Network of Secondary Standard Dosimetry Laboratories

by Horst H. Eisenlohr

In general, radiation dosimetry refers to the whole field of radiation measurements; more specifically, it is the quantitative determination of the absorbed dose. Recognizing the importance of accurate absorbed dose standards, the International Atomic Energy Agency started an active programme in dosimetry soon after its foundation and has been operating an internationally recognized dosimetry laboratory.

Recently, the IAEA and the World Health Organization reached an agreement on the creation of an IAEA/WHO Network of Secondary Standard Dosimetry Laboratories. The purpose of the network is to improve the accuracy of radiation dosimetry related to medical applications of radiation, other applications of radiation (for example, in industry and agriculture), and radiation protection. The network will ensure the world-wide comparability of radiation measurements, and assist in making calibration facilities available to all Member States concerned.

EARLIER DOSE COMPARISON PROGRAMMES

In April 1968, about a dozen experts met in Caracas at the invitation of the IAEA to discuss "Dosimetric Requirements of Radiotherapy Centres". This meeting, in which representatives of WHO and its regional offices also took part, was prompted by expert reports to the IAEA in which it was pointed out that, while an increasing number of cobalt-60 teletherapy units for the treatment of malignant tumours were being used in many countries, in those very same countries the radiation physics aspects – essentially the radiation dosimetry – of this modern method of treatment had not kept up with the development of medical methods.

This was substantiated by the statement that in the whole of Latin America, for example, there were at most only five health physicists, whereas at least 50 were needed on the basis of the number of irradiation units in the region. It was also pointed out that there was not a single institution in the whole of Latin America which could calibrate dosimeters or at least perform comparison measurements with them. Similar observations were made in other regions, too.

As a result, patients at many radiotherapy clinics were being irradiated without dosimetric controls, so that there were considerable uncertainties regarding the doses received.

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The implications of this are clearer if one realizes that an upward or downward deviation of the radiation dose by only 5% can lead to a clinically observable change in the effect of irradiation and that the prospects of a cure decrease rapidly with increasing deviation of the radiation dose from the optimum value.

However, a dosimetric accuracy of ± 5% pre-supposes the skilful use of a properly calibrated dosimeter and a profound knowledge of the basic aspects of dosimetry; otherwise, serious irradiation errors can occur. In this context it is worth noting that, according to the results of the joint IAEA/WHO Co-60 dose comparison programme, dosimetry errors of ± 10% are common, ± 20% errors are not infrequent and errors of ± 50% or more are being observed occasionally.

The group of experts which met in Caracas did not confine itself to pointing out certain inadequacies in the field of clinical radiation dosimetry; it also made practical suggestions for overcoming them. One suggestion was the establishment of regional dosimeter calibration laboratories supported scientifically and co-ordinated by the IAEA in co-operation with WHO. This suggestion was subsequently discussed, during several meetings at the IAEA, with experts from the large national standards laboratories, for it was clear that such regional laboratories would somehow have to be fitted into the existing, official system of metrology.

It was also clear that the establishment of a primary standard laboratory in every country was neither necessary nor desirable (there are at present 18 national standard laboratories with radiation dosimetry sections, i.e. with primary dosimetry standards; in addition, there is the International Bureau of Weights and Measures in Paris). This led to the idea of "Secondary Standard Dosimetry Laboratories" (SSDLs).

Since 1969, nine laboratories have been designated by WHO as SSDLs — in Argentina, Brazil, India, Iran, Mexico, Nigeria, Romania, Singapore and Thailand. In several other countries — Bulgaria, Chile, Indonesia, Israel, the Philippines and Turkey — SSDLs are being established within the framework of IAEA technical assistance projects. In some countries, the laboratories come under the ministry of health and in some they come under the atomic energy commission; a reason more for close co-operation of IAEA and WHO in this project.

NEW WORKING AGREEMENT

Recognizing the importance of the international co-ordination of this activity and taking into account the fact that the IAEA is itself operating an SSDL — the IAEA's Dosimetry Laboratory — the IAEA and WHO have reached a working arrangement concerning the creation of an international network of SSDLs. The relevant document contains the usual definitions, necessary for a clear understanding of the working arrangement, describes the network's objectives and the procedures leading to membership of the network, and delimits the tasks of the IAEA and WHO.

WHO, in Geneva, performs the functions of a secretariat for the SSDL network, while the IAEA is responsible for its technical and scientific aspects. The initiators and organizers of the network believe that the SSDLs will be very important in the field of radiation measurement, especially in the developing countries, where the number of radiation sources being used in medicine, research and industry is increasing rapidly.

It is now probably no longer possible to ascertain the names of all those who have been in some way actively associated with the idea and execution of this international undertaking. However, the author would like to mention here those who, over many years and with great personal effort, have repeatedly championed it: P. Pfalzner and W. Henry (Ottawa), W. Seelentag (WHO), A. Jennings (Teddington), L. Lanzl (Chicago), R. Loevinger (Washington), H. Reich (Braunschweig), K. Zsdanskzky (Budapest), R. Alves (Rio de Janeiro), M. Guiho (Paris) and B. Waldeskog (IAEA, formerly WHO).

EXTRACT FROM THE WORKING ARRANGEMENT BETWEEN IAEA AND WHO

Definitions and objectives

Secondary Standard Dosimetry Laboratories (SSDLs)

An SSDL – in the context of this paper – may be national or regional. A national SSDL is a laboratory in a country in which there is no Primary Standard Dosimetry Laboratory (PSDL) and which has been designated by the competent national authorities to undertake the duties of a calibrating laboratory for that country. A regional SSDL is an SSDL which is designated, by intergovernmental agreement or an international organization, to provide in addition to national functions, calibration services and advice to other countries.

An SSDL is equipped with secondary standards which have been calibrated against primary standards of laboratories participating in the international measurement system.

Objectives

- An SSDL should maintain and apply secondary standards for the calibration of instruments for the uses of radiation in medicine, other applications of radiation and radiation protection;
- It should undertake, or assist the user of radiation to undertake, radiation measurements, including checks of the output of radiation sources;
- It should provide training in applied dosimetry and give advice on the appropriate application of dosimeters.

The IAEA/WHO Network of SSDLs

The SSDL Network is an informal association of SSDLs which agree to co-operate in promoting the objectives of that Network under international auspices. WHO accepts for the time being the main responsibility for operating the Network; IAEA will be responsible for its technical and scientific development.

Objectives

- To improve dosimetric accuracy, particularly in medical applications, and to promote the application of radiation by supporting centres and laboratories for the creation and distribution of knowledge in applied dosimetry;
- To help exchanging experience between members and affiliated members and to provide support to each other where necessary;

- To establish and facilitate links of members with the international system of radiation measurements through PSDLs;
- To promote campatibility of methods applied for calibration and performance of dosimetry in order to achieve uniformity of measurements throughout the world.

Organization of the Network

It is understood that the organizations promote the Network until, at some later time, it becomes self-sustaining without further need for support by IAEA and WHO.

Membership

Members. A national SSDL becomes a member of the IAEA/WHO SSDL Network on a request from the government concerned. Such an SSDL shall fulfil the technical, organizational and performance of work criteria set for membership. Members are to submit annually a status report to the Secretariat of the Network. WHO Collaborating Centres for SSD, in collaboration with IAEA, are members of the Network during the validity of their designation without specific request.

Affiliated members of the Network are PSDLs participating in the international measurement system and willing to provide to the Network advice, support and calibration of secondary standards.

Collaborating organizations with the Network are inter-governmental and non-governmental organizations engaged in the field of calibration and dosimetry and willing to support the objectives of the Network. The Organisation Internationale de Métrologie Légale (OIML) may participate and contribute to the Network's activities through its Pilot Secretariat for Ionizing Radiations, in formulating international recommendations as regards calibration instrumentation and procedure, and in respect to performance characteristics of dosimeters.

Corresponding experts are individuals with specific experience in related tasks and willing to make their experience available to the Network.

Advisory Group

The Advisory Group is an informal ad hoc group of experts appointed to solve a specific task or to provide advice for a determined period of time. The Expert Advisory Group will include representatives of members and affiliated members of the Network in their personal capacity and other experts, as necessary, for solving specific tasks.

Role of affiliated PSDLs

Within agreed limits the PSDLs will: provide access to the international measurement system by performing calibrations; accept for training qualified persons from SSDLs, and provide them with training appropriate to their responsibilities at the SSDLs; provide consultation on tehcnical problems, as requested, by a member of the Secretariat. This may be done either by mail or by visit, as is appropriate and convenient.

The Secretariat

WHO will provide, for the time being, the Secretariat for the Network until the Network is self-sustaining. The IAEA will provide scientific and technical support.

Specifically, the IAEA's technical and scientific involvement is as follows:

- to advise the atomic energy authorities of Member States on setting up SSDLs;
- to keep contact with members of the Advisory Group;
- to assist members, in collaboration with WHO, in obtaining access to the international measurement system for calibration or recalibration of secondary standards, and to establish links with PSDLs willing to assist a specific SSDL;
- to conduct calibration intercomparisons with SSDLs;
- to organize or assist in organizing training activities for staff of member SSDLs;
- to initiate and assist in the formulation of recommendations concerning calibration instrumentation and procedures for SSDLs;
- to convene meetings of the Advisory Group when necessary and provide secretariat assistance to it.