. Only then, our long written Constitution will have meaning.

Discussed below are some of the facts which the Prime Minister was required to consider but failed to consider while replying to Questions in the Parliament on the desirability of continued investment on nuclear electricity and that too while the reverberations of Fukushima are still rocking the world.

The oft- witnessed habit of the Indian Nuclear Establishment to push every serious issue under the carpet has generated anxiety in the minds of the Indian people. Public Interest Petitions have been filed before higher Courts seeking independent examination of the radiation levels in and around all the existing nuclear installations, reprocessing units, fuel fabrication units and uranium mining and processing areas, to know the levels of radiation in the soil, vegetation, air, waters and underground water table.

Regarding nuclear power plants next to the sea like in Tarapur on the west coast and Kalpakkam on the east coast, the anxious Public has been seeking independent examination of the temperature of water at discharge points while in full power operation, and independent examination for radiation levels in sea weeds, marine growth and marine plants and in the fish and marine organisms and in the soil on the shore.

The insistence on independent examination became necessary because the Atomic Energy Regulatory Board (AERB) for various reasons failed to inspire public confidence in acting like an effective watchdog in nuclear safety matters. One such Public Interest Petition is about Thane Creek.

#### **(i) Contamination in Thane Creek**

Geographically, Bhabha Atomic Research Centre (BARC) is located on the eastern suburb of Mumbai on the west bank of Thane Creek which has a geological fault line. There are three major fault- lines around Mumbai. They lie under the Thane, Panvel and Dharamtar Creeks. Mumbai falls in Seismic Risk Zone III. It can experience earthquakes measuring up to 6.5 on the Richter Scale. After Tsunami hit the east coast of India in December 2004, a WRIT PETITION (Public Interest) No. 647 of 2005 was filed before Bombay High Court by 'Citizens For A Just Society', social organization founded by Dr.Usha Mehta, noted Gandhian, Freedom Fighter and Padma Vibhushan. This writer appeared before Bombay High Court and argued for the Petitioners. The Petition raised two issues.

First issue is about the geographical position of Bhabha Atomic Research Centre (BARC), which has been officially declared in 2000 to be India's nuclear weapon making establishment, more specifically termed, "strategic application

centre". BARC is located on the edge of a confirmed fault line in Thane Creek in a notified seismic zone III and that too in the thickly populated area of Mumbai. A serious nuclear accident at BARC will have grave consequences for Mumbai, the commercial capital of India. In all other countries, nuclear weapon making venture is located away from thickly populated areas. The Writ Petition sought shifting of the nuclear weapon making venture from BARC to a suitable remote location.

The second issue is about the nuclear discharges into the Thane Creek from activities inside BARC. For over forty years, nuclear effluents are being discharged into Thane Creek from research reactors and reprocessing units and such other related operations at BARC. There is the possibility of nuclear contamination of Thane Creek similar to the contamination of Lake Ontario in Canada where from the regular discharges of nuclear plants into the lake over the years, the waters in the lake, the lake bed and fish in the waters and the soil around have been found contaminated. Due warning signals have been erected and issued in respect of Lake Ontario in Canada. But there are no such warning signals in respect of Thane Creek in Mumbai, India and no information to the public on the radiation levels in Thane Creek.

After officially declaring it as a nuclear weapon making establishment in 2000, the Bhabha Atomic Research Centre (BARC) has been taken out of the regulatory control of Atomic Energy Regulatory Board (AERB). The Writ Petition sought an independent examination of the Thane Creek to know the radiation levels in the waters, bed and shores and also in the fish and marine organisms in the waters.

In their affidavits-in-reply, the nuclear scientists of DAE and BARC admitted before the Bombay High Court that there is radiation in the fish and marine organisms in Thane Creek but declined to disclose the levels of radiation. The affidavit stated that the radiation levels are not disclosed in public interest. To prevent the High Court from passing any orders to disclose the radiation levels in the fish and marine organisms and also to prevent any knowledgeable person from estimating the radiation levels from the officially monitored data on effluent discharges, the nuclear scientists in their affidavit further stated, very cleverly, *"It is submitted that the activities in BARC, being strategic in nature, detailed data on the effluent discharges cannot be made public."* (W.P. No. 647 of 2005, Citizens For A Just Society . vs. Union Of India, Order dated 28 April, 2005, paragraph 24, of Bombay High Court.) [2]

The Bombay High Court in its order dated 28 April 2005 in WP No.647 of 2005, recorded, *"Undoubtedly, this petition raises issues of public health, environment and safety. This petition also raises questions which are extremely important from the point of view of national security. But at the same time, the matter is extremely sensitive and it is difficult to comprehend what could be the repercussion and ramification of the disclosure of such vital information. Security of the nation has to be of paramount importance. There cannot be any compromise on that."* (W.P. No. 647 of 2005, Citizens For A Just Society . vs. Union Of India, Order dated 28 April, 2005, paragraph 40, of Bombay High Court.) [2]

Aiming at the respondents (Central Government, DAE, BARC, AERB and others), the Bombay High Court recorded, *"We hope and trust that the material which has been made available by the petitioners would be looked into by the respondents very carefully and we have no doubt that the respondents would take all necessary steps which are imperative to be taken in connection with the safety of the people, interests of the nation and environment. The litigation may provide a further opportunity of introspection for both the Atomic Energy Commission and Bhabha Atomic Research Centre to once again have the general overview of its safety measures and impact on environment. We advise the petitioners and such other enlightened people to approach these organisations*

*directly instead of filing petitions.” (W.P. No. 647 of 2005, Citizens For A Just Society . vs. Union Of India, Order dated 28 April, 2005, paragraph 42, of Bombay High Court.). [2]*

The Bombay High Court disposed of the Writ Petitions with its view, “43. In our considered view, no further directions are necessary. This petition is accordingly disposed of. In the facts and circumstances of the case, we direct the parties to bear their own costs.” (W.P. No. 647 of 2005, Citizens For A Just Society . vs. Union Of India, Order dated 28 April, 2005, paragraph 43, of Bombay High Court.). [2]

The hope, trust and belief of Bombay High Court, “*We hope and trust ... we have no doubt that the respondents would take all necessary steps which are imperative to be taken in connection with the safety of the people, interests of the nation and environment.*”, remained as an earnest hope of the Bombay High Court, with no meaningful steps by the Authorities concerned to measure up to the hope, trust and belief of the Bombay High Court.

The Atomic Energy Commission and Bhabha Atomic Research Centre have not done any “*introspection*” as expected by the Bombay High Court to “*once again have the general overview of its safety measures and impact on environment.*”

Therefore, the assurance given by Prime Minister Dr. Manmohan Singh to the Parliament on My 16, 2012 regarding nuclear safety in India lacks credibility.

Members of Parliament as well as Indian Public should notice that the nuclear radiation problems persisting at Thane Creek in Mumbai and the existence of nuclear radiation in the fish and marine organisms in Thane Creek admitted by the nuclear scientists of DAE and BARC in their affidavits before Bombay High Court are not isolated matters. Such problems are present in one form or the other, in- and-around all nuclear installations in India, including Tarapur in Maharashtra, Rawatbhata in Rajasthan, Kalpakam in Tamilnadu, Naraora in Uttar Pradesh, Kakrapar in Gujarat, Kaiga in Karnataka, Nuclear Fuel Complex (NFC) in Hyderabad in Andhra Pradesh and Uranium Mining Fields at Jaduguda in Jharkhand and other places in India. But the DAE and the Central Government have not been informing the public fully and properly. It raises serious questions about the desirability of investing further in nuclear electricity.

## **(ii) Harm from nuclear radiation in normal operation**

Regarding nuclear radiation effects from normal operation of nuclear reactors, the Indian public has a difficult task to choose from two mutually contradictory versions, one is the official version of the nuclear establishment and the other is the version of experts from outside the establishment.

The establishment version is that the levels of radiation around the nuclear power plants in India are only negligibly higher than background radiation, and produce no major ill effects. The establishment version also takes the stand that the epidemiological surveys have found no rise in cancer morbidity, birth defects or other ailments among plant employees, compared to residents of areas far from plants. So far there is no authoritative document on radiation-linked health incidents to support the version of the establishment. To fill this vacuum, the Department of Atomic Energy (DAE) and the Nuclear Power Corporation of India Ltd. (NPCIL) have recently (May 2012) commissioned Tata Memorial Centre (located in Mumbai) to study and prepare India’s first authoritative document on radiation-linked health incidents, in a “Mega study to track cancer around n-plants” [3]

Whereas the version of the experts from outside the establishment has some support in the scientific study carried out by some qualified persons regarding the nuclear radiation effects from the normal operation of nuclear installations.

The study by Dr Manjula Datta (funded by DAE) shows that the number of people in proximity to Kalpakkam nuclear facilities in Tamilnadu, southern India, suffering from cancer is a cause of concern. The report states that cancer cases in villages close to Kalpakkam are seven times higher (210 per 1 lakh people) compared to just (30 per 1 lakh people) in distant villages. Morbidity levels in areas near the nuclear reactor are 2-3 times higher than normal. The study covered 22 proximate villages (within 8km radius) and three distant villages (50km from the reactor site). This report was not made public. [3a]

Another study conducted by Dr. Pugazhendhi et. al. showed that auto immune thyroid disease among women living in up to 40kms from the Kalpakkam site was significantly higher than those living 500kms away. In another study conducted by same doctor in 2003 among employees and family members had shown that the death rate due to Multiple Myeloma (A bone marrow cancer) is statistically significant. [3b]

The Department of Atomic Energy treats the studies by Dr Manjula Datta and Dr. Pugazhendhi et. al. as private studies lacking official stamp.

However, after being in denial for years, the Department of Atomic Energy (DAE) has for the first time admitted in October 2011 that the deaths of its employees at the Kalpakkam nuclear site and their dependents were because of multiple myeloma, a rare form of bone marrow cancer linked to nuclear radiation. [3a]

Though the Department of Atomic Energy (DAE) of India awaits report from its officially commissioned "Mega study to track cancer around n-plants" in India [3] there is a research study in France recently published with its finding that Children living near nuclear power plants are noticed having increased rates of leukemia (blood cancer). [4].

Renowned French research institute, Institut National de la Sante et de la Recherche Medicale (French Institute of Health and Medical Research, or INSERM) published a study in January 2012 in the International Journal of Cancer, which notes increased rates of leukemia in children living close to French nuclear power plants (NPPs.).

The study found a leukemia rate twice as high among children under the age of 15 living within a 3.1-mile radius of France's 19 nuclear power plants.

The research report builds upon the findings of a German study published in late 2007 studying German children under 5 years old, which found that children of that age in the vicinity of German NPPs had suffered an increase in the incidence of childhood leukemia.

The research article in the International Journal of Cancer, titled "Childhood leukemia around French nuclear power plants – the Geocap study, 2002 – 2007," is online in English at: [4]

The research article and the findings thereof on Childhood leukemia around French nuclear power plants have ominous implications for the future of the nuclear industry in France, which opted for a full-blown nuclear energy program with minimal public debate after the first oil crisis in 1974 and whose 19 NPPs' 58 reactors now provide more than 78 percent of the country's electricity.

In a poll conducted post-Fukushima by *Journal du Dimanche*, 77% of French people said that they would like to see nuclear phased out. Despite the best propaganda efforts of the French nuclear industry, it appears the French are not convinced. Their trust in the nuclear industry and the government departments so closely associated with it was already badly eroded 25 years ago in the aftermath of the accident at Chernobyl." [5 ]

With a world-leading 78 percent of its electricity coming from nuclear power, newly elected President François Hollande of France has said he intends to reduce this share to roughly 50 percent by 2025. This is a pointer to the looming decline of nuclear power.



In the mean time, the Indian people are not only denied the disclosure of admitted facts about the levels of nuclear radiation in places such as Thane Creek, but also have to cope-up with a determined Prime Minister Dr.Manmohan Singh who is keen to turn India into a market place for nuclear power reactors. Knowing fully well that the nuclear electricity in India is less than 3% of the total energy generated, Dr.Manmohan Singh misinformed, misguided and misdirected the Indian Parliament on May 16, 2012 that harm would descend upon India if India passes an ordinance to phase out nuclear power.

Prior to the Fukushima crisis, Japan had 54 reactors providing close to 30% of its electricity, with plans to increase this share to more than 50% by 2030. Now all the 54 reactors are closed down, though there is a talk to restart a few of them to get over the power shortage in summer. Even if the reactors are started, the Japanese government have stated, power from nuclear energy will be reduced to 15% or from about 40GW to 20GW.

Thus it can be seen, the leaders of France have plans to reduce dependency on nuclear electricity from 78% to 50% by 2025. Japan which had during pre-Fukushima about 30% of its electricity from nuclear is also having plans to reduce the dependency from 30% to 15% with eventual phase out perhaps like Germany. Therefore, India trying to invest on nuclear electricity to go up from the present level of less than 3% cannot be said to be a prudent energy policy, while its enormous hydro, solar and wind potential remain untapped. In the last week of May 2012, there were reports that the German solar power plants produced a world record 22 gigawatts of electricity – equal to 20 nuclear power stations at full capacity. [5a]

Of course, the most dramatic shift in nuclear energy policy following Fukushima occurred in Germany. Within days of the disaster, Chancellor Angela Merkel announced that Germany's seven oldest reactors, all built before 1980, would shut down immediately. And in May 2011, the German government declared that by 2022 Germany would phase out nuclear entirely.

Just before Germany's phase out decision, Switzerland abandoned plans for three new reactors that were going through the approval process. Some 40 percent of electricity in Switzerland comes from five nuclear reactors. The Swiss government announced that all five of the country's reactors will close permanently as their operating licenses expire over the next 22 years.

Italy, though discontinued its nuclear program after the 1986 Chernobyl nuclear disaster, had in fact decided in 2010 to restart it. But in a June 2011 referendum, more than 90 percent of Italian voters chose to say no to nuclear power.

However much the nuclear industry may attempt to win the support of the people for nuclear electricity, the people in several countries are determined to convey to their governments that the reliance on nuclear power is dangerous to the present and future generations and no public relations exercise can mitigate the opposition to nuclear electricity.

### **Is it a mere public relations exercise?**

The new Chairman of the Atomic Energy Commission (AEC) of India and Secretary, Department of Atomic Energy (DAE), Dr. Ratan Kumar Sinha, who has been elevated to his new office on April 30, 2012, appears to believe like all his predecessors that allaying the fears of nuclear radiation is a only a public relations exercise.

Dr Sinha, upon assuming the charge from Dr Srikumar Banerjee, counts as his first priority the removal of "an irrational fear of radiation in the public mind". Dr.Sinha is committing the very same blunder that his predecessors had committed, to term the fear of radiation in public mind as irrational. Internet has been playing a great role to increase the information content to the people on the safety and economics of nuclear power plants. To call their informed opposition to nuclear electricity as irrational fear of nuclear radiation is itself a display of

irrationality which is noticed in the very first public interview of the new chairman of AEC, Dr.R.K. Sinha. [6].

Dr.Sinha goes on to say in the interview, "The common person tends to associate radiation with the catastrophe in Hiroshima and Nagasaki and is, hence, scared. Studies on the survivors of the two bombings (in Japan, 1945) and the persons exposed to radiation following the Chernobyl accident (1986) reveal consequences are far less harmful than what was postulated earlier." [6]. Hiding facts about the radiation levels in places such as Thane Creek, keeping the reports on nuclear accidents and incidents in Indian nuclear power plants and installations away from public scrutiny, airing and spreading untenable arguments through the media but unwilling to come for a public debate on those arguments, is a luxury available to the top brass of the Indian nuclear establishment.

Dr.Sinha spells out his ways, "I will also try to launch a programme to communicate, as well as implement the benefits of the DAE programmes, by involving non-governmental organisations and the local agricultural universities with good linkages with neighbouring rural population." [6]. The catch words are "the benefits of the DAE programmes." Using public money to win people to sing the benefits of the DAE programmes is an exercise that has been going on for a long time and it is clearly visible at Koodankulam in Tamilnadu, Jaitapur in Maharashtra and Kovvada in Andhra Pradesh.

The Village Panchayats at Koodankulam and in surrounding areas are already victims of corrupt practices to win support for the commissioning of Koodankulam nuclear plant. Dr.Sinha wants to enhance the net, of course with public money, to capture more people to sing in praise of "the benefits of the DAE programmes."

The undesirability of nuclear electricity and the need to revisit the nuclear priorities of India is discussed in sufficient depth as could be seen at [7]. The only sure "benefits of the DAE programmes." are for the self-serving nuclear scientists who put their personal interests above the national interests.

Dr.Sinha fails to realise that people affected by the proposed nuclear power parks at Jaitapur, Kovvada and other places are not prepared to part their lands no matter how much compensation is offered for their lands. It is because, people, both educated and uneducated, are relying on their rational minds and are filled with a foresight that they should not burden the future generations with insurmountable problems of nuclear radiation.

Ignoring such a glaring reality regarding land acquisition for nuclear power plants, Dr.Sinha is confidently and somewhat imprudently making his point, "Some of the issues relate to meeting the expectations of the neighbouring population with regard to the compensation package that should be provided. We have also expanded the scope of our neighbourhood development programme, and that should help in providing early benefits to the neighbouring population around the nuclear power plants." [6]

The echo is same from AEC Chairman Dr.R.K.Sinha to the media and from Prime Minister Dr. Manmohan Singh to the Parliament. The echo in the words of Dr.Sinha is "I do not see any sustained constraints for the large growth of nuclear energy in our country." [6] Members of Indian Parliament and Indian Public should examine carefully this bulldozing attitude to make India a market place "for the large growth of nuclear energy" in India. It will only ensure career plans for nuclear scientists and will surely impoverish India.

