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REVIEW ARTICLE

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Use Of Nuclear Energy in Medicine and Nuclear Program in Iran

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ABSTRACT

Nuclear technology is technology that involves the reactions of atomic nuclei. Among the notable nuclear technologies are nuclear reactors, nuclear medicine and nuclear weapons. Nuclear medicine and radiology are the whole of medical techniques that involve radiation or radioactivity to diagnose, treat and prevent disease. While radiology have been used for close to a century, "nuclear medicine" began approximately 50 years ago. Today, about one-third of all procedures used in modern hospitals involve radiation or radioactivity. The largest use of ionizing radiation in medicine is in medical radiography to make images of the inside of the human body using x-rays. This is the largest artificial source of radiation exposure for humans. Medical and dental x-ray imagers use of Cobalt-60 or other x-ray sources. A number of radiopharmaceuticals are used, sometimes attached to organic molecules, to act as radioactive tracers or contrast agents in the human body. Positron emitting nucleotides In biology and agriculture, radiation is used to induce mutations to produce new or improved species. Another use in insect control is the sterile insect technique, where male insects are sterilized by radiation and released, so they have no offspring, to reduce the population.

Key words: Radiation , Medicine and Nuclear Technology.

INTRODUCTION

In 1896, Henri Becquerel was investigating phosphorescence in uranium salts when he discovered a new phenomenon which came to be called radioactivity.[1] He, Pierre Curie and Marie Curie began investigating the phenomenon. In the process, they isolated the element radium, which is highly radioactive. They discovered that radioactive materials produce intense, penetrating rays of three distinct sorts, which they labeled alpha, beta, and gamma after the Greek letters. Some of these kinds of radiation could pass through ordinary matter, and all of them could be harmful in large amounts. All of the early researchers received various radiation burns, much like sunburn, and thought little of it.

History nuclear program of Iran

The nuclear program of Iran was launched in the 1950s with the help of the United States as part of the Atoms for Peace program. The participation of the United States and Western European governments in Iran's nuclear program continued until the 1979 Iranian Revolution that toppled the Shah of Iran. After the 1979 revolution, a clandestine nuclear weapons research program was disbanded by Ayatollah Ruhollah Khomeini (1902–1989), who considered such weapons as haram (sinful) and forbidden as unethical and immoral in Muslim jurisprudence. Iran has signed treaties repudiating the possession of weapons of mass destruction including the Biological Weapons Convention,[4] the Chemical Weapons Convention and the Nuclear Non-Proliferation Treaty (NPT). Iran's nuclear program has included several research sites, two uranium mines, a research reactor, and uranium processing facilities that include three known uranium enrichment plants.

Figure 1. Nuclear facilities in Iran.

Iran's first nuclear power plant, Bushehr I reactor was complete with major assistance of Russian government agency Rosatom and officially opened on 12 September 2011. Iran has announced that it is working on a new 360 MW nuclear power plant to be located in Darkhovin. The Russian engineering contractor Atomenergoprom said the Bushehr Nuclear Power Plant would reach full capacity by the end of 2012. Iran has also indicated that it will seek more medium-sized nuclear power plants and uranium mines in the future.[4]

1950 and 1960

The foundations for Iran's nuclear program were laid on 5 March 1957, when a "proposed agreement for cooperation in research in the peaceful uses of atomic energy" was announced under the auspices of Eisenhower's Atoms for Peace program. In 1967, the Tehran Nuclear Research Center (TNRC) was established, run by the Atomic Energy Organization of Iran (AEOI). The TNRC was equipped with a U.S.-supplied, 5-megawatt nuclear research reactor, which was fueled by highly enriched uranium.[55][56] Iran signed the Nuclear Non-Proliferation Treaty (NPT) in 1968 and ratified it in 1970, making Iran's nuclear program subject to IAEA verification.

1970

The Shah approved plans to construct, with U.S. help, up to 23 nuclear power stations by 2000.[57] In March 1974, the Shah envisioned a time when the world's oil supply would run out, and declared, "Petroleum is a noble material, much too valuable to burn ... We envision producing, as soon as possible, 23,000 megawatts of electricity using nuclear plants.


یک‌چهارم گروه
دانشمندان اتمی
ایران خانمها
هستند!
* چگونه میتوان شوهر را با اتم آشتی داد؟
* زنان اتم‌شناس ایران خیاطی و آشپزی را نیز با اندازه کارخویش دوست میدارند

Figure 2. Iranian newspaper clip from 1968 reads: "A quarter of Iran's Nuclear Energy scientists are women." The photograph shows some female Iranian PhDs posing in front of Tehran's research reactor.

U.S. and European companies scrambled to do business in Iran. Bushehr, the first plant, would supply energy to the city of Shiraz. In 1975, the Erlangen/Frankfurt firm Kraftwerk Union AG, a joint venture of Siemens AG and AEG, signed a contract worth $4 to $6 billion to build the pressurized water reactor nuclear power plant. Construction of the two 1,196 MWe, and was to have been completed in 1981. In 1975 Sweden's 10% share in Eurodif went to Iran. The French government subsidiary company Cogéma and the Iranian Government established the Sofidif (Société franco–iranienne pour l'enrichissement de l'uranium par diffusion gazeuse) enterprise with 60% and 40% shares, respectively. In turn, Sofidif acquired a 25% share in Eurodif, which gave Iran its 10% share of Eurodif.

