**Civil nuclear technology-challenges & opportunities**

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February 20, 2021

Civil nuclear technology should be a priority and it is time to shift narrative of nuclear deterrence to peaceful uses of nuclear energy for food, agriculture and medicine (food security, green revolution and health), cheap electricity, applied nuclear medicine, environment & climate change and for revival of industry & industrialization and for society as safe source of energy with a low carbon & reduction in greenhouse gas emissions. In energy sector, there is a dire need of paradigm shift from coal & oil based production to nuclear and hydel energy. This is the way forward to successfully achieve a low carbon, competitive and energy secure system, Nuclear energy is and will be a key in fight against climate change and reduction in greenhouse gas emissions. Pakistan is blessed with abundant resources and deposits of uranium and these resources need to be fully explored & utilized for energy production.

Nuclear Technology involves the nuclear reactions of atomic nuclei. Important nuclear technologies are nuclear reactions, nuclear medicine and nuclear weapons. It is also used in smoke detectors and gun sights. Normally commercial reactors generate energy by burning enriched uranium or plutonium in light water reactions. The first power plant to produce electricity by using heat from the splitting of uranium atoms in the 1950s was by the US. Nuclear energy play an important contribution in providing a significant ratio of the world’s low carbon electricity. Nuclear power has essential uses across multiple sectors including agriculture and food, industry, environment, transport, water resources, customer products, space, medicine and scientific research. There are several other benefits for nuclear technology in addition to creating electricity.

Agricultural workers use radiation to prevent harmful insects from reproducing which will lead to stop insect’s growth and reproduction and finally the world will have more food production. This kind of sterilization occurs without smoking food radioactive or significantly affecting the nutritional value of any food. Irradiation is the best way to kill bacteria and other harmful organisms in raw and frozen food effectively. Food irradiation is the process of exposing food stuff to gamma rays to kill bacteria that cause food-borne disease and to increase shelf life. This technology is becoming popular all over the world to preserve food. Further, irradiation can delay ripening of fruits and vegetables to give them greater shelf life and helps to control pests and reduce required quarantine periods for exports of Pakistani meat, fruits and vegetables. Radioisotopes and radiation are used in food and agriculture and helping to reduce chronic undernourishment as per FAO report of the United Nations (UN).

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Government need to focus on improving food production for food security by improving food sustainability assisted by nuclear and related biotechnologies. Plant mutation breeding is the process of exposing the seeds or cuttings of a given plant to radiation (gamma rays) to cause mutations. The use of radiation essentially enhances the natural process of spontaneous genetic mutation significantly shortening the time it takes. Radiation is used to control insect populations via the sterile insect technique (SIT). SIT involves rearing large populations of insects that are sterilized through irradiation (gamma or x-rays) and introducing them into natural populations.

Medical imaging and nuclear technologies provide images inside the human body and can help to treat disease properly. Nuclear technology and research has allowed medical doctors to predict precisely the amount of radiation needed to kill cancer tumors without damaging healthy cells. Medical research institutes and hospitals sterilize medical instruments and equipments with gamma rays safely including heart valves, surgical gloves, burn dressings and syringes. In medical Science, Diagnostic techniques in nuclear medicine use radiopharmaceuticals or radiotracers which emit gamma rays from within the body. Nuclear medicine images with CT or MRI scans can provide comprehensive views to physicians to aid diagnosis process. An Advantage of nuclear over x-ray technique is that both bone and soft tissues can be images successfully. Nuclear medicine is also used for therapeutic process especially radioactive iodine is used in small amounts to treat cancer and other conditions affecting the thyroid gland. An emerging filed is targeted alpha therapy (TAT) especially for control of disperse cancers. Gamma rays technique is cheaper and more effective than steam heat sterilization .Radiation can be used to sterilize a range of heat sensitive items such as powders, ointments and solutions as well as biological preparations such as bone, skin, nerve etc. used in tissue grafts. The benefits to humanity of sterilization by radiations is tremendous. It is safer and cheaper. Most medical radioisotopes made in nuclear reactors are sourced from relatively few research reactors.

Nuclear technology makes deep space exploration possible. The spacecraft generators use the heat from plutonium to generate electricity and can be operated for years.

Potable water is a major priority in sustainable development for Pakistan in near future. Desalination of seawater, mineralized ground water or urban wastewater is required. Integrated nuclear desalination plants are best option. Water desalination is the method of removing salt from saltwater to make the water drinkable. This method needs a lot of energy. Nuclear energy can provide the large amount of energy that desalination plants need to provide fresh drinking water. According to one survey it is considered that one fifth of the world’s population does not have access to safe drinking water. This technology can play significant role in overcoming this challenge Radioisotopes give such atoms several applications across many aspects of modern day life and this is used as radiation detection instrument. The use of radioactive tracers in environmental science is now routine matter. The function of many common customer products is dependent on the use of small amounts of radioactive material. Smoke detectors, clocks and watches and non-stick materials utilize the natural properties of radioisotopes in their design. Radioisotopes are used by manufacturers as tracers to monitor fluid flow and filtration, detect leaks and gauge engine wear and corrosion of process equipment. Radioactive materials are used to inspect metal parts and the integrity of welds across a range of industries. Carbon dating involves analyzing the relative abundance of naturally occurring radioisotopes is of vital importance in determining the age of rocks and other materials that are of interest to archaeologists, geologists and anthropologists.

Indo-US civilian nuclear agreement have allowed India to have civilian nuclear trade along with the nuclear weapons program recognition and will help India to run for civil nuclear technology program effectively. Pakistan failed to achieve this civil nuclear agreement deal with the US in spite of several sacrifices for the US in the last 70 years. We must enhance Pakistan’s nuclear energy development and food security through civil nuclear technology program. We should explore more venues for collaboration with China and Russia for civil nuclear energy program. Pakistan needs to rethink and revisit its policies to increase capacity of nuclear energy through civil nuclear diplomacy with China and Russia. It will help Pakistan to alleviate its energy crisis and food security and also will produce a positive impact on the climate. Nuclear energy is and will be a key to achieve this target. This will lead toward successful transition to a low carbon emission society, country and nation with a positive image at global level and will impact socio-economic development of country.

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