Every study made or commissioned by DAE and NPCIL to know the effects of nuclear radiation on people and environment from the operation of nuclear power plants, reprocessing units, nuclear fuel fabricating complexes and uranium mining places should be a scientific study to bring out scientific results and not a process to favour the stand of the nuclear establishment. The study should be objective and there should be no scope for any external or internal influence to deflect that objectivity. This principle appears to have been diluted while commissioning Tata Memorial Centre to study and prepare India's first

authoritative document on radiation-linked health incidents, in a "Mega study to track cancer around n-plants" [3]. The principle is diluted because there are no independent members named to participate in the study. One can take a look at the Tata Memorial Centre (TMC) Governing Council. Chairman, AEC is also the Chairman of TMC Governing Council. Joint Secretary (R&D), DAE is Member (Ex-officio) in TMC. There are several other retired scientists of DAE and BARC as Members of the TMC Governing Council. [8].

It is not difficult to imagine the would be undue influence of the AEC, DAE and BARC on the commissioned mega study to document the incidence of the disease among residents of areas close to nuclear installations. Even data collection can be manipulated. This attempt to pull wool over the eyes of the Indian people will make Indian nuclear scientists once more a laughing stock before the scientific community of the world. Recently, two top Indian nuclear scientists became laughing stock when they expressed their professional opinions on Fukushima Daiichi nuclear crisis:

*"There is no nuclear accident or incident in Japan's Fukushima plants. It is a well planned emergency preparedness programme which the nuclear operators of the Tokyo Electric Power Company are carrying out to contain the residual heat after the plants had an automatic shutdown following a major earthquake,"* said SK Jain, the Chairman and Managing Director of Nuclear Power Corporation. [8a]

*"It was purely a chemical reaction and not a nuclear emergency as described by some section of media,"* said Dr. Srikumar Banerjee, Chairman of the Atomic Energy Commission.[8a]

One should take notice of the boldness of S.K.Jain and Srikumar Banerjee for they demonstrate not only to the Indians but also to the while world, the type of nuclear scientists who alone can reach the top positions in the Indian Nuclear Establishment. Indians are blessed to be proud of them.

### **No nuclear accidents in India?**

While asserting that there will be no compromise on the question of nuclear safety, Prime Minister Dr.Manmohan Singh stated before the Members of Parliament, "We have 19 functional reactors and there has never been any accident. After Fukushima, I ordered a complete revisit to all the reactors and those reports are on the [Nuclear Power Corporation of India Limited](#) (NPCIL) website." [1]

"19 functional reactors and there has never been any accident.", is a statement from the highest Executive of the Country, Prime Minister of India who holds direct charge of the Department of Atomic Energy and so it should be one of the most comforting statements to the people of India. Unfortunately, it is not supported by facts, for the facts do show that there were accidents which were kept away from public knowledge.

Upon coming to know what these nuclear accidents and incidents are, the people of India are bound to raise some compelling questions – (i) at whose instance, whether at the instance of the Prime Minister or at the instance of the DAE or at the connivance of both, these accidents are kept away from public knowledge? (ii) Whether the Prime Minister is a pawn in the hands of top nuclear scientists? (iii) Whether there is a need to reorient and restructure DAE?. There will be many more such questions. We recall below a few of those nuclear accidents and incidents.

- **NAPS:** The Narora Atomic Power Station (NAPS) in Uttar Pradesh, northern India, has Pressurised Heavy Water Reactors (PHWR) of Canadian

design. It has two units each of 220 MW installed capacity. The first went critical in 1989 and the second in 1991. On March 31, 1993 there was a serious accident at Narora Atomic Power Station (NAPS). India was close to repeating Chernobyl, in a nuclear disaster that could have changed the very face of the subcontinent. Two enquiry reports were obtained one by the Committee setup by the Atomic Energy Regulatory (AERB) and the other by the Nuclear Power Corporation of India Limited (NPCIL). Neither of them has been made public. Some details on this accident, where a mechanical turbine blade failure escalated to a serious nuclear accident, are covered in the subsequent part of this analytical essay. In a similar fire accident on March 22, 1975, at the Brown's Ferry Nuclear Plant near Decatur, Alabama, the US Nuclear Regulatory Commission published a detailed report on February 1976, marked it NUREG-0050, and made it available to the public from the National Technical Information Service, Springfield, Virginia.

- **Dome Collapse:** The collapse of the containment dome of Unit-I of the Kaiga Atomic Power Plant under construction in Karnataka in 1994, with about 130 tonnes of concrete falling from a height of nearly 30 meters during construction was a unique event in the world. If it occurred during the operation of the nuclear reactor, it would have been a catastrophe. Two investigating teams were commissioned, one by the AERB and the other by NPCIL. However, the findings of both Committees have been kept secret.

- **RAPS:** Rajasthan Atomic Power Station (RAPS) at Rawatbhata in Rajasthan has Pressurised Heavy Water Reactors (PHWR) of Canadian design. It has two units, each of 220 MW installed capacity. Unit-I went critical in 1972, Unit-II in 1980. But due to various technical problems, neither of the units ever worked at its installed capacity. In fact in Unit-I, a crack in the end-shield of the reactor core forced the plant to shut down for several years in the 1980s. Some patchy repair work was done, but it is now running at only at about a third of its rated capacity. Unit-I is running at less than 100 MWe. Unit-II had tube leakage and other technical problems and it could never operate continuously at its rated capacity. Unit-II was shut down in August, 1994 for about three and a half years. 306 coolant tubes in Unit-II were replaced at a cost of Rs 170 crore. Unit II is running at less than 200 MWe. The details of these problems have never been made public.

- **MAPS:** Madras Atomic Power Station (MAPS) at Kalpakkam near Chennai also has PHW reactors of Canadian design. It has two units, each of 220 MW installed capacity, the first went critical in 1983 and the second in 1985. However, due to technical and safety problems both the units have been downgraded to 170 MW each. Both units ran into major problems soon after they were commissioned in the mid-1980s. The moderator distribution systems collapsed inside the reactor and advanced robotics had to be developed to remove the debris. The NPCIL was able to only partially solve the problem and as a result both the units are forced to run at about 75 per cent of their rated capacity. Unit-I of MAPS faced a major problem in 1990 - a broken turbine blade. The problems triggered by that breakdown required the use of industrial robots to repair them. None of the details of these breakdowns have been made public. Moreover, The fishermen near Kalpakkam know that when both the units of MAPS are in operation, the temperature of the sea around it rises excessively. They say that when they go out to sea during those times in their small boats they are unable to catch fish because if they get hit by a wave while they are out fishing, they start to itch and the lower half of their body breaks out in blisters.

- **KAPS:** Kakrapar Atomic Power Station (KAPS) in Gujarat also uses PHW reactors of Canadian design. It has two units each of 220 MW installed capacity. Unit-I went critical in 1992 and Unit-II in 1993. There was a near-disastrous fire accident in 1991 at the KAPS plant. Extensive damage was also

caused to the plant by floods in 1994. Deterioration in the health of the people and in the purity of environment around the plant is quite visible. Amongst the safety issues in technology adopted for KAPS, there are issues which remain unresolved by the DAE and NPCIL. Public has not been kept informed of the details of the problems which afflicted KAPS.

- **TAPS:** The Tarapur Atomic Power Station (TAPS), located about a 100 miles north of Mumbai, was commissioned in 1969 as a turnkey project by General Electric (USA). It uses ordinary water as a coolant and moderator. It is called a Boiling Water Reactor (BWR) because water boils in the reactor to form steam. The steam thus formed is used to run a turbine which is coupled to an electric generator to produce electricity. The installed capacity of TAPS is 420 MW (two units of 210 MW each). However, due to ageing and excessive radiation levels, TAPS has now been downgraded to 320 MW (two units of 160 MW each).

While the DAE and NPCIL continue to churn out glossy magazines and newsletters about TAPS in which problems never find a mention, many crucial questions regarding its functioning remain unanswered, which may also serve as indicators of the problems other plants may be facing. Public cannot know the full answers for the following questions regarding TAPS:

- What are the radiation levels in various sub-systems, machinery, pipes, pumps and engineering components of the BWR at TAPS? Are these radiation levels within the limits of the internationally accepted safety standards?

The intergranular corrosion of primary piping in the BWR is well known. For example, due to a leaky emergency condenser tube in loop A of TAPS Unit 2, on May 13, 1992 about 11.94 curies of radioactivity was released into the environment. On many occasions, such leaks of radioactivity have been hushed up. The tube failure is attributed to corrosion-assisted thermal fatigue.

The amount of iodine-129 and other radioactive substances discharged from the Tarapur complex remains unknown. The half-life of iodine-129 is approximately 16 million years. If radioactive iodine makes its way into the body in excessive quantities, it accumulates mainly in the thyroid gland and can cause a variety of illnesses including cancer.

- What has the NPCIL done to examine the integrity of the core shroud in TAPS, in the light of the observations of cracks in many foreign BWR shrouds? Why has the NPCIL not made public its findings from the examination of the core shrouds in TAPS?
- How safe is the sea at Tarapur from excessive radiation levels? Are the fish and other marine life in the sea affected by the radiation brought in by effluents from the nuclear power plant and the nuclear reprocessing plant at Tarapur?

In September 1989, it was reported that highly radioactive iodine had been detected in seaweed gathered around Tarapur plant. Scientists of BARC paid a price for publishing in a marine science journal that the amount of iodine-129 found at Tarapur was 740 times the normal level. The scientists had concluded that the main cause of this unnatural amount of iodine was the nearby fuel reprocessing plant. This revelation made a splash in the newspapers and was also subsequently referred to at several fora.

- Why is the NPCIL reluctant to make public the radiation dose levels reported in the medical records of people working permanently and temporarily at TAPS? Hundreds of workers have reportedly been exposed to excessive doses of radiation at Tarapur.

For example, labourers brought from outside are sent home after they receive excess doses of radiation. They are not informed of the dangers of radiation. Many a time, there is not even a record of their having worked at Tarapur. According to knowledgeable sources, at least 300 workers at Tarapur have been exposed to levels of radiation far higher than the permissible 5 rems per annum. On March 14, 1980, cooling water leaked from the No.1 reactor, and 26 workers engaged in repairs had to be rushed to a hospital in Mumbai.

The Tarapur plant has been operating since 1969. Its counterpart, built in the USA, the Dresden-I, underwent many modifications, all of which did not extend to Tarapur. The Dresden-I plant, in its original form, no longer exists anywhere else in the world, but it remains in operation in India.

Is NPCIL willing to allow an independent body of experts to inquire into these questions concerning Tarapur?

- **BARC:** Bhabha Atomic Research Centre (BARC) appears in the news every now and then with fantastic claims of progress in all fields of nuclear science and engineering. However, the characteristic feature of its culture is to keep knowledgeable persons away from BARC, so that the veil of secrecy remains firm and assertions of achievement remain unquestioned.

Among the notable units at BARC are the CIRUS and DHRUVA research reactors. The 40 MW CIRUS research reactor was of Canadian design, similar to the NRX reactor at Chalk River. It attained criticality on July 10, 1960. The CIRUS reactor uses natural uranium as fuel, heavy water as moderator, and light water as coolant. It attained full power on October 16, 1963.

The DHRUVA research reactor is based on the NRX research reactor of the Canadians. Because of the incorrect approach of the design team which worked on DHRUVA under the technical leadership of Anil Kakodkar, there was a mix-up. The intended operating pressure of 100 MW was taken as the design pressure, which should in fact be higher than the operating pressure. This major mistake was discovered after the construction of the reactor reached an advanced stage. The only thing possible to do at that stage was to lower the power to around 80 MW instead of the planned 100 MW. Kakodkar has since been elevated to the post of Director of BARC, went on to become Chairman of AEC and now retired. In 1988, DHRUVA experienced heavy vibrations. Some repairs were done but DHRUVA could never reach a fully satisfactory operating condition thereafter.

Since fuel failures at DHRUVA continued to be high and the cause of these failures could not be established, the Safety Review Committee for Operating

Plants (SARCOP) was forced to stipulate a continuation of its earlier restriction on burn-up level. The restriction would be discontinued only after resolving the fuel failure issue. There is no confirmation to show whether the fuel failure issue is resolved fully and satisfactorily. The public is in total darkness as to the safety aspects of all nuclear establishments including BARC. In fact, Dr R. Chidambaram himself filed an affidavit in January 1997 before the Bombay High Court, refusing to reveal the safety position of our nuclear establishments and he took refuge under the Official Secrets Act, 1923 and Atomic Energy Act, 1962.

The directors of BARC are unable to control the leakage and the spread of radiation underground in and around BARC. An underground pipeline (36 inches in diameter) in the CIRUS complex developed a leak in December 1991. The leaking water was found to be radioactive, with Caesium-137 possibly accompanied by the emission of lethal isotopes such as Cs-134, Sr-89 and Ru-106. AERB also found that in the course of CIRUS operation over the years, radioactive water was being pumped through a 4-inch diameter leaky pipeline. On May 14, 1992 soil in the area of the Effluent Treatment Plant (ETP), Trombay\_a BARC location\_get contaminated due to leakage of liquid waste from mildsteel underground pipe of the ETP. Two million tonnes of liquid nuclear waste is stored in tanks at BARC, Trombay. These tanks are leaking due to ageing, corrosion and faulty welds.

Radioactivity in the form of Caesium-137 has been reported to be present in the soil, water and vegetation near the discharge lines of CIRUS and DHRUVA research reactors. Other areas on the BARC sites and the Trombay coast, where the storm drains meet the Thane creek, are heavily contaminated with hundreds of curies of Cs-137 in the soil, water and vegetation. The contaminated grass and other plant material grown inside the BARC facilities, auctioned every year, for 20 years and more, may have spread the radioactivity into the food chain through the milk of cattle fed on contaminated fodder, or may have otherwise entered homes in the form of packing. Considering the long half - life of Cs-137 (over 30 years), this contamination will persist as a threat to the safety of the people and the environment for a long time to come.

The bed of the Thane creek, which is an extension of the sea at Mumbai port, has become highly radioactive because of the nuclear effluents discharged by the research and reprocessing plants at BARC. The fish get irradiated, yet the fishermen have no knowledge of what is happening. The Thane creek separates Navi Mumbai from old Mumbai, and the radioactive contamination of the creek spells danger to the whole of Mumbai. The leaking liquid nuclear waste storage tanks at BARC spell danger to the population living around BARC. An urgent and independent inquiry into these problems is necessary. For example, the Waste Immobilisation Plant at Tarapur, which is under the control of BARC, witnessed leakage of Caesium-137 from cracked pipes in April 1995.

A specific incident is enough to illustrate that the nuclear radiation levels being allowed in India are much more than those permitted by international

agencies. Dr Gopinath, the then Director of the Health Physics Division at the BARC, disclosed in 1993 at a meeting of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the numerical values of the radioactive discharges from Indian nuclear power plants. UNSCEAR was outraged and officially told the Indian government that these discharges were higher than the safe limits by about 100 times. Another instance of the nonchalant attitude of the Indian nuclear establishment towards radiation dangers is that the radiation doses borne by personnel working in Indian nuclear establishments are at least 10 times greater than those in the United States, Europe, Japan and most other places in the world.

- **NFC** : The Nuclear Fuel Complex (NFC) at Hyderabad, the capital city of Andhra Pradesh, fabricates and supplies nuclear fuel to nuclear plants in India, Pressurised Heavy Water Reactors (PHWR), Boiling Water Reactor (BWR) and Fast Breeder Reactor (FBR). Nuclear Fuel Complex caters to the fuel and Zirconium requirements of the Nuclear Power Program in India.

Despite the strong objections of the Committee of experts appointed by the government in 1995, the NFC management went ahead with expansion plans. This expansion plan is being implemented despite the fact that the NFC has already been castigated for dumping waste and contaminating the ground water. This is an illustration of the short shrift given to environmental concerns. The situation in and around Hyderabad on account of NFC has already become grave. The invisible contamination has started taking its toll. Mysterious and painful diseases have already visited residents in the vicinity of NFC.

All the uranium mined and refined at Jadguda is taken to NFC, where all of the complex churns out over 50,000 tonnes of contaminated waste water per day. This huge quantity of contaminated water, containing radioactive materials and chemical wastes, is discharged into a waste storage pond, known as the lagoon, which is located in the northern part of the complex. The pond works on the principle of natural evaporation from the heat of the sun. However, evaporation is impossible, as over 50,000 tonnes of waste water accumulates every day. Slowly, the contamination is seeping into the underground water table making it highly radioactive.

The contamination of the underground water supply is not limited to Ashok Nagar, near the NFC. Eleven other villages in the vicinity of the NFC face the same problem, and the contamination is spreading. Hyderabad has an acute shortage of drinking water. Consequently, many residential complexes install their own bore-wells to pump up underground water for consumption. A day may come when it will be highly dangerous to use the underground water and people may have to desert Hyderabad as has happened in the area near Hanford works in the USA. Already, the DAE has forbidden the people of Ashok Nagar to use their wells. This is not scare-mongering but a reality that we must face.



More details on the colossal gap between the promise and performance of the DAE and NPCIL are discussed in the article "India's Nuclear Prowess False Claims and Tragic Truths" published in MANUSHI [ 10]

Very recently, stunning similarities between the Indian Nuclear Establishment and the Japanese nuclear power industry have come to public knowledge.

The former Prime Minister of Japan, Naoto Kan, has given striking testimony to his country's Parliament, in which he accepted blame for his own poor response during the Fukushima meltdown, but also revealed the disturbing characteristics of the nuclear power industry and its enormous influence on all walks of life in Japan.

Prime Minister Naoto Kan also urged his country's Parliament to abandon nuclear power. He referred to the detrimental domination of the Tokyo Electric Power Company (TEPCO) and the other Electric Power Companies of Japan. Kan's testimony recorded:

*"TEPCO and the Electric Power Companies of Japan have dominated the nuclear power industry for the last 40 years. Through this nuclear clique and the rules they created, they expelled and isolated industry experts, politicians and bureaucrats who were critical, while the rest just looked on because of self-protection and an attitude of peace-at-any-cost. I'm saying this because I feel partly responsible."*

...

*"This nuclear clique, which has been created by the vested interest, is similar to the former Imperial Japanese military. We have to totally destroy and eradicate the organizational structure of the vested interests and (the) influence it has on the public. I think this should be the first step in reforming the nuclear industry."*[10a]

Prime Minister Kan's testimony further recorded:

*"In Japan, the term "The Atomic Village" refers to an isolated elite that has formed around the country's nuclear complex. ...It's as if Austrian writer Robert Jungk's horrific vision of the "nuclear state" had become reality....Even many media organizations, as recipients of generous payments for the electricity industry, are part of the cartel...."Our country was literally brainwashed," says Taro Kono, a member of the lower house of the Japanese Diet for the conservative LDP. "Atomic energy is a cult in Japan." ...Many scientists, especially at the University of Tokyo, are partial to TEPCO. The company contributes millions to the university and supports many associations, think tanks and commissions....Meanwhile, the Japanese government has begun asking Internet providers to remove "false reports" about Fukushima from the web...In Japan, the insiders who talked about the abuses at TEPCO were intimidated, as were journalists who reported on these abuses...." [10a]*

The " *The Atomic Village* " in Japan is akin to "India's Nuclear Estate". Both shine with "isolated elite " that has "formed around" respective "country's nuclear complex."

As much as in Japan, in India also "many media organizations, as recipients of" generosities from the nuclear industry, systematically ensure, "country was literally brainwashed" in favour of nuclear power.

Very similar to the position in Japan where "Atomic energy is a cult", in India also Atomic Energy has become a "cult", especially after the Indo-US Nuclear Deal.

While the "scientists, especially at the University of Tokyo, are partial to TEPCO" in Japan, in India very many scientists and engineers at every Indian Institute Technology (IIT) in India and at several Indian Universities have become captive scientists of the Department of Atomic Energy (DAE) which dolls out research funds (of course public money) only to those who toe the line of the DAE. This is a well-known phenomenon in India.

But the similarity does not extend to the Prime Ministers of Japan and India while they talk to their respective parliamentarians. Instead there is a stark contrast.

While the former Japanese Prime Minister Naoto Kan could give testimony on May 28, 2012 to the Japanese Parliament explaining the rot in the Japanese nuclear power industry and could even urge the Parliament to end the nuclear power, the Indian Prime Minister Dr. Manmohan Singh pushed under the carpet all the mismanagement in the Department of Atomic Energy which he himself holds under his direct charge and misinformed and misdirected the Indian Parliament on May 16, 2012 on the functioning of the DAE with regard to the nuclear power plants and thereby showed his determination to keep the flag of Indo-US nuclear deal high and to flood India with imported nuclear power plants.

### **Post Fukushima Stress tests on Russia's nuclear reactors and Lessons for India**

After Fukushima crisis in Japan, the leaders of all countries having nuclear reactors directed stress tests on their reactors. Russian Leaders directed examination of their reactors and Indian Leaders caused revisit of their reactors. Prime Minister Dr. Manmohan Singh informed the Members of Parliament on May 16, 2012, "After Fukushima, I ordered a complete revisit to all the reactors and those reports are on the [Nuclear Power Corporation of India Limited](#) (NPCIL) website." [1]

A comparison of the Reports thus rendered in Russia and India shows an amazing frankness in the Reports brought out in Russia after Fukushima on the nuclear safety of reactors in Russia which is lacking in NPCIL reports that were referred to by the Indian Prime Minister Dr. Manmohan Singh.

This may not mean, Russian Government is, at all times, more open than Indian Government in informing the public on the nuclear safety issues in the nuclear reactors which are in the civilian sector. But it only means, there are some Russian nuclear scientists who have the courage of conviction and are not prepared to shed their intellectual honesty while they are commissioned to render Reports on the safety issues in Russian nuclear power plants. In the Indian nuclear establishment there are no such intellectually honest nuclear scientists serving or retired who are prepared to call a spade a spade. Department of Atomic Energy is very successful in nurturing a type of culture where personal loyalty counts more than professional integrity.

#### **(i) Stunning in candour**

A report stunning in its candour prepared for Russian President Dmitry Medvedev by state agencies concerned with the safety of the country's nuclear power reactors in the wake of Japan's Fukushima disaster reveals that Russia's atomic reactors are grievously under-prepared for both natural and man-made disasters ranging from floods to fires to earthquakes or plain negligence. [11]

In the wake of Japan's Fukushima Daiichi nuclear disaster, stress tests on Russia's nuclear reactors have been conducted and a report was prepared by the state agencies concerned.

The report was presented to Russian President Dmitry Medvedev , at a state council meeting on June 9, 2011. The report is remarkable for its extraordinary candour.

The report revealed that Russia's atomic reactors are grievously under-prepared for both natural and man-made disasters ranging from floods to fires to earthquakes or plain negligence.

A copy of the report was obtained by Bellona Web and other environmental groups and distributed to Norwegian and Russian media. [11]

The findings in the report are ominous for the Russian VVER 1000 nuclear reactors at Koodankulam in Tamilnadu. The people's movement against Koodankulam nuclear plant should not be brushed aside on political grounds.

(ii) Some of the salient points of the report presented to Russian **President Dmitry Medvedev** & Lessons For India

Among the more critical safety failings relayed to Russian President Medvedev in the report were:

(i) Russia's plants do not have relevant regulations in place for personnel to know how to deal with large-scale natural disasters or other serious contingencies. This point is a wakeup call for India also. Indian Nuclear Regulator, the present Atomic Energy Regulatory Board (AERB) should not pretend that the situation in India is any better than the situation in Russia and with Russian nuclear reactors.

(ii) protective shelter for workers would not accommodate the largest teams on any given shift in the event of an accident, and Rosatom does not keep records of previous accidents, meaning workers do not have the benefit of learning from previous mistakes or improving remedial measures, among other shortcomings. This point is a lesson for India as well. Indian nuclear establishment does not keep proper and full records of previous accidents and does not afford any opportunity to learn from previous mistakes or to find better remedial measures.

(iii) electrical and safety-significant systems in Russian nuclear power plants do not receive the attention they need, resulting in a lack of required protection.

In India, inadequate attention to electrical and safety-significant systems was the main reason to transform the mechanical turbine blade failure to a serious nuclear accident. On March 31, 1993 there was a serious accident at Narora Atomic Power Station (NAPS) in Uttar Pradesh. India was close to repeating Chernobyl, in a nuclear disaster that could have changed the very face of the subcontinent.

The accident at NAPS was triggered by turbine blade failure. The spreading fire travelling through the duct burnt the bunched electrical cables carrying the safety control signals. It was a bad design to bunch the electrical wires for lighting along with electrical lines carrying safety control signals. The result was a total blackout of the station and also loss of control of reactor from the control room.

Two enquiry reports were obtained one by the Committee setup by the Atomic Energy Regulatory (AERB) and the other by the Nuclear Power Corporation of India Limited (NPCIL). Neither of them has been made public. In a similar fire accident on March 22, 1975, at the Brown's Ferry Nuclear Plant near Decatur, Alabama, the US Nuclear Regulatory Commission published a detailed report on February 1976, marked it NUREG-0050 and is available on the web.

(iv) The report on the Russian nuclear reactors questioned the capability of reactors to remain safe for extended periods of time if cooling systems fail. There is no guarantee that power backup systems will be effective should this happen -

the primary difficulty that beset Fukushima Daiichi when the quake and tsunami hit.

The Indian nuclear establishment also carried out stress tests on all of its 20 nuclear reactors, in the wake of Japan's Fukushima Daiichi nuclear disaster. Interim Report concluded, as expected, "Present review and re-evaluations conducted indicate that adequate provisions exist at Indian nuclear power plants to handle station blackout situation and maintaining continuous cooling of reactor core for decay heat removal." Interim Report also states that "to further augment the safety levels and improve defense in-depth" some salient recommendations have been made for short and long term implementation and they would be implemented in due course. [11a ], [11b]

Indian public has no choice but be happy with such reports from AERB because only those who toe the line of the nuclear establishment are selected to author those Reports. The report was probably submitted to Prime Minister Dr.Manmohan Singh who holds direct charge of the Department of Atomic Energy (DAE).

NPCIL, AERB and DAE have failed to prove to the Indian people that the reactor stress tests purportedly carried out on the nuclear reactors in India assure the safety of the reactors . It is necessary to point out that even the head of the Nuclear Safety Commission of Japan , Haruki Madarame cast doubts when he stated back in Jan/Feb 2012 that the stress tests don't assure reactor safety.

(v) The report on the Russian nuclear reactors pointed out that the key equipment involved in the cooling process suffers from metal fatigue and welding flaws – yet another problem that was ignored at Fukushima Daiichi's reactor No 1 when regulators there agreed to give it a 10-year operational life span extension – which contributed to a total failure of cooling at the reactor.

In India, AERB which has only delegated powers under the Atomic Energy Act, 1962, keeps extending the life of aged nuclear reactors at Tarapur Atomic Power Station (TAPS) which were commissioned in 1969 and similarly aged reactors at Rajasthan Atomic Power Station(RAPS).

(vi) The report on the Russian nuclear reactors that the hydrogen control systems do not correspond to regulations, meaning Russian reactors are vulnerable to the kinds of hydrogen explosions that tore through three reactor buildings at Fukushima Daiichi.

(vii) The report on the Russian nuclear reactors, most importantly states that the risk of earthquakes has not been considered as a safety factor for Russian nuclear facilities. Furthermore, not all of Russia's reactors have automatic shutdown mechanisms like the Fukushima Daiichi plant, should. an earthquake occur

This is a very relevant point for Koodankulam nuclear reactors, because the Russian Report says, the risk of earthquakes has not been considered as a safety factor for Russian nuclear facilities. .

(vii) The report on the Russian nuclear reactors states that currently there are no clear guidelines or sufficient infrastructure for spent nuclear fuel (SNF) management, leading to fears of SNF leaks during a disaster – as also happened in Japan.

This point on the spent nuclear fuel (SNF) management also should put India on the alert.

(viii) Reactor buildings at many of Russia's nuclear power plants are also aged and susceptible to structural failure - meaning the buildings could collapse without the help of Mother Nature.

India too should be concerned with the aged nuclear power plants like the ones at Tarapur and Rajasthan.

(ix) Further, Rostekhnadzor lacks safety inspectors, and there is a shortage of qualified maintenance workers at NPPs across Russia.

This point should be an eye opener for AERB in India since almost all AERB Inspectors are from the DAE pool. Independence of AERB is a myth.

(x) When Norwegian news outlets and Russian environmentalists had publicized the findings of the report on the Russian nuclear reactors, Rosatom Chief Sergei Kiriyenko was quick to say, it was just a matter of money to fix Russia's shortcomings in the area of back-up power and coolant system deficiencies.

In the Vedomosti business daily, Rosatom Chief Sergei Kiriyenko cited a figure of 5 billion rubbles (\$986 million) to bring Russia's reactors up to specifications by enhancing their back-up power and coolant systems. To counter cost overruns, Kiriyenko told the paper, Rosatom would rely on the government.

By the same logic, in order to fix the shortcomings in Koodankulam nuclear reactor, Rosatom Chief Sergei Kiriyenko is bound to count on Indian Government.

Choking on earlier words

Vladimir Sliviyak, co-chair of Russia's Ecodefence - one of the first Russian environmental groups to get hold of the report - was quick to point out the contrast between the Russian government's initial statements that what had happened at Fukushima could never be repeated in Russia, with the report which says that it could. [11]

"Soon after March 11, Premier Putin ordered a check of Russia's nuclear power plants. Later the announcement was heard that all reactors had been checked and Fukushima will not be repeated here," wrote Sliviyak in his [June 9 blog for EkhoMoskvy radio](#) (in Russian). [11]

"No information that would allow the confirmation or refutation of these conclusions was released," he wrote. [11]

"So what did we get as a result?" continued Sliviyak. "That the announcements of authorities at different levels - all the way to the prime minister - that the checks carried out after the Fukushima crisis revealed that Russia's nuclear power plants were completely safe is a complete fantasy." [11]

In India, to thwart people's fear generated by the Fukushima Daiichi nuclear disaster in Japan, Prime Minister Dr. Manmohan Singh wrote to Chief Minister Jayalalitha in September 2011, to assure her and also the Indians in general and the people of Tamilnadu in particular, "The safety track record of our nuclear power plants over the past 335 reactor-years of operation has been good. Nevertheless, after the Fukushima incident, the Central Government had ordered technical reviews of all safety systems of our nuclear power plants, including the Kudankulam Nuclear Power Project. The interim reports of these reviews have been made public and are available on the website of the Department of Atomic Energy. While these safety reviews have reaffirmed our ability to handle

emergency situations, further recommendations have been made to augment safety. All the recommendations are being implemented." [12]

With such an assurance from Prime Minister Dr.Manmohan Singh, Indians are blessed to live in complete fantasy.

Thus it is clear, on May 16, 2012, Prime Minister Dr.Manmohan Singh gave a distorted picture of the safety status of the Indian Nuclear Power Plants and made the Members of the Parliament and the Indian Public complacent over the precarious position of safety of the nuclear installations in India.

### **Mixture of Politics & Science and Ironies in Koodankulam Issue**

Koodankulam issue has proved to be not only a complicated mixture of politics and science but also a colourful bunch of ironies.

First is the politics part. Chief Minister Jayalalithaa sent letter to Prime Minister Manmohan on September 19, 2011, asking him to prevail upon officials not to go ahead with works in the Koodankulam nuclear plant till the concerns of the agitating people are addressed. In a formal sense it was a correct step. It is a correct step because, Koodankulam Atomic Power Project is a Central Government project and Prime Minister holds direct charge of the Department of Atomic Energy.

Prime Minister replied to Chief Minister and also took steps in September 2011 to appoint a Panel of Experts to study all the safety aspects related to Koodankulam atomic power plant. [12]. The panel thus constituted came to be known as Central Panel. At that time the State Government did not appoint any Panel or Committee of its own.

Central Panel certified in January 2012, that the state-of-the-art safety features in Kudankulam Nuclear Power Project such as passive heat removal system, double containment, core catcher, and hydrogen re-combiner installed in the reactors instead of conventional methods made the pressurised water reactors the safest and hence there was no need for any fear. "If there is any fear even after this, it is not based on scientific principles." [12a].

But the Central Panel failed to address the concerns of the agitating people fully and properly. At that juncture, what could the State Government do?

If the State Government changed its earlier stand and wanted to lend support to the commissioning of the nuclear plant it could have taken its decision on the basis of the Central Panel's conclusion. Instead, the State Government "constituted in February 2012, a four-member expert committee, headed by former chairman Atomic Energy Commission M. R. Srinivasan, to look into the safety aspects of the Kudankulam nuclear power project and address the fears of the locals. Srinivasan's inclusion is significant as he is known to be a strong votary of nuclear power. He was one of the architects of the Indo-US nuclear deal." [12b]

In the State Government constituted four member expert committee the only person having working experience with nuclear power plants is Dr.M.R.Srinivasan who heads the committee. The other three members are Anna University physics professor Dr Arivu Oli, energy research centre director Dr S Inniyan and former chief secretary L N Vijayaragavan. It means, Chief Minister Jayalalithaa chose to put more faith in Dr.M.R.Srinivasan compared to all the experts in the Central Panel. While choosing M.R.Srinivasan as the head of the four member State Committee, Chief Minister Jayalalithaa was fully aware that Dr.M.R.Srinivasan is an ardent advocate for commissioning Koodankulam nuclear plant and he has written series of articles in the newspapers and magazines and also gave interviews to the electronic media professing that the Russian reactor design at Koodankulam is an advanced type, and is safe, which is also the conclusion of the Central Panel.

However, purportedly going by the recommendations of the State appointed Committee headed by Dr.M.R.Srinivasan, a decision was taken by Chief Minister Jayalalithaa on the Koodankulam issue. With that decision Chief Minister Jayalalitha gave her consent in March 2012 to commission the Koodankulam nuclear reactors.

When Chief Minister Jayalalithaa constituted in February 2012 the four-member expert committee to look into the safety aspects of the Kudankulam nuclear power project and to address the fears of the locals, DMK president M. Karunanidhi termed it "a ploy to deceive people who were up in arms against" the Koodankulam nuclear plant [12c]. Recalling the letter sent by Chief Minister Jayalalithaa to Prime Minister Manmohan on September 19, 2011, asking Prime Minister to prevail upon officials not to go ahead with works in the plant till an agreement was reached on the issue, Mr. Karunanidhi wanted to know why such a State committee was not formed at that time. [12c].

"Did she write to the Prime Minister to deceive the people? Is the announcement of an expert committee also aimed at deceiving them," Karunanidhi asked. He wanted to know if the resolution adopted by the Cabinet in September 2011, calling for a halt to works at the project site until the people's fears were allayed, was also an attempt to hoodwink the local residents. [12c]. Thus the politics part is clear even to common people. What Mr.Karunanidhi has said and asked is also being said and asked by even common people.

### **Now comes the irony part.**

The biggest irony is, there is not even one person in the Central Panel who can be called an expert on Pressurised Water Reactor (PWR) and the Russian VVER 1000 type reactor at Koodankulam is a PWR. In the State Committee also even Dr.M.R.Srinivasan cannot claim he is an expert on PWR design and operation. Srinivasan throughout his tenure in DAE worked only on Pressurised Heavy Water Reactors (PHWR) of Canadian design . There is a vast difference in the design and operation of a PWR and a PHWR. Knowledge does not automatically descend on people when they are named as experts.

The next irony is when the main issue is about the safety in the design and operation of a nuclear reactor and its radiological impact on the people and

environment from a possible accident, the spokesperson for the Central Panel is oceanography expert A. E. Muthunayagam who confidently states, "safety measures such as passive heat removal system, double containment, core catcher, and hydrogen re-combiner installed in the reactors instead of conventional methods made the pressurised water reactors the safest and hence there was no need for any fear. "If there is any fear even after this, it is not based on scientific principles."" [12a] It is not only an irony but also a tragedy, mere familiarity with terms makes a person expert on behalf of the Central Government on a serious subject which is gripping not only the people of Tamilnadu but also the people throughout India.

### **State-of-the-art Safety features? What about human errors?**

The VVER, or WWER, (from Russian: Водо-водяной энергетический реактор; transliterates as *Vodo-Vodyanoi Energeticheskyy Reaktor; Water-Water Power Reactor*) is a series of pressurised water reactor designs originally developed in the Soviet Union, and now Russia, by [OKB Hidropress](#).

The VVER-1000/412 (AES-92) design of Russian nuclear reactors installed at Koodankulam and inching now towards commissioning and commercial operation has been developed by the enterprise OKB "GIDROPRESS".

OKB "GIDROPRESS" was established by the decree of Council of People's Commissars of the USSR on January 28, 1946 and by the order of the People's Commissar of the USSR heavy engineering on February 01, 1946 and it is a renowned enterprise. [12d] [12e].

As an accomplished enterprise OKB "GIDROPRESS" implements a complex of design, theoretical, analytical, R&D and production activities in reactor development for nuclear power plants of various purposes including nuclear submarines and land-based reactors.

With such a background of the OKB "GIDROPRESS" in the design field, the incorporation of safety measures in Koodankulam nuclear reactors such as passive heat removal system, core catcher, and hydrogen re-combiner installed in the reactors instead of the conventional methods could be an advanced design step intended to gain public acceptance of nuclear power. But that by itself cannot eliminate the factors which caused the serious accidents such as at Three Mile Island (TMI), Chernobyl and to some extent even at Fukushima- human errors and material failures.

Accidents do happen in other areas as well. But what makes the human errors and material failures in nuclear power plants more alarming is the reality of the serious and long lasting consequences that follow.

It is worth recalling the human errors and material failures that led to serious consequences in TMI, Chernobyl and Fukushima. The consequences of the material failure of the stuck Pilot Operated Relief valve (**PORV**) and human errors in TMI cannot be ruled out in Koodankulam nuclear reactors from the material failure of hydraulic accumulators and such other devices in the passive heat removal system. See the description of "Passive safety in VVERs" [12e1].

In any case, whether a country should go in for nuclear electricity or not should be considered only upon examination of all other safe potential sources of energy such as hydro, solar, wind, etc. Hydro potential should be tapped to the maximum because in addition to electricity it offers other advantages such as irrigation and drinking water. India is blessed with many rivers. Not even 30% of hydro potential is tapped. Many parts of the country suffer from shortage of drinking water.

More than the shortcomings in the design of the nuclear reactors, the occurrence of material failures and human errors led to serious nuclear accidents that had progressed up to core melting as could be seen at Three Mile Island



(March 1979, USA), Chernobyl (April 1986, former USSR) and Fukushima (March 2011, Japan). It is not the lack of sophistication in the design that triggered these major accidents and carried up to core melting, but a combination of human errors and material failures.

Moreover, the performance of the claimed advanced features in Russian VVER 1000 reactors at Koodankulam would be tested for the first time and to that extent they should be called experimental reactors and India became the testing ground for Russian reactors.

**TMI:** Three Mile Island (TMI) accident started when two secondary cooling system pumps stopped operating. With no secondary cooling system flow, the turbines shut down, and heat stopped being removed from the secondary system. Consequently, heat stopped being removed from the primary system through the steam generator. The emergency feed-water pumps activated but they were operating against closed valves: they had been closed during maintenance two days earlier. The operators did verify that the pumps were operating, but they did not know that they were accomplishing nothing because of the closed valves. One of the two indicator lights on the control panel that might have alerted them to the valves being closed was obscured by a repair tag hanging on the switch above it. It was only eight minutes later that this problem was discovered.

With no secondary circulation, no more heat was being removed from the reactor core, its temperature started to rise, and the automatic emergency shutdown procedure, known as a "scram," was started. Though the chain reaction itself was stopped by the scram, there was heat from fission products, known as decay heat. Because no heat was being removed through the secondary coolant system, temperatures and therefore also pressures rose within the core and primary coolant system.

Because of the pressure rise in the primary, Pilot Operated Relief Valve (**PORV**) opened to reduce the pressure. After reduction in pressure, the PORV was instructed to close, but it did not close due to malfunctioning. Therefore the radioactive primary coolant continued to be drained into the sump. Because of the pressure reduction in the primary, water in the pressure vessel commenced boiling with formation of bubbles. The bubbles in the core grew larger and larger as coolant turned to steam at the reduced pressures. Steam is much less effective at conducting heat away from the reactor fuel rods, so their temperatures rose even faster, reaching values that permitted them to resume fissioning.

As soon as the pressure had been adequately reduced, a signal was sent to the PORV to close again. An indicator light on the control panel showed that this signal had been sent. Unfortunately, despite the indicator light showing that the valve was being told to close, it did not in fact close. The primary cooling system stayed open for 140 minutes, venting 32,000 gallons, one third of the core capacity, and keeping the pressure in the core at a much lower level than it would have been with the PORV properly seated.

The reduced pressure caused steam bubbles to form, with four results: [12f]

- (i) It reduced the effectiveness of the cooling wherever those bubbles were in direct contact with the fuel rods.
- (ii) It impeded the flow of coolant through the core and the pipes.
- (iii) The fuel rod temperatures rose.
- (iv) The chain reaction resumed, releasing even more heat.

The High Pressure Injection (HPI) pumps activated (one automatically, one by operator intervention) to flood the core with cold water. When the pressurizer pressure indicator rose toward the point that would indicate that the pressurizer was to fill, the operators reduced the High Pressure Injection.

The reduced pressure also caused cavitation in the reactor coolant pumps, which could erode the moving metal parts of the pump, distributing fragments throughout the coolant (where they would destroy other pumps and valves in the system), so the reactor coolant pumps had to be shut down, further reducing coolant flow.

Due to the sustained operation at reduced pressure but high temperature and with the loss of one-third of the coolant, the zirconium cladding of some of the fuel rods reacted with the water, oxidizing the zirconium and leaving free hydrogen behind. The hydrogen accumulated in the reactor, forming pockets that prevented water from reaching parts of the core to cool it. At TMI, the hydrogen-air explosion took place 33 hours into the accident. There was partial melting of the core.

These known facts are recalled only to show that at Three Mile Island the root causes of the accident include simple material failures such as stuck relief valve and human errors such as wrong judgments of operators. Material failures and human errors can never be ruled out in the operation of nuclear reactors, no matter how sophisticated the design might be. Consequently, serious accidents can never be ruled out in nuclear reactors with grave consequences for the present and future generations.

Recent research study by scientists of Max Planck Institute for Chemistry at Mainz (Germany) published on May 12, 2012 estimated that that with 440 civilian reactors worldwide a major accident can be expected to occur about once every few decades. The research study also showed that previously the occurrence of INES 7 major accidents and the risks of radioactive contamination have been underestimated.

**Chernobyl** : On Saturday, April 26, 1986, a disaster occurred at reactor No. 4, which has been widely regarded as the worst accident in the history of nuclear power. As a result, reactor No. 4 was completely destroyed and has since been enclosed in a concrete and lead sarcophagus to prevent further escape of radiation. Large areas of Europe were affected by the accident. The radiation cloud spread as far away as Norway, in Scandinavia.

At the time of the Chernobyl accident, on 26 April 1986, the Soviet Nuclear Power Programme was based mainly upon two types of reactors, the WWER, a pressurised light-water reactor, and the RBMK, a graphite moderated light-water reactor. While the WWER type of reactor was exported to other countries, the RBMK design was restricted to republics within the Soviet Union.

The Chernobyl Power Complex, lying about 130 km north of Kiev, Ukraine, and about 20 km south of the border with Belarus, consisted of four nuclear reactors of the RBMK-1000 design, Units 1 and 2 being constructed between 1970 and 1977, while Units 3 and 4 of the same design were completed in 1983 (IA86). Two more RBMK reactors were under construction at the site at the time of the accident.

The RBMK-1000 is a Soviet designed and built graphite moderated pressure tube type reactor, using slightly enriched (2% U-235) uranium dioxide fuel. It is a boiling light water reactor, with direct steam feed to the turbines, without an intervening heat-exchanger. Water pumped to the bottom of the fuel channels boils as it progresses up the pressure tubes, producing steam which feeds two 500 MWe [megawatt electrical] turbines. The water acts as a coolant and also provides the steam used to drive the turbines. The vertical pressure tubes contain the zirconium-alloy clad uranium-dioxide fuel around which the cooling water flows. A specially designed refuelling machine allows fuel bundles to be changed without shutting down the reactor.

The most important characteristic of the RBMK reactor is that it possesses a "positive void coefficient". This means that if the power increases or the flow of water decreases, there is increased steam production in the fuel channels, so that the neutrons that would have been absorbed by the denser water will now produce increased fission in the fuel. However, as the power increases, so does the temperature of the fuel, and this has the effect of reducing the neutron flux (negative fuel coefficient). The net effect of these two opposing characteristics varies with the power level. At the high power level of normal operation, the temperature effect predominates, so that power excursions leading to excessive overheating of the fuel do not occur. However, at a lower power output of less than 20% the maximum, the positive void coefficient effect is dominant and the reactor becomes unstable and prone to sudden power surges. This was a major factor in the development of the accident.

The accident occurred during a planned test on the reactor. The planned test focused on the switching sequences of the electrical supplies for the reactor. The test procedure was to begin with an automatic emergency shutdown. No detrimental effect on the safety of the reactor was anticipated, so the test program was not formally coordinated with either the chief designer of the reactor (NIKIET) or the scientific manager. Instead, it was approved only by the director of the plant (and even this approval was not consistent with established procedures)

By the time of the accident, the Chernobyl power plant had been in operation for two years without the capability to ride through the first 60–75 seconds of a total loss of electric power, and thus lacked an important safety feature. The station managers presumably wished to correct this at the first opportunity, which may explain why they continued the test even when serious problems arose, and why the requisite approval for the test had not been sought from the Soviet nuclear oversight regulator (even though there was a representative at the complex of 4 reactors). [12g]

The Unit 4 reactor was to be shutdown for routine maintenance on 25 April 1986. It was decided to take advantage of this shutdown to determine whether, in the event of a loss of station power, the slowing turbine could provide enough electrical power to operate the emergency equipment and the core cooling water circulating pumps, until the diesel emergency power supply became operative. The aim of this test was to determine whether cooling of the core could continue to be ensured in the event of a loss of power.

Unfortunately, this test, which was considered essentially to concern the non-nuclear part of the power plant, was carried out without a proper exchange of information and co-ordination between the team in charge of the test and the personnel in charge of the operation and safety of the nuclear reactor. Therefore, inadequate safety precautions were included in the test programme and the

operating personnel were not alerted to the nuclear safety implications of the electrical test and its potential danger.

The planned programme called for shutting off the reactor's emergency core cooling system (ECCS), which provides water for cooling the core in an emergency. Although subsequent events were not greatly affected by this, the exclusion of this system for the whole duration of the test reflected a lax attitude towards the implementation of safety procedures.

As the shutdown proceeded, the reactor was operating at about half power when the electrical load dispatcher refused to allow further shutdown, as the power was needed for the grid. In accordance with the planned test programme, about an hour later the ECCS was switched off while the reactor continued to operate at half power. It was not until about 23:00 hr on 25 April that the grid controller agreed to a further reduction in power.

For this test, the reactor should have been stabilised at about 1 000 MWt prior to shut down, but due to operational error the power fell to about 30 MWt, where the positive void coefficient became dominant. The operators then tried to raise the power to 700-1 000 MWt by switching off the automatic regulators and freeing all the control rods manually. It was only at about 01:00 hr on 26 April that the reactor was stabilised at about 200 MWt.

Although there was a standard operating order that a minimum of 30 control rods was necessary to retain reactor control, in the test only 6-8 control rods were actually used. Many of the control rods were withdrawn to compensate for the build-up of xenon which acted as an absorber of neutrons and reduced power. This meant that if there were a power surge, about 20 seconds would be required to lower the control rods and shut the reactor down. In spite of this, it was decided to continue the test programme.

There was an increase in coolant flow and a resulting drop in steam pressure. The automatic trip which would have shut down the reactor when the steam pressure was low, had been circumvented. In order to maintain power the operators had to withdraw nearly all the remaining control rods. The reactor became very unstable and the operators had to make adjustments every few seconds trying to maintain constant power.

At about this time, the operators reduced the flow of feedwater, presumably to maintain the steam pressure. Simultaneously, the pumps that were powered by the slowing turbine were providing less cooling water to the reactor. The loss of cooling water exaggerated the unstable condition of the reactor by increasing steam production in the cooling channels (positive void coefficient), and the operators could not prevent an overwhelming power surge, estimated to be 100 times the nominal power output.

The sudden increase in heat production ruptured part of the fuel and small hot fuel particles, reacting with water, caused a steam explosion, which destroyed the reactor core. A second explosion added to the destruction two to three seconds later. While it is not known for certain what caused the explosions, it is postulated that the first was a steam/hot fuel explosion, and that hydrogen may have played a role in the second. [12h]

Thus human errors in the judgments of operators on the state of reactor during the test, circumventing the laid down procedures, lack of sufficient technical knowledge of the operators regarding the instability of reactor at low power

operation and the effect of xenon build up and the effect of "positive void coefficient" and of course the inherent characteristics of RBMK design with "positive void coefficient" all have contributed to the occurrence of the accident. Human error is the dominant factor for causing the accident.

## **Fukushima**

In March 2011, a major earthquake and tsunami ravaged the Pacific coast of northern Japan and crippled the Fukushima Daiichi nuclear power plant and damaged the cooling system of the plant resulting in a severe accident. The event at the Fukushima plant is rated as LEVEL 7 nuclear disaster, the highest in the event scale. Serious releases of radioactive material resulted in contamination of the surrounding environment and led to the evacuation of several thousand inhabitants from their homes.

"There will always be uncertainty in natural disasters," conceded Shinichi Kawamura, who was in-charge of the Fukushima Daiichi nuclear plant when the tsunami short-circuited all its safety features in March 2011. "The reactor's temperature went down but we still don't know where the fuel is located at its bottom," he said in the first week of June 2012 adding that it would take 30 to 40 years before all-clear is sounded. [12i]

World Association of Nuclear Operators' Chairman L. Stricker attributed the disaster to the management system — lack of imagination and insufficient robustness being the chief reasons. [12i]

In the light of the Fukushima nuclear crisis, most nuclear countries including Japan announced safety reviews of all their nuclear reactors (stress tests) and the revision/improvement of their plans to address similar emergency situations. In Japan at present the gripping public debate is whether a few of the idled nuclear reactors should be restarted on a temporary basis to get over the likely shortage of electrical power during the summer.

Japanese now oppose nuclear power more strongly than they did while the tsunami-damaged Fukushima plant was still in crisis a year ago. The survey released on Tuesday, June 5, 2012 by the Washington-based Pew Research Centre said 70% of Japanese believe the country should reduce its reliance on nuclear energy, up from 44% last year. [12j].

Before the disaster, Japan relied on nuclear power for about a third of its energy needs. All 54 of Japan's nuclear reactors have been shut down as of May 2012 due to routine inspections and safety concerns, straining the country's ability to meet power demands.

The survey found that 80% of Japanese are dissatisfied with the government's handling of the nuclear crisis, caused by a massive earthquake and tsunami on March 11, 2011, that damaged the Fukushima Daiichi nuclear power plant, which spewed radiation into the surrounding air, soil and water. [12j].

Overall, the poll showed widespread pessimism: Some 78% of the people are unhappy with the direction of the country, and 93% perceive the economy to be in a bad state.

According to the Ministry of Science of Japan, in 2011, the radiation contaminated about 10,000 sq km, across 9 prefectures. It must be something like 3% of the total land mass of Japan. About one third of that is contaminated above 20 millisieverts per year, and mostly in Fukushima.

According to the Government of Japan, the area near the Fukushima plant is so contaminated with dangerous levels of radiation, no one will be able to ever live there again. A large area of the no-go zone is contaminated above 50 millisieverts per year and people won't be allowed to return to those areas. The areas between 20-50 millisieverts per year will be advised not to return. Below 20

millisieverts per year, people will be allowed to return once the government finishes the decontamination work. [12k]

Nearly a third of Japan's ruling party lawmakers have petitioned Prime Minister Yoshihiko Noda on June 5, 2012 to be cautious about restarting nuclear reactors given safety concerns after last year's earthquake and tsunami.

"It is clear from surveys that the majority of the people think that we can survive this summer by conserving energy and transferring electricity among regions," said the Democratic Party of Japan (DPJ) petition

"We urge you to consider the fact that there is insufficient agreement within the party and among the people and the feelings of the 160,000 victims of the disaster, and be all the more cautious about a decision to restart the reactors.", the petition urged Prime Minister Noda. [12k].

Japanese government-appointed investigative committee released on December 26, 2011 its 507-page interim report on the March 2011 nuclear accident at Fukushima Daiichi. The report attaches blame for the nuclear accident and its consequences to Japan's central government and administration, as well as the utility that operates the plant, Tokyo Electric Power Company (Tepco). [12k1]

The crisis in Japan has been described as "a nuclear war without a war". In the words of renowned novelist Haruki Murakami: ""This time no one dropped a bomb on us ... We set the stage, we committed the crime with our own hands, we are destroying our own lands, and we are destroying our own lives." [12k2]

Nuclear power supplied nearly 30% of Japan's electricity needs before last year's earthquake and tsunami crippled the Fukushima plant in northeast Japan. But all of the country's 50 *functioning* reactors have since been taken offline for checks.

On January 18, 2012, Japan's Nuclear and Industrial Safety Agency (NISA) held a hearing to discuss with a committee of experts the results of the "stress test" for judging whether to restart Kansai Electric's Ooi Nuclear Power Plant. The hearing was supposed to be open to public, but at the last minute NISA decided to hold the meeting in a separate room without the audience. The angry audience, who were locked out in a room with a TV monitor, eventually rushed into the meeting room and made a protest.

In the middle of the confusion, an unidentified woman from Fukushima came out of the audience. The woman's poignant words in Japanese are captured in the video clipping which describes with English captions the deep pain of the affected people of Fukushima expressed during the public hearing to decide whether idled nuclear reactors should be restarted. [12L]. This video clipping is making waves around the world.

Prior to this public hearing, three of the committee members were found to have received donations (bribes according to public perception) from a nuclear-related company, Mitsubishi Heavy Industries. One of them is Dr. Koji Okamoto, Professor of the University of Tokyo and Moderator of this meeting, to whom the woman from Fukushima addressed her last question.

The stress tests cannot give complete assurance because they are only computer models based on probabilities and not on possibilities. Such tests may indicate the reactors are safe, when clearly, they are not.

Upon being called as a panel witness in February 2012 to address the Fukushima Accident Independent Investigation Commission, which was jointly set up by the House of Representatives and the House of Councillors of Japan, the Chief of the Cabinet Office's Nuclear Safety Commission (NSC) Haruki Madarame

apologized for flaws in the government's nuclear safety regulations, including nuclear power plants' countermeasures against tsunami. Haruki Madarame also stated before the Commission that the stress tests conducted on all other reactors couldn't assure the safety of the reactors.

The head of NSC Haruki Madarame stated before the Diet-sponsored Commission, "It was a mistake that tsunami risks weren't addressed in detail, and that the regulations stipulated, 'There is no need to consider the serious impact of prolonged power loss [at nuclear power plants].'" [12m]

The NSC chief said a fundamental review of the government's nuclear safety standards was needed and that the problems were deep-seated. [12m]

"While other countries considered [stricter nuclear safety standards], Japan made excuses to avoid them. A system was created in which decision-making was difficult and change was avoided," he said.

"I think this attitude is at the root of various problems," Madarame added.[12m]

Much of what was said by the Chief of the Cabinet Office's Nuclear Safety Commission (NSC) Dr. Haruki Madarame before the Diet-sponsored Commission of Japan, "a fundamental review of the government's nuclear safety standards was needed", "the problems were deep-seated.", "Japan made excuses to avoid" stricter nuclear safety standards, and the "attitude" which is "at the root of various problems", would be very much applicable to the nuclear regulation in India and the attitude which is at the root of various problems in the Department of Atomic Energy of the Central Government of India. But the Chief Scientific Adviser to the Central Government in India Dr.R.Chidambaram does not have the intellectual honesty with which head of NSC Haruki Madarame could speak before the Diet-sponsored Commission of Japan. Dr.Chidambaram does not feel any obligation to speak the truth to the Prime Minister of India, to the people of India and even before the High Court of Judicature at Bombay. This view about Dr.R.Chidambaram is purely based on his acts and omissions as a public servant and it does not in any way touch on his personal life.

### **People's Movement against Koodankulam Plant**

People of Koodankulam, Idinthakarai and other neighbouring villages, in Tirunellveli-Kattabomman District of Tamil Nadu State in southern India, fear for the safety of their lives from a possible accident occurring at the Koodankulam nuclear power plant. They fear their livelihood from fishing in the sea would be affected by the operation of the nuclear plant. They came to know that a research conducted by reputed scientists in France has shown that children living in the vicinity of nuclear reactors in France have developed leukaemia (blood cancer). They are aware that the studies conducted by Indian doctors have shown higher rate of cancer and thyroid cases in people living in the vicinity of Kalpakkam nuclear power plant compared to the people living far away from the nuclear plant. Nuclear radiation problems heaped on the people of Japan from the crippled Fukushima Daiichi nuclear plant hit by earthquake and tsunami on March 11, 2011 are ringing alarm bells in the minds of people of many countries and so is in the minds of people of Kudankulam, Idinthakarai and other neighbouring villages. A significant aspect of the people's protest against Koodankulam nuclear plant is majority of the participants are women and children.

The leaders of the People's Movement Against Nuclear Energy (PMANE) repeatedly put forth before the Central Government and the State Government the precise concerns of the agitating people over the nuclear plant which include: 1) risk of Tsunami and earthquakes,

2) inherent danger in locating the nuclear power plant in Koodankulam area which is characterised by sub-volcanic intrusions – an indication of volcanism in the near vicinity of the proposed nuclear plant,

3) the presence of basaltic intrusions into the crust and the Gulf of Mannar seabed,

4) entire Koodankulam region is known for its lime stone formations and the events that have occurred in Nov 26, 2011, 2008, 1998 at locations at Pannaiyarkulam, Radhapuram both located 10kms from the site and Maruthankulam (25kms) have suggested that this is a "KARST" Region. AERB's safety regulations clearly state that if a Karst region is suspected a detailed study has to be conducted. Such a study has not been attempted by NPCIL.

5) occurrence of sea withdrawal in Tamilnadu coast. During 2004 Tsunami the withdrawal of the sea was around 4-5 Kms from the shore. Every year after this Tsunami, some places of the coast of Tamilnadu have faced the issue of Sea water withdrawal at least 3 times a year. Tsunami hazard manual released by USNRC in March 2009 states that if sea water withdrawal is an issue at the site then the chances of the reactor going in for a dry intake should be studied thoroughly. Dry intake can cause damage to the turbines and reactors. Each minute a reactor needs about 5,000 cubic-metres of sea water. Hence a detailed volcanic hazard study, Tsunami hazard study and a study about the "Karst" Terrain is mandatory. In the absence of such mandatory studies, the Koodankulam nuclear plant should not be commissioned.

6) inadequate supply of fresh water. According to the available information, the Koodankulam nuclear plant has assured supply of freshwater for merely 36 hours and 25 minutes. The dependence on a single source, namely, the desalination plant further reduces the reliability of this water source as desalination plants rely on the sea and electricity and can be disrupted both by disturbances in electricity supply and cyclones and extreme weather events in the sea along with Jelly fish intrusions. In such a situation reactors will have to be closed down immediately and they have just enough water for maintaining the safety systems for 10 days. The reserve of potable water for the KKNPP Township is sufficient for 2 days. The seawater intake pipeline of the Minjur desalination plant in Thiruvallur district was uprooted in 2008 during the Cyclone Nisha. Repairing the pipeline required engineers from the Netherlands and took more than 45 days. Lack of adequate fresh water supply aggravated the crisis at Fukushima in Japan. Therefore, Koodankulam nuclear plant should not be commissioned till this fresh water problem is solved.

The regulatory requirement, according to AERB is "if the minimum water supply required for long term heat removal from the core cannot be ensured under all circumstances, then the site shall be deemed unsuitable. Availability of adequate quantity of water to maintain the reactor under safe shutdown state for *at least thirty days* needs to be ensured under all circumstances." [12n]

7) the occurrence cancer in the vicinity of a nuclear plant. Department of Atomic energy (DAE) funded study conducted by Dr. Manjula Datta has found that the Morbidity burden in the proximity villages of Kalpakkam is 400% higher than in distant villages. The diseases include Cancer, mental retardation, thyroid problems, infertility, lumps, stroke, cataract, TB, ulcer and diabetes. Another study conducted by Dr. Pugazhendhi et. al. showed that auto immune thyroid disease among women living in up to 40kms from the Kalpakkam site was significantly higher than those living 500kms away. These studies clearly show



that Low level Radiation from the nuclear reactors is a health hazard. Therefore, the fears of people agitating against the Koodankulam nuclear plant are genuine and founded in scientific studies.

8) the health hazard to workers working in nuclear installations. Study conducted by Dr. Pugazhendhi et. al. in 2003 among employees working in nuclear installations and their family members had shown that the death rate due to Multiple Myeloma (A bone marrow cancer) is statistically significant. Studies based on data supplied by NPCIL shows that the prevalence of cancer in workers (and their families) working in Bhabha Atomic Research Centre (BARC) and Tarapur Atomic Power Station (TAPS) is significantly higher than that found in Madras Atomic Power Station (MAPS). The BARC and TAPS are functional much before MAPS, thereby showing that the number of cancer cases grows with time. The research reactors at BARC became critical during 60's and the reactors at TAPS became operational in the 70's whereas MAPS went critical during 1984-85. There are also cases of genetic mutations. Therefore, the fears of people agitating against the Koodankulam nuclear plant are well founded in scientific studies.

The USA and Japan have compensatory laws for employees as well as people living around the nuclear plants. (Energy employees occupational illness compensation program act) that too when the reactors function normally without any leaks or accidents. This clearly shows that Low level Radiation from the reactors is a health hazard.

9) the cost of producing nuclear electricity when the entire nuclear fuel cycle including decommissioning cost is considered. The decommissioning cost of a nuclear reactor is more than the cost of construction and commissioning. Yet, another unsolved problem is the safe disposal of spent nuclear fuel both in terms of technology and economics. Spent fuel will remain highly radioactive for 1000's of years. In Fukushima it has been estimated that it will cost over 75,000 crores and 30 years to decommission the failed nuclear plants. Taken this into account all the nuclear plants are unviable and un-economical; and,

10) no-disclosure or public hearing of environmental impact assessment and safety analysis reports, 11) forced removal of residents within 2.5 km radius from the plant, 12) 1 million people are living within 30 km radius from the plants, 13) disposal of cooling water and low-level waste to sea, 14) risk of contamination with food and environment,

There are several other issues which show that the pursuit of nuclear electricity in India with disproportionate investments compared to the dismal percentage addition of electricity from nuclear with all its potential dangers to the present and future generations and too without tapping the huge potential from hydro (India is blessed with many rivers and not even 30% potential is harnessed while there are additional benefits of irrigation and drinking water, etc.), abundant sunshine and wind power flowing from three sides Indian Ocean, Bay of Bengal and Arabian Sea, therefore, there is need to revisit the nuclear priorities of India [7].

The agitating people want the Koodankulam nuclear project scrapped. Their on-going agitation, led by People's Movement Against Nuclear Energy (PMANE), has halted work at the project, delaying commissioning of the first unit which was earlier scheduled to start operation in December 2011.

It is a fact, local agitations against the Koodankulam nuclear plant have been going on since long before Fukushima crisis in Japan. It is also a fact that the government has been ignoring all such protests and at the same time has been trying to win over people through various inducements. It is also fact that

some office bearers of local Panchayats (elected village governing bodies) have fallen prey to such inducements.

However, the people's movement opposing the Russian VVER type nuclear reactors 2 x 1000 MWe at Koodankulam in Tirunelveli-Kattabomman District of Tamil Nadu State in southern India gained momentum after the Fukushima Daiichi crisis in Japan on March 11, 2011.

Chief Minister of Tamil Nadu, Dr.J. Jayalithaa was the first Chief Minister of a State in the Federal Structure of India to write in September 2011 to the Prime Minister of India Dr.Manmohan Singh pointing out the need for the Prime Minister, who holds direct charge of the Department of Atomic Energy of the Central Government, to assuage people's fear of the 'dangerous' pursuit of the nuclear electricity instead of the benign alternate renewable methods of generating electricity. It appeared Koodankulam is destined to reset the nuclear priorities in India. [13].

The Expert Committee of the Central Government instituted at the instance of Prime Minister merely endorsed the view of the DAE and NPCIL that there are no dangers of earthquake and tsunami at Koodankulam and the Russian VVER type PWR design is a very advanced version and the fear of the people is from lack of understanding of nuclear science. However, the Expert Committee of the Central Government did not share the relevant documents with the Expert Team constituted by The People's Movement Against Nuclear Energy (PMANE) and there was no adequate scientific discussion on the issues raised by the PMANE and therefore the opinion the Expert Committee of the Central Government looked more like an arbitrary official assertion and carried less of scientific reasoning. It was only because of the stand taken by Chief Minister Jayalitha in September 2011, the commissioning of Koodankulam plant was stopped for several months.

Pointing out all the issues, the Expert Team of the People's Movement Against Nuclear Energy (PMANE) urged the Chief Minister of Tamilnadu Dr.Jayalithaa to consider those issues and cause the Central Government to avoid nuclear electricity and invest in energy efficiency and renewable energy like Solar, Wind and excess bio-mass which are available in plenty in Tamil Nadu. PMANE further urged that the pursuit for these renewable energies should be taken up on a war-footing as was done in the case of rain water harvesting. Request was also made to implement the distributed renewable energy system and institute proper policies as was done for grid connected renewable energy generation. PMANE pointed out that Tamil Nadu has got a greater potential for solar energy (25-30MW per sq.Km) and 300 cloud free days and it is possible to establish Tamil Nadu as the pioneer in Renewable energy in India coinciding with the "International Year of Sustainable energy for all." The cost of these clean renewable energies has come down considerably in recent times making them viable.

Public debate went into questions like, "Should The Koodankulam Power Nuclear Plant Be Commissioned Or Abandoned?" [14]

However, for reasons not known, Chief Minister Jayalithaa deviated from her initial stand taken by her in September 2011 that work on Koodankulam nuclear plant should be stopped till the Central Government allays the fear of the agitating people. Having changed her stand, Jayalithaa gave her consent and support on March 19, 2012 to commission the nuclear plant. Commissioning work was resumed immediately in full earnestness. Koodankulam plant is now expected to go into commercial operation in August 2012.

In the matters of atomic energy in India, understanding of science and respect for its role in decision making have declined. An excessive coverage in the

media to every unsubstantiated statement of the serving and retired nuclear scientists and Members of Parliament and Legislatures expressing their support to nuclear electricity as dictated by their political party bosses, have combined to produce an environment in which science is easily drowned out by misinformation or manipulated for the benefit of private interests.

### **Media Lens is reluctant to capture the true picture of DAE**

Corruption exists in many forms and defies a strict definition. The unbecoming practices in the Department of Atomic Energy (DAE) and Bhabha Atomic Research Centre (BARC) are fully known to those who are or were closely associated with DAE and BARC. But there is hardly anybody (barring a very few exceptions) to speak up for fear of being victimised. The media lens in India is reluctant to capture the true picture of the Indian nuclear establishment. The reasons for such reluctance are many. For the benefit of the Members of Parliament and Indian people, we list here a few facts which hint at the big disappointing picture of the Indian nuclear establishment:

- (i) The Indian nuclear establishment made huge investments on the research and development of many things including the design and development of a desalination plant for use at Koodankulam nuclear plant to produce fresh water from sea water. Repeated claims have been made year after year that the Indian design for desalination plant is ready and of world class. But when it came to installing desalination plants at Koodankulam for day to day operation it was a design from Israel. The 'ultra-mega desalination plant at the Koodankulam nuclear power plant site was imported from Israel to yield 76.80 lakh litres of fresh water a day which is supposed to meet the day-to-day operations of the reactors.'[14a]. Indian nuclear establishment makes fantastic claims to indigenous designs but when it comes to putting in place a new equipment or a system some foreign collaboration is the routine practice. When ultra-mega desalination plant was required at the Koodankulam nuclear power plant it had to be imported from Israel. Politicians in power have at all times exhorted the people of India to feel proud of their nuclear scientists.
- (ii) On September 14, 1998, delivering the convocation address at Nagpur University in Maharashtra, the then AEC Chairman Dr R. Chidambaram, said, "India is totally self-reliant in the field of nuclear technology, and control regimes would not affect our nuclear programme in any way." The young people passing out of the University have no reason to disbelieve India's highly placed nuclear scientist Dr.R.Chidambaram. There are two reassuring messages from Chidambaram. Firstly, India is totally self-reliant in the field of nuclear technology,. Secondly, the controls and sanctions imposed on India by the nuclear power countries after India's nuclear tests - Pokhran -I in May 1974 and Pokhran-II in May 1998 would not render India helpless in any way in the field of nuclear technology.

If India is self-reliant in the field of nuclear technology as proclaimed by Dr.R.Chidambaram on September 14, 1998, then why was the Inter-Governmental Agreement on the Koodankulam Atomic Power project signed on November 20, 1988 by Prime Minister Rajiv Gandhi and Soviet President Mikhail Gorbachev, for the construction of

two reactors. [15]. The cost to India was estimated to be US\$ 3 billion (Rs.13,615 Crores) in 2001.

The Koodankulam Atomic Power project remained in limbo for a decade due to the political and economic upheaval in Russia after the post-1991 Soviet breakup. The construction eventually began in 1997. There were also objections from the United States, on the grounds that the agreement does not meet the 1992 terms of the Nuclear Suppliers Group (NSG). It means, the controls and sanctions were in place against India. To overcome those controls and sanctions India had to pay a heavy price of signing Indo-US nuclear deal in July 2005 to make India a market place for nuclear power reactors. Yet, nothing prevented Dr.R.Chidambaram from boasting during his Convocation Address on September 14, 1998, at Nagpur University that "control regimes would not affect our nuclear programme in any way." .

One can get the big picture about the Indian Nuclear Establishment, upon reading all the material on the claims of Dr.R.Chidambaram about the self-sufficiency of India in the field of nuclear technology, the Inter-Governmental Agreement on the Koodankulam Atomic Power project signed by Prime Minister Rajiv Gandhi and Soviet President Mikhail Gorbachev, and the Indo-US nuclear deal signed by US President G.W. Bush and Indian Prime Minister Dr.Manmohan Singh, alongside the statement of another AEC Chairman Dr.Anil Kakodkar to Marathi daily Sakaal in January 2011, "We also have to keep in mind the commercial interests of foreign countries and... companies ... America, Russia and France were the countries that we made mediators in these efforts to lift sanctions, and hence, for the nurturing of their business interests, we made deals with them for nuclear projects." The meaning flowing from the statement of Dr.Kakodkar has already been explained above.

