NUCLEAR ENERGY AND ENVIRONMENT

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ABSTRACT

"It is a dangerous myth that nuclear energy is a clean alternative"

-Ian Lowe

Nuclear Energy is consider as the clean source of energy as there is less emission of carbon but in the process of extracting nuclear atom like thorium, plutonium, uranium and many more the carbon emission is more which have negative impact on environment. This kind of process produces waste which are bifurcated into three kinds, they are low, intermediate and high level waste which can have negative impact in environment and human safety. For management these waste the India had adopted the guidelines of International Atomic Energy Agency. The nuclear damage meaning according to the civil liability for nuclear damage act, 2010. Than we discussed about the important issue of nuclear power that is disposal of nuclear waste which harm the environment the most. Then we discussed about other issue of nuclear that safety, health storing radioactive waste, weapons proliferation and terrorism. Then we discuss about the International Atomic Energy Agency report on nuclear power and climate change. The main issue related to nuclear activities and installation is related to safety. There is very poor public awareness of the issues and there is no transparency. Also the regulatory body is not functionally Independent, i.e. Atomic Energy Regulatory Board is dependent on Department of Atomic Energy. So clearly there is no separation between the functions of the regulatory body and the organization which is concerned with promotion of nuclear energy. It is important to undertake a study of the status of Atomic Energy Regulatory Board and the effectiveness of this board as a regulator of India because of the Issues of risks and safety issues which could lead to very disastrous environmental Impact. The main impact of nuclear power is discharge of cooling water into sea, and nuclear waste. High level nuclear safety and radiation safety is the key requirement to manage environmental impact of nuclear energy.

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INTRODUCTION

Nuclear is obtained by nucleus of atom, minerals like uranium, thorium, radium, plutonium, lithium, beryllium and zirconium.[3]Uranium is the best mineral for nuclear energy but in India it is not in large amount whereas Thorium is present in large amount in India but there is no mature technology for this mineral.There are two process of extracting it, they are fission and fusion. In the process of fusion energy is released when atoms are combined or fused together to form are large atom. In the process of fission the atoms are split into parts to form a smaller atoms which releases energy. The nuclear energy is converted through the fuel cycle, there are eight stages:

1. Mining and milling- In this stage uranium is mined, the ores are converted into fine powder by crushing them and then there are converted into uranium oxide;
2. Conversion- In this stage the uranium oxide is converted into uranium hexafluoride with the help of chemical transformation;
3. Enrichment- In this stage the highly fissionable U-235isotope is increased from natural level of 0.7% to 0.4%;
4. Fuel fabrication- In this stage enriched UF6 is converted into uranium dioxide powder and pressed into pellets that are inserted into zirconium to form fuel rods;
5. Electricity generation- In this stage the electricity is generated from the fuels;
6. Interim spent fuel storage- In this stage the spent fuel assemblies taken from the reactor and stored in the special pools which are located plant site so the heat and radioactivity is decreased. The fuel which is removed from the reactor is stored in a water-filled spent fuel for a year or more to reduce the temperature and from shielding it from radioactivity;
7. Reprocessing of spent fuel- In this stage plutonium, other type of mineral from which nuclear is obtained is always found with other minerals, and uranium is separated; and
8. High-level waste disposal- It is last stage, in this stage spent fuel which is not reprocessed is encapsulated in corrosion resistant metals that is buried is buried in deep underground rock structure.[4]

[3]Radioactivity in Minerals, (18 January, 2019, 9:00am)http://webmineral.com/help/Radioactivity.shtml#.XEmd7fkzbIU.
[4]The Nuclear Fuel Cycle, (18January, 2019, 9:15am)http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/nuclear-fuel-cycle-overview.aspx.

