Effects of Nuclear Radiation and Various Aspects of Nuclear Power Plant in India

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***Abstract*: Healthy and clean environment is a fundamental right in India, simultaneously in modern time energy requirements are increasing. It is required that dependency on traditional source of energy should be decreased because of environmental and other reasons. Nuclear energy undoubtedly a present day hope for the energy requirement due to rich and eco-friendly source of energy. But this source also contains some danger for human health and wellbeing. It is a basic question before every nation that what safety and regulatory measures should be adopted to secure the safe use of nuclear energy. This article is an attempt to analyse the impact radiations caused by nuclear accidents on human health and environment. It also analyse the international regulatory measures and national legal and policy measures, adopted to combat the nuclear disaster. The article enumerates the liability issue arise due to the enactment of new law in 2010, it analyse the controversy and provide concluding remarks on the issue.**

***Keywords*: nuclear, environment, pollution, protection, judiciary.**

INTRODUCTION

Nuclear power reactors are fuelled mostly with low-enriched and natural uranium, which undergoes a fission chain reaction releasing heat and creating radioactive fission products and plutonium and other transuranic elements. The heat is used to produce steam to drive turbines that produce electricity. Eventually, the concentration of chain reacting isotopes drops to the point where the fuel is considered "spent" and has to be replaced with fresh fuel. The intensely hot and highly radioactive spent nuclear fuel from power reactors is unloaded into a water-filled pool immediately adjacent to the reactor to allow its heat and radiation level to decrease. It remains in this pool for periods ranging from a few years to decades. After cooling, the fuel may be transferred to massive air-cooled dry casks for storage on site or in a centralized facility. In a few countries, spent fuel is sent to a reprocessing plant, where the fuel is dissolved and the plutonium and uranium recovered for potential use in reactor fuel. These processes also produce high-level wastes that contain the fission products and other radioisotopes from the spent fuel -- as well as other streams of radioactive waste, including plutonium waste from the manufacture of plutonium-containing fuel. It is widely accepted that spent nuclear fuel and high-level reprocessing and plutonium wastes require well-designed storage for periods ranging from tens of thousands to a million years, to minimize releases of the contained radioactivity into the environment. Safeguards are also required to ensure that neither plutonium nor highly enriched uranium is diverted to weapon use. There is general agreement that placing spent nuclear fuel in repositories hundreds of meters below the surface would be safer than indefinite storage of spent fuel on the surface. The environmental impact of nuclear power results from the nuclear fuel cycle, operation, and the effects of nuclear accidents. The greenhouse gas emissions from nuclear fission power are much smaller than those associated with coal, oil and gas, and the routine health risks are much smaller than those associated with coal. However, there is a "catastrophic risk" potential if containment fails, which in nuclear reactors can be brought about by over-heated fuels melting and releasing large quantities of fission products into the environment.The most long-lived radioactive wastes, including being evacuated from a 20 km exclusion zone set up around the power plant, similar to the 30 km radius Chernobyl Exclusion Zone still in effect.

HIGH-LEVEL WASTE

The spent nuclear fuel from uranium-235 and plutonium-239 nuclear fission contains more than 100 carcinogenic radionuclide isotopes such as strontium-90, iodine-131 and caesium-137, and includes some of the most long-lived transuranic elements such as americium-241 and isotopes of plutonium. The most long-lived radioactive wastes, including spent nuclear fuel, must be contained and isolated from humans and the environment for hundreds of thousands of years. Disposal of these wastes in engineered facilities, or repositories, located deep underground in suitable geologic formations is seen as the reference solution. The International Panel on Fissile Materials has said: It is widely accepted that spent nuclear fuel and high-level reprocessing and plutonium wastes require well-designed storage for periods ranging from tens of thousands to a million years, to minimize releases of the contained radioactivity into the environment. Safeguards are also required to ensure that neither plutonium nor highly enriched uranium is diverted to weapon use. There is general agreement that placing spent nuclear fuel in repositories hundreds of meters below the surface would be safer than indefinite storage of spent fuel on the surface.

RADIOACTIVE GASES AND EFFLUENTS

Most commercial nuclear power plants release gaseous and liquid radiological effluents into the environment as a by-product of the Chemical Volume Control System, which are monitored in the US by the EPA and the NRC. Civilians living within 50 miles (80 km) of a nuclear power plant typically receive about 0.1μSv per year. For comparison, the average person living at or above sea level reeives at least 260 μSv from cosmic radiation. All reactors in the United States are required by law to have a containment building. The walls of containment buildings are several feet thick and made of concrete and therefore can stop the release of any radiation emitted by the reactor into the environment. Laws also exist that require nuclear power plants to retain all of their nuclear waste within the plant. Therefore, there is no radioactive waste that is released into the environment. If a person is to worry about an energy source that releases large amounts of radiation into the environment, they should worry about coal-fired plants. Hundreds

of tons of uranium and thorium are contained in the ash released into the environment by coal-fired plants. Coal-fired plants are not required to retain their radioactive wastes like nuclear power plants are but rather "expel their radioactive by-products into the environment and expose people to anywhere from one hundred to four hundred times more radiation than nuclear plants do" (Cravens 2007). Coal-fired plants are much more hazardous to people's health than nuclear power plants as they release much more radioactive elements into the environment.