Now it should not be difficult for the Members of Parliament and people of India to understand the mismatch between the promise and performance of the Indian nuclear establishment.

- (iii) Every now and then, the Indian nuclear bosses proudly declare the three stage program conceived by Dr.Homi Bhaba – first stage of Pressurised Heavy Water Reactors (PHWR) using natural uranium and heavy water, second stage of Fast Breeders running with plutonium obtained from spent fuel of the first stage with thorium blanket to produce fissionable U-233 and the third stage of running power reactors from fissionable the U-233 obtained from the second stage. In this three stage program, there is no room for the Pressurised Water Reactors (PWR) of the type being installed at Koodankulam which use enriched uranium and light water (ordinary water). Then why India is paying for the Russian VVER type PWR reactors at Koodankulam? It is because when the incompetent Indian nuclear scientists after having failed with three of their designs over ten years to develop nuclear submarine

propulsion plant, two successive Prime Ministers Mrs .Indira Gandhi and Rajiv Gandhi decided to approach the Russians for help.

Russians proposed, India should not only pay for the design of nuclear submarine propulsion plant with Russian experts helping in its construction in India, but India also should be willing to purchase civilian nuclear power reactors of PWR design from the Russians. Because of the incompetency in BARC and DAE, Indian leaders had no choice but to agree to pay for the nuclear submarine propulsion system design in the defence sector and also for the nuclear power reactors in the civilian sector. Consequently, the nuclear submarine project commenced at Vishakhapatnam in Andhra Pradesh with land based prototype of nuclear submarine propulsion reactor coming up at Kalpakam and the nuclear power reactors of VVER type fell in the lap of Koodankulam in Tamilnadu.

One can gauge the level of intellectual honesty of Dr.Anil Kakodkar when he boldly claimed that the first nuclear submarine reactor is fully of indigenous design. In an exclusive interview to Pallava Bagla, Science Editor for NDTV and correspondent for Science, one can see the extent to which the then Chief of India's Atomic Energy programme Anil Kakodkar could go in August 2009 to pull wool over the eyes of the Indians. When asked by Bagla why the Indians should be proud of the nuclear submarine propulsion plant prototype, Kakodkar told Bagla, "Well, one has to be proud because it has been done here, it has been done by Indians and this is something which is not available for the asking, whatever money you want to pay. There is no way to acquire that unless you do it yourself and not many countries have such a capability. So it is certainly a matter to be proud of."

When Pallava Bagla prodded, "So this is not a Russian design?", Kakodkar replied, "It is an Indian design."

Pallava Bagla prodded further, "Indian design, made in India, by Indians?"

Kakodkar had no hesitation to say, "Yes, that's right." [16]

If what Kakodkar says is right, one has to think which of the two statements aptly describes the situation, 'Indians are blessed to be proud of their nuclear scientists' or "Indians are condemned to be proud of their nuclear scientists."

The pretence to knowledge of the people who headed the Indian Nuclear Establishment commencing with Dr.Raja Ramanna was discovered for the first time when twenty Indian Navy officers and eighty five scientists of BARC commenced work from June 1976 on the Indian nuclear submarine project with a propulsion plant design that was prepared by BARC in 1971. One of those twenty naval officers, who specially selected and appointed by Naval Admirals as he had proven abilities was directed to examine if the 1971 design of BARC

would work for Navy. Upon going into detailed calculations the naval officer found that the 1971 design of BARC would not work for a nuclear submarine as it was a copy of the design of German nuclear merchant ship OTTO HAHN. The 1971 design was dropped in December 1976. The second design of BARC was similarly dropped in the beginning of 1979 as it was not viable for naval application. On the third of BARC, the then Prime Minister Mrs. Indira Gandhi took in March 1980 professional opinion of the very same naval officer who assessed the earlier two designs. Since the written professional opinion of the naval officer showed that the third design of BARC failed to meet the Ground Rules and Safety Rules strictly followed in all other nuclear navies of the world, Smt. Indira Gandhi decided not to sanction Rs.150 crore sought by BARC scientists to construct the land-based prototype of their third design. When a proposal was made to handover the control of the nuclear submarine project to Indian Navy, Dr. Raja Ramanna and his Team strongly opposed it saying that the overall control should always be with BARC scientists. It was at that time, Indian Government started looking to Russia for design help on the nuclear submarine project. Russians agreed to help India provided India paid not only for the nuclear submarine design but also would purchase nuclear power plants from Russia. That is how the birth of nuclear power plant at Koodankulam took place. Though Dr. Anil Kakodkar was obliged to tell the truth to Indian nation, he made untrue statements to Pallava Bagla, Science Editor for NDTV and correspondent for Science, perhaps believing that pretence to knowledge of the top nuclear scientists of India would never be discovered. Indian media would do a great service to Indian nation if the truth about the Indian nuclear submarine project could be unearthed and presented to the people.

Now one more occasion is coming up to know the pretence to knowledge of the top nuclear scientists of the Indian nuclear establishment. Indian nuclear scientists commencing with Dr. Raja Ramanna have repeatedly claimed that they have mastered uranium enrichment technology and India is ahead of Pakistan in enrichment technology. Similarly Indian nuclear scientists also claimed that they are very advanced in reprocessing technology.

However, now it came to public knowledge that the Indian nuclear establishment has been making strenuous attempts for a long time to obtain enrichment and reprocessing technology transfer from Russia. The media report says, "Asked if Russia would comply with its promise to transfer enrichment and reprocessing (ENR) technology to India in view of the 2011 Nuclear Suppliers' Group (NSG) Noordwijk plenary having recently tightened the rules for its transfer to non-NPT signatories, of which India is one, a top Rusatom official told *The Hindu*: "Russia is a signatory to the Nuclear Non-Proliferation Treaty and it intends to comply with its provisions. The transfer of ENR technology will be restrained to countries that want to develop this sensitive technology. Russia will observe all international obligations as per the treaties [it has signed]."" [16a]

"India will find it difficult to reach the third phase of nuclear technology development without the ENR technology — which would enable it to use its rich Thorium resources." [16a]. Thus the cat is out of the bag now. India's three stage program conceived by Dr. Homi

Bhabha would be affected if ENR technology transfer from Russia does not materialise.

It is high time the Indian Parliamentarians and Indian people realised that the dead wood in DAE should be purged and DAE should be reoriented and reorganised, lest India should always be dependent on transfer of technologies from other countries in the nuclear field.

- (iv) The biggest scam of all scams in India is the nuclear scam whereby Indian nuclear top brass knowingly, wilfully and deliberately claimed that the first hydrogen bomb test of India in May 1998 (Pokhran-II) succeeded while it was an utter failure. The details are in the article, "[Our Nuclear Scam](#)" [17]. Some relevant facts are also discussed above.
- (v) If Homi Bhabha's projections made in the 1950s had materialised, India we would have been producing at least 50,000 MWe of nuclear electricity by now. But the present production of nuclear electricity according to NPCIL web site is 4385 MWe [18]. At present, about 25 percent of our energy budget goes to the DAE, which accounts for less than 3 per cent of total power output. Most of the India's 20 reactors are on the list of the most unreliable 50 in the world. They are being closely monitored by the IAEA. Can this state of affairs inspire confidence to go ahead with commissioning more nuclear plants?

[Mikhail Gorbachev](#), the Soviet premier at the time of the Chernobyl explosion, wrote in Bulletin of the Atomic Scientists 's March/April 2011 issue, " it is necessary to realize that nuclear power is not a panacea , as some observers allege, for energy sufficiency or climate change. Its cost-effectiveness is also exaggerated , as its real cost does not account for many hidden expenses. In the United States , for example, direct subsidies to nuclear energy amounted to \$115 billion between 1947 and 1999, with an additional \$145 billion in indirect subsidies . In contrast, subsidies to wind and solar energy combined over this same period totalled only \$5.5 billion. " [19]

Moreover, among low-carbon energy sources, the nuclear power brings with it important economic, waste disposal, safety, and security risks. This unique detrimental feature of the nuclear power has been highlighted in a detailed study in the United States by the Union of Concerned Scientists (UCS) where it is concluded in their report, "Shifting these risks and their associated costs onto the public is the major goal of the new subsidies sought by the industry (just as it was in the past), and by not incorporating these costs into its estimates, the industry presents a skewed economic picture of nuclear power's value compared with other low-carbon power sources." A definite finding of this study is "Nuclear Power - Still Not Viable without Subsidies." [20].

But as if there are miracles in India, the seniors in DAE and NPCIL, serving and retired, keep claiming every now and then in their interaction with the Indian media, that nuclear electricity is very cheap in India. One such claim has been made recently by Dr.S.K. Jain, Chairman and Managing Director, Nuclear Power Corporation of India Ltd (NPCIL) while he informed enthusiastically on May 30, 2012, "The Kudankulam nuclear power project, which is expected to pump in the first unit of electricity into the grid by the end of June, will sell power to the state utilities at around Rs 2.65 a unit." [21]

Dr.Jain also goes on to claim, "No alternative to nuclear power", a slogan often repeated by other stalwarts in the nuclear field, Dr.R.Chidambaram, Dr.M.R.Srinivasan and a host of others, , serving and retired, from DAE and NPCIL. Print and electronic media in India does not allow space and time to show vividly to the people of India the method and the manner in which persons like Dr.S.K.Jain, Dr.R.Chaidambaram, Dr.M.R.Srinivasan and others including Dr.Abdul Kalam pull wool over the eyes of the Indian people while singing the merits of nuclear electricity.

- (vi) Many revealing things can be noticed, if one examines carefully the reports of the Standing Committee on Energy of the 11<sup>th</sup> Lok Sabha. For instance, according to the 34<sup>th</sup> report of Standing Committee on Energy (1995-96) of the 10<sup>th</sup> Lok Sabha, with Mr Jaswant Singh as its chairman, the Department of Atomic Energy admitted in writing that over Rs 1,000 crore was wasted due to advance procurement of equipment from abroad for six units of 500 MWe and four units of 220 MWe. Equipment procured more than 10 years in advance became scrap due to long storage. We see here one more nuclear scam, which is more serious than the fodder scam, urea scam or any bank scam. In this nuclear scam of advance procurement, Member & Former Chairman, Atomic Energy Commission (AEC) of India, Dr.M.R.Srinivasan had a lot to answer but he escaped, because under the veil of secrecy, it remained guarded from any further public focus. Dr.M.R.Srinivasan has been leader of the Team which advised Chief Minister Jayalalithaa to give nod to the commissioning of Koodankulam nuclear plant and she relied on that advice and gave in March 2012 her nod to commission the Koodankulam plant. However, we can be sure of one fact. Whether the operating base is 200 MW or 20,000 MW, no internal surpluses will accrue unless and until capacity factors improve the break-even point. This will be felt even more acutely when TAPS and RAPS become obsolete, since these vintage power stations were procured at very low prices compared to their successors.
- (vii) Nuclear power has been so tangled up with governments and nuclear weapons, right from the beginning that it's hard to say what the actual costs would be if the industry was completely unregulated but was also completely decoupled from weapons programs. In India the intersection between the pursuit of nuclear weapons in the defence sector and the pursuit of nuclear electricity in the civilian sector is so vast and firm that it is helping to push under the carpet all the



mismanagement in the Indian nuclear establishment and it is the most harmful thing to India in more than one dimension. This intersection between the defence and civilian sectors in the nuclear field affords a comfortable elevated position of Principal Scientific Adviser to Government of India to even people like Dr.Abdul Kalam and Dr.R.Chidambaram who projected in 1998 to the then Prime Minister Atal Bihari Vajpayee, that the first Hydrogen Bomb Test of India succeeded even though both of them ( Kalam and Chidambaram) knew it was a failure. The words of the present Principal Scientific Adviser to Government of India, Dr.R.Chidambaram are carried as the guiding principle on the web site of Nuclear Fuel Complex (NFC), Hyderabad, " The Indian concerns and priorities are thus quite unique for its long term energy security, India has no option but to deploy nuclear power according to a strategy precisely tuned to its needs and resources" - **DR. R. CHIDAMBARAM.** <http://www.nfc.gov.in/html-nuclear.htm>

No wonder, Prime Minister Dr.Manmohan Singh emphasised in Lok Sabha on May 16, 2012 that an ordinance on denial of nuclear power is harmful to India. Manmohan Singh's Principal Adviser is R. Chidambaram.

- (viii) It is the same Dr.R.Chidambaram who committed fraud upon the Bombay High Court in Public Interest Writ Petitions, WP Nos. 1785/96 & 1792/96, filed by People's Union For Civil Liberties (PUCL) and Sarvodaya Mandal. One of the issues in those Writ Petitions was whether the 90 nuclear safety violations in the nuclear power plants should be disclosed to the public. These 90 nuclear safety violations are from out of the total 130 nuclear safety violations in all the nuclear establishments in the country compiled by the then chairman of AERB Dr.A.Gopalakrishnan.

Department of Atomic Energy (DAE) vehemently opposed the disclosure of those 90 nuclear safety violations in the nuclear power plants. Dr.R.Chidambaram as the then Chairman of AEC & Secretary DAE himself filed affidavit before the High Court claiming secrecy and privilege and declining to disclose even the 90 nuclear safety violations in Indian nuclear power plants. The Petitioners argued that since the nuclear power plants are in the civilian sector and not in the defence sector, the secrecy and privilege did not apply. To overcome this argument of the Petitioners, Dr.Chidambaram committed fraud upon the Bombay High Court in January 1997 which is discussed very briefly here.

Dr.Chidambaram and his Team submitted to the High Court in January 1997 a Memorandum purportedly issued under the purported instructions of the then Prime Minister Shri.Deve Gouda. The Memorandum constituted a high power technical committee with Dr.Raja Ramanna as chairman of the committee and Dr.Abul Kalam, Mr.Anil Kakodkar and others as members.

On the basis of the Memorandum, the DAE argued that the Writ Petitions should not be admitted as the grievances of the Petitioners would be addressed by the high power technical committee. When it was brought to the judicial notice of the High Court that the Memorandum was only talking about the reorganisation of the AERB (Atomic Energy Regulatory Board) and there was not even a whisper in

the Memorandum about the 90 nuclear safety violations in the nuclear power plants, the DAE gave an undertaking in the open Court that the high power technical committee would also look into the 90 nuclear safety violations in the nuclear power plants.

The Petitioners further submitted to the Bombay High Court that the Memorandum which entrusted in January 1997 the task of reorganising the AERB to a high power technical committee headed by Dr.Raja Ramanna amounted to committing fraud not only upon the High Court but also upon the nation because the defective AERB, which made the nuclear regulation a 'farce' in India as termed openly by Dr.Gopalakrishnan, was in fact brought into existence as a salve to monitor the master by a letter signed by Dr.Ramanna in 1983 when he was the Chairman of AEC & Secretary DAE.

Believing in the contents of the Memorandum purportedly issued at the instance of the then Prime Minister Shri.Deve Gouda, and also relying on the undertaking given by the DAE in the open Court, and also believing that the high power technical committee would look into all the issues raised in the two public interest petitions (WP Nos. 1785/96 & 1792/96), the Bombay High Court did not admit the public interest petitions. But the Court was kind enough to keep "the doors open if an occasion demands" and also recorded in its order that "information on the safety violations cannot be denied to the public for all times."

The Memorandum at the purported instance of the then Prime Minister Shri.Deve Gouda, the contents of the Memorandum showing formation of a high power technical committee with Dr.Raja Ramanna as chairman of the committee, and the undertaking given in the open Court regarding the 90 nuclear safety issues in the nuclear power plants also to be examined by the high power technical committee, all were only meant to prevent the Bombay High Court from admitting the public interest petitions. It came to be known that the high power committee did not meet even once to take up seriously the task entrusted to it as per the undertaking given in the open Court and if it met and discussed, it did nothing in the matter to fulfil the undertaking given to the Bombay High Court. Thus there is documentary evidence to show conclusively the fraud committed upon the Bombay High Court by Dr.R.Chidambaram and his Team for which they could prosecuted even now.

### **Prosecution of Public Servants**

Common people including women and children concerned for their life and livelihood are engaged in peaceful protest against a much feared nuclear power plant at Koodankulam. When majority of the informed and educated people in the country remain unconcerned and un-alerted of the dangers to the present and future generations from the pursuit of nuclear electricity, the 'CROSS' is being carried by the bleeding common people of Koodankulam, Idinthakarai and other villages with considerable solidarity flowing from different parts of India and abroad. In evaluating the pros and cons of huge investment in nuclear electricity, science should play a larger role in the decision making. But science gave way to politics.

Three factors have shifted the decision making in the area of nuclear power in India from science to predominantly towards politics. First is country's inability to discover the pretence to knowledge of the nuclear scientists in key positions who had enthused the politicians in power to celebrate even the failure of India's first hydrogen bomb test as a grand success. Second is the intellectual dishonesty of the nuclear scientists who for the sole purpose of getting controls and sanctions lifted had colluded with the politicians in power to make India a market place for nuclear reactors and generated a spin that nuclear power is the gateway for India's prosperous future. The third is Prime Minister Dr. Manmohan Singh's obsession with Indo-US nuclear deal and his willingness to ignore the economics of nuclear electricity, even though he is known to be a reputed economist.

Consequently, science took a back seat and politics commenced playing larger role in handling the historic People's Movement Against Nuclear Energy (PMANE). The Central Government failed to address people's fear at Koodankulam through open scientific discussion with all the relevant documents made available to the people, documents such as the mandatory Site Evaluation Report (SER), Environmental Impact Assessment, Environmental Clearance, AERB clearance and Safety Analysis Report (SAR).

Such reluctance of the part of the Central Government, DAE and NPCIL has compelled the affected people to resort to The Right To Information (RTI) Act, 2005, only to discover in the process some evidence for the violation of law by several public servants at various levels who with their "acts and omissions" appear to have committed criminal offences under the Indian Penal Code, while they proceeded for the construction of the Koodankulam Atomic Power Project by ignoring and neglecting the mandatory procedures established by Law and the Rules and Regulations made thereunder. Chapter IX of the Indian Penal Code deals with "Of Offences By or Relating to Public Servants". It is possible to prosecute all the concerned public servants who had violated law. Of course, to pursue criminal cases against them effectively, some knowledge at the intersection of nuclear technology and criminal law would be required.

Some raw truths about the Koodankulam nuclear power plant are bound to surface as a result of the orders dated 30 April 2012 of the Chief Information Commissioner (CIC) the highest functionary under the Right To Information Act, 2005. With those Orders, the CIC directed the Nuclear Power Corporation of India Limited (NPCIL) to provide to the Appellant Dr. S.P. Udayakumar an attested photocopy of the Safety Analysis Report (SAR) and Site Evaluation Report (SER) after severing any proprietary details of designs provided by the suppliers. NPCIL preferred a Review Petition seeking modification of the orders dated 30 April 2012 of the CIC citing their difficulties to furnish the Safety Analysis Report. The Review Petition is awaiting consideration by the CIC. Though it appears to be a complicated matter, there is, in fact, no complication at all if the CIC could be correctly and adequately guided in the area of intersection between the nuclear technology and law, to clear the confusion the NPCIL is trying to create.

Very recently on May 11, 2012, the Bombay High Court ruled "Any project that affects forests and the environment and is in violation of rules or lacks required permissions cannot be permitted to continue." [22]

Ground break for Koodankulam Nuclear Power Plant was on September 2001 and First Pour of Concrete was on March 2002. People's agitation against Koodankulam Atomic Power Project has been in existence much before the ground break for the Project and has been continuing over the years.

After Fukushima nuclear crisis in Japan in March 2011, the people's movement against Koodankulam Atomic Power Project picked up momentum and gathered intensity, all of it in a peaceful and democratic manner. Being unable to handle the peaceful and democratic people's agitation, and being desperate to commission the nuclear plant, the government unleashed repression at an unprecedented level against the agitating common people.

To break the morale of the people, the government filed First Information Reports (FIR) and registered criminal cases against thousands of people. Criminal cases registered under the Indian Penal Code, include section 121 (waging or attempting to wage war or abetting waging war against Government of India), section 124-A (Sedition). A careful examination of the facts suggests that it is difficult to establish the 'offence elements' under Sections 121 (waging war) and Section 124-A (sedition) in the Koodankulam issue. Such renowned personalities as Mahatma Gandhi, the Father of the Nation, and Bal Gangadhar Tilak were tried and punished during the hey-day of British Empire under section 124-A.

On 14 May, 2012 a public hearing was held at Chennai, Tamilnadu by a Jury headed by *Justice A.P. Shah*, former Chief Justice of Madras and Delhi High Court. The public hearing afforded an opportunity to the people affected by the arbitrary actions of the government, and to the persons leading the people's movement against the Koodankulam nuclear power plant, and also to public spirited people and organisations who have been expressing solidarity to the people's movement against Koodankulam nuclear plant.

Jury published its Report in the first week of June 2012. The Report contains evidence for suppression of human rights, constitutional rights and for denial of information to the public which was mandatorily required to be furnished to the public. A noteworthy analysis and finding in the Report is with regard to the registered criminal cases of "Waging war against the Government of India" (section 121 of the Indian Penal Code), "Waging war against any Asiatic Power in alliance with the Government of India." (Section 125 IPC), and "Sedition" (Section 124 A).

Upon examination of the facts, the Jury concluded and recorded in the Report, in respect of Section 125 IPC (Waging war against Asiatic Power in alliance with the Government of India) , "the penal provisions may never stand up to scrutiny in a court of law but have been used to threaten and frighten people".

In respect of Section 121 IPC (Waging war against the Government of India), the finding in the Report is, "FIR nowhere makes out a case that the persons accused were waging war against the Government of India but only indicates that they were protesting. Nevertheless Section 121 has been included."

In respect of Section 124 A (Sedition), the Jury recorded in the Report, "Two cases ( Crime No 372/11 and 373/11 in Koodungalam P.S) registered on the same day cover 3450 unnamed "other accused" under section 124 A. In order to attract the provisions of section 124 A, there must be specific words either spoken or written or there must be visible representations made by the person charged. By putting unnamed persons as "other accused," clearly the police want to add names as and when they decide. According to the PUCL report, the alleged acts of threatening the sovereignty of India are mechanically included just so that an offence is made out in the specific incidents referred to. Similarly, while it is alleged that the protestors spoke about the plant, nothing is stated about how it caused disaffection."

From the findings of the Jury recorded in the Report, it is possible to say that there is prima facie evidence to prosecute the concerned public servants who caused the registration of criminal cases under Sections 121, 124 A, and 125 of the Indian Penal Code.

Repressive measures unleashed upon common people engaged in peaceful protest against nuclear power plant at Koodankulam in Tirunelveli-Kattabomman District of Tamil Nadu State in Southern India received national and international attention.

Several British MPs and members of the European Parliament including Labour MPs Jeremy Corbyn, John McDonnell, Mary Glendon and Paul Flynn; Green Party's Caroline Lucas and its MEP Keith Taylor ; Kate Hudson of the Campaign for Nuclear Disarmament; and Estella Schmid of the Campaign against Criminalising Communities (CACC) signed a letter addressed to Prime Minister Manmohan Singh and Tamil Nadu Chief Minister Jayalalithaa demanding a halt to the Kudankulam Nuclear Power Project (KKNPP) and withdrawal of police and court cases against anti-KKNPP protesters.[23]

Signatories accused the authorities of using "draconian measures" to put down anti-KKNPP protests and alleged that "non-violent protesters are being intimidated, harassed, imprisoned, and falsely charged." [23]

The letter said the project violated the International Atomic Energy Agency (IAEA)'s safety guidelines as it was in "a tsunami and earthquake-prone region."

It was "also in violation of the mandatory requirement for construction of fresh water reservoirs."

"The primary cause for all major accidents such as at Three Mile Island, Chernobyl and Fukushima was lack of fresh water," the letter said, expressing "deep concern" over the project's environmental impact. [23]

Signatories criticised the Indian government for accusing anti-KKNPP activists of being backed by foreign money.

"The fact is that the Indian nuclear programme itself is backed heavily by foreign corporates," said Amrit Wilson of the South Asia Solidarity Group (SASG). [23].

The process of Public Interest Litigation (PIL) has afforded an opportunity to the public spirited individuals to file PIL Writ Petitions to seek redress from inaction as well as arbitrary action of the State authorities and thereby secure justice in public interest.

But the pursuit of PIL even in bonafide cases places enormous burden on those who pursue it. This is because, the Government as Respondent uses public money and the Petitioners pursuing PIL have to spend their own hard earned money. This difficulty has been aptly and succinctly summed up by an experienced and well known environmentalist Captain J. Rama Rao, *"Historically disputes between Industry, Governments and Community are always Unequal and Unfair, because people who have been damaged by irresponsible industries, almost never have the expertise or funding to conduct their own studies. Governments invariably support this mindless damage in the name of GDP Growth, which is highly discriminative and not Inclusive. The policy and decision makers in the Governments, invariably ignore universally accepted "Precautionary Principle" for protection and improvement of the Human Environment"*.

Therefore, time has come to search beyond the pursuit of PIL. The search should be to look for ways to mitigate the 'Unequal and Unfair' nature in the disputes between the Government and the Community.

Government has both power and public money on its side. Community has only the strength of law on its side. Up till now, public spirited persons pursuing PILs are only resorting to civil proceedings against inaction or arbitrary action of public servants in the Government. PIL is a civil proceeding. In a dispute between the Government and the Community, the fight need not be all the time in a civil proceeding. It could as well be in a criminal proceeding in some cases where the offence elements are clear.

If a public servant knowingly disobeys any direction of law and causes injury to any person, it is an offence under Section 166 of the Indian Penal Code. Whether the prosecution should be for offences under the Indian Penal Code or under any other special law like the Atomic Energy Act, 1962 or Environment Protection Act, 1986, would be a matter of detail to be decided by looking at the facts. But it is clear, if a public servant knowingly disobeys any direction of law and causes injury to any person, it is an offence under the Indian Penal Code

But to institute a criminal proceeding against a public servant, sanction from appropriate authority is required under Section 197 of the Criminal Procedure Code. As per a recent judgment of Supreme Court, if no reply is received for four months, on an application seeking sanction to prosecute, the sanction is deemed to have been granted.

Upon obtaining sanction to prosecute, a criminal complaint can be filed by any person. Therefore, one of the ways to mitigate the 'Unequal and Unfair' nature in the disputes between the Government and the Community is, not to resort to PIL in every such dispute and thereby land in a civil proceeding, but to take the help of law and institute criminal proceedings against the concerned public servants, wherever such a thing is possible. Chapter IX of the Indian Penal Code deals with "Of Offences By or Relating to Public Servants".

Of late, the higher judiciary has been paying a good deal of attention to corruption cases. But the issues of corruption, by and large, are viewed and understood only in terms of loss of money to the State and personal gains of the individuals. Whereas much more significant losses are occurring from the mismanagement in the Department of Atomic Energy (DAE) causing not only the avoidable drain of huge amounts of nation's money but also in destroying the vitality of the nation.

From now on, in public interest, independent experts in nuclear technology should take the help of experienced lawyers in the country to pursue not the PILs in civil proceedings but to institute criminal proceedings against the concerned public servants in DAE including the Prime Minister who holds direct charge of

DAE, whenever these public servants bulldoze their pet projects by knowingly violating statutory law and causing injury to people. These are not to be viewed purely as policy matters to be left to the Government or Parliament. Courts cannot shun examination, when there are clear cut cases of public servants committing offences under the Indian Penal Code and some special Acts like the Atomic Energy Act, 1962 and Environment Protection Act, 1986 and the Rules made there under, as could be seen from the facts at Kovvada, Jaitapur and Koodankulam nuclear power projects. .

Article 361 of the Constitution of India which provides for "Protection of President and Governors", clearly states that there is no restriction to proceed against the Central Government or a State Government. More precisely, the proviso to Article 361 states, "Provided further that nothing in this clause shall be construed as restricting the right of any person to bring appropriate proceedings against the Government of India or the Government of the State."

The Internet has given people the incredible power to share thoughts, organize, and rally for what they believe in. Internet helps to climb the learning curve and it is also the most effective new information transmission instantaneous mail.

Experts deployed by the Government to hype the advantages of nuclear electricity are sustained by public money. The people carrying on the anti-nuclear movement depend on independent experts to hold out a scientific basis for the antinuclear movement, while all of them struggle for resources. The unrelenting view of the establishment experts is that the nuclear power is necessary for nation's progress and also to overcome the power shortages. The persistent view of the independent experts is that the nuclear power plants pose danger to the environment, all life forms on earth, the present generation as well as the future generations; and there are alternate sources of energy hydro, solar, wind and others, in addition there are also methods of managing the electrical grid to minimise power losses, in order to attain and sustain energy security for the nation. This debate on nuclear electricity is worldwide and by now the arguments on both sides are quite standard and so are in India. But the legal issues thrown up at Kovvada, Jaitapur and Koodankulam are peculiar to India. These peculiar legal issues in India which suggest that it is in public interest to prosecute the concerned public servants of the Central Government including Prime Minister for knowingly violating law and causing injury to the people.

### **Opposition to Nuclear Electricity Is Justified**

India is blessed with a large number of rivers. There is enormous scope for medium and small hydropower projects even if one chooses to avoid large hydro dams. From hydropower projects, one gets not only electricity but also irrigation and drinking water. India is largely an agricultural country and every venture which helps in enhancing irrigation should be pursued with vigour. Moreover many areas in the country still suffer from shortage of drinking water even after six decades of independence. Therefore, hydropower projects should be priority projects in the country.

#### **Hydro**

According to National Hydro Power Corporation (NHPC), a Government of India Enterprise, India is blessed with immense amount of hydro-electric potential and ranks 5th in terms of exploitable hydro-potential on global scenario.

As per assessment made by CEA, India is endowed with economically exploitable hydro-power potential to the tune of 1 48 700 MW of installed capacity.

The basin wise assessed potential is, Indus Basin 33,832 MW, Ganga Basin 20,711 MW, Central Indian River system 4,152 MW, Western Flowing Rivers of southern India 9,430 MW, Eastern Flowing Rivers of southern India 14,511, Brahmaputra Basin 66,065 and total **1,48,701 MW**. [24].

In addition, 56 number of pumped storage projects have also been identified with probable installed capacity of 94 000 MW. In addition to this, hydro-potential from small, mini & micro schemes has been estimated as 6 782 MW from 1 512 sites. Thus, in totality India is endowed with hydro-potential of about 2 50 000 MW. However, exploitation of hydro-potential has not been up to the desired level. Only less than 20% of this entire massive hydro potential has been harnessed so far. [24].

Hydro power is a renewable economic, non polluting and environmentally benign source of energy. Hydro power stations have inherent ability for instantaneous starting, stopping, load variations etc. and help in improving reliability of power system. Hydro stations are the best choice for meeting the peak demand. The generation cost is not only inflation free but reduces with time. Hydroelectric projects have long useful life extending over 50 years and help in conserving scarce fossil fuels. They also help in opening of avenues for development of remote and backward areas.

India is endowed with enormous economically exploitable and viable hydro potential assessed to be about 84,000 MW at 60% load factor (1,48,700 MW installed capacity). In addition, 6781.81 MW in terms of installed capacity from small, mini and micro hydel schemes have been assessed. Also, 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. However, only 15% of the hydroelectric potential has been harnessed so far and 7% is under various stages of development. Thus, 78% of the potential remains without any plan for exploitation. [24]

Despite hydroelectric projects being recognised as the most economic and preferred source of electricity, share of hydro power has been declining steadily since 1963. The share of hydro power has been continuously declining during the last three decades.

The hydro share has declined from 44 per cent in 1970 to 25 per cent in 1998. The ideal hydro thermal mix should be in the ratio of 40:60. Because of an imbalance in the hydel thermal mix especially in the Eastern and Western regions, many thermal power stations are required to back down during off peak hours. The capacity of the thermal plants cannot be fully utilised resulting in a loss of about 4 to 5 per cent in the plant load factor.

Indian Energy Planners should come out of their obsession with nuclear power which is grabbing maximum share of energy investment and starving funds for other sources of energy. They should take notice of the data compiled by *World Atlas & Industry Guide*, 2007 and U.S. Energy Information Administration, on **worldwide hydro power** cultivation and installed capacities and generation, China 130,000 (MW) & 440 TWh/year, Canada 70,858 (MW) & 355 TWh/year, Brazil 73,678 (MW) & 351 TWh/year, USA 90,090 (MW) & 270 TWh/year, Russia 46,100 (MW) & 168 TWh/year, Norway 28,691 (MW) & 119 TWh/year and India 35,000 (MW) & 105 TWh/year.

Three Gorges Dam in China is the largest hydro power plant in the world. Whereas, India has harnessed less than 20% of its huge hydro potential of 1,48,701 MW. The writing on the wall is clear. India is going to face wars, internal as well as external, if it fails to harness on a war footing its water resources in harmony with its energy security.

## **Wind**



Global wind power capacity was 238 Gigawatts (GW) at the end of 2011, up from just 18 GW at the end of 2000, with an average growth rate of over 25% over the past five years [25]

Country-wise installed Wind Energy Capacities as of 2009 are - U.S.: 35,159 MW, China: 25,853 MW, Germany: 25,813 MW, Spain: 18,784 MW, India: 10,827 MW, Italy: 4,845 MW, France: 4,775 MW, U.K.: 4,340 MW, Portugal: 3,474 MW, Denmark: 3,408 MW. Thus India stands at fifth position in the world in cultivating wind energy as of 2009. [26]

Having built huge foreign exchange reserves, China has been investing in all forms of energy. China pays considerable attention to the renewable energy and generates at present 50,000 MW of power from wind turbines. India has to invest more on wind power.

## **Solar**

There are two main kinds of solar energy:

- Solar photovoltaic (PV) directly converts solar energy into electricity using a PV cell made of a semiconductor material.
- Concentrating solar power (CSP) devices concentrate energy from the sun's rays to heat a receiver to high temperatures. This heat is transformed first into mechanical energy (by turbines or other engines) and then into electricity – solar thermal electricity (STE)

Over the period 2000-11, solar PV was the fastest-growing renewable power technology worldwide. Cumulative installed capacity of solar PV reached roughly 65 gigawatts at the end of 2011, up from only 1.5 GW in 2000. In 2011, Germany and Italy accounted for over half the global cumulative capacity, followed by Japan, Spain, the United States and China. [27]

In 2011, Germany generated 20% of its total power from renewable energy, with the largest amounts provided by wind and solar. In fact, in May 2012, Germany broke a record by generating 20GW of power at noon, from solar power.

Over the past five years, solar PV has averaged an annual growth rate of over 50%. Growth has been mostly concentrated in a few countries, where PV generates today a few percent of total yearly electricity production. [25]

Cost of Solar photovoltaic (PV) power production has reduced drastically in the past few years.

Concentrated solar power (CSP) is a re-emerging market. Roughly 350 megawatts (MW) of commercial plants were built in California in the 1980s; activity started again in 2006 in the United States, and Spain. At present, these two countries are the only ones with significant CSP capacity, with respectively about 1 GW and 500 MW installed, and more under construction or development. [27]

The geographic location of India makes it a strong candidate for harnessing solar energy. With about 300 clear, sunny days in a year, India 's theoretical [solar power](#) reception, on only its land area, is about 5 Petawatt-hours per year (PWh/yr) (i.e. 5 trillion k [Wh](#)\_/yr or about 600 [TW](#)). The daily average solar energy incident over India varies from 4 to 7 kWh/m<sup>2</sup> with about 1500–2000 sunshine hours per year (depending upon location), which is far more than current total energy consumption. For example, assuming the efficiency of PV (Photo Voltaic) modules were as low as 10%, this would still be a thousand times greater than the domestic electricity demand projected for 2015. However, at present solar energy produced in India is less than 1% of the total energy demand. The grid-interactive solar power as of December 2010 was merely 10 MW. [28]

Thus it is clear, India has abundant wind and solar power. In independent India, while more than 95% of energy research budget went to nuclear, the allocation for solar and wind is not even 1%. Yet, the contribution to the total electrical power production from nuclear is not even 3% of the total production.

Global biofuel production grew from 16 billion litres in 2000, to more than 100 billion litres in 2010. This biofuel provides around 3% of the world's fuel for transport. (In Brazil, biofuel provides 23% of all transport fuel, compared with 4% in the United States and 3% in the European Union).[25]

From above furnished discussion and analysis, it is clear, India can certainly move away from nuclear and build its base power from renewables including hydro, wind, solar and biofuels coupled with energy saving methods.

There is no need for India to clamour for nuclear electricity just because France has 78% and Japan had 30% pre-Fukushima from nuclear. France and Japan do not have hydro and solar potential comparable to India. At present India has only less than 3% of its electricity from nuclear. This is the right time to phase out nuclear power in India instead of climbing more on nuclear power curve and realising at some later date that it is difficult to reduce the dependency on nuclear. Sometimes, it is easy to open a door but difficult to close it again.

Japan is realising now very painfully how difficult it is to reduce its dependency on nuclear from 30% to 15% in a proposed time span, with its economy badly hit by the Fukushima nuclear crisis and with the looming burden of cost of clean- up of radiation contamination and compensation and resettlement of affected people. It is estimated that all of it would cost more than 30 trillion yen over thirty years.

Yes! now and then, we do hear the clarion call like the call from Gorbachev , "To end the vicious cycle of " poverty versus safe environment " , the world must quickly transition to efficient, safe, and renewable energy, which will bring enormous economic, social, and environmental benefits. As the global population continues to expand, and the demand for energy production grows, we must invest in alternative and more sustainable sources of energy - wind, solar, geothermal, hydro - and widespread conservation and energy efficiency initiatives as safer, more efficient, and more affordable avenues for meeting both energy demands and conserving our fragile planet. " [19]

There are right reasons to dispense with nuclear energy in India. Atomic power plants are expensive to build and operate. The cost of the entire fuel cycle, the hidden costs, subsidies, decommissioning costs and the costs to secure the spent fuel should all be considered to know how costly the atomic power plants are. Then there are huge costs if an accident of the type Chernobyl or Fukushima occurs. Very high levels of safety are required to operate and it seems almost impossible to avoid human error. Chernobyl, Three Mile Island and Fukushima happened because of human error.

Thus, basically we can find enough right reasons based on facts and common sense not to use nuclear energy. Fear of radiation need not be the sole reason to shun atomic power plants, though the fear is not irrational since scientific studies have confirmed harmful effects of nuclear radiation.

Therefore, there is meaning in, as well as sound reason for, the agitation against the Koodankulam nuclear power plant. It is immaterial its design is Russian, French or American. The opposition is to the nuclear plant.

Common people of Koodankulam, Idindakarai and other villages are opposing the nuclear power plant and are bearing the brunt of the harsh and unjustified measures of the government determined to commission the nuclear plant. These common people and all those who express solidarity with them are collectively engaged in a task to save not only the present generation of India but also the future generations from the misery of the type the people of Japan are facing right now due to the nuclear crisis at Fukushima Daiichi.

## **Conclusion**

From the above furnished analysis the following things are clear:

- (i) There is an enormous harm in store for India if India becomes a market place and a testing ground for the so called new generation nuclear reactors pursuant to Indo-US Nuclear Deal.
- (ii) If India like Germany decides to give up the pursuit of nuclear electricity and passes a resolution in both houses of Parliament to phase out completely the nuclear reactors in a planned time frame commencing with aged reactors, then there will be sufficient funds to invest in renewable sources of energy, like hydro, solar, wind, biofuels and in energy saving measures. That will help in ensuring the energy security of India. It will certainly save India from a possible unprecedented nuclear crisis of the type Japan is now facing. It will also help India to invest adequately for hydro power so that there will be not only electricity but also the benefit of irrigation and drinking water. The writing on the wall is clear, India is going to face internal and external wars for water.
- (iii) There is an urgent need to purge all the deadwood from DAE, BARC, NPCIL, AERB and other installations under DAE and to reorient AEC and DAE.
- (iv) There is a need in public interest and in the interest of justice to prosecute the concerned public servants who launched Koodankulam Atomic Power Project by ignoring and neglecting the mandatory provisions of Law and the Rules made there under.
- (v) There is a vital need to stop the commissioning and commercialisation of the Unit 1 and Unit 2 of Koodankulam Atomic Power Project till a proper and full examination could be carried out of the compliance of all the mandatory provisions of all the applicable Laws and the Rules made thereunder.
- (vi) The commissioning of the nuclear plant should be suspended till the public had an opportunity to study and express opinion on the reports like Site Evaluation Report (SER), Environmental Impact Assessment (EIA) and the Safety Analysis Report (SAR). There should be an open

scientific discussion on those Reports and an opportunity should be afforded to the public to know whether the safety from all angles has been considered. All this is in consonance with a recent ruling of Bombay High Court on May 11, 2012, "Any project that affects forests and the environment and is in violation of rules or lacks required permissions cannot be permitted to continue." [22].

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### References:

[1] *India must have option of nuclear power: Manmohan Singh*,  
<http://economictimes.indiatimes.com/news/politics/nation/india-must-have-option-of-nuclear-power-manmohan-singh/articleshow/13162573.cms>

[1a] **Q: Did Our 'H' Bomb?**  
<http://www.outlookindia.com/article.aspx?261655>

[1aa] **Pokhran-II Thermo-Nuclear Test: A Failure**  
<http://www.mainstreamweekly.net/article1669.html>

[1b] **Indo-US Nuclear Deal- Some Unexplored Angles**  
<http://www.countercurrents.org/ind-subbarao090306.htm>

[2] **Citizens For A Just Society . vs. Union Of India** , Order dated April 28, 2005 of Bombay High Court in WRIT PETITION (Public Interest) No. 647 of 2005  
<http://indiankanoon.org/doc/705621/>

[3] **"Mega study to track cancer around n-plants"**  
<http://www.indianexpress.com/news/mega-study-to-track-cancer-around-nplants/951850/>

3a) **DNA investigations: Deaths confirm cancer risk near N-reactors**,  
[http://www.dnaindia.com/mumbai/report\\_dna-investigations-deaths-confirm-cancer-risk-near-n-reactors\\_1637359](http://www.dnaindia.com/mumbai/report_dna-investigations-deaths-confirm-cancer-risk-near-n-reactors_1637359)

[3b] **PMANE Expert Panel Meeting's Report – Dec 30, 2011**

<http://www.dianuke.org/pmane-expert-panel-meetings-report-dec-30-2011/>

[4] **“Childhood leukemia around French nuclear power plants – the Geocap study, 2002 – 2007,”**

<http://onlinelibrary.wiley.com/doi/10.1002/ijc.27425/pdf>

[5] **French Nuclear Power Not Safe**, a fully referenced article can be obtained through this site.

[http://www.i-sis.org.uk/French\\_Nuclear\\_Power\\_Not\\_Safe.php](http://www.i-sis.org.uk/French_Nuclear_Power_Not_Safe.php)

[5a] **Solar power generation world record set in Germany**

<http://www.guardian.co.uk/environment/2012/may/28/solar-power-world-record-germany>

[6] **“Priority is to remove irrational fears about radiation: Ratan Kumar Sinha Interview with Chairman, Atomic Energy Commission”**

<http://www.business-standard.com/india/news/priority-is-to-remove-irrational-fears-about-radiation-ratan-kumar-sinha/473927/>

[7] **“Need To Revisit The Role Of Nuclear Power For India 's Energy Security”** Buddhi Kota Subbarao Ph.D, 15 December, 2011, Countercurrents.org

<http://www.countercurrents.org/subbarao151211.htm>

[8] **TATA MEMORIAL CENTRE GOVERNING COUNCIL**

<http://tmc.gov.in/misc/governing%20council%20.htm>

[8a] Japan N-blasts not accidents: Indian experts, [Press Trust Of India](#)

<http://ibnlive.in.com/news/japan-nblasts-not-accidents-indian-experts/146022-3.html>

[9] **“Japan N-blasts not accidents: Indian experts”**, [Press Trust Of India](#)

<http://ibnlive.in.com/news/japan-nblasts-not-accidents-indian-experts/146022-3.html>

[10] **“India's Nuclear Prowess False Claims and Tragic Truths”, MANUSHI**, Volume 109.

[http://www.manushi-india.org/pdfs\\_issues/PDF%20file%20109/4.%20Indias%20Nuclear%20Prowess.pdf](http://www.manushi-india.org/pdfs_issues/PDF%20file%20109/4.%20Indias%20Nuclear%20Prowess.pdf)

OR

[http://www.manushi-india.org/issues/issue\\_cover109.htm](http://www.manushi-india.org/issues/issue_cover109.htm)

[10a] **Bombshell: Japan PM says Japan under nuke dictatorship**

<http://www.dailykos.com/story/2012/05/29/1095555/-Bombshell-Japan-PM-says-Japan-under-nuke-dictatorship>

[11] **Checks of Russian nuclear reactors fail safety hopes - and worse, leaked report reveals,**

[http://www.bellona.org/articles/articles\\_2011/rosatom\\_report](http://www.bellona.org/articles/articles_2011/rosatom_report)

[11a] [http://www.npcil.nic.in/pdf/Final\\_Report\\_Four\\_TFs\\_combined\\_report.pdf](http://www.npcil.nic.in/pdf/Final_Report_Four_TFs_combined_report.pdf)

[11b] <http://www.npcil.nic.in/pdf/presentation.pdf>

[12] **Koodankulam: Prime Minister's Letter to Tamil Nadu Chief Minister Ms Jayalalithaa**

<http://www.dianuke.org/prime-ministers-letter-to-tamil-nadu-chief-minister-ms-jayalalithaa-on-kudankulam/>

[12a] **Kudankulam reactors safest: Central panel**

<http://www.thehindu.com/news/states/tamil-nadu/article2640076.ece>

[12b] **N-expert to head Kudankulam panel**

[http://articles.timesofindia.indiatimes.com/2012-02-10/chennai/31045678\\_1\\_pmane-kudankulam-central-committee](http://articles.timesofindia.indiatimes.com/2012-02-10/chennai/31045678_1_pmane-kudankulam-central-committee)

[12c] **Expert committee may be a ploy: Karunanidhi**, The Hindu, February 6, 2012,

<http://www.thehindu.com/news/states/tamil-nadu/article2863495.ece>

[12d] **"Historical notes". OKB Hidropress**. Retrieved 5 June 2012.

<http://www.gidropress.podolsk.ru/en/about/history.php>

[12e] **"WWER-type reactor plants". OKB Hidropress**. Retrieved 5 June 2012

<http://www.gidropress.podolsk.ru/en/projects/wwer.php>.

[12e1] **Passive safety in VVERs**

<http://www.neimagazine.com/story.asp?storyCode=2060518>

[12f] **Book Review "Normal Accidents"**

<http://www.ohio.edu/people/piccard/entropy/perrow.html>

[12f1] **Global risk of radioactive fallout after major nuclear reactor accidents**

[www.atmos-chem-phys.net/12/4245/2012](http://www.atmos-chem-phys.net/12/4245/2012)

[12g] **Chernobyl disaster**

[http://en.wikipedia.org/wiki/Chernobyl\\_disaster](http://en.wikipedia.org/wiki/Chernobyl_disaster)

[12h] **Chernobyl Accident - The site, accident sequence, Conclusions**

<http://www.oecd-nea.org/rp/chernobyl/c01.html>

[12i] **At Moscow expo, atomic industry makes a strong pitch**

<http://www.thehindu.com/todays-paper/tp-national/article3495066.ece>

[12j] **Poll: Japanese opposition to nuclear power stronger**

[http://www.japantoday.com/category/national/view/poll-japanese-opposition-to-nuclear-power-stronger?](http://www.japantoday.com/category/national/view/poll-japanese-opposition-to-nuclear-power-stronger?utm_campaign=jt_newsletter&utm_medium=email&utm_source=jt_newsletter_2012-06-06_PM)

[utm\\_campaign=jt\\_newsletter&utm\\_medium=email&utm\\_source=jt\\_newsletter\\_2012-06-06\\_PM](http://www.japantoday.com/category/national/view/poll-japanese-opposition-to-nuclear-power-stronger?utm_campaign=jt_newsletter&utm_medium=email&utm_source=jt_newsletter_2012-06-06_PM)

[12k] **zichi** JUN. 05, 2012 - 10:18PM JST,

<http://www.japantoday.com/member/view/zichi>

**Nearly one-third of DPJ lawmakers urge Noda to be cautious about nuclear restarts**

[http://www.japantoday.com/category/politics/view/nearly-one-third-of-dpj-lawmakers-urge-noda-to-be-cautious-about-nuclear-restarts#comment\\_1324193](http://www.japantoday.com/category/politics/view/nearly-one-third-of-dpj-lawmakers-urge-noda-to-be-cautious-about-nuclear-restarts#comment_1324193)

[12k1] **Details Emerge About Failures at Fukushima**

<http://theenergycollective.com/dan-yurman/73454/details-emerge-about-failures-fukushima>

[12k2] **Fukushima: A Nuclear War without a War: The Unspoken Crisis of Worldwide Nuclear Radiation**

<http://globalresearch.ca/index.php?context=va&aid=28870>

[12L] **"Stress Test Meeting" Interrupted: Audience's Protest and Poignant Words from A Fukushima Woman**

[https://www.youtube.com/watch?feature=player\\_embedded&v=hLYrZsCQsko](https://www.youtube.com/watch?feature=player_embedded&v=hLYrZsCQsko)

[12m] **NSC head says system flawed / Nuclear risks ignored, govt regulations lax, Diet inquiry told**

<http://www.yomiuri.co.jp/dy/national/T120216005656.htm>

[12n] **AERB Code of Practice on Safety in Nuclear Power Plant Siting,**

<http://www.aerb.gov.in/T/documents/regprocess.pdf>

[13] **“Koodankulam Nuclear Power Plant Is Destined To Reset The Nuclear Priorities In India”,** 16 October, 2011, [countercurrents.org](http://www.countercurrents.org)

<http://www.countercurrents.org/subbarao161011.htm>

[14] **“Should The Koodankulam Power Nuclear Plant Be Commissioned Or Abandoned?”** 08 March, 2012, [Countercurrents.org](http://www.countercurrents.org)

<http://www.countercurrents.org/subbarao080312.htm>

[14a] **Kudankulam plant not to draw water from Pechipaarai dam, Tamirabharani**

<http://www.thehindu.com/todays-paper/tp-national/article3444097.ece>

[15] **Kudankulam Atomic Power Project**

[http://en.wikipedia.org/wiki/Kudankulam\\_Atomic\\_Power\\_Project](http://en.wikipedia.org/wiki/Kudankulam_Atomic_Power_Project)

[16] **INS Arihant is an Indian design: Anil Kakodkar**

The Hindu, Sunday, Aug 16, 2009

<http://www.hindu.com/2009/08/16/stories/2009081655260900.htm>

[16a] **Russia plays hardball on ENR transfer to India**

The Hindu, June 8, 2012

<http://www.thehindu.com/news/national/article3502170.ece>

[17] **Our Nuclear Scam?**, MANUSHI/Issue 108

<http://www.indiatogether.org/manushi/issue108/pokharan.htm>

[18] **Nuclear Power in India**, (Updated January 2012)

<http://www.world-nuclear.org/info/inf53.html>

[19] ‘ **Chernobyl 25 years later: Many lessons learned** ’, Mikhail Gorbachev, *Bulletin of the Atomic Scientists* 2011 67: 77,

<http://bos.sagepub.com/content/67/2/77.full>

[20] **‘Nuclear Power - Still Not Viable without Subsidies.’**, *Union of Concerned Scientists*, February 2011.

[http://www.ucsusa.org/nuclear\\_power/nuclear\\_power\\_and\\_global\\_warming/nuclear-power-subsidies-report.html](http://www.ucsusa.org/nuclear_power/nuclear_power_and_global_warming/nuclear-power-subsidies-report.html)

[21] **Kudankulam plant to sell power at Rs 2.65 a unit;** The Hindu Business Line, May 30, 2012

<http://www.thehindubusinessline.com/industry-and-economy/article3472110.ece>

[22] **HC: cant’ allow projects that affect the environment**, *Hindustan Times*, Mumbai, May 13, 2012

<http://www.hindustantimes.com/India-news/Mumbai/HC-cant-allow-projects-that-affect-the-environment/Article1-854942.aspx>

[23] **Protests in London against Kudankulam project**, LONDON, May 19, 2012, The Hindu,

<http://www.thehindu.com/todays-paper/tp-international/article3434501.ece>

[24] **Hydro Potential of India**,

[http://www.nhpcindia.com/English/Scripts/Hydro\\_Scenario.aspx](http://www.nhpcindia.com/English/Scripts/Hydro_Scenario.aspx)



[25] **International Energy Agency site FAQ: Renewable Energy**  
<http://www.iea.org/aboutus/faqs/renewableenergy/>

[26] **2009 Renewable Energy Data Book, published August 2010**  
[http://www1.eere.energy.gov/maps\\_data/pdfs/eere\\_databook.pdf](http://www1.eere.energy.gov/maps_data/pdfs/eere_databook.pdf)

[27] **International Energy Agency site Solar (PV and CSP)**  
<http://www.iea.org/topics/solarpvandcsp/>

[28] **Solar power in India** [http://en.wikipedia.org/wiki/Solar\\_power\\_in\\_India](http://en.wikipedia.org/wiki/Solar_power_in_India)