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Atomic Energy Organization of Iran

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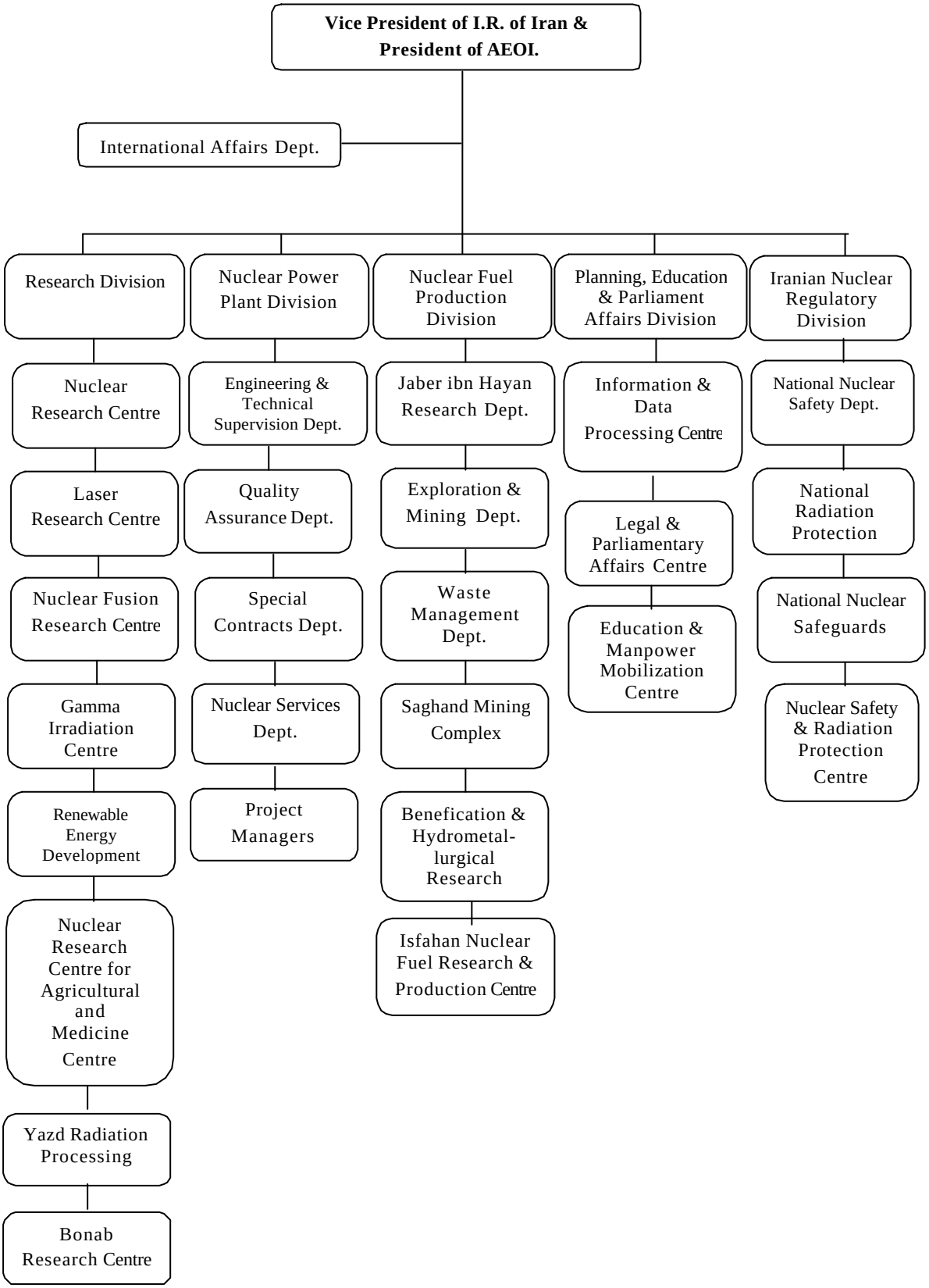
Introduction