CHERNOBYL DISASTER

As of 2013 the 1986 Chernobyl disaster in the Ukraine was and remains the world's worst nuclear power plant disaster. Estimates of its death toll are controversial and range from 62 to 25,000, with the high projections including deaths that have yet to happen. Peer reviewed publications have generally supported a projected total figure in the low tens of thousands; for example an estimate of 16,000 excess cancer deaths are predicted to occur due to the Chernoby accident out to the year 2065 made by the International Agency for Research on Cancer and published in the International Journal of Cancer in 2006.4 The IARC also released a press release stating "To put it in perspective, tobacco smoking will cause several thousand times more cancers in the same population", but also, referring to the numbers of different types of cancers, The exception is thyroid cancer, which, over ten years ago, was already shown to be increased in the most contaminated regions around the site of the accident. The full version of the World Health Organization health effects report adopted by the United Nations, also published in 2006, included the prediction of, in total, 4,000–9,000 deaths from cancer among the 6.9 million most-exposed former- Soviet citizens. A paper which the Union of concerned scientists took issue with the report, and they have instead estimated, for the broader population, that the legacy of Chernobyl would be a total of 25,000 excess cancer deaths worldwide. That places the total Chernobyl death toll below that of the worst dam failure accident in history.

FUKUSHIMA DAIICHI NUCLEAR DISASTER AND RADIATION EFFECTS

In March 2011 an earthquake and tsunami caused damage that led to explosions and partial meltdowns at the Fukushima I Nuclear Power Plant in Japan. Japanese Fukushima nuclear disaster, authorities shut down the nation's 54 nuclear power plants. As of 2013, the Fukushima site remains highly radioactive, with some 160,000 evacuees still living in temporary housing, and some land will be unfarmable for centuries. The difficult clean up job will take 40 or more years, and cost tens of billions of dollars. Japan towns, villages, and cities around the Fukushima Daichi nuclear plant. The 20.km and 30km areas had evacuation and sheltering orders, and additional administrative districts that had an evacuation order are highlighted. Radiation levels at the stricken Fukushima I power plant have varied spiking up to 1,000 mSv/h (millisievert per hour), which is a level that can cause radiation sickness to occur at a later time following a one-hour exposure. Significant release in emissions of radioactive particles took place following hydrogen explosions at three reactors, as technicians tried to pump in seawater to keep the uranium fuel rods cool, and bled radioactive gas from the reactors in order to make room for the seawater. Concerns about the possibility of a large-scale release of radioactivity resulted in 20. km exclusion zone being set up around the power plant and people within the 20–30 km zone being advised to stay indoors. Later, the UK, France and some other countries told their nationals to consider leaving Tokyo, in response to fears of spreading nuclear contamination. New Scientist has reported that emissions of radioactive iodine and cesium from the crippled Fukushima I nuclear plant have approached levels evident after the Chernobyl disaster in 1986. On March 24, 2011, Japanese officials announced that "radioactive iodine-131 exceeding safety limits for infants had been detected at 18 water-purification plants in Tokyo and five other prefectures". Officials said also that the fallout from the Dai-ichi plant is "hindering search efforts for victims from the March 11 earthquake and tsunami". According to the Federation of Electric Power Companies of Japan, "by April 27 approximately 55 percent of the fuel in reactor unit 1 had melted, along with 35 percent of the fuel in unit 2, and 30 percent of the fuel in unit 3; and overheated spent fuels in the storage pools of units 3 and 4 probably were also damaged". As of April 2011, water is still being poured into the damaged reactors to cool melting fuel rods. The accident has surpassed the 1979 Three Mile Island accident in seriousness, and is comparable to the 1986 Chernobyl disaster. The Economist reports that the Fukushima disaster is "a bit like three Mile Islands in a row, with added damage in the spent-fuel stores", and that there will be ongoing impacts: Years of clean-up will drag into decades. A permanent exclusion zone could end up stretching beyond the plant's perimeter. Seriously exposed workers may be at increased risk of cancers for the rest of their lives.

