Radiation Protection Dosimetry (2011), Vol. 144, No. 1–4, pp. 115–118 doi:10.1093/rpd/ncq411
Advance Access publication 8 December 2010

BRAZILIAN EXTERNAL OCCUPATIONAL DOSE MANAGEMENT SYSTEM

Claudia L. P. Mauricio[1,*], Herica L. R. da Silva[1], Claudio Ribeiro da Silva[2], Rosaria Viana Bittencourt[2] and Denison Souza-Santos[1]
[1]Instituto de Radioproteção e Dosimetria, IRD, Av. Salvador Allende s/n, 22780-160 Rio de Janeiro, RJ, Brazil
[2]Comissão Nacional de Energia Nuclear, CNEN, R. Gal.Severiano 90, 22290-040 Rio de Janeiro, RJ, Brazil

*Corresponding author: claudia@ird.gov.br

Brazil, a large country, with more than 120 000 workers under individual monitoring for ionising radiation, developed, more than 20 y ago, a centralised data bank for external occupational dose. This old database, however, presented some problems and does not satisfy any more Brazilian present needs, not allowing dose analysis reports, for example. Therefore, a new system that reduces manual tasks, provides system communication support, manages reports and improves data storage management is being developed. This paper describes this new web-based information system, named Brazilian External Occupational Dose Management database system—GDOSE.

INTRODUCTION

The Comissão Nacional de Energia Nuclear (CNEN) is the Brazilian government agency responsible for the licencing and control of all practices involving ionising radiation, except in Medical and Odontological Radiology facilities, which are under the control of the Health Ministry.

All workers occupationally exposed to ionising radiation must use an individual monitor obtained from authorised External Individual Monitoring Services (IMS), according to norms and regulations guided by law CNEN NN-3.01[(1)] and Edict 453/98 of the Brazilian Department of Health[(2)]. External individual monitoring must be made on a monthly basis. The IMS' authorisation is granted by CNEN, with support from the Instituto de Radioproteção e Dosimetria (IRD). The IMS have to comply with administrative and technical requirements[(3)] in order to keep their licences. They provide information to a central does registry system at IRD, as demanded by regulation, such as information about the monitored workers; any dose value higher than 4.0 mSv; and the total annual accumulated doses, once a year.

This kind of national central dose registry is not available in most developed countries—for example, the USA and some European countries[(4)]. As Brazil is a developing country, with a large number of monitored people, increasing fast and steadily, the difficulty in developing and keeping this central dose registry system (SRD) is even higher.

In order to keep a central workers' dose record, the IRD has two different databases: the High-Dose Database and the SRD. These existing systems supporting the external dose record process do not satisfy the individual monitoring needs because they are only a computer-based data storage system. The principal problems of these databases to be overcome are the high amount of manual work, unfriendly interface and impossibility of automatic report emission, rendering it extremely difficult to retrieve information. As stated by Julius and Bermann[(5)], a useful dose registration and information system (IS) must be more than this, allowing dose analysis reports and statistical and epidemiological studies. Thus a new IS has been designed. In order to understand the demands for the new IS, CNEN Information Technology (CGTI) team depicted the radiation protection dosimetry business process.

This work presents the structure and functionalities of this new IS, named External Occupational Dose Management (GDOSE), which must store an accurate, reliable and secure record of about 120 000 workers, providing room for a continuous growth.

THE BRAZILIAN EXTERNAL INDIVIDUAL MONITORING PROCESS SCENARIO

In order to improve radiation protection, it is necessary to have knowledge of the occupational radiation dose levels in all radiation facilities. This information comes from individual monitoring, whose management involves the following: the Government, which requires historical radiation level exposure information; workers who ask for personal historical information and international and national entities responsible for workers' protection and dosimetry. Process suppliers are IMS, which are responsible for measuring and providing information about workers' radiation exposure. Each IMS monitors a different

number of working facilities and provides all information for the central registry system.

SRD management system

Since the 1980s, CGTI has been in charge of developing different ISs in order to support the process of management of individual monitoring information for radiation protection. The existing system, SRD, developed in the 1990s, needs updation and improvements, now available with new information technologies (IT). The SRD stores external individual occupational data provided by Brazilian authorised IMS. The system analyses data quality and stores data from around 300 000 workers. This database currently has 1 300 000 records, which have been collected since 1987 from the IMS. Until 2009 year-end, Brazil had 10 authorised IMS and around 120 000 monitored persons. This number increased to 11 in the beginning of 2010. Information of the Brazilian IMS is presented in Table 1.

SRD's data quality analysis is performed by a batch process, which is highly time-consuming and does not support the actual needs, as consistent data and quality in its storing process. The external occupational dose information needs consistency and integrity; the system functions, which manipulate such data, need optimisation of time and space performance.

GDOSE management system

The new IS (GDOSE) has to overcome problems regarding information reliability, consistency, availability, accuracy and integration of data with the current database. It is also required to present new functionalities with a web support for information-processing tasks such as:

- lifetime dose record requested by workers all over the country, with a web-based follow-up;
- request by IMS for facility registry coding;
- workers' radiation annual dose storage;
- worker's dose higher than 4.0 mSv to be notified by IMS to the suitable regulatory board (CNEN or Health Ministry);
- management reports to regulatory areas and
- reports that summarise data for international organisations—UNSCEAR for example—national entities, and statistical and epidemiological studies.

GDOSE functionalities and IS qualities

The IMS upload changes in information of monitored facilities and worker personal data once a month. Dose values higher than 4.0 mSv are also informed monthly. Worker's dose radiation data are uploaded once a year. Such data allow IRD to learn the radiation level of workers from each professional activity. Additionally, it is possible to identify problems from any facility or risks to workers' health. This process is depicted in Figure 1.

The external occupational dose data involve:

- workers' radiation level of exposure information;
- workers' personal information;

Table 1. Brazilian photon external IMS.

IMS	Type of laboratory	Type of detector	Monitored workers
CDTN/CNEN	Government	Film	~4000
CIDRA	Public university	TLD	~8000
DEN/UFPE	Public university	Film	~10000
ETN	Government	TLD	~3000
IF/USP	Public university	TLD	~600
IPDR	Private	TLD	~2500
IPEN/CNEN	Government	TLD	~1500
IRD/CNEN	Government	Film	~4000
PRO-RAD	Private	TLD	~40000
SAPRA/ LANDAUER	Private	TLD	~40000
TEC-RAD	Private	TLD	~9000

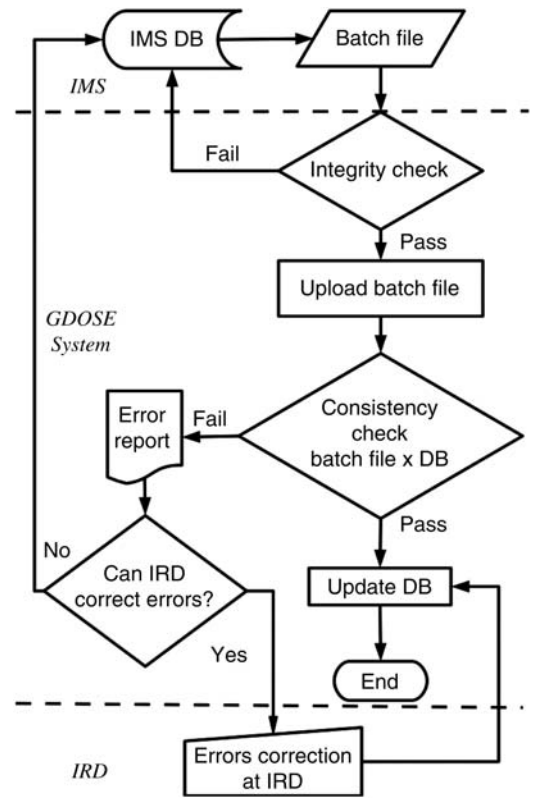

Figure 1. Data-loading process in database.

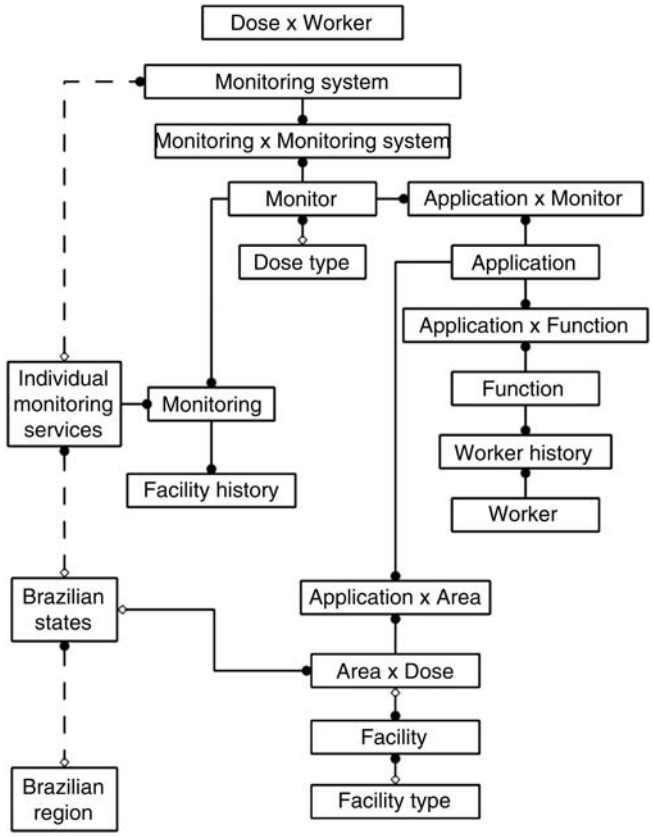

Figure 2. Database structure tables of workers' annual dose.

- working facilities' information in Brazil and
- individual monitor information.

These data are supplied by IMS and stored in the CNEN data server in Rio de Janeiro. The IS has a centralised database server, a secure storage with a regular backup and a quality data batch process which leads to consistency checks of data provided by IMS. Additionally, a secure control access assures confidentiality and integrity.

Figure 2 represents the database management system structure. The Electronic Data Management allows for data collection from IMS. Additionally, different IMS are allowed to evaluate a different set of monitoring systems. The integration of these data guarantees that only authorised IMS provide external occupational dose data. The data integration allows the quality analysis process to store only consistent and reliable data.

The electronic request of a worker's historical dose information makes the solicitation web-available and agile. Security and cost concerns make it necessary to send any signed request by conventional mail, as digital signature certificate is an expensive technology. Otherwise, the IS offers a web follow-up status request for the workers. Figure 3 shows, as an example, the structure database of this module.

High-Dose Management allows IMS to notify the occurrence of a high dose, with support by an electronic form. This event starts a process in which the system sends e-mails in order to notify a worker's dose higher than 4.0 mSv to the entities in charge of controlling ionising radiation practices.

Management Reports offer statistical analysis and process indicators in order to provide information so as to manage practices involving ionising radiation. Such information contributes, with decision support, to keep protection from undesirable levels of ionising radiation. The reports also summarise data for international and national entities responsible for radiation protection, or any other relevant study. This is the most important tool of this newly developed IS, which was impossible to do in the old data bank SRD. With GDOSE, Brazil will be able to do national dose statistics like other countries that have modern national central registry systems[4–9].

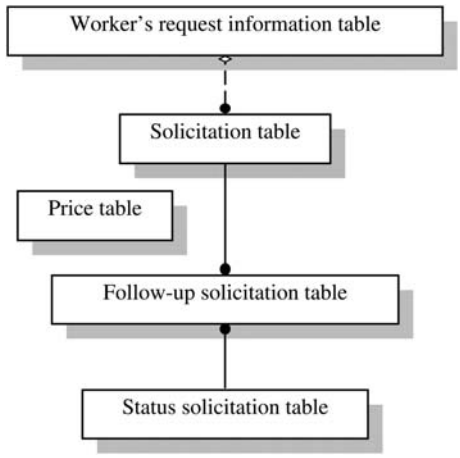

Figure 3. Electronic request of a worker's historical dose information database structure.

Another system module is the Electronic Request of registry coding for nuclear and radioactive monitored facilities. This module can give a new code for facilities that has never been monitored before or inform the code already generated for registered facilities. The IMS are in charge of notifying a new monitored facility and requesting the registry coding of this facility. The IMS are also responsible for notifying when a facility cancels its individual monitoring contract. Up to now, this module only allows the IMS to request the code; it does not provