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Radiation Protection Databases of Nuclear Safety Regulatory Authority

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ABSTRACT

Radiation protection and nuclear safety of nuclear installations have a common objective, protection against ionising radiation. The operational safety of a nuclear power plant is evaluated using performance indicators as for instance collective radiation exposure, unit capability factor, unplanned capability loss factor, etc. As stated by WANO (*World Association of Nuclear Operators*) [1] the performance indicators are "a management tool so each operator can monitor its own performance and progress, set challenging goals for improvement and consistently compare performance with that of other plants or industry".

In order to make the analysis of the performance indicators feasible to an operator as well as to regulatory authorities a suitable database should be created based on the data related to a facility or facilities. Moreover, the international bodies found out that the comparison of radiation protection in nuclear facilities in different countries could be feasible only if the databases with well defined parameters are established.

The article will briefly describe the development of international databases regarding radiation protection related to nuclear facilities. The issues related to the possible development of the efficient radiation protection control of a nuclear facility based on experience of the Slovenian Nuclear Safety Administration will be presented.

1 INTRODUCTION

A nuclear facility contributes during its lifetime and in the decommissioning phase to the dose of the workers who are employed in a facility as well as to the population living around the nuclear facility. Both exposures are controlled through well defined procedures related to:

- methodologies of dose assessment,
- management of the records at the nuclear facility, laboratories and regulatory bodies.

During normal operation and during the decommissioning phase, today the collective dose to workers are usually of the order of magnitude of some man Sieverts per year, while the dose to a member of the critical group are very often of the order of magnitude of one

micro Sievert per year. The dose limits for both types of exposure are given in the ordinances valid for all facilities as for instance stated in [2] or in a license of a specific nuclear facility.

The occupational dose limits are usually given using the effective dose, as well as equivalent dose limits for organs. The limits are related to the age of workers and also to occupationally exposed cases as for instance special planned work, life saving action etc. Although not very common, some national legislation give the basis of the life time dose limit [2].

The dose limits for the population are very often given through the sum of exposures related to the direct exposure pathways and to the dose limit laid down for the discharges from facilities, with additional dose limits for organ doses as for example given in [2]. The effective dose of a member of the public is kept below 0.3 mSv/year for discharges from a facility and the theoretical dose limit due to the direct radiation is restricted to be about 0.4 mSv/year. Visitors of nuclear facilities as members of a public are usually protected through a lower dose limit of the operator in order to meet the dose limit of 1 mSv/year valid for the population.

Moreover to the dose limit, the limit of discharges from a facility is prescribed during the licensing procedure. The reports of the actual radioactive effluents of facilities from some European countries can be found in [3] where the data are given for a specific radionuclide as for example H-3 or I-131 and for a physical state of the discharge. In [3] the discharges are classified regarding the type of a reactor and normalised by the electrical power output.

The dose to the workers and discharges of a facility are one of the main parameters showing the effectiveness of radiation protection unit in a nuclear facility. Besides these two fundamental databases, also other databases including the database related to the waste management should be established. In order to analyse the trends in radiation protection the facilities as well as national regulatory authorities established databases which can be used not only on a national level but with some restrictions related to the confident data also internationally. These databases reflect the performance of the utility and enable its analysis.

2 RADIATION PROTECTION DATABASES OF A REGULATORY AUTHORITY

The need for the first international database related to radiation protection was already mentioned in [4] from the year 1990, when the computer network of the European Union related to the personal dose of outside workers was predicted. In addition, in 2002 the IAEA started with the project named the *International Database on Discharges of Radioactive Material to the Environment*. This database will facilitate the analysis of trends and discharge levels and will also provide a basis for assessing the impact on the environment.

The comprehensive review of the occupational exposure registers in European countries can be found in [5,6] . The registers of countries of European Union usually include the basic parameters from the directive prescribed in [4]. These parameters, which are given in Table 1, are necessary in order to control cross-frontier outside workers, but can be also applicable to permanent staff of a nuclear facility. The list can be substantially larger taking into account the need of the regulatory authority or the operator to improve radiation protection, as for instance the radionuclide identification causing the internal contamination of workers, medical records, etc.

Table 1: Data of networks predicted in [4] for the control of occupationally exposed workers

Database of the regulatory authority	
Data given before the start of the activity	Identification of the undertaking
	Medical classification of the worker
	Date of the last periodic health examination
	Results of the individual exposure monitoring
Data given after the end of any activity or data taken periodically	The period of activity
	Estimate of the effective dose
	Estimate of the dose-equivalent in different parts of the body
	Estimate of the activity taken in or the committed dose.

Based on the above mentioned data, the trends related to occupational radiation protection can be assessed, as already given for example in [7] for the Krško NPP by taking into account:

- collective dose and the trend of collective dose,
- maximum dose or average dose,
- normalised collective dose etc.

A specific forum for radiation protection experts, the ISOE (*Information System on Occupational Exposure*), celebrated in the year 2002 the tenth anniversary [8], covering occupational exposure data from 461 reactors from 29 countries at the end of the year 2001. The ISOE activities clearly demonstrate downward trend of collective doses in nuclear power plants. The average annual collective dose of pressurised water reactors was 2.01 man Sv in the year 1992, but the annual collective dose was just 0.91 man Sv in the year 2001. The ISOE is promoted by the NEA and the IAEA. A part of the ISOE database, which is available to the regulator, contains the annual dose data and technical data of nuclear power plants.

Moreover, radiation protection as well as the efficiency of the regulatory process can be assessed using other performance indicators related to radiation protection. The following databases can be useful in the efficient assessment of radiation protection:

- an occurrence of failure to provide means of personnel dose monitoring as given in [9],
- unexpected contamination of people, area or tools,
- unexpected production of radioactive waste,
- occurrence of hot spots,
- occurrence of failure of radiation protection equipment,
- occurrence of noncompliance of radiation protection procedures in a facility etc.

While the IAEA project *International Database on Discharges of Radioactive Material to the Environment* (DIRATA) [10] started in the year 2002, the monitoring of radioactive discharges from nuclear facilities in Slovenia already started in the early eighties with extensive programmes. In the Nuclear Power Plant Krško the monitoring started in 1981, in the uranium mining and milling facility at Žirovski Vrh in 1985, in the Research Reactor

TRIGA and in the Central Storage for Radioactive Waste in Brinje near Ljubljana in 1986. Discharges from nuclear medicine departments are not regularly controlled and only some rough estimates were done. Radioactive discharges to the environment in Slovenia are under steady control of operators and regulatory authorities. All relevant data are gathered by the operators and reported to regulatory authorities. The data are published also in annual reports of the Slovenian Nuclear Safety Administration and are available to the public. In 2002 the Slovenian Nuclear Safety Administration started with the development of the database of radioactive discharges. The database comprises the activities of fission and activation products from the Nuclear Power Plant Krško, the Research Reactor TRIGA and the Central Interim Storage for Radioactive Waste Storage in Brinje as well as the data related to the U-Ra decay chain from the U-mine as shown in Table 2.

Table 2: Data of liquid and gaseous discharges from different types of nuclear facilities in Slovenia, which comprise the database of the Slovenian Nuclear Safety Administration

Type of nuclear facility	Liquid discharges	Gaseous discharges
Nuclear Power Plant Krško	Total activity (without H-3 and noble gases)	Noble gases
		Iodines
		Aerosols
	H-3	H-3
	Noble gases	C-14
Research Reactor TRIGA	Total activity	Ar-41
Central Interim Storage for Radioactive Waste in Brinje	/	Rn-222
U-mine	U-238	Rn-222
	Ra-226	

The data are in the form of tables and graphic form and are available for recent years. In the future they will be available for other regulatory authorities, and will also be reported to the international organisations (EU and IAEA). They will be presented on web-sites for information of general public.

3 CONCLUSIONS

The databases related to radiation protection in nuclear facilities are established in facilities as well as in national regulatory bodies. The databases can be fundamental ones as for example the dose database or the database related to discharges. In addition, more specific databases can be created, as for instance the hot spot occurrence database. On the international level only the ISOE dose database has been fully developed. The international database of discharges from nuclear facilities sponsored by IAEA is under construction and no waste management database has been predicted up to now.

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