INTERNATIONAL LAW OF NUCLEAR LIABILITY

Liability for Nuclear disasters is explained in four conventions. They are: The International Atomic Energy Agency's (IAEA) Vienna Conventionof 1963 (since 1977); The Organization for Economic Co-operationand Development's (OECD) Paris Convention on third party liability in the field of nuclear energy of 1960 (since 1968); Brussel's Supplementary Convention of 1963; Convention on Supplementary Convention (CSC) 1997. The very low liability levels which were started with the Paris Convention of SDR 5 million, or €6 million, to SDR 175 million (about €210 million) were adopted by the Brussels Convention. However, by the 1982 Protocol, those levels were raised to SDR 300 million. In 1997, the Vienna Protocol and the Convention on Supplementary Convention (CSC) marked increased limits and set up a somewhat extensive, but still limited, definition of nuclear damage altered to include preventive steps and environmental reinstatement, and changes such as allowing compensation to residents of non-Contracting Parties and making 300 million DRs (about €360 million) the minimum amount that State Parties must make available under national laws, and the CSC would provide for a supplementary fund. On the basis of installed nuclear capacity, the CSC provides for additional funds to be made available through contributions by State Parties collectively and a UN rate of assessment. Although the CSC is not functional yet and is not going to come into force anywhere in the near future, whether or not a State is party to any existing nuclear liability convention or has nuclear installations on its' territory, it may adopt to the CSC.

LEGAL PROTECTION OF NUCLEAR POLLUTION IN INDIA

With a view to control the use of atomic energy, the Indian Parliament enacted the Atomic Energy Act of 1962. The Act deals with control over mining, disposal and concentration of substances containing uranium and the power to obtain information regarding materials, plants and processes. The Act also deals with special provisions with regard to safety. Some of the measures which are supposed to be taken have been serialised in Section 17 (1) (a) (b) (c).

These sub-clauses are being reproduced below:

"17(1) (a) to prevent injury being caused to the health of persons employed at such premises or places or other persons either by radiations, or by the ingestion of any radioactive substance;(b) to secure that any radioactive waste products resulting from such manufacture, production, mining, treatment, storage, or use as aforesaid are disposed of safely;(c) to prescribe qualifications of the persons for employment at such premises or places and the regulation of their hours of employment minimum leave and periodical medical examination: and the rules may, in particular and without prejudice to the generality of this sub-section, provide for imposing requirements as to the erection or structural alterations of buildings or the carrying out of the works."

The provisions of Sections 17 and 21 of the Atomic Energy Act of 1962 came up for consideration before the Supreme Court of India in the case of M.K. Sharma and others v. Bharat Electronics Ltd. and others. The petitioners before the Supreme Court of India were employees of Bharat Electronics Ltd, a public sector undertaking. This company engaged in the manufacture of electronic components and equipment, including integrated circuits, TV picture tubes and sophisticated Radars used by the country's defense establishments. The grievance of the petitioners was that in the course of employment, the employees were being exposed to the ill- effects of X-ray radiation. It was urged that precautionary measures were not being taken by the company. The Supreme Court, in an interim order, directed medical examination of 68 workers who complained of exposure to radiation. It was found that no facility for examination of the petitioners existed in the Indian Council of Medical Research. The Court, accordingly, directed that 68 workers be examined at Bhaba Atomic Research Centre in convenient batches.

The result of the medical examination that was carried out did not show that there was any proof of injury or ill- effect on the workers having been exposed to X-ray radiation. The Court, nevertheless, gave directions for adopting safety measures and for meeting the claims for compensation. It was directed that every workman should be insured for a sum of Rs. 1 lac and the officer should be insured to the extent of Rs. 2 lacks, so that in the event of any accident, the money may be available. This decision was given on 29 April 29, 1987.

Seventeen years have passed since, and the amount of compensation now needs to be reconsidered. For meeting the claims of compensation, the guidelines indicated in the judgment referred to above, i.e., MK Sharma's case, and those given by the Supreme Court while dealing with the Bhopal Gas Tragedy case can be taken note of.

The need to regulate the production and transport of radioactive substances and other related measures is visualized by the Atomic Energy Act, 1962. There are enough guidelines in this regard. It is well settled that guidelines must be found out from the subject matter covering the field. The notification of the discovery of uranium or thorium, control over mining operations, the disposal of uranium, and the power to obtain information are within the scope and ambit of the Atomic Energy Act, 1962. Section 13 provides information with regard to contracts. Section 14 of the Act postulates control over production and use of atomic energy. Restrictions regarding disclosure of information as contained in Section 18 are not specific in nature and identify the areas where such disclosures are prohibited. The powers of the Central Government to make an order in terms thereof are, thus, limited. People's Union for Civil Liberties and Another v. Union of India and Anothers10. Relying of upon the earlier decision in HamdardDwakhana and another v. Union of India and others11 it was held, that the provisions of Section 18 of the Atomic Energy Act, 1962 have not bestowed unguided powers on the Central Government. Sections 13 and 18 of the Atomic Energy Act, 1962 had to be enacted by the Parliament as information in wrong hands can pose a danger not only to the security of the State but to the public at large. Reference in this connection was made to a decision of the Supreme Court of India in Organ on (India) Ltd. and Another v. Collector of Excise and Others12