Mohammed Reza Shah Pahlavi lent 1 billion dollars (and another 180 million dollars in 1977) for the construction of the Eurodif factory, to have the right of buying 10% of the production of the site.

"President Gerald Ford signed a directive in 1976 offering Tehran the chance to buy and operate a U.S.-built reprocessing facility for extracting plutonium from nuclear reactor fuel. The deal was for a complete 'nuclear fuel cycle'."[60] The Ford strategy paper said the "introduction of nuclear power will both provide for the growing needs of Iran's economy and free remaining oil reserves for export or conversion to petrochemicals." A 1974 CIA proliferation assessment stated "If [the Shah] is alive in the mid-1980s ... and if other countries [particularly India] have proceeded with weapons development we have no doubt Iran will follow suit.

Post-revolution, 1979–1989

Following the 1979 Revolution, most of the international nuclear cooperation with Iran was cut off. Iran has later argued that these experiences indicate foreign facilities and foreign fuel supplies are an unreliable source of nuclear fuel supply.

At the time of the revolution, Iran was a joint owner in the French Eurodif international enrichment facility, but the facility stopped supplying enriched uranium to Iran shortly afterwards. Kraftwerk Union stopped working at the Bushehr nuclear project in January 1979, with one reactor 50% complete, and the other reactor 85% complete, and they fully withdrew from the project in July 1979.

The United States cut off the supply of highly enriched uranium (HEU) fuel for the Tehran Nuclear Research Center, which forced the reactor to shut down for a number of years, until Argentina's National Atomic Energy Commission in 1987–88 signed an agreement with Iran to help in converting the reactor from highly enriched uranium fuel to 19.75% low-enriched uranium, and to supply the low-enriched uranium to Iran.

In 1981, Iranian governmental officials concluded that the country's nuclear development should continue. Reports to the IAEA included that a site at Esfahan Nuclear Technology Center (ENTEC) would act "as the center for the transfer and development of nuclear technology, as well as contribute to the formation of local expertise and manpower needed to sustain a very ambitious program in the field of nuclear power reactor technology and fuel cycle technology." In 1983, IAEA officials were keen to assist Iran in chemical aspects of reactor fuel fabrication, chemical engineering and design aspects of pilot plants for uranium conversion, corrosion of nuclear materials, LWR fuel fabrication. A former U.S. official said "we stopped that in its tracks." Iran later set up a bilateral cooperation on fuel cycle related issues with China, but China also agreed to drop most outstanding nuclear commerce with Iran, including the construction of the UF 6 plant, due to U.S. pressure.

In April 1984, West German intelligence reported that Iran might have a nuclear bomb within two years with uranium from Pakistan. The Germans leaked this news in the first public Western intelligence report of a post-revolutionary nuclear weapons program in Iran. During the Iran-Iraq war, the two Bushehr reactors were damaged by multiple Iraqi air strikes and work on the nuclear program came to a standstill. Iran notified the International Atomic Energy Agency of the blasts, and complained about international inaction and the use of French made missiles in the attack.

In a 2007 National Intelligence Estimate, the United States Intelligence Community assessed that Iran had ended all "nuclear weapon design and weaponization work" in 2003. In November 2011, the International Atomic Energy Agency (IAEA) Board of Governors criticized Iran after an IAEA report concluded that before 2003 Iran likely had undertaken

research and experiments geared to developing a nuclear weapons capability. A number of Western nuclear experts have stated there was very little new in the report, that it primarily concerned Iranian activities prior to 2003,[15] and that media reports exaggerated its significance. Iran threatened to reduce its cooperation with the IAEA.

2003, the International Atomic Energy Agency (IAEA) first reported that Iran had not declared sensitive enrichment and reprocessing activities. In exchange for suspending its enrichment program, Iran has been offered "a long-term comprehensive arrangement which would allow for the development of relations and cooperation with Iran based on mutual respect and the establishment of international confidence in the exclusively peaceful nature of Iran's nuclear program." Iran's position was endorsed by the Non-Aligned Movement, which expressed concern about the potential monopolization of nuclear fuel production. From the beginning of the 1990s, Russia formed a joint research organization with Iran called Persepolis which provided Iran with Russian nuclear experts, and technical information. Five Russian institutions, including the Russian Federal Space Agency helped Tehran to improve its missiles. The exchange of technical information with Iran was personally approved by the SVR director Trubnikov. President Boris Yeltsin had a "two track policy" offering commercial nuclear technology to Iran and discussing the issues with Washington. In 1991 France refunded more than 1.6 billion dollars, Iran remained shareholder of Eurodif via Sofidif. However, Iran refrained from asking for the produced uranium.

Table 1. The nuclear station in Iran.

No	Station
1	Anarak
2	Arak
3	Ardakan
4	Bonab
5	Bushehr
6	Chalus
7	Darkovin
8	Fordow
9	Isfahan
10	Karaj
11	Lashkar Abad
12	Lavizan
13	Natanz
14	Parchin
15	Saghand
16	Tehran
17	Yazd

RESULT AND DISCUSSION

In 1992 Iran invited IAEA inspectors to visit all the sites and facilities they asked. Director General Blix reported that all activities observed were consistent with the peaceful use of atomic energy. The IAEA visits included undeclared facilities and Iran's nascent uranium mining project at Saghand. In the same year, Argentine officials disclosed that their country had canceled a sale to Iran of civilian nuclear equipment worth $18 million, under US

pressure. In 1995, Iran signed a contract with Russia's Ministry of Atomic Energy to resume work on the partially complete Bushehr plant,[82] installing into the existing Bushehr I building a 915 MWe VVER-1000 pressurized water reactor, with completion expected in 2009.

2002–2006

According to arrangements in force at the time for implementation of Iran's safeguards agreement with the IAEA. Iran was not required to allow IAEA inspections of a new nuclear facility until six months before nuclear material is introduced into that facility. At the time, Iran was not even required to inform the IAEA of the existence of the facility. This "six months" clause was standard for implementation of all IAEA safeguards agreements until 1992, when the IAEA Board of Governors decided that facilities should be reported during the planning phase, even before construction began.

Nuclear power is a type of nuclear technology involving the controlled use of nuclear fission to release energy for work including propulsion, heat, and the generation of electricity Nuclear energy is produced by a controlled nuclear chain reaction which creates heat—and which is used to boil water The medical applications of nuclear technology are divided into diagnostics and radiation treatment. The use of radiation in medicine has been an important tool in diagnosing and treating patients for over a century. For instance, radiation is used in x-ray medical imaging and cancer-treating radiotherapy. Exposure to radiation can harm the health of both patients and medical staff however. With human exposure to ionising radiation in medicine exceeding that of any other man-made source, it is important to have safety standards in place.

Figure 3. Show Use nuclear medicine professions.

Nuclear medicine is a branch of medical imaging that uses small amounts of radioactive material to diagnose and determine the severity of or treat a variety of diseases, including many types of cancers, heart disease, gastrointestinal, endocrine, neurological disorders and other abnormalities within the body. Because nuclear medicine procedures are able to pinpoint molecular activity within the body, they offer the potential to identify disease in its earliest stages as well as a patient's immediate response to therapeutic interventions. In industrial and food applications, radiation is used for sterilization of tools and equipment. An advantage is that the object may be sealed in plastic before sterilization. An emerging use in food production is the sterilization of food using food irradiation. Food irradiation is the process of exposing food to ionizing radiation in order to destroy microorganisms, bacteria, viruses, or insects that might be present in the food. The radiation sources used

include radioisotope gamma ray sources, X-ray generators and electron accelerators. Further applications include sprout inhibition, delay of ripening, increase of juice yield, and improvement of re-hydration. Irradiation is a more general term of deliberate exposure of materials to radiation to achieve a technical goal (in this context 'ionizing radiation' is implied). As such it is also used on non-food items, such as medical hardware, plastics, tubes for gas-pipelines, hoses for floor-heating, shrink-foils for food packaging, automobile parts, wires and cables (isolation), tires, and even gemstones. Compared to the amount of food irradiated, the volume of those every-day applications is huge but not noticed by the consumer.

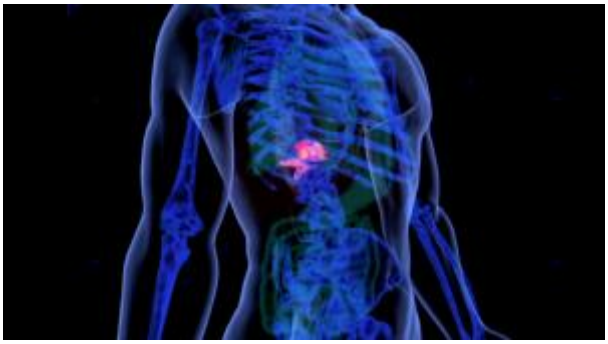

Figure 4. The nuclear medicine in Iran.

Food irradiation is currently permitted by over 40 countries and volumes are estimated to exceed 500,000 metric tons (490,000 long tons; 550,000 short tons) annually world wide.

Figure 5. The nuclear medicine in medicine woman

About Nuclear Medicine at Women's College Hospital

The nuclear medicine division at Women's College Hospital has three gamma cameras, including two new state-of-the-art hybrid SPECT/CT imaging systems. Both diagnostic and therapeutic nuclear medicine procedures are offered. Nuclear medicine at Women's College Hospital specializes in nuclear cardiology, particularly the use of myocardial perfusion imaging in the diagnosis of coronary artery disease. Additional areas of specialty include the diagnosis and treatment of cancers common in women, including breast, thyroid, parathyroid, melanoma and neuroendocrine, as well as injuries related to sports medicine and rheumatologic disorders.

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