

PERSONNEL MONITORING AT JINR

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1. INTRODUCTION

For more than 40 years the Division of Radiation Protection (DRP) has provided personnel monitoring (PM) at the Joint Institute for Nuclear Research (JINR). The JINR have a set of basic nuclear facilities, such as: 10 GeV proton and light nuclei Synchrophasotron and superconducting accelerator of relativistic nuclei "NUCLOTRON", the U-400, U-400M, U-200 heavy ion cyclotrons, the 680 MeV proton phasotron, the fast neutron pulsed reactors IBR-2 and IBR-30. These facilities are a powerful sources of ionization radiation filds with wide energy range and complex composition. The DRP carries out a sistematic personnel monitoring service of gamma, beta, X-ray and neutron exposures at the JINR. The number of persons monitored has not changed considerably for the last years and at present it amounts to about 2100 persons, including visiting scientists and outside contractors(120). The PM for external exposure is still based on film badge IFK-2,3 with TLD cards for gamma dosimetry, the double film ORWO RD-3,4 for X-ray and beta and nuclear emulsion MK-20 for neutron. The film badge IFK-2,3 contains the different filters combination and open window.

2. METHOD AND MEANS

For gamma dosimetry are used cards containing two natural LiF chips (G1) of identical dimensions (3x3x1mm) mounted between Teflon foils. A hope code is used for identification of the dosimeter cards. One TL-detector is placed behind a filter of 850 mg/cm² Pb and another one behind open window. The dose equivalent randges are 0,1 - 1000 Sv. For photon the energy randges 100 keV - 3 MeV the error is not more than 40%, at low energy the error is increasis. The system consists HARSHAW 2271, containing an automated reader and autoranging picoammeter. The absorbed dose beta radiation above 0,12 MeV are indicated by means of film by comparing the optical densities behind the three filters and open window. The absorbed dose range are 0,2 mGy - 0,15 Gy. The TL-detectors of CaSO₄ thickness 0,1mm are used in finger ring dosimeters ters for beta and X-ray. The neutron dosimeter are based on nuclear emulsion MK-20 thickness 20 μ m supported on a 140 μ m cellulose triacetate base. The MK-20 are packed into the correction packet to correcte the energy dependence. The correction packet with MK-20 are placed behind a TLD card in film badge - IFKn-method /1/. Remresponse of the MK-20 are determined for energe randges from thermal neutron to 20 MeV /2/. The dose equivalent for high-energy hadron (above 20 MeV) are determined by the star prodaction in the nuclear emulsion (three and more rays). Most of neutron dose mesurements (without high-energy hadrons) made by film are within the error randge 50%. For high-energy stray filds IFKn-method is overestimates the dose equivalent by a factor of two. In these cases are used correction method for reading of film dosimeters /1/.

Latent image fading of track density from high-energy hadrons is not more than 30% and from Cf-252 source neutrons is not more than 10% for three months. A data bank realises storing, updating, retrieval, statistics processing and output of the personal and dose information for over 2100 persons, controlled quarterly for external radiation /3/. The basic components of the data bank are a data base (personal and dose files as current as archival) and a package of application programs for the work with the data base in the dialog mode by means of menus. The data bank was organized on the basis PC AT-386 with assistance of the relational DBMS dBASEIII PLUS and the Clipper compiler for the interpretive dBASEIII programming language, working under the control MS DOS, version 6.10.

3. CALIBRATION PROCEDURES

The gamma dosimeters are calibrated free in air of Co-60 radiation. The calibration irradiation are in terms of exposure. The exposure values are converted to dose equivalent with conversion 0,97 cSv/R. The area of the open window of the film badge with ORWO is calibrated in addition to dose equivalent of beta-rays of Sr-90+Y-90. In routine the neutron dosimeters are calibrated free in air of Cf-252 (for dosimeters are used in Laboratories of Neutron Physics and of Nuclear Reactions) and Pu-Be (for another laboratories). For calibration are used the fluence-to-dose equivalent conversion factor ($3,3 \cdot 10^{-10}$ Sv*cm² for Cf-252 and $3,6 \cdot 10^{-10}$ Sv * cm² for Pu-Be), factor on-phantom and free -in-air calibration and factor normal and rotatory irradiation for calibration /4/.

4. PERSONNEL DOSES

About 2100 radiation workers are subject to individual monitoring of external radiation in the JINR. This number includes 1500 persons monitored for neutron exposures. About 60 persons wear additionally film ORWO. Dosimeters are issued normally for a period of 3 months. Each monitored person has a personal card, where the values of all doses received and recorded. The individual dose values besides being stored in an electronic data bank also recorded in the personal radiation passport of each radiation worker. The results of dose measurement for whole body are summed each year. The mean annual dose equivalent for person has not changed considerably for last 15 years and amounts about 2 mSv. Annual reference dose for radiation workers is 50 mSv in Russia. The mean annual dose (\bar{H}) and collective dose (H_{Σ}) is shown in fig.1. As an illustration fig.2 show the annual dose distribution for 1994. About 40% persons have annual dose below the detection limit (about 1 mSv). The exposures registered are very low, for example, in 1994 about 99,8% less than 15 mSv and 0,2% between 15 and 50 mSv per year. Maximum value was 20 mSv.

REFERENCES

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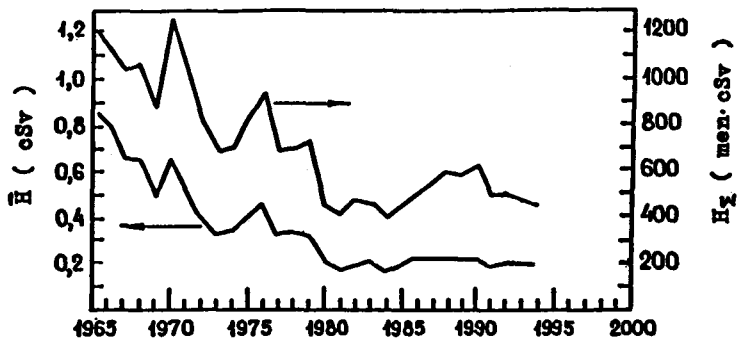


FIG.1 THE COLLECTIVE (H_{Σ}) AND AVERAGE (\bar{H}) DOSE EQUIVALENT

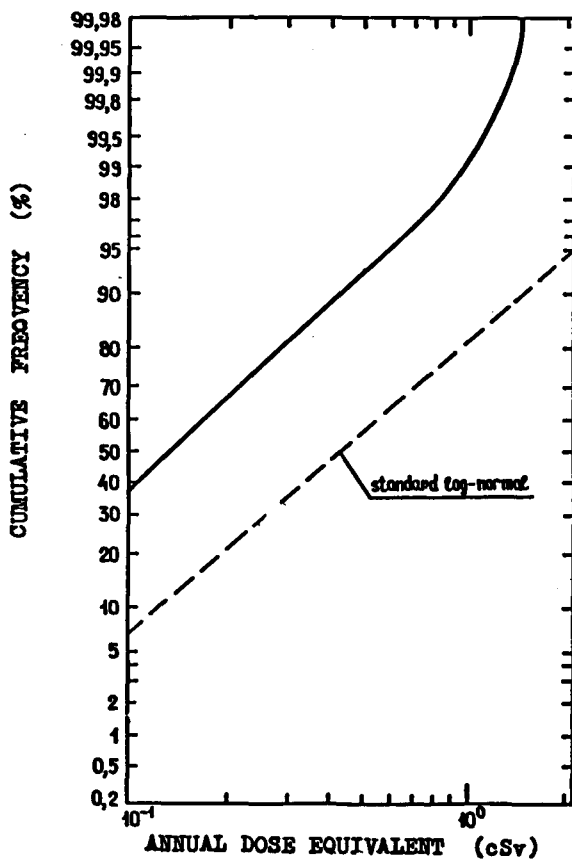


FIG.2 DOSE DISTRIBUTION FOR 1994 FOR PERSONNEL JINR