RADIATION PROTECTION REVIEW BY AERB

The Atomic Energy (radiation protection) Rules, 2004, form the basis of regulatory control activities related to radiation protection. These rules are implemented by the utilities through various procedures. In addition, the AERB practices other measures to exercise control on radiation protection aspects for NPPs, which, among others, include the following:

1. Collective dose budget: The AERB approves the annual collective dose budget for each NPP. The stations are required to propose the budget along with planned activities. The AERB committees review the collective dose expenditure and the proposed budget and, based on the review, formally approve the annual budget within which all the operation and maintenance activities have to be managed.
2. Review of excess exposure cases: Exposure cases exceeding the investigation limits are investigated and reported by the Exposure Investigation Committee set up at each NPP. Such reports are reviewed by the AERB Safety Committees and the Safety Review Committee for Operating Plants. The root causes of such exposures are established and corrective measures are recommended.
3. Regulatory inspection: The adequacy of the radiation protection program and its implementation in the operating NPP are inspected twice a year. The deficiencies are reported and corrective measures are recommended and followed-up through enforcement procedures.
4. Review of the radiological safety aspects

A regulatory body reviews the report on radiological safety aspects of the plant on a quarterly and annual basis.

LIABILITY FOR NUCLEAR DAMAGE

The Civil Liability for Nuclear Damage Act, 2010 provides the civil liability for Nuclear Damage and prompt compensation to the victims of a nuclear accident through a 'No Fault' Liability to operator, and it also includes the liability of supplier. If a nuclear

accident was occurred The Atomic Energy Regulatory Board constituted under the Atomic Energy Act, 1962 shall, within a period of fifteen days from the date of occurrence of a nuclear incident, notify such nuclear incident but the Atomic Energy Regulatory Board is satisfied that the gravity of threat and risk involved in a nuclear incident is insignificant, it shall not be required to notify such nuclear incident. The Atomic Energy Regulatory Board shall, immediately after issuing the notification, cause wide publicity to be given to the occurrence of such nuclear incident, in such manner as it may deem fit. Sec.4 of The Civil Liability for Nuclear Damage Act, 2010 is describe The liability of operator of the nuclear installation for nuclear damage caused by a nuclear incident and sec. 6 of The Civil Liability for Nuclear Damage Act, 2010 is describe The maximum amount of liability in respect of each nuclear incident. Sec. 7 of The Civil Liability for Nuclear Damage Act, 2010 is refer to liability of The Central Government for nuclear damage in respect of a nuclear incident. There can be no two opinions that nuclear stockpile, whether stocked for war or peaceful purposes, is a constant threat to all bodies. There has to be a united global effort in this regard. Humanity should not be left to chance. The belief that nothing can go wrong has proved to be wrong on more than one occasion. Society as a whole must rise to the occasion and build a public opinion, so that generations to come may live in an atmosphere which is free from the threat of nuclear pollution.

CONCLUSION

Development status of a country could be measures in different ways, in these per capita energy consumption is also an indicator. Whole world is now thinking about the unconventional source of energy, because the conventional source is limited and not environment friendly. Nuclear energy is a rich and eco-friendly source of energy, despite this, leakage of radiations is a hidden danger associated with this.

The Sovereign Republic of India in its 60th year of Constitutional Rule of Law is reinventing the liability jurisprudence to detriment of people and for the benefit of MNCs. It can also be condemned because it promotes all terms of MNCs at the cost of people and future generation. The Act is virtually the Corporate Immunity for National Damage Act 2010. It appears that Indian political rulers are apprehending post-nuclear-accident-trauma of foreign corporate bodies and scripting a legal remedy as a sequel to nuclear disaster if happens at all. 'King can do no wrong' was an old British maxim about sovereign immunity in tort (civil wrongs) law. But for modern India, the new maxim is 'MNC can do no wrong'. The jurists and activists are questioning why the state should take responsibility for the damage which might be caused in nuclear accidents resulting from nuclear reactors by enacting self-imposing liability legislation? Whether India is trying to curry favour of US companies by this law, just to secure foreign direct investment or foreign technology and the nuclear reactors to India to increase the generation of nuclear power in future? It is required that the suppliers liability should be fixed towards victims in real sense.

In sum, it must be admitted that safety comes first, while liability comes just right after. Thus, safety-based treaties and legal measures have priority over other questions (such as liability, which must not be underestimated under no consideration). This apt conclusion can expressively symbolize the relevancy of liability issues. Resolving and contemplating of these edifications can significantly foster the acceptance and re-crescendo of nuclear issues. This study dealt with summarizing the cornerstones heading towards this ideal paradigm-shift after the Fukushima accident and its direct consequences.

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