Resources of fossil fuel are plentiful, but finite, which will eventually limit the use of these fuels. The Islamic Republic of Iran, with considerable resources of oil and gas, is one of the exporters of primary energy to other countries. However, during the past three decades, due to the ongoing process of social and economic developments, the present strategy of utilizing energy resources in the country is being halted by two unavoidable situations. On the one hand, to meet improving living standards and to support plans to boost GDP, the increasing trend of energy demands from all domestic sectors has to be fulfilled while, on the other hand, the country's economy is largely dependent on foreign currencies earned from oil exports. Under such circumstances, the present trend of utilising such 'depletable' fuels is bound to change, with a view to obtaining long-term and sustainable energy planning for the country. Moreover, the real value of fossil fuels is too great simply to burn them for their heat and, due to the limited life of oil reserves, their availability for future generations must also be considered, so that they may have more options to utilise these currently badly treated treasures.

In view of the above universally accepted facts, and based on the policies of the government of the Islamic Republic of Iran which emphasize the minimum extraction of fossil fuels and coping also with technological progress with a view to the environmental considerations, it is without doubt necessary to develop the utilisation of alternative sources of energy and to move towards a sensible energy policy in the country. As part of this process, the Atomic Energy Organization of Iran (AEOI) has paid much attention to the optimal peaceful use of nuclear energy, and also to its applications in medicine, agriculture and industry.

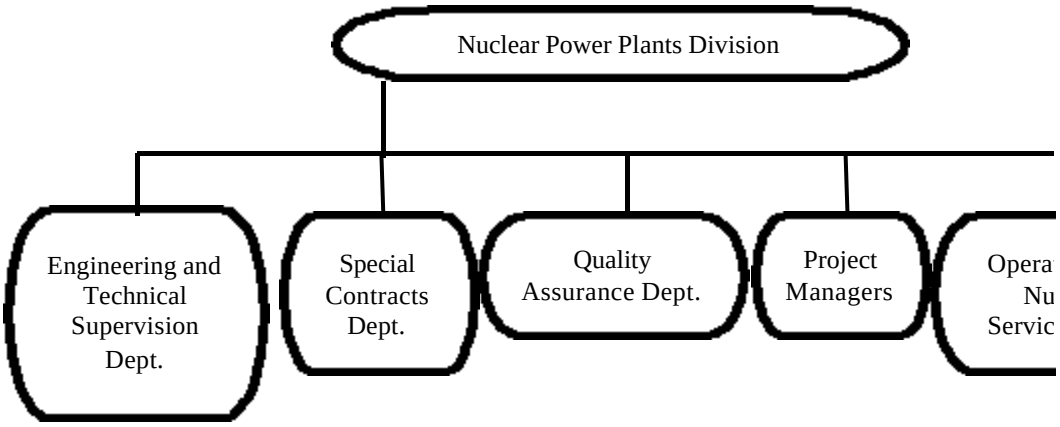
In 1968, an Atomic Research Centre affiliated to Tehran University was established allowing the operation of a 5 MW pool type research reactor. Later, in 1973, the Atomic Energy Organization of Iran (AEOI) was established, primarily to supervise the implementation of a 23 000 MWe nuclear power programme. In 1979, the objectives and priorities of AEOI became subject to thorough fundamental revision. It underwent a complete reorganization with particular emphasis being placed on peaceful research and development. Many new research centres and divisions were established, and the technological and scientific nuclear infrastructures in Iran were greatly enhanced. For nuclear energy production, the Bushehr Nuclear Power Plant with the capacity of 1000 MWe is now under construction.

In this report, I intend to present an overview of the different divisions and departments at AEOI, highlighting their goals, activities and achievements. The AEOI consists of five different divisions, including Research, Nuclear Power Plant, Nuclear Fuel Production, Nuclear Regulatory Authority and Planning, Education and Parliamentary Affairs. Each division consists of several departments with specific organizational charts, as follows:



A brief history of the different divisions and their functions are as follows:

Nuclear Power Plant Division (NPPD)

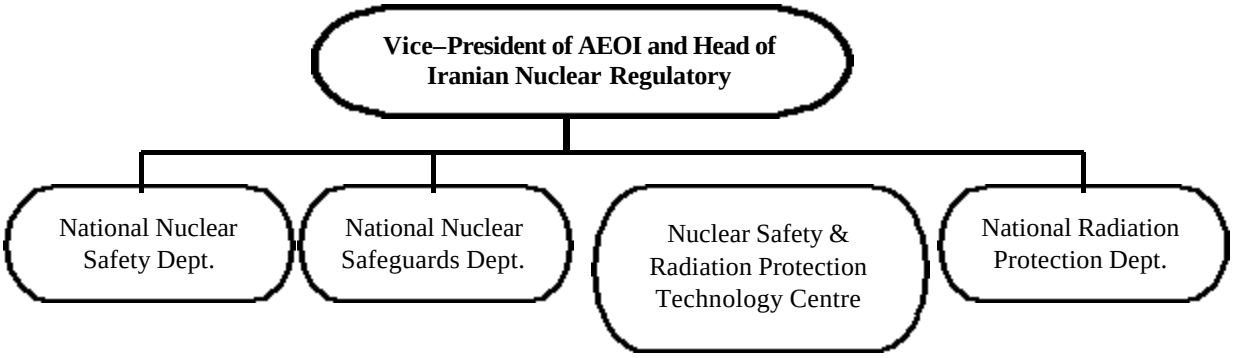


As part of the establishment of AEOI, a Nuclear Power Plant Division (NPPD) was founded. The Nuclear Power Plant Division is responsible for planning, siting, construction, commissioning, decommissioning and safety of nuclear power plants (NPPs). Major functions and responsibilities of NPPD are as follows:

- Preparation and arrangement for government approval of long-term planning of NPPs in the Islamic Republic of Iran (IRI).
- Budget planning and financing for approved NPPs and their operation.
- Development of organizational structures and provision of the necessary expert personnel.
- Measures necessary for the siting, design, engineering, construction, commissioning and operation of NPPs, and arrangements for technology transfer to groups within AEOI and outside AEOI in the Islamic Republic of Iran.
- Arrangements for the safe and reliable operation of NPPs and provision of appropriate security measures for the physical protection of NPP sites.
- The provision of appropriate facilities and equipment for the physical protection and maintenance of NPPs, nuclear materials, and the sites and boundaries of NPPs.
- The development and implementation of crisis management and emergency programmes.

The construction of the first nuclear power plant consisting of two 1230 MWe reactors was started by KWU, and currently completion of one of these reactors by Russian companies is underway and operation expected by 2004.

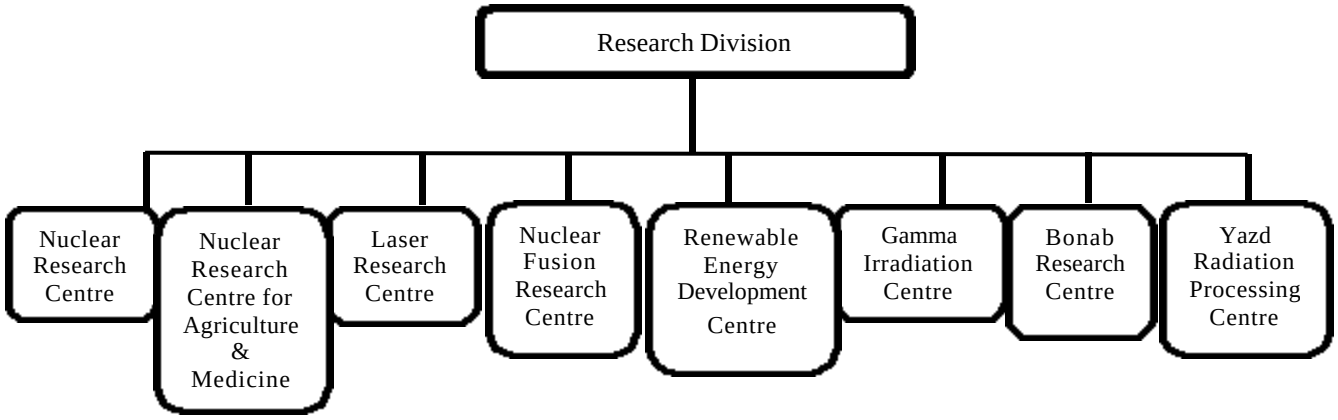
Iranian Nuclear Regulatory Authority



The operation of NPPs, nuclear installations, equipment and instruments using radiation in industry, medicine and agriculture has potentially dangerous consequences. To avoid accidents, which could threaten public health, and to perform technical inspections and supervisions, a regulatory body called the Nuclear Regulatory Authority has been set up.

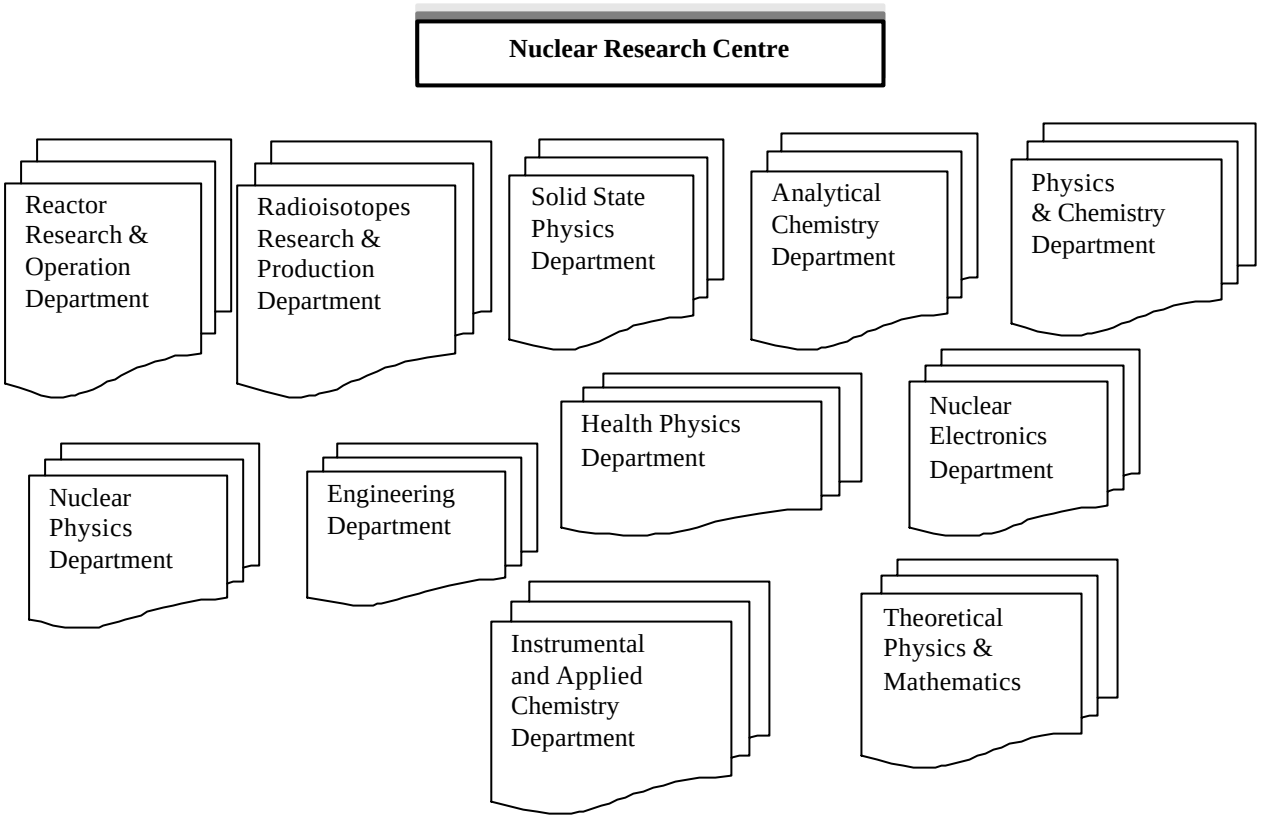
The Nuclear Regulatory Authority is required to prepare the necessary technical standards, regulations and procedures in all fields related to the safety of nuclear installations and radiation protection, and to supervise their application.

Research Division



The Research Division (RD) is responsible for planning and guiding the research projects as well as transferring and developing the peaceful nuclear technologies within the country. All of the approved projects are implemented by the affiliated subdivisions independently.

Nuclear Research Centre



The Nuclear Research Centre (NRC) was established in 1974 in Tehran. Since then the NRC has sought to be a pioneer in nuclear science and technology by engaging in advanced research and development activities. The NRC has a long history of expertise in the field of nuclear science. The centre, in cooperation with the International Atomic Energy Agency (IAEA) in Vienna, works towards the peaceful implementation of atomic energy applications. At present, the NRC consists of 11 departments as reflected in the organization chart.

The NRC has a pool type reactor with a maximum thermal capacity of 5 MW, which operates with LEU fuel. It is used mainly for fundamental nuclear research, such as the study of reactor physics, training and co-operation with universities in the nuclear field and the production of radioisotopes for industrial and medical applications.

In recent years, the production of radioisotopes for radiopharmaceuticals, kits and radio-immuno-assay for medical applications and the production of high specific activity of some other radioisotopes for brachytherapy and industry has been accelerated and increased.

Nuclear Research Centre for Agriculture and Medicine

In 1976, a site of approximately 104 hectares was allocated by AEOI to the Nuclear Research Centre for Agriculture and Medicine at Karaj 40 km west of Tehran. Construction of the infrastructure began in 1986 and the buildings for the

Nuclear Agriculture Research (NAR), Secondary Standard Dosimetry Laboratory (SSDL) and Ion Beam Application (IBA) were completed and became operational in 1991.

The most important accomplishment was the installation of a 30 MeV cyclotron, whose infrastructure and affiliated laboratories took one and a half years to construct and which was completed in 1995. Various radioisotopes such as Ga-67, Ti-201, Kr-81m, FDG-81, for diagnostic purposes in the field of medicine, have been produced and regularly distributed to hospitals throughout the country over the last few years.

At present, NRCAM is constituted of the following departments:

- Nuclear Agriculture Research Dept.
- Cyclotron Accelerator Dept.
- Ion Beam Application Dept.
- Materials Engineering Dept.
- Secondary Standard Dosimetry Laboratory
- Nuclear Electronics Dept.
- Nuclear Medicine Dept.
- Health Physic Dept.

Gamma Irradiation Centre

The facilities of this centre consist of an irradiator system and related laboratories, which provide sterilization of medical supplies and disinfecting services for food and hygiene products. The centre is also involved in research and development in the fields of microbiology, polymer science, food irradiation, high dose dosimetry and environmental monitoring.

Yazd Radiation Processing Centre (YRPC)

The Yazd Radiation Processing Centre (YRPC) is located near the city of Yazd, 700 km south of Tehran, which is becoming a new industrial complex of Iran.

This national irradiation centre will play an important role in supporting the new industries in this area. The electron accelerator is an IBA, type Rhodotron TT200, with outputs of 5 MeV and 10 MeV beam lines and maximum power of 100 kW. It was installed in January 1998.

The aim of this multipurpose facility is to use the results of radiation research in the field of applied radiation chemistry.

E–beam radiation can improve the properties of polymer materials by significantly modifying their chemical structure (cross-linking, grafting, etc.). Improved thermal, chemical and/or mechanical properties are usually obtained from inexpensive and unchlorinated polymers, high energy making it possible to treat large components in their final shape.

In YRPC, by means of a modern polymer laboratory complex, some research and treatments on hot water pipes, halogen–free cables, heat–shrinkable tubes and tapes from 2mm up to 250mm in diameter, mainly for electronic and electrical applications, have been started.

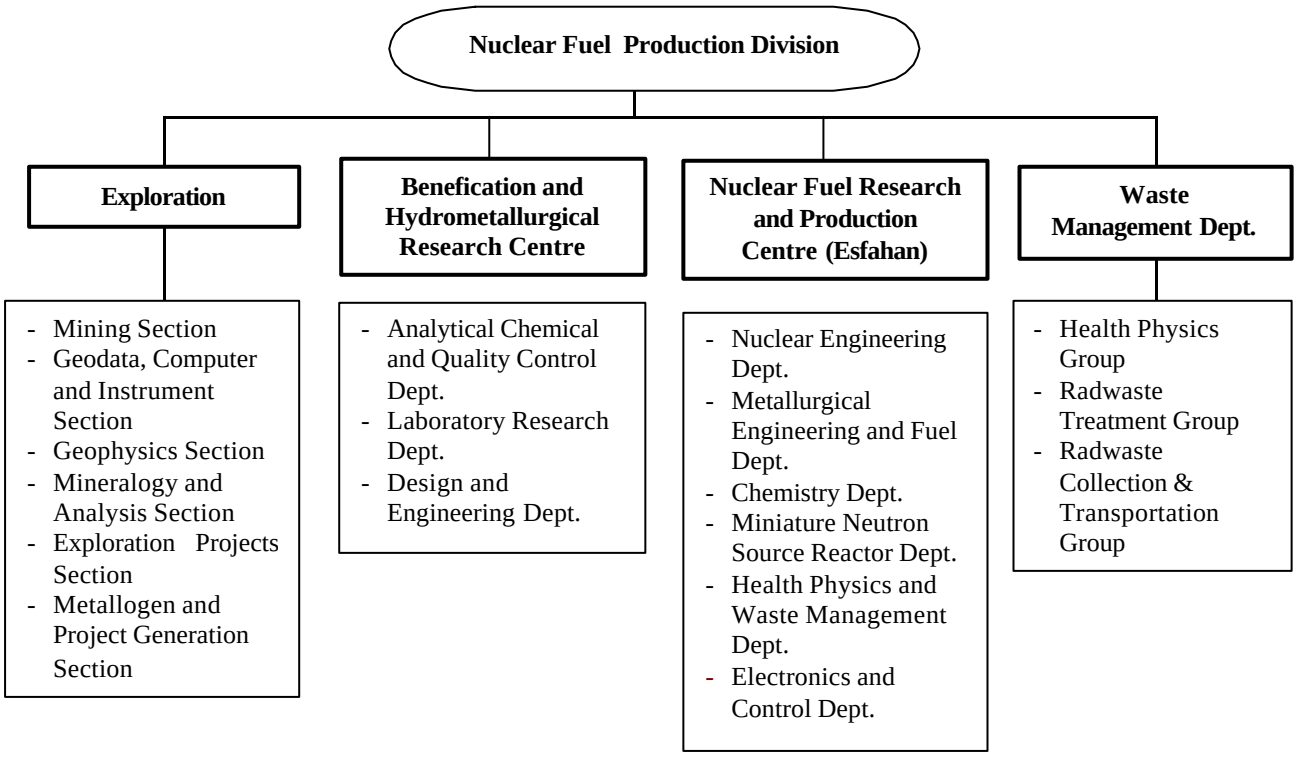
Electron beam sterilization of medical disposable goods (surgical gloves, drapes and gowns, sutures, needles and syringes, bandages, blood transfusion and haemodialysis kits, etc.) offer significant benefits such as:

- it avoids the use of toxic gases, harmful to the environment;
- it permits the sterilization of pharmaceuticals and medical supplies which cannot be subjected to heat;
- it allows sterilization inside the final packaging with no risk of recontamination;
- all stages of production can be carried out under non–sterile conditions.

By international standards, YRCP has one of the most modern microbiology, polymer and dosimetry laboratories for quality control, validation and dose setting, of the various products.

Nuclear Fuel Production Division

Because of importance of uranium and the demand for nuclear energy, the main goal of Nuclear Fuel Production Division (NFPD) of AEOI is research and development in the field of nuclear fuel cycle including: uranium exploration, mining, milling, conversion and nuclear waste management. The implementation of industrial units related to the nuclear fuel cycle for the nuclear power plant at Bushehr is another activity of NFPD.



Uranium exploration began in Iran in support of an ambitious nuclear electric power programme launched in the mid-1970s. The programme continued over the last two decades, despite sharp fluctuations in the level of activities and the suspension of the nuclear power programme for a period of time. The main activities started with airborne surveys conducted by foreign companies and field reconnaissance carried out by AEOI prospectors and geologists.

These surveys covered one-third of the area of Iran. The airborne geophysical data were processed in the form of digital and hardcopy maps by contractors, as well as within the framework of joint projects between AEOI and the IAEA.

This work was followed up by reconnaissance and detailed ground surveys.

The regional and detailed exploration activities were started in the best prospective regions, depending on the available infrastructure and exploration manpower. Follow-up of about one-sixth of the area covered by the airborne surveys led to the definition of a few small prospects.

The existing deposits with RAR and EAR-I resources have been evaluated. The total estimated reserve in the Saghand 1 and 2 (RAR and EAR-I category) is 1367 tonnes uranium. The Bandarabass Calcrete-type, and resources of polymetallic vein-type in Talmesi deposits are estimated at about 200 tonnes U EAR-II. The cost of production of these resources is between US$80-130/kg U.

Regarding the undiscovered conventional resources (EAR-II and SR category), and on the basis of geological setting and the type of host rocks, the following types of uranium resources are expected:

- The most favourable province for uranium prospecting is the central domain, where late Precambrian basement and Pan-African riftogenic series are present.
- Saghand ore, and a few uranium, and uranium-thorium prospects (Narigan, Sechahun, Zarigan and Khoshumi) are located in this region.

There are 3 types of radioactive mineralizations, as follows:

1. Albite-amphibole metasomatite-type with U-TH-REE mineralization.
2. Hydrothermal-metasomatic vein-type with U- (Mo, Y) mineralization.
3. Hydrothermal-type polymetalic-Uranium mineralization.

The first two types belong to the Pan-African Metallogenic stage and the third one is considered as Alpine-type.

Among the known prospects and resources, the Saghand, Narigan, Sechahun and Zarigan are of Pan-African age, while the Talmessi, Khoshumi, Kale–Kafi and Arusan prospects were formed in the Alpine Phase.

Benefication and Hydrometallurgical Research Centre

The Benefication and Research Centre of NFPD has the goal of investigating the mineralogy, mineral processing, benefication, preparation and leaching of

uranium ores, and finally of determining the best methods for benefication, leaching, extraction, precipitation, purification and recovery of the uranium as the final product. This centre consist of two sections, research labs and engineering, which are active in the following areas:

- sampling, crushing, grinding, preparation and mineral processing of all kinds of minerals;
- research and determination of process flow-sheet, for hydrometallurgy of the resources in bench scale and pilot plant;
- research for comparison between lab and pilot-plant conditions;
- expansion of heap-leaching methods, in-place, in-situ and bacteria leaching;
- preparation of technical specification and the layout of pilot plant for production of yellowcake.

Esfahan Nuclear Fuel Research & Production Centre

The Esfahan Nuclear Fuel Research and Production Centre is located in an area approximately 2400 hectares and consists mainly of the following departments:

- Nuclear Engineering Department
- Metallurgical Engineering and Fuel Department
- Chemistry Department
- Miniature Neutron Source Reactor Department

The Nuclear Engineering Department, with modern laboratories, appropriate equipment and technical knowledge, is able to support engineering services in the field of nuclear engineering. A list of laboratories in this department will be found below.

A sub-critical reactor has been established for neutron source strength measurement; neutron activation analysis; measurement of neutron age in H_2O; measurement of diffusion and migration length in H_2O; and measurement of delay neutron precursors.

The Zero Power Reactor is used mainly for absolute neutron flux measurement; relative neutron flux measurement; buckling and reflector saving measurement; cadmium ratio measurement; spectrum parameter measurement; thermal and epithermal spectrum measurement. It has a reference thermal column for neutron spectroscopy.

Extensive progress has been made in this department through a research reactor called 'Miniature Neutron Source Reactor' which is equipped with two pneumatic transfer systems, high sensitive γ-ray spectrometers, a computer and SPAN software. The department has extensive experience in neutron activation analysis, the production of short-lived radioisotopes, and in teaching and training in scientific and research applications.

A wide range of different samples, such as geological, mineral, environmental, industrial, agriculture, life science, medicine, etc. from universities, research institutes, and other industrial centres has been analyzed.

Material Engineering & Fuel Department

The Material Engineering and Fuel Department has modern laboratories, appropriate equipment and technical knowledge and is able to support the following engineering services in the field of metallurgical engineering:

- consultant services in metallurgical engineering; and
- research and laboratory services in fuel and material sciences.

This department has several laboratories, including:

- Mechanical Test Lab.
- Metallography Lab.
- Heat Treatment Lab.
- Corrosion & Electrochemical Lab.
- Fuel Fabrication Lab.

All the sections and centres under AEOI are under regular inspection and supervision by the IAEA, through the visits of expert teams from the IAEA.

The declared policy of the Islamic Republic of Iran is to utilise the peaceful applications of nuclear power for the improvement of lives of its people.