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In India initially there was no institution which work on the subject of nuclear so the first nuclear institute was established in 1945 with the initiative of Dr. H. Bhabha with the collaboration of Tata group, J.R.D. Tata' s son, named Tata Institute of Fundamental Research. This institute research in nuclear physics and cosmic rays. In 1954, the area of nuclear energy grows and there was need for the new laboratories and research in this sector so new institute was established name, Atomic Energy Establishment, Trombay (AEET) and when Dr. Bhabha died in 1966, then Prime Minister Indira Gandhi changed the name of this institution into Bhabha Atomic Research Centre.[5] In this institution there is research and development in reactor technologies, fuel reprocessing and waste management.[6]

Nuclear Energy is consider as a clean source of energy as it does not affect the environment as compare to other source of energy like coal, petroleum, extra. It affect the environment at the stage of extraction of the minerals from earth. The use of nuclear energy is electricity, medicine, agriculture and many more.

NUCLEAR ENERGY SCENARIO

In Indian's energy mix, the percentage of nuclear is very less. The development of fast breeder technology which exploits the large part of fuel energy through fuel cycle. As per the National Energy Policy, 2017 the government want to increase the percentage of nuclear energy to 63 GW by 2030. For this the government has change in economic viability, technology, liability and public confidence. The changes in the strategy like India needs fast-track nuclear, modify the functions of Atomic Energy Regulatory Board and this will contribute in the campaign of "Make in India."[7]The development of nuclear energy object is of peaceful uses of nuclear and improve the standards of people. In current time in this sector has multi-dimensional multidisciplinary with sixty-three organizations of Department of Atomic Energy.[8]

Dr. Bhabha established three-stage technologies which aim to optimum utilization of the indigenous nuclear resource profile of modest Uranium and abundant Thorium resources. This three-stage program

[5]Department of Atomic, Bhabha Atomic Research Centre, EnergyAbout BARC, (18January, 2019, 9:30am)http://www.barc.gov.in/about/index.html#.
[6]Department of Atomic, Bhabha Atomic Research Centre, Atomic Energy in India,(18January, 2019, 9:45am)http://www.barc.gov.in/about/index.html#.
[7]NITI Aayog, Government of India, Draft National Energy Policy 47-50 2017.
[8]Nuclear Energy Scenario and Institution, (18January, 2019, 10:15am)https://www.iasscore.in/topical-analysis/nuclear-energy-scenario-institutions.

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based on a closed fuel cycle in which spent fuel of one stage is reprocessed to produce fuel for the next stage.The commercial nuclear power program of the first stage which comprising of PHWR and imported LW is being implemented by Nuclear Power Corporation of India Limited, and the second stage which comprising of Fast Breeder Reactors by company Bharatiya Nabhikiya Vidyut Nigam Limited, both companies owned fully by the union government in accordance with the provisions of the act.

The first nuclear reactor of India was Apsara and currently there are twenty-two reactor. Recently India has entered into an agreement with United States of America, 123 agreement for supplying the reactors in India for this purpose India had passed a new legislation in 2010 that is Civil Liability for Nuclear Damage, 2010.

NUCLEAR ENERGY AND DAMAGE

Nuclear energy is energy in the nucleus of atom. Nuclear is obtained by many minerals like uranium, thorium, radium, plutonium and many more. The process of extracting these minerals causes harm to the environment. There are two process of extracting nuclear. They are nuclear fusion; energy is released when atoms are combined or fused together to form a large atom, and nuclear fission; atoms are split apart to form smaller atoms, releasing energy. The nuclear damage is caused by injury to or the death, sickness or disease to a person or damage to the environment including loss of property which arises from ionizing radiation associated with a nuclear installation, nuclear vessel or handling of radioactive materials. Nuclear safety means the achievement of safe operating conditions, prevention of nuclear accidents or mitigation of nuclear accident consequences, resulting in the protection of workers and the environment against the harmful effects of ionizing radiation or radioactive material.[9]

Nuclear damage is defined under the civil liability for nuclear damage act, 2010 under section 2(g), there are seven sub-sections. The section deals with loss of life or personal injury, property, economic loss, there shall be costs of measures of reinstatement of impaired to environment, there can be loss of income, costs of preventive measures or any other economic loss. These loses shall be

[9] What is nuclear energy? (18January, 2019, 12:30pm) http://www.nnr.co.za/what-is-nuclear-energy/.

