

## **Evolution and current status of personal dosimetry in the Slovak NPPs**

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### **A. History**

In archive of the Public Health Office, there is a lot of documents which demonstrate that since the beginning of design of the first NPP in Slovakia, there has been considerable attention dedicated to personal dosimetry. But only few facts will be mentioned here. The external exposure was monitored by national (Czechoslovak) dosimetry service in Prague until 1977. NPPs have had their own services since then. Film detectors have been used for legal purposes since the beginning. The structure of the film detector allows measurements of beta and gamma radiation, assessment of main direction and energy of radiation, identification of surface contamination. Exposed films are kept in the archive. The operational dosimetry has been developed significantly, from simple pen detectors with ionization chamber to electronic dosimeters. The internal contamination has been monitored by medical service (under Health Ministry) which was established in NPP Bohunice until 1987. Since then the internal dosimetry services have been operated by the NPPs. The whole body counters and laboratories for analysis of biological samples have been available on both nuclear sites of Slovakia. The measurement system, the rules and the methodology were regularly improved. Quick body monitors and monitors for thyroid monitoring are available also on both sites at present.

### **B. Current legal basis**

The act on the health protection and the regulation of the Health Ministry on radiation protection determine the requirements for external and internal personal dosimetry of occupationally exposed workers. Personal dose of any occupationally exposed worker of A category in controlled area must be monitored by personal dosimeter. All relevant components of radiation field on a workplace must be monitored by the basic (legal) personal dosimeter or dosimeters. Monitoring period for NPPs is one calendar month, but for less risk practices monitoring period up to three months is acceptable.

The extremity dosimeter is necessary if the extremity dose (or dose in lens of eye) could be significantly higher than personal dose monitored on the standard place for monitoring of personal dose equivalent. Direct readable operative personal dosimeter is obligatory in areas where the dose rates are higher than  $1 \text{ mSv}\cdot\text{h}^{-1}$  or where the radiation field changes rapidly so that accidental exposure is possible.

Requirements for the parameters and testing of personal dosimeters are based on technical recommendation of EC and the Safety Guide No. RS-G-1.1 on Assessment of occupational exposure due to external exposure.

Evaluation of exposure caused by internal contamination is obligatory on workplaces with radioactive substances. If the risk of internal contamination is not relevant, only area monitoring is obligatory. When the individual monitoring of internal exposure is required, the monitoring frequency and monitoring system depend on the risk of internal exposure.

The basic (legal) system for personal monitoring must be metrologically approved by the National Metrological Institute (stated by the act on metrology). Monitoring of personal doses in controlled area is obligatory. Only approved services can perform the basic (legal) personal dosimetry. The Public Health Office is responsible for approval and licence issuing for these services. In Slovakia there are three approved personal monitoring services for external exposure and two services for monitoring and evaluation of internal exposure at present.

### **Central register**

The central register of the occupationally exposed in Slovakia is established at Public Health Office of SR. This register co-operate with the register of radiation sources and licensees.

### **Radiation Passport**

The radiation passports are not used in Slovakia at present. This is a weak point of the system of radiation protection and of the Slovak legislation. Slovakia will become a member of European Union and it is necessary to apply the directive on radiation protection of outside workers of EC. In the prepared

amendment of the act on health protection, there should be the legal basis for issuing of radiation passports. I expect that national register will issue the passports.

#### Outside workers

The operator is committed to ensure the same level of protection for the employees and for outside workers including the individual monitoring of external and internal exposure in controlled area. The operator is obliged to require the data about foregoing doses of the outside workers.

#### C. Current status of the personal dosimetry in Slovak NPPs

##### Monitoring of occupationally exposed workers to external radiation

There are two approved personal dosimetry services, one on site of Bohunice and the other one on site of Mochovce, both are operated by the Slovak Electric joint stock company. The personal dosimetry services were approved and licensed by the Health Ministry (in the future by the Public Health Office of SR). Film dosimeters are evaluated monthly (calendar month). The system of film personal dosimetry is metrologically approved by the National Metrological Institute in two years interval. The system of personal monitoring on site Bohunice and Mochovce differs, because of historical development. Any person in controlled area in NPP has a legal film dosimeter for gamma and beta radiation, electronic personal dosimeter for gamma radiation (or beta –gamma), and if necessary also neutron dosimeter and extremity dosimeter.

##### Basic (legal) personal dosimetry

In NPP Bohunice, they use FOMA Personal monitoring Film (Czech Republic) (high and low sensitive). The cassette contains three Cu filters (thickness: 0.05, 0.5, 1.5 mm), Pb filter (0.5 mm) and a window (diameter 10 mm). Thermoluminescent dosimeters type LiF 600 are used for basic neutron dosimetry. Only very limited number of these dosimeters is necessary. Extremity dosimeters LiF 100 as finger dosimeters are used, if the extremity dose could be significantly higher.

In NPP Mochovce, the film dosimeter for gamma radiation contains Cu filters (0.05, 0.8 mm), Pb filter (0.2 mm)+ Sn (0.6 mm), Cd filter (0.8 mm) and window without filter. They use also FOMA personal monitoring film R10 and R2, with high and low sensitivity. Neutron radiation doses are monitored by the TLD600/TLD700 in Bicron cassette. Extremity dosimeters - Aluminophosphate glass as finger dosimeters are used in special cassette.

Both personal dosimetry services use films irradiated in the National Metrological Institute (up to 30 films of the same rank as the film used in dosimeters irradiated with various doses) for the monthly calibration of densitometers (Gretag D 200 – II). The dosimeters are calibrated in  $K_a$ . The conversion factors recommended by the ICRP 74 are used for the calculations. The quantities of  $H_p(10)$  and  $H_p(0.07)$  have been implemented since the beginning of 1993.

##### Operational personal dosimetry

Any electronic personal dosimeter is calibrated in metrological laboratory of NPP annually. The metrological laboratory is approved by the National Metrological Institute and connected to the national standard.

NPP Bohunice. Electronic dosimeters MGP, (DMC 90 and readers LDM 91) are used routinely for operational personal dosimetry (remote control WRM 91 is also available). The TLD system used for personal dosimetry is metrologically approved by the National Metrological Institute. The LiF 100 dosimeters are used, the Harshaw Model 6600 reader and card holders 8805.

NPP Bohunice is in the process of improvement of operational electronic personal dosimetry and replacement DMC 90 with the dosimeters of DMC 2000 type with new readers and calibrator.

NPP Mochovce. Electronic dosimeters Siemens MARK 1 and MARK 2 (beta gamma) are used for operational personal dosimetry in controlled area and limited number of electronic neutron dosimeters is available. TLD system for operational personal monitoring consists of an aluminophosphate glass (diameter 8 mm, in plastic DIPRA cassette with perforated Pb filter) and reader SOLARO 680. The TLD system is regularly approved by the National Metrological Institute in two years interval.

NPP Mochovce intend to use the EPD as the basic monitoring system in the future. The authority requires to use dosimeters resistant to magnetic field and being able to monitor the weak penetrating radiation only. It is also required to use simultaneously film and EPD systems for few years, an analysis how

the transition to EPD will influence the system of radiation protection, mainly in case of higher exposure, because available EPD gives less information on energy and direction of radiation and surface contamination of dosimeter. It is also necessary to evaluate possibilities and conditions of safe data recording and storing.

#### Internal exposure monitoring

Whole body counting, quick body monitoring for screening, I-131 in thyroid monitoring system and laboratories for analysis of biological samples are available on both NPP sites. Methodology for analysis of gamma nuclides in biological samples, tritium and strontium in urine and plutonium in faeces are approved.

Admission monitoring for any person who will work in controlled area (outside workers and new employees) is obligatory. Monitoring after retiring from work in controlled area (ending of the job on contract for outside workers, retiring of employees or retiring from work in controlled area) is obligatory. Routine monitoring – usually monthly obligatory for groups of workers working in enhanced risk of internal contamination. Periodical – annual monitoring is obligatory for all occupationally exposed (part of medical examination). Special monitoring – in case of anomalies, when the internal contamination is possible or expected.

Usually the highest relevant inhalation dose coefficient given in the BSS is used, if the chemical form of contaminant is unknown. Intake is calculated on the base of respiratory tract model (ICRP 66) and biokinetic models in ICRP 30.

#### Dose data management and record keeping

Computer network system for work planning and dose management is available. It manages the data from basic dosimetry (film) and operational personal doses in the current month. After the evaluation of basic (film) dosimeter are the data on personal dose from operational dosimetry during last month are removed and superseded by the reading from basic dosimetry. The data from operational dosimetry are also kept in the archive.

All data on personal doses are archived on two different places in two forms – written and electronic. All measured values are recorded including those from operational dosimetry including data on methodology and important parameters. The data are regularly reported to the Central Registry and to the RP authority.

#### International comparison

The personal dosimetry service of NPP Bohunice participated successfully in the international comparison for individual monitoring of external exposure from photon radiation organized by IAEA in 1997-1998. The personal dosimetry service of NPP Mochovce participated in international comparison of accidental dosimeters organized by Silene- Valdue. The results have not been published yet. Both personal dosimetry services took part in the international comparisons for whole body measurements and I-131 in thyroid measurements organized by IAEA. The results of intercomparison have not been published too.

#### Reporting system

The dosimetric services and the licensee (for practice) are obliged to send the data on results of basic (legal) personal dosimetry during each monitoring period to the RP authority and to the central registry. They are also committed to provide analysis of personal dose (monthly and annually), annual and 5-years summaries. In the licence there is also specified what levels of individual doses (including those from operational dosimetry and internal dosimetry) should be reported without any delay to the authority.

#### Conclusions

The good system of personal monitoring is the basic condition for appropriate radiation protection of occupationally exposed workers. Current system of individual personal monitoring of occupationally exposed workers in Slovak NPPs seems to be adequate and compatible with good practice. The main weakness of the system seems to be the missing system of the radiation passbooks. But we can expect that this problem will be solved till the end of this year.