Introduction:

The nuclear industry is relatively young in Iran. Most activities, up to now, have been focused on the research and production of radioisotopes for research, medical and industrial uses. Recently, due to the planning and construction of the Boushehr Nuclear Power Plant (BNPP), this focus is shifting to include activities on nuclear fuel cycle and related industry.

Because of the lack of written documents and acts in this area, I had to arrange several unofficial meetings and discussions with various responsible people, scientific and technical experts in different fields in order to obtain some relatively accurate information in regards to waste management and related topics. This text is intended to briefly summarize the information obtained from the discussions, and is intended to summarize current nuclear activities in Iran. However, as this information is primarily the result of these meetings and discussions, there are not any written documents, acts, or rules in this area.

A. Nuclear Research Center (NRC)

The Nuclear Research Center (NRC) of the Atomic Energy Organization of Iran (AEOI), has a 5 MW pool-type research reactor, the Tehran Research Reactor (TRR), built in 1957 for the production of short-lived radioisotopes. The initial purpose the NRC was to provide a domestic supply of radioisotopes to isotope users, mainly researchers who were importing radioisotopes. This effort was coupled with a program to encourage the use of radio pharmaceuticals in medicine.

By late 1975, the initial aims of the radioisotope program were considered to have been fulfilled and the production of radioisotopes for medical applications is one of the prime
objectives of the AEOI. $^{99m}$Tc is the most widely used radioisotope in the world as well as in Iran, and it is expected to remain so, in the near future. The development of $^{99m}$Tc technology at the NRC not only meet the demands of existing nuclear medicine centers, but helps the country to develop the know how in this valuable area. The output of the project during the past years was the production and supply of $^{99m}$Tc generator and different kits, which is primary objective with the technical assistance of IAEA.

Originally, $^{99m}$Tc generators were produced using $^{99}$Mo that was produced in the TRR by the irradiation of MoO$_3$. Due to the easier availability of fission product $^{99}$Mo from several suppliers, The Radioisotope Production Department (RPD) of NRC now imports $^{99}$Mo from Belgium for the production of $^{99m}$Tc generators and kits. The center currently produces several radio pharmaceutical kits and generators to facilitate a variety of $^{99m}$Tc applications. The NRC also produces several radiopharmaceuticals based on the $^{131}$I radioisotope. The center has also produces high specific activity $^{151}$Cr, $^{32}$P, $^{33}$S, $^{198}$Au colloid, and some other short-lived radioisotopes for research purposes at the mCi level.

B. Nuclear Research Center for Agriculture and Medicine (NRCAM)

In 1986, the AEOI established the Nuclear Research Center for Agriculture and Medicine (NRCAM) as a research center for investigation of the application of nuclear techniques in this area. Construction activities began in 1988, and the buildings for Nuclear Agriculture Research (NAR) and some other buildings were completed in 1991. One of the most important projects at this center, following extensive preliminary attempts for its approval, is the 30MeV cyclotron facility. The cyclotron building and its associated laboratories were commissioned in January 1995. Since commissioning, the cyclotron facility has been used for the production of several short-lived radioisotopes, such as $^{67}$Ga and $^{201}$Tl, for the medicine purposes.

C. Nuclear Medicine Centers and other Industries

There are currently more than 77 Nuclear medicine centers using radio-pharmaceuticals, as well as several industries which are using radioactive sources for non-destructive testing (NDT).
D. Gamma Irradiation Center (GIC)

The Gamma Irradiation Center facilities consist of an irradiation system using a CO-60 source and related laboratories. The GIC is used for the sterilization of medical supplies and disinfecting food and hygienic products. The Center is also involved in research and development in the fields of microbiology, polymer science, food irradiation, high-dose dosimetry, environmental monitoring, and electronics.

E. Boushehr Nuclear Power Plant (BNP)  (*under construction*)

Recently, the government has decided that the AEOI should work to complete the Nuclear Power Plant (NPP) in Boushehr, which is currently under construction using Russian technology. This plant will produce special nuclear wastes which must be taken into account in developing the national waste strategy.

F. Uranium Conversion Facility (UCF)  (*under design*)

The construction and operation of the proposed Uranium Conversion Facility (UCF), and the accompanying outfitting and exploitation of a uranium mine in the central part of Iran will produce another category of nuclear waste which have to treat in special manner. The AEOI has the mission to treat, manage and handle all of the predicted waste streams in the near future.

Nuclear Waste Management:

The goal of this fact sheet is to give some information about waste management (treatment, transportation and disposal) in Iran, specifically for the waste produced at the RPD of NRC, the cyclotron laboratories of NRCAM, and nuclear medicine centers, as well as the projected waste streams from the Boushehr NPP and UCF.

The radioisotopes used for medical purposes are short-lived radioisotopes with moderate and suitable energies. Because of their nature, most of the widely used radiopharmaceuticals should not pose a long term, harmful radiation risk to human health and the environment, provided that they are managed in a scientific manner.

Based on a report (INT/9/081) of the IAEA Radioactive Waste Management Advisory Program (WAMAP) Mission that visited the waste management facilities of
AEOI in May 1990, it seems that there aren’t any powerful regulations for the waste management in Iran. However, all work connected with the management and disposal of these wastes are the responsibilities of the Waste Management Division (WMD), including control and management. The regulatory aspects for waste disposal were based on the U.S. NRC regulations until March/April of 1990, when the first Radiation Protection Act was formulated (only the Persian version is available).

At present, the produced waste streams are primarily low level waste (LLW) and, in smaller quantities, intermediate or medium level wastes (ILW). The waste streams (solid and/or liquid) from the NRC and the NRCAM containing short lived isotopes are stored in several interim repository tanks for decay. After the proper time of delaying and decaying of the existing, short-life radioisotopes to reduce the activity levels to safe values, the waste solutions are discharged to a special existing site at Kavir. This site has certain favorable geological features, and has been selected based on the criteria established by the Geological Department (GD) of AEOI. It seems that further geological and hydrological studies should be carried out on this site. If such investigations show favorable results, then this site can also be used for the disposal of low- and intermediate-level non-NPP wastes.

Fortunately, to date, there have not been any nuclear accidents on the production lines for radiopharmaceuticals at the NRC. The Radiation Protection Department (RPD) and Health Physics Division (HPD) of AEOI cooperate with WMD in all stages of the waste management processes for the nuclear medicine centers’ solid and liquid wastes. It can be conclude that the WMD now has responsibility for the collection of certain solid waste from NRC and other laboratories of AEOI and hospitals for storage at a place about 40km west of Tehran, and for the disposal of some of these wastes, along with the decayed LLW, at the Kavir disposal ground, about 70km east from Tehran.

The waste streams from the cyclotron facility are essentially the same as from the other research and production centers for radiopharmaceuticals, with the exception of $^{65}$Zn, a comparatively longer-lived radioisotope (244 day half life) which is produced as a byproduct from the Cu in the backing layer of the sample (target) holder. As a result, the cyclotron facility has both solid and liquid wastes with a considerable amount of $^{65}$Zn radioisotope. The liquid waste is stored in several 15,000L tanks as an intermediate
storage for two years (at least) to bring the activity level of the radioisotope to a favorable level for discharge. The solid waste, which consists of the backing of the sample holder, is allowed to decay for at least 2 years before disposal or re-use.

Because of the 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, and conversion. As such, it seems that the WMD will have the responsibility for the treatment and management of the projected waste streams from these activities. The implementation of industrial units related to nuclear fuel cycle for nuclear power plants is another activity the of NFPD.

Waste Management Department (WMD)

Radioactive wastes are unavoidably generated during nuclear fuel cycle and from the use of the radioactive materials in research, medicine and industry as well. The most important issues in nuclear technology are the control, transportation, treatment, disposal, and long term storage of these radioactive wastes. The waste management department of the NFPD-AEOI is responsible for dealing with radioactive waste in a manner that is protective of human health and the environment. This is achieved through the proper collection, treatment and disposal of radioactive waste in accordance with the objectives and principles set forth by the IAEA and in the national nuclear safeguard regulations.

The waste management department accomplishes its research and executive tasks under three divisions: Treatment, Health Physics, and Collection. The WMD has a good relationship with IAEA. To date, several projects have been completed or are still progressing under the framework of this relationship, such as the “Construction and commissioning of LLW and MLW treatment facility” (Technical co-operation project with IAEA, 1999-2000) and the “Establishment of a National System for Radioactive Waste Management” (Technical co-operation project with IAEA, 2000-2001). Through this later Technical Co-operation project (2000-2001), this department is planning to establish a national nuclear waste management strategy under the IAEA supervision. In this concern they established four expert groups for preparing technical documents and acts about nuclear waste generated by nuclear research centers and industrial users,
nuclear power plants, mining and milling activities, and the transportation and disposal of radioactive wastes.

Reference:
As mentioned above, all of this information has obtained of some non official discussions and meetings. However, the official web site of the AEOI should be useful: http://www.aeo.org/NewWeb/default1.asp. This site provides a general introduction to the AEOI, as well as contact information for the agency.