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result of ionizing radiation from nuclear installation or nuclear fuel or radioactive products or nuclear material.[10]

NUCLEAR WASTE AND ITS MANAGEMENT

The problem in the nuclear sector are the management of waste, health problem, safety, weapons proliferation and terrissom. In this paper we will focus on the waste management.

Nuclear waste is produce by using the nuclear power plant which generate nuclear waste due to its radioactivity. Nuclear waste is classified into following:

- Low-level waste
- Intermediate level waste
- High level waste

Low-level and intermediate- level waste is known as the reactor waste which is created during the stage of activity and maintenance of nuclear power plant. Structure of plants like pressure vessel and related piping became radioactive substances. At the point when the plant is shut all the reactor waste and decommissioning waste is disposed of. The procedure by which minerals like uranium, thorium, plutonium etc. into nuclear energy is called the fuel cycle. Uranium create the radioactive fission products. Spent atomic fuel is abnormal state atomic waste and will be dealt with in such a way, to the point that it doesn't hurt the biosphere.

REACTOR WASTE

Low-level waste is maintenance waste that has been tainted with radioactive substances. Low-level waste includes, among different objects, protective plastic sheets, apparatuses, protective clothing and towels utilized during maintenance work, as well as motor parts and piping removed from the plant. The compound used in cleaning the coursing water is intermediate-level waste. The yearly amount of reactor waste generated is distinctive of the organization in Finland like Olkiluoto, is from 150 to 200 m^3 and in Loviisa from 100 to 150 m^3. This waste is stored inside the power plant and afterwards in separate interim storage facilities for low and intermediate waste. The waste is sent to a vault facility excavated at the plant site. The waste is sent to the repository through a tunnel with a special-purpose car. When the repository is no longer being utilized, all connections to the store are sealed off. The

[10]Civil Liability for Nuclear Damage Act, 2010 § 2(g) (India).

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radioactive substance contained in the waste lose their unsafe consequences on the environment. The waste poses no threat to the biosphere.

DECOMMISSIONING WASTE

Some nuclear power plant structures become radioactive during the activity, and these structures have to be discarded of when the plant is shut down. The structure is the reactor pressure vessel. The radioactive structures and hardware of the encapsulation plant yet to be commissioned will likewise disposed of.[11]On account of atomic reactors, about 99% of the radioactivity is related with thefuel. Apart from any surface contamination of plant, the rest of radioactivity comes from 'activation item' for example, steel parts which have for quite some time been exposed to neutron irradiation. Their particles are changed into various isotopes such as iron-55, cobalt-60, nickel-63, and carbon-14. The initial two are exceptionally radioactive, emitting gamma beams, but with correspondingly short half-lives so that followinf 50 years from final shutdown their risk is much diminished. Some caesium-137 can also be found in decommissioning wastes.Some piece material from decommissioning might be reused, however for utilization outside the industry very low clearance levels are applied, so most is covered and some is recycled inside the industry.

REGULATORY FRAMEWORK & CONCERNS ABOUT REGULATORY FRAMEWORK

The Atomic Energy Regulatory Board was established for to the development of the programme, which was later reorganized in 1984 to introduce safety regulations in nuclear power plants and other nuclear installations in the nation. It has helped achieve high standards of safety in all aspects of nuclear power reactors from siting to design, construction, commissioning operation and maintenance and renovation and modernization and other activities of the Atomic energy programme in the country. The AERB check the safety and security of the country's Operating Nuclear Power Plants, Nuclear Power Projects, Fuel Cycle Facilities, and Other Nuclear/Radiation Facilities and Radiation Facilities.[12]AERB helps the user to dispose of the disused sources at any authorized waste management agency in the country after

[11] Posiva Oy Olkilluoto, What is nuclear waste? (19 January, 2019, 10:00am) http://www.posiva.fi/en/final_disposal/nuclear_waste_management/what_is_nuclear_waste#.W-150rEzbIU.
[12] Public Accounts Committee 2013-2014, Activities of Atomic Energy Regulatory Board, (19 January, 2019, 10:30am) https://www.aerb.gov.in/index.php/english/regulatory-facilities.

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completing all the regulatory formalities".[13] After the disused source is properly and safely received by the domestic supplier for safe disposal, intimation is sent to AERB."[14]

One of the major concerns regarding any nuclear regulatory framework is the lack of autonomy of the regulator from the nuclear energy establishment. The nuclear regulator, AERB, is not an independent entity, as it depends on the government for funding and expertise, and reports to the Atomic Energy Commission, of which the Chairperson is the secretary of the Central Government's Department of Atomic Energy. The government also appoints the regulatory body's head. As A. Gopalakrishnan, who was former head of the AERB, points out, "Similarly, we have almost all AERB Advisory Committees stacked with vast majority of Ex-DAE personnel, who all jointly skew their opinion mostly in the DAE's favour."[15]

Indeed, these long-standing concerns have found a prominent place in recent reports by India's Comptroller and Auditor General of India (CAG) and the Parliament of India's Public Accounts Committee. Both reports highlighted a number of institutional, safety, performance, and other related issues regarding nuclear regulation in India. Most of the concerns raised by these reports have direct or indirect implications for the larger issue of nuclear security. The CAG report of 2012-13 submitted to the President of India reported the following problems with the functioning of the AERB: –

"The AERB is an authority subordinate to the Central Government, with powers delegated to it by the latter.

- AERB do not have the authority to frame or revise the rules relating to nuclear and radiation safety.

- The amounts of fines are too low to serve as deterrents against offences/contraventions related to nuclear and radiation facilities, which involve substantial risks. Also, AERB had no role in deciding the quantum of penalties and no powers with regard to imposition of the same.

[13] Government of India, Department of Atomic Energy, Lok Sabha Starred Question No.404 Due on 25.8.2010 by Shri Abdul Rahman Regarding Radioactive Material (19 January, 2019, 12:00pm) http://dae.nic.in/writereaddata/lssq404_250810.pdf.

[14] Nuclear Safety Bill to be Taken up in Next Session: Minister, (20 January, 2019, 5:00pm) https://economictimes.indiatimes.com/news/politics-and-nation/nuclear-safety-bill-to-be-taken-up-in-next-session-minister/articleshow/22368276.cms.

[15] A Gopalakrishnana, Nuclear safety regulator: The US model, (20 January, 2019, 5:15pm) https://www.dnaindia.com/analysis/column-nuclear-safety-regulator-the-us-model-1624980.

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-The consenting process and system for monitoring and renewal were found to be weak in respect to radiation facilities which led to a number of radiation facilities operating without valid licenses. [16]

CONCLUSION

In this project we have discuss about the nuclear energy, nuclear waste and nuclear damage. The nuclear damage meaning according to the civil liability for nuclear damage act, 2010. Than we discussed about the important issue of nuclear power that is disposal of nuclear waste which harm the environment the most. Then we discussed about other issue of nuclear that safety, health storing radioactive waste, weapons proliferation and terrorism. Then we discuss about the IAEA report on nuclear power and climate change. Atomic waste is produced at each phase of the nuclear fuel cycle, from uranium mining and enrichment, to reactor activity and the reprocessing of spent nuclear fuel. Much of this nuclear waste will remain hazardous for huge number of years. The current "solution" for meaning with highly radioactive nuclear waste includess burying it in deep underground sites.

Despite India is the fifth-largest producer of electricity, about 40 % of the number of people or population of the country does not have access to electricity today. The per capita utilization of power, which has a immediate correlation with the Human Development Index, is very low at about 700 kWh per annum, about a fourth of world average and way beneath that of advanced countries. There exist deficiencies in energy and peak power in the range 10-15%. Fast economic growth is also critical to accomplish developmental objectives and poverty alleviation. In reality, a sustained economic growth of about 8 to 10% is required over the next few decades. As power is a key driver for economic growth, it is important that there is a massive augmentation in electricity capacity, apart from transmissions and distribution systems. The Integrated Energy Policy of the country projects the requirement for an installed capacity of about 778 GW by the year 2032 for a growth rate of 8%, of which atomic power is envisaged to be about 63 GW by 2032.

[16] Atomic Energy Regulatory Board, Executive Summary (20 January, 2019, 12:00am) https://aerb.gov.in/images/PDF/Annual_report/ar2016/summary.pdf.

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