THE STATE OF RADIATION PROTECTION IN IRAN

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A national radiation protection authority (NRPA) is a vital need in a country to give proper advice on radiological safety and protection matters and to enforce rules, regulations and standards to reduce exposure of man and his environment from harmful effects of ionizing radiation to a level below which preventing detrimental non-stochastic effects and limiting the probability of stochastic effects while allowing useful applications of radiation to be advanced for human benefit (1). To achieve this goal, the NRPA needs to have governmental authority for regulatory enforcement and it should have a qualified leader, experts, proper equipment and dosimetry services as well as scientific and technical support.

Historically, radiation protection in Iran can be related to when the first x-ray machine was applied for medical diagnosis. However, organized activities were started with the establishment of the Tehran University Nuclear Center (TUNC) in 1959, and within a broader scope when AEOI research reactor went into operation in 1967. Until 1974, the RP activities were limited to those at TUNC and to those requested by medical, industrial and research institutions.

In 1974, the Atomic Energy Organization Law of Iran was ascribed the responsibility for radiological safety and protection to the AEOI (2). Then this responsibility was assigned by AEOI to the Radiation Protection Department (RPD), as the national authority. Its main objectives have been to achieve the following:

-Development of criteria, recommendations, guidelines, rules, regulations and standards in radiological safety and protection,
-Radiation control for production, importation, export, ownership or any other related actions regarding radioactive materials and radiation producing machines in the country including registration, inspection and licensing,
-Reseach and development on methods and techniques of internal and external dosimetry to promote dosimetry services,
-Establishment of nationwide dosimetry services for routine and emergency personal monitoring, environmental measurements, radiation field measurements and instrument calibration,
-Environmental protection due to natural and man-made sources,
-Education and training of radiation workers and public.

The RPD's organization and functions have been divided into three main RPD divisions: 1-Radiation Protection Control, 2-Radiation Dosimetry Research and Development and Services, and 3-Radiological Protection of the Environment, the functions and activities of each division are as follow:

1-Although radiation applications are widely spread in Iran in the fields of medicine, industry, agriculture, nuclear industry, education and research, the applications of x-ray machines and radionuclides in medicine predominates. Many types of sources such as

high acitvity sources, high energy x-ray machines, neutron generators, neutron isotopic sources, x-ray diffractometers, etc. are also applied in industrial radiography, radiation processing, gauging, material analysis, etc. Thanks to the Atomic Energy Law of Iran which has made radiation control program easy due to requirements for prior permission from RPD of AEOI for any transactions regarding radiation producing sources. In fact opening of any credit account in any bank for ordering radiation sources require prior permission from RPD of AEOI. So far as the rules, regulations and standards are concerned, basic radiation protection standards and requirements have been prepared previously which is under revision.

Eight separate sections, forming the Radiation Protection Control Division, have the resposibility over radiology departments, nuclear medicine and test laboratories, research and educational institutions, nuclear facilities, industrial centers, mines and non-ionizing radiation installations, as well as registration and accounting, and medical surveillance. The Medical Section is responsible for periodic examinations of AEOI personnel as well as monitoring medical results of radiation workers across the country and examinations of individuals overexposed. Non-ionizing radiation control is not well established yet, however efforts are being done to enforce NIR regulations. The division also provides dosimetry measurments and calculations for pregnant women with medically exposed fetus. Efforts have been done by TV programs as well as journal articles and posters to reduce such unwanted exposures (4). Also genetically significant dose due to medical exposure by x-rays was surveyed and found to be about 0.1 mSv (5).

2-Radiation dosimetry research and development to provide nationwide dosimetry services for public and radiation workers is the prime responsibility of this division. Five sections deal with different aspects of dosimetry for beta, x and gamma, neutrons, alpha particles, etc. using film badges, thermoluminescence dosemeters, soild state nuclear track detectors, ionization chambers, etc. for personnel and environmental dosimetry as well as radiation field measurements and calibration of instruments.

A film badge service provides personnel monitoring services to about 7500 persons from 1200 institutions as well as doing research and development (6). This service was established by TUNC in 1960 and it was transfered to AEOI in 1974. A thermoluminescence laboratory also gives dosimetry services to some groups of radiation workers as well as environmental monitoring. For neutrons and charged particle monitoring, solid state nuclear track detectors are used based on research and development done at AEOI (7-9). A neutron dosimetry service is being developed based on multi-component albedo dosemeters developed at RPD (8,10). Biological dosimetry is also provided to some groups of radiation workers especially those being overexposed. So far as the public monitoring is concererned, a national indoor radon monitoring program has been set up based on electrochemically-etched polycarbonate inside diffusion type chambers some results of which are being reported at this conference (11). Also, TLD's and film badges have been accompanied the radon chambers for indoor beta-gamma radiation measurements especially in high radiation area of Ramsar. Radiation field and instrument calibration is based on secondary standard ionization chambers. A joint project

with IAEA is also being carried out on SSDL. Many other dosimetry projects especially as B.S., M.S. and Ph.D. theses are being carried out at RPD.

3- A nationwide environmental protection against natural and man-made sources are being conducted to assess critical radionuclides from inside or outside the country's boundaries, critical exposure pathways and calculation of population exposure and evaluation of annual doses as well as the determination of internal contamination by bio-assay techniques and whole body counting are the main responsibility of this division. Four sections in this divistion do research for radioactive determination in air, water, soil, vegetables and foodstuff as well as measuring internal contamination to achieve above. One of the main functions of the division after Chernobyl accident has been environmental measurements and radioactivity level control in foodstuff imported to prevent food with radioactivity above Iran's Intervention Level. Over 15000 activity and spectrometry measurements have been done after chernobyl.

Besides the organizational responsibility of each division, the education and training is also of primary importance for RPD (12), as a part for enforcement of rules and regulations. Such education and training is divided into three main categories including: a) formal university courses for students in the field of science and technology, b) intensive courses for radiation workers, and c) education of general public. Such educational activities are summarized as follow:

a) The first formal university health physics course was organized by the Tehran University Nuclear Center as a three credit hour M.S. level course which is still being taught there. A one and half year M.S. program was offered twice in the School of Public Health of Tehran University, the first of which was in cooperation with WHO in 1973. In 1977, the RPD of AEOI also offered a one-year M.S. equivalent program in health physics. At the moment, health Physics courses at B.S. and M.S. levels are offered in nuclear physics options of physics or nuclear technology programs of almost all universities, as well as Ph.D. level courses at Amir Kabir Polytechnic University in collaboration with the Atomic Energy Organization of Iran. Besides formal courses, education and training through research as well as different level theses projects have been or being conducted at RPD of AEOI and other institutions.

b) Intensive national and international courses have been offered on different occasions for radiation workers. As examples, a six-week course on "Radioisotope Applications" were offered for several years since early in 1960's, with emphasis also on health physics for medical doctors, scientists and engineers. An international course on "Handling of Radiation Accidents" was offered by IAEA at TUNC in 1967. Since then several other intensive courses have been offered. In 1987, some national radiation protection courses being conducted monthly, have been organized by RPD of AEOI for radiation workers in different fields, consisting of 100 hours of theory and practice within three weeks. Over 800 applicants have registered. Since September 1987, about 200 radiation workers have been trained during five separate courses.

c) Public education and training have been of great concern to

RPD, and have been carried out by TV programs, journal articles, newspapers, brochures and posters. A formal TV serial was prepared byRPD in 1983 in cooperation with National TV Network consisting of 18 haf-hour programs on radiation protection matters epecially in medical applications of x-ray machines and radionuclides. This program have been very effective for general public and professionals.

Besides the above activities, some other organizations such as the Ministry of Health and Ministry of Labor have had some minor activities respectively in medical and industrial aspects of radiation protection in some centers under their influence. However, due to the Atomic Energy Organization Law of Iran, rules and regulations developed by EAOI are enforced.

In conclusion, our experiences with such a program as well as some personal views can be summarized. Before any rules and regulations can be enforced in a developing country, a well-organized RP program having a qualified leader,qualified experts, proper equipment, maintenace, inspection facilities, motives as well as budjet and govenment authority should be developed with emphasis on education and training. Although IAEA, WHO or other organizations may be effective for education and training, a developing country should develop its own potential to do so. A proper personal monitoring is a vital need. Although film badge is usually considered a "poor-man's" personal dosimeter, it still should be preferred before one can develop other personal dosimetry systems with self-support. The system of dose limitation including dose equivalent limit and derived limits for public should be adjusted for countries facing only the cost part of a nuclear program and not the benefit side of the coin. In fact, I personally think the dose limit for radiation workers and especially the public should be decreased from its present limit. So far as the quality factor for high-LET radiation especially for neutrons are concerned, the $\bar{Q}$ values recently proposed by ICRP (13) and ICRU (14) should be applied.

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