been given the tasks of increasing the output of over 100 standard master and working measuring facilities and also of modernizing the standard technical documents for the manufactured products, of developing and reviewing the metrological standard technical documents, and of modernizing the organization and improving the efficiency of the activities in the metrological departments of the enterprises and organizations in the field.

Studies made in the organizations of Gosstandard SSSR (All-Union State Standard of the USSR) showed that by 1990 the need of the national economy for metrological security will increase by eight to ten times.

Considering that labor costs for measurements are still high and, on the average, amount to 10% of all expenditures in the national economy, even reaching 50 to 60% in the industrial fields that produce complicated materiel, it is then clear that it is necessary to assign more valid requirements to medical materiel in order to avoid the economically unwarranted expenditures that are associated with the use of more thorough methods and inspection facilities.

A large and necessary effort is being made in this field to develop metrological security, but much must yet be done to have metrological security become an orderly complex system that covers all stages and steps in the development and fabrication of a product.

The most efficient form of development is a complex plan that represents a complex program of metrological security for the field. The state five-year plan for the development of the USSR's national economy in 1976–1980 provides for the development of a metrological security program according to the Ministry of the Medical Industry and the Ministry of Public Health of the USSR. This work is of prime importance because it will permit the technological developmental and manufacturing processes for medical materiel to be systematically instrumented with more advanced and higher-speed measuring facilities.

LITERATURE CITED

TECHNICAL EQUIPMENT FOR CLINICAL
ROENTGENOLOGY AND RADIOLOGY

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On the eve of the memorable date in the history of our country – the 60th Anniversary of the Great October Socialist Revolution – this would seem to be a good time to analyze the development and assess the current level of Soviet technical equipment for clinical roentgenology and radiology.

The technical equipment for clinical roentgenology and radiology at the present time can be subdivided conventionally into three groups: equipment for radiodiagnosis, equipment for radiotherapy, and instruments for dosimetry. Each of these groups of equipment in turn consists of two subgroups depending on the type of ionizing radiation used. For instance, equipment for radiodiagnosis includes roentgenodiagnostic and radiodiagnostic apparatuses (instruments). Equipment for radiotherapy includes apparatuses for x-ray and γ-ray therapy. Instruments for dosimetry includes roentgenometers and radiometers.

Several stages, with a mean duration of 20 years, can be distinguished during the development of all these groups of articles: 1896–1916 (pre-revolutionary), 1921–1941 (pre-war), 1946–1966 (post-war), and from 1967 to the present time (contemporary).
In the pre-revolutionary period x-ray apparatus was universal in application: for both diagnosis and therapy. Open ion tubes, initially containing an air-cooled, later a water-cooled fixed anode, predominated. The x-ray power supply consisted of an induction coil with mechanical or mercury interruptor. The high voltage was led to the tube along electrically dangerous exposed cables. The stands were made of wood. Despite the utmost primitive nature of this first generation of x-ray apparatuses Tsarist Russia was unable to produce them on a large scale. Except for a few models, all apparatuses and accessories were imported. By 1914 there were only 146 x-ray apparatuses in the whole country (the same number is now produced each month), and they were concentrated in large cities [1]. Installation of the apparatuses and technical supervision were carried out by the staff of the corresponding foreign firms which had their representatives in Moscow and St. Petersburg. There were no Russian engineers or technicians familiar with these apparatuses [2]. Specialists in the field of physics and electrical engineering were working in the field of technical equipment for roentgenology and radiology: I. I. Borgman, N. G. Egorov, A. F. Ioffe, P. I. Lazarev, D. D. Pletnev, A. S. Popov, and others.

Radiotherapy was carried out by means of x-ray apparatuses and also natural radioactive substances, primarily radium (1903). The radium preparations used at that time were enclosed in glass or ebonite, and ordinary test tubes were used as the applicators. Because of the absence of dosimeters, the activity of the preparations was determined by the physician at best by self-acting radiation indicators in the form of strips of paper on which a paste containing potassium iodide was applied or by transilluminating his own hand with the aid of a screen [3]. The main obstacle to the widespread use of radium was the small amount of it available, obtained from abroad. According to approximate data [4], in 1913 there was only a little more than 100 mg radium in the whole country.

In the pre-revolutionary period there was virtually no Russian-made apparatus in this class, nor any specialist x-ray engineers.

During the first few years after the revolution the needs for x-ray apparatuses continued to be satisfied by importing. In 1924 apparatuses worth 2 million gold rubles were imported [5]. The problem arose of the formulation of a single engineering policy in x-ray apparatus construction, the training of the country's own scientific and production workers, and the creation of a manufacturing basis. These problems were entrusted for solution to the physicotechnical department of the Moscow, Leningrad, and Kiev Roentgeno-Radiological Institute. Besides clinical dosimetry, exploitation of existing apparatus, and other production work, these departments trained teams of specialists, developed prototype designs, and directed their production in the experimental workshops of their own institutes. As a result it became possible to reorganize the workshops of the institutes into factories. In this way the "Burevestnik" X-Ray Apparatus Factory was founded in 1922 in Leningrad, the "Mosrentgen" factory in 1929 in Moscow, and the "Rentok" factory in 1930 in Kiev. These factories, and also the "Svetlana" X-Ray Tube Factory, the Uritskii Film Factory (both in Leningrad), and the Semashko Screen Factory (Moscow) enabled the importation of technical equipment for roentgenology to be discontinued.

The factor with the greatest influence on the development of technical equipment for clinical roentgenology and radiology was the foundation in 1924 of the Moscow Roentgeno-Radiological Research Institute (MNIRRI) as a unique type of combined physical and clinical establishment. The experimental workshops of MNIRRI produced sets of x-ray apparatuses (Table 1), and large batches of other diagnostic equipment, and dosimeters. The laboratories for x-ray tubes, apparatuses, radiological equipment, screens and films, and clinical dosimetry, by solving major problems of a theoretical and applied character, drew up scientifically based programs of development of medical radiation engineering, medical engineering requirements for new articles, methods of monitoring functional parameters, and technical standardization documentation, and they also trained scientists and production workers for the branch.

The results of this purposive activity of the Institute made themselves felt even the in pre-war years. For the first time in the world, a scheme of voltage trebling suggested by engineer V. A. Vitka ("Vitka scheme") was designed and produced on a large scale (the RU-330, RU-360, and other apparatuses [6, 7]). Diagnostic and therapeutic x-ray apparatuses of the second generation, distinguished by having electronic x-ray tubes with stationary anode, partly protected jackets for them, and power supply units on transformers, were created. Meanwhile, the low standard of technological facilities available at the production base still did not allow abandonment of voltage transmission along exposed busbars or the use of simple wooden stands. Besides these apparatuses, small batches of small-frame fluorographs, tomographic attachments, roentgenokymographs, x-ray scattering grids, and others were created and produced. Original designs of tubes, apparatuses, and accessories were created during this period by V. A. Vitka, V. G. Ginsburg, G. A. Zhegalkin, Ts. Ya. Russo, F. I. Solov'ev, G. P. Tilik, A. I. Tkhorzhevskii, V. I. Feoktistov, F. N. Kharadzha, Ya. L. Shekhtman, and others.