RNI. MAHMUL02805/2010/33461
Interlink Research Analysis
IMPACT FACTOR 6.20
ISSN 0976-0377
Issue : XXII, Vol. X, July 2020 To Dec. 2020

Jaitapur Nuclear Power Project Issues and Concerns

Dr. D. V. Raje
Dept. of Physics,
Rajarshi Shahu Mahavidyalaya (Autonomous),
Latur, Dist. Latur

4 Research Paper -Physics

ABSTRACT

This paper highlights on challenges and prospects in Jaitapur to Nuclear Power Project. Hence by considering these facts researcher has tried to see pros and cons for inhabitants and to the environment. Hence, this paper covers remedies and suggestions on the said problems.

Keywords : Jaitapur, Nuclear, Power, displacement, benefits and suggestions

Introduction :

Jaitapur Nuclear Power Plant derived its name From Jaitapur lighthouse which is mentioned in many international maps. Government of India has decided to promote nuclear power at a large scale in view of rapidly rising demand for electricity, limited and depleting fossil resources, environmentally benign and safe nature of nuclear power etc. Accordingly, Government of India accorded its sanction in October 2005 to set up the Nuclear Power Plant at Jaitapur besides three other locations. The Site Selection Committee recommended setting up a nuclear power plant at Jaitapur, based on the suitability of meeting criteria like which include availability of land vs. population density, available source of cooling water , seismicity, safe-grade elevation at site (flood analysis etc), environment aspects and proper access for transportation of heavy/over-dimensional equipment to plant site. Along with these conditions and based on some other considerations the Government approved Jaitapur site for the establishment of the NPP. The site selection for is carried out by the Site Selection Committee, notified by the

Government of India which selects site for setting up a nuclear power plant, revied various parameters as per the requirements laid down in the code of Atomic Energy Regulatory Board and the laid-down criteria. The Jaitapur site is not considered earthquake-prone. As per seismic zoning map of Government of India, Jaitapur site falls within zone III. The longitude and latitude of the land covered for Jaitapur nuclear power project are given below:

Latitude of JNPP site: 16° 34' 38" N to 16° 36' 29" N

Longitude of JNPP site: 73° 19' 02" E to 73° 20' 48" E

As per the Atomic Energy Regulatory Board (AERB) codal requirement, there should not be any active fault within 5 km radius from the proposed site of an NPP. Further, based on the studies carried out by various government institutes/ organisations, there is no active fault found up to 30 km radius from JNPP site. Hence, the site is not considered earthquake-prone. This is to further confirm that based on the available data of seismicity prevailing in the geographical region, all the structures, buildings and equipments of JNPP would be designed to qualify the "ground motion acceleration"

One unit of 1650 MWe plant operating at full capacity shall generate 36-39 million units per day. Presently, generation capacity of six units is 1650 MWe capacity each. Evolutionary Pressurised Reactors (EPR) from AREVA, France is under consideration of the Government of India. There will be six reactor units of 1650 MWe each at JNPP. The distance between each adjacent reactor unit is planned to be 250-300 meters. 5 to 6 months' time is required to declare commercial operation after completion of construction. The time required for completion of each unit is approximately six years from the start date. Approximately all the six units of 1650 MWe each will be constructed in a twin-unit mode in phased manner and implemented in a period of 15-18 years. The guaranteed life of the proposed plant is 60 years. This plant will be "PWR-type", based on enriched uranium fuel. Irrespective of the fuel type, all the safety guidelines based on International Atomic Energy Agency (IAEA)/Atomic Energy Regulatory Board (AERB) regulations are strictly adhered to by NPCIL to ensure that there is no adverse effect on environment, health and life of people through air, sea and land as a result of the operation of the NPP. Theuranium will be supplied by AREVA,

France, which will be also supplying the reactor units. The fresh water requirement of the plant units and the proposed residential complex of JNPP will be met from a desalination plant facility installed by (NPCIL).

REVIEW OF LITERATURE :

Time scales in the nuclear world vary greatly. Some nuclei decay to form another nucleus on the time order of 10-20 seconds. There are however vast number of nuclei with lifetimes of minutes or hours, but sometimes lifetimes can be more than millions of years or longer for stable elements. (Krane, 1988)

Many heavy nuclei decay through alpha decay process, but even though alpha decay is important, in nuclear reactor the fission products usually have excess amount of neutrons. Due to this, fission products usually decay through beta decay. As mentioned, gamma-decay is usually involved in decay- or fission-process and therefore very common in nuclear reactor. All of these decay processes contribute by generating heat, as seen also in used nuclear fuel, which continues 9 to produce heat after taken from a nuclear reactor. (Krane, 1988)

Radioactivity is a property of an element that decays to form another element of isotope. This spontaneous change in the structure of the atom usually accompanied by the emission of alpha or beta particle and/or gamma rays. The rate at which the material is decaying is called the activity of the material. This activity is measured in curies, one curie being 37 billion disintegrations per second. (Suppes & Storvick, 2007)

High radiation doses are deadly to cells, while low doses can damage or alter DNA, the genetic code of the cell. High doses are capable of killing great amount of cells at one time, so that the cell repair system is not able to repair the damage, resulting in damage to organs or tissues triggering Acute Radiation Syndrome. Every individual has a different response to high radiation dose and therefore it is hard to say what amount of radiation is lethal for a human being. However, it is thought that a dose to the whole body of 350-500 rems in a period of minutes to a few hours will result in death for 50% of the population receiving this dose. Effects of low doses, fewer than 10 rems during years, do not cause immediate problems for human body. The problems will be accounted in cell level and problems might surface after 5 to 20 years. (U.S. NRC, 2004)

The storage concept is based on three protective barriers to provide sufficient isolation (SKB, 2009). These barriers are a copper capsule, bentonite-clay and the crystalline bedrock (SKB, 2009). The ceramic form of used fuel itself is one protective barrier, as there is a gas-proof metal surface and uranium inside the fuel elements is in form of solid substance which is not easily dissolved in water (Posiva, 2009).

DISPLACEMENT AND LIVELIHOOD DESTRUCTION :

The project is to be spread over 968 hectares of land, swallowing five villages-Madban, Niveli, Karel, Mithgavane and Varliwada-which together have a population of 4,000. Madban and Varliwada have been identified for the site of the project proper, while Karel, Niveli and Mithgavane would become the township for the project staff. The Department of Atomic Energy (DAE) maintains that the Jaitapur nuclear power park will not lead to any displacement of people, and that much of the acquired land is unproductive. This strains credulity. As we see below, the land in the area supports a thriving agricultural and horticultural economy-and thousands of livelihoods.

People in the Jaitapur area received land acquisition orders in 2007, and by January 2010, the government of Maharashtra had completed the acquisition of 938.026 hectares. Villagers were offered Rs 2.86 per square foot for barren land and Rs 3.70 per square foot for cultivable land. This was subsequently raised to Rs 4 lakhs an acre, and most recently, to Rs 10 lakhs, with the guarantee of one job for every affected family.

However, despite forcible acquisition of land, only 114 out of 2,375 farmer families have claimed the compensation offered; all others have refused to take the cheques. The land acquisition process has been utterly undemocratic and violent at times.

NPCIL has labelled 65 percent of the land as barren. The local population finds this outrageous because the land is highly fertile and produces rice, other cereals, the world's most famous mango (the Alphonso), cashew, coconut, kokum, betel nut, pineapple and other fruits in abundance. Some of the land is also used for cattle-grazing and rain-fed agriculture and is hence productive.

Ratnagiri was declared a "horticulture district" by the Maharashtra government in 2003. Farmers have invested big amounts in horticulture (mainly mangoes and cashew nuts) under government schemes, often with loans. Besides complaints about the

government not recording their plantation crops correctly, people also claim that the compensation for these trees is substantially less than what they earn from them annually. The rate is Rs. 9,386 per tree in case of mangoes, whereas they earn Rs 10,000-15,000 from a single tree annually; and it is Rs 1,989 for a plant of cashew whereas the annual earning per plant is usually Rs 4,000-5,000. As mentioned in a recent report by the Tata Institute of Social Sciences, the government, which now claims that the land is barren, paid compensation of nearly Rs 14 lakhs in 2007 in the same area for the loss of mango production due to floods.

Ratnagiri has 15,233 hectares under mango cultivation, with an estimated annual business turnover of Rs. 2,200 crores. The mango crop is extremely sensitive to the minutest changes in temperature and soil chemistry. The local people apprehend that a good deal of the mango harvest would be lost if the project comes up. Besides farming and horticulture, the Jaitapur-Madban area has a sizeable fishing economy. The fishing population will also be affected, since the plant will daily release a huge 52,000 million litres of hot water into the Arabian Sea. Besides the rise in seawater temperature, tighter security in the coastal region would also restrict fishing severely.

The community leaders fear that once the project becomes operational, its elaborate security arrangements would imperil fishermen's unhindered use of the two creeks of Jaitapur and Vijaydurg, where they get a depth of 20 fathoms, which is usually found at a distance of 2 to 3 nautical miles on other coasts. Altogether, the nuclear park would jeopardise the livelihoods of 40,000 people, including 15,000 dependent on fishing. According to the Maharashtra Macchimar Kruti Samiti, seven fishing villages-Sakhari Nate, Tulsunde, Ambolgad, Sagwa, Kathadi, Jambhali and Nana Ingalwadi-will be threatened by the nuclear power project. The annual fish catch in Ratnagiri district is 1,25,000 tonnes and about 40,000 tonnes comes out of Sakhari Nate.

The annual turnover from fishing in these villages is about Rs 15 crore. In Nate alone, there are 200 big trawlers and 250 small boats. Nearly 6,000 people directly depend on fishing in the area and more than 10,000 are dependent on related or ancillary activities. A sizeable amount of this fish catch is exported to Europe, Japan and other countries. Fish exports are also likely to be affected because produce from the area

might fail the stringent requirements of European "catch certificates" which demand a declaration of the location, depth, temperature, and time of fishing. Not many consumers in the developed countries would relish eating fish or mangoes grown in the neighbourhood of nuclear reactors. Mango consignments from Ratnagiri have been rejected in Japan because traces of pesticides were found in the packaging material.

Besides the population directly dependent on farming, horticulture and fishing, thousands of people in Jaitapur-Madban make their living out of secondary occupations such as mango and cashew processing, trading, transportation, mending of fishing nets, maintenance of various kinds of equipment and machinery which need both skilled and unskilled labour services. In 2006, the area was designated as an Agro-Economic Zone and Tourist Zone by the concerned departments of the state government.

THREAT TO A UNIQUE ECOSYSTEM:

Konkan has been called the "Kashmir of Maharashta" because of its stunning beauty. The Konkan scenario offers a magical combination of mountains and undulating hills, verdant plateaus, creeks, lagoons, the open sea and infinite greenery. There is hardly a square foot of land that is not lush with vegetation. The Konkan ecology contains virgin rainforests and an immense diversity of plant, animal and marine life. Botanists say it is India's richest area for endemic plant species.

Konkan is one of the world's 10 "Hottest Biodiversity Hotspots". The Sahyadri mountains in the Western Ghats are home to over 5,000 species of flowering plants, 139 mammal species and 508 bird and 179 amphibian species, including 325 globally threatened ones.31 Two great peninsular rivers (the Krishna and the Godavari) originate there. The region's ecology is so precious and unique that one would need a diabolically destructive imagination and intent to destroy it by building a nuclear power plant in it.

Jaitapur is located in a seismically sensitive region. It comes under Zone IV as per the earthquake hazard zoning of India, ranging from I to V in growing seismic intensity. This zone is called the High Damage Risk Zone. According to Greenpeace, "Over the past 20 years alone, there have been three earthquakes in Jaitapur exceeding 5 points on the Richter scale. In 1993, the region experienced one reaching 6.3 leaving 9,000 people dead. In 2009, an earthquake caused the bridge to Jaitapur to collapse.

None of this was taken into account when the site was chosen." It is far from clear if the project authorities have evolved the construction parameters such as special reinforcements needed for "earthquake-proofing" the structure to a reasonable degree, and if they have the technical competence to do so. It is not apparent that they have considered the high-magnitude earthquake scenario and based their structural design on it. The Konkan region's rich natural resources are already under severe threat on account of several "development" projects along the Western Ghats-from Panvel in Raigad district, across Madban in Ratnagiri, to Sawantwadi in Sindhudurg. These include 15 coal-based power projects totalling nearly 25,000 MW, 40 medium and small ports, nearly 40 medium and mega Special Economic Zones, major mining projects, and "chemical hubs". The environment minister himself has admitted that the total power generating capacity proposed on a narrow strip of coastal land 50 to 90 km wide and 200 km long is around 33,000 MW.

The gigantic Jaitapur nuclear project will damage this ecosystem irreparably. As the Bombay Natural History Society notes, "the true impact of a project of this scale will never be known" without a comprehensive biodiversity assessment. Water discharged from the plant will be 5 °C hotter than the ambient sea temperature. But "even a 0.5 °C of continual thermal stress will lead to mortality of marine species." The BNHS has also mapped 407 hectares of mangrove vegetation around a 10 km-radius of the nuclear plant.

A recent environmental study of Ratnagiri and Sindhudurg districts by the chair of the Western Ghats Ecology Expert Panel, the renowned environmentalist Madhav Gadgil, sharply criticises the government for violations of environmental laws and norms in Konkan. Gadgil's interim report questions the very logic of setting up so many power projects in an ecologically invaluable yet fragile region. Instead, the report argues for micro- and mini-hydel projects.

* The current energy requirement of these districts is 180 megawatts, while their current production is 4,543 megawatts, so the area is producing vastly more than its own needs.
* The report also holds that the Environmental Impact Assessments (EIAs)

conducted in the region by the government are flawed "almost without exception."

* Comparing solar energy with nuclear and coal-based electricity, the report says it is important "not to rush into environmentally damaging options if there is evidence that much less damaging options are likely to become available in the near future". One of these is tapping the area's mini- and micro-hydroelectricity potential, estimated by former Maharashtra irrigation secretary D R Pendse to be as high as 2000 MW using only 30 percent of he total water available in Konkan for hydel development
* Gadgil also laments the utter disrespect shown by the state agencies for civil rights in pushing for these "development" projects. In fact, his own field trip and consultations with the people in the area had to be cut short because the District Collector had imposed Sec 37(1)(3) of the Bombay Police Act, 1951 prohibiting gatherings of more than five people.

However, none of these environmental concerns figures in the 1,600-page Environmental Impact Assessment (EIA) report prepared by the National Environmental Engineering Institute (NEERI). The EIA report wholly ignores the serious environmental problems posed by nuclear power, including potentially catastrophic accidents and routine radioactivity exposure through effluents and emissions. Nor does it take into account the cumulative environmental impact of numerous project under way, or the ecosystem's carrying capacity.

NEERI has acquired a notorious reputation on account of is sloppy work which favours many promoters of dubious industrial projects. By its own admission, NEERI lacks the technical competence to assess the specific radiation-related hazards of nuclear reactors. Its EIA report does not even mention the issue of radioactive waste and ways of storing it for long periods of time. It is also to be noted that the EIA was conducted for just two rectors; the NPCIL wants to build six EPRs in Jaitapur.

Yet, the Union Minister of State for Environment and Forests, Jairam Ramesh accepted the EIA report and granted environmental clearance to the Jaitapur project with 35 conditions and safeguards on November 28, 2010. Some of these conditions

pertain to studies that should have been conducted much earlier and to safeguards systems that should have been designed well in advance.

Many of Ramesh's conditions are vague. Together, they fail to address the real flaws and deficiencies in the project. Some of them convert valid objections raised to the project-and hence constitute strong grounds for rejecting it-into "conditions". In any case, given the MoEF's past record, it is unlikely that compliance with the conditions will be monitored. The environmental clearance was granted to NPCIL 80 days after it submitted its EIA report, a process that normally takes six months or longer. It wasn't a coincidence that this was this was formally notified less than a week before French President Nicolas Sarkozy's visit to India beginning December 4 last.

The minister tried to avoid questions regarding the clearance by claiming that that he is not competent to pass a judgment on matters related to the need for, and the economics and safety of, nuclear power plants. He reportedly also told activists: "I can't stop the project. It is going to come up because it is not just about energy but also about strategic and foreign policy." Ramesh called it "paradoxical" that environmentalists should oppose nuclear power although it is green and clean, but he dodged questions on the environmental and radiation effects of the project.

EPRS: UNTESTED REACTORS

There are genuine concerns about the safety and viability of the European Pressurised Reactor that are to be imported for the Jaitapur nuclear power "park". Areva's 1650 MWe EPRs are based on the French N4 and German Konvoi-type reactors. However, nowhere in the world has an EPR been fully built or commissioned so far. There are four EPRs in different stages of construction in the world. Two of them are already facing serious financial problems and delay. Areva itself has been going through a devastating financial crisis. In 2009, it sought $4 billion in a short-term bailout from French taxpayers. Its shares plunged by over 60 per cent. Areva sold its first EPR to Finland. This is Western Europe's first nuclear reactor contract since Chernobyl (1986). The reactor has been under construction in Olkiluoto (OL-3) since 2005 and was to be completed by 2009. Several safety, design and construction problems have pushed its start-up to the second half of 2013-a delay of 42 months, with a cost escalation of 90

percent. The OL-3 fiasco has led to the walkout of the German engineering company Siemens from the project and entangled Areva and the Finnish operator in bitter litigation.

* France itself decided to set up the second EPR at Flamanville, and the construction started in December 2007. Issues similar to those at OL-3 have led to a 50 percent cost increase and a delay in commissioning to 2014. Several problems in the reactor design were noted by the French nuclear safety agency. France has also witnessed fierce protests against the EPR in the cities of Rennes, Lyon, Toulouse, Lille and Strasbourg, as well as in Flamanville.
* China has contracted to buy two EPRs, but it is moving cautiously towards completion dates (2013 and 2014).
* Over 3,000 safety and quality problems were recorded with the construction of Olkiluoto-3 by the Finnish safety agency STUK, the French nuclear safety agency Autorité de Sûreté Nucléaire, and the UK's Nuclear Installations Inspectorate.
* In 2009, the United Arab Emirates (UAE) declined Franco-American bids for EPRs which were in an advanced stage of negotiation and awarded a contract for the construction of four non-EPR plants (APR-1400) to a South Korean group.
* Citing deficiencies in EPR's sump design, the US Nuclear Regulatory Commission (NRC) has delayed its design certification to the EPR from June 2012 to February 2013. The sump is part of the reactor's vital emergency core-cooling system. The NRC has also pointed to problems with the EPR's digital instrumentation and control design, as well as with Areva's seismic and structural modelling analysis.
* If the issue of assigning responsibility for the loss caused by the 90 percent cost escalation at Olkiluoto in Finland is not resolved soon, the project could well be abandoned, probably sounding the death-knell for nuclear power in the West.
* The EPR is the world's largest-ever nuclear reactor design and has a much higher density of fission-causing neutrons and fuel burn-up than do normal reactors of 500-1000 MW capacity. EPR's high fuel-combustion rate will lead to greater

production of harmful radionuclides, including seven times higher production than normal of iodine-129, with dangerous implications for radioactivity releases, damage to the fuel cladding, and waste generation.

* India's Department of Atomic Energy has a long history of poor regulation, below-par performance and accidents. Moreover, it has no experience of running huge reactors like EPRs. Existing Indian reactors are up to eight times smaller (220 MWe), the biggest ones being one-third (540 MWe) the size of an EPR (1,650 MWe).

NUCLEAR IS UNSAFE :

India's super-ambitious nuclear expansion plans are based on assumption that a global nuclear renaissance is under way and that nuclear power is the best solution both to the climate change crisis and to the national energy security question. But as we see in the last section, there is no nuclear renaissance worldwide. Nuclear power is in decline. One of the main reasons for this is that nuclear power is unpopular and nuclear reactors are seen as bad neighbours. Nuclear power generation is inevitably fraught with radiation, an invisible and insidious poison, which is unsafe in all doses, however small. Radiation causes cancers and genetic damage, for which there is no cure, antidote or remedy. Nuclear plants expose not just occupational workers, but also the general public to radioactive hazards in numerous ways.

Radioactive wastes of different intensity or level are produced in all stages of the so-called nuclear fuel cycle. Wastes are produced in a nuclear reactor's core. They are created in uranium mining, refining and enrichment, and in fuel fabrication. Handling and transporting nuclear materials also generates wastes. As does the reprocessing of spent-fuel rods which contain vast amounts of dangerous radionuclides. An average reactor generates 20 to 30 tonnes of high-level nuclear waste every year. Even after decades of claims by the nuclear industry, humankind has found no way of safely disposing of nuclear waste. It remains dangerously radioactive and hazardous literally for thousands of years.

For instance, the half-life of plutonium-239, a particularly lethal component of nuclear reactor waste, is 24,000 years. The half-life of uranium 235, the fissile isotope of

The "inalienable" right to "peaceful" nuclear technology, accepted and legalised under the Nuclear Non-Proliferation Treaty, has been held sacrosanct by both political and industry groups. It marks a pivotal self-contradiction in the global non-proliferation regime. "Proliferation-resistant" reactor technology is also an oxymoron. The "closed" nuclear fuel cycle that India is following will allow it to amass a large stockpile of weapons-grade plutonium. India has been reluctant to join negotiations on the Fissile Material Cut-off Treaty (FMCT) on shallow grounds. It recently even blocked a meeting of the International Panel on Fissile Materials (IPFM)-a body of independent scientists. In 2010, the global stock of weapons-grade plutonium was 485±10 tonnes. But just 3 to 8 kilogrammes of this material is enough for a Nagasaki-type bomb. Nuclear power tends to weaken, and even undermine, undermines democracy. Because nuclear technology is strategically "sensitive" in nature, large-scale and centralised energy generation through nuclear power demands and encourages secrecy, and generates vested interests in the form of unaccountable, undemocratic technocratic elite. It effectively turns a constitutional state into a totalitarian one.

The mystique that surrounds high technology amongst the common people and the nationalism and developmental urgency attached to nuclear energy is used to silence, discredit and sideline any opposition. In India's case, the undermining of democratic institutions-from panchayats in the case of Jaitapur to Parliament itself in the case of the Indo-US nuclear deal and the Nuclear Liability Bill-has been rife and open.

ADVERSE ECONOMICS OF THE PROJECT:

Serious questions have been raised about the economic costs of the Jaitapur project based on the extremely expensive European Pressurised Reactors. Each of the six 1,650 MW reactors would cost around $7 billion assuming the capital cost of the EPR being built at Olkiluoto does not escalate beyond the latest estimate of 5.7 billion Euros. This works out to Rs 21 crores per megawatt (MW) of capacity.

This cost estimate, however, does not include fuel costs or maintenance costs. The nuclear industry has devised ways to hide several other costs too-storage of hundreds of tonnes of the nuclear waste generated annually; the cost of reactor decommissioning which could amount to one-third to one-half of the total construction

uranium, is 710 million years! High-level wastes containing isotopes such as uranium-234, neptunium-237, plutonium-238 and americium-241, and also tritium, strontium-90 and caesium-137 etc. are extremely dangerous to humans, other life forms, and generally, to nature. There is no safe or acceptable dose of these radioactive poisons. Even uranium tailings at the mining sites are radioactive and cause serious health problems among the surrounding population. This is callously ignored in India by the DAE despite weighty evidence of the grievous health damage suffered by the people in and around the Jadugoda mines in Jharkhand.

Eminent scientists have warned us on the alarming quantities of nuclear waste being generated, and inadequate mechanisms and practices to handle it in India. But it doesn't seem to be a problem for our environment minister. Nuclear power generation is the only form of energy production that can produce a catastrophic accident like Chernobyl which killed an estimated 65,000 to 105,000 people. All existing reactor types in the world are vulnerable to a core meltdown like Chernobyl, leading to the release of large quantities of radioactivity into the environment. There have been at least 22 major and thousands of minor accidents before and after Chernobyl. Even during the normal operation of nuclear plants, large quantities of radioactive materials are routinely discharged into water and air. Transportation of nuclear material and wastes is also vulnerable to accidents or sabotage.

The safety record of India's nuclear installations is appalling. Fast-Breeder Reactors (FBRs), the poster boy of the Indian nuclear elite, are particularly vulnerable to severe accident risks. The recent radiation leak incident in Mayapuri in Delhi exposed institutional inadequacy to deal with such incidents. Nuclear proliferation risks are inextricably attached to "peaceful" nuclear energy projects. Since Eisenhower's "Atoms for Peace" programme, launched in 1953, many countries have received international assistance in nuclear technology under the civilian garb. Some later used it for their nuclear weapons programmes. In the recent past, the International Atomic Energy Agency (IAEA) warned of the emergence of up to 20 "virtual nuclear weapons states"-countries that have advanced nuclear capabilities, but have stopped short of assembling nuclear weapons.

cost; the extensive additional physical security costs, including anti-aircraft batteries and extra coast guard deployment. Of course, environmental costs, and health costs imposed on miners, plant workers, and the public living close to nuclear installations, and the associated medical expenses, are ignored altogether.

Comparing the likely cost of electricity generation in Jaitapur, based only on the capital cost, with other available options leads us to alarming conclusions. According to the current Finnish estimate, itself conservative, the EPR's capital costs (Rs 21 crores per MW) turn out far more expensive than those of the indigenous CANDU reactors installed at the Rajasthan, Madras, Narora and Kaiga power stations, which are about Rs 8-9 crores per MW. They are and even higher than the capital costs of supercritical coal-fired thermal power stations (Re 5 crores per MW).

Put another way, the six EPRs at Jaitapur will together cost the Indian public about Rs 200,000 crores, even more than the upper limit of the loss caused to the exchequer by the 2G scam estimated by the Comptroller and Auditor General of India at Rs 1,76,000 crores.

The latest EPR cost estimate based on the Olkiluoto reactor may not be the last word on the issue. Several figures have been quoted in different countries for the EPR's capital costs per MW, ranging from Rs 21 crores in Finland and the UAE, to Rs 27 crores in the US and South Africa, to an astronomical Rs 59 crores in Canada.

Depending on the capital cost, quoted from this range, the unit cost of electricity to be generated at Jaitapur would come to Rs 5 to Rs 8 per kilowatt-hour. This is more than double, even triple, the cost of electricity from coal- or gas-fired plants (about Rs 2 to 2.50 a unit). Indeed, nuclear power is far costlier than electricity from renewable sources like wind power, biomass and solar-thermal.

CONCLUSION:

Nuclear technology sector is on the new rise due to the fight against emissions of greenhouse gases. Currently limited research and development budgets will hopefully grow, providing new technologies, with reduction in waste, increase in safety and proliferation resistance, and higher electricity yield. In this paper, technologies used in the world today were in the spotlight, mostly because sustainability for the next 100 years is

attached to technologies used and built today. Some new technologies, mainly traveling wave reactor (TWR) was showcased, as it is currently one of the most interesting technologies from the viewpoint of sustainability. Fusion was not discussed, as it is not seen as a technology for near future.

Technologies which provide sustainability in absolute terms were reviewed, while relative 118 sustainability of current technologies was also shown. Minimal effects to global scale were deemed as number one sustainability goal. Goal number two was to leave as little as possible local waste behind. Third goal was not to deplete the resources of the world. While it is obvious that nuclear power plant is not sustainable in absolute terms, it was competitive against other base-load capacity providing power plants. The main reason for this assessment of better sustainability was due to the high emissions from competitors, which was infringement of the first goal or, if CCS were used, goal number two.

References :-

1. "Jaitapur nuclear plant will be a social disaster: TISS report" , DNA Mumbai, Dec 26, 2010 http://digital.dnaindia.com/epaperpdf%5C27122010%5C26main%20edition-pg3-0.pdf
2. As per our discussion with Dr Milind Desai in Mithgvane village, Jan 07, 2010
3. Social Impact Assessment report by the Tata Institute of Social Science
4. "Jaitapur may jeopardise 15,000 fishermen's livelihood" Sakal Times, Dec . 12, 2010 http://www.sakaaltimes.com/SakaalTimesBeta/20101212/4747658152490648049.htm
5. Ibid.
6. "Fisherfolk join the fight against nuclear plant in Jaitapur " The Hindu, Jan 18, 2010 http://www.thehindu.com/news/national/article81725.ece
7. Areva Drops After Losing U.A.E. Nuclear Plants Bid " Bloomberg, Dec 28, 2010 http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aSlIUIJ6OLEc
8. "EPR design certification delayed", Nuclear News Flash, Jan 14, 2010, http://

www.mail-archive.com/greenyouth@googlegroups.com/msg12533.html

9. "EPR design certification delayed", Nuclear News Flash, Jan 14, 2010, http:// www.mail-archive.com/greenyouth@googlegroups.com/msg12533.html
10. Arjun Makhijani and Scott Saleska, "High-level Dollars, Low Level Sense", http:/ /www.ieer.org/pubs/highlvl1.html
11. M. V. Ramana, Dennis George Thomas and Susy Varughese, "Estimating nuclear waste production in India" Current Science 81(11), December 10, 2001. http://www.ias.ac.in/currsci/dec102001/1458.pdf
12. "Nuclear waste not an immediate problem for India: Ramesh", Rediff News, Jan 03, 2011. http://www.rediff.com/news/report/nuclear-waste-not-a-problem-for-india-jairam-ramesh/20110103.htm
13. "22 Accidents since Chernobyl"Millions against nuclear. http://www.million-against-nuclear.net/background/accidents.htm
14. "Calendar of nuclear accidents", Greenpeace Archives, http:// archive.greenpeace.org/comms/nukes/chernob/rep02.html
15. Ashwin Kumar, "Nuclear Safety: A poor record" Indiatogether, http:// www.indiatogether.org/2007/mar/env-nukesafe.htm
16. Ashwin Kumar and M V Ramana, "Severe accident risk at India's fast breeder nuclear reactor" Bulletin of the Atomic Scientists, July 21, 2009 http:// www.thebulletin.org/web-edition/features/the-safety-inadequacies-of-indias-fast-breeder-reactor
17. Krane, K. S. (1988). Introductory Nuclear Physics. John Wiley & Sons, Inc.
18. Posiva. (2009). Loppusijoitus. Retrieved August 10, 2010, from Posiva web site: http://www.posiva.fi/loppusijoitus
19. U.S. NRC. (2004). Biological Effects of Radiation.
20. Suppes, G. J., & Storvick, T. S. (2007). Sutainable Nuclear Power. Elsevier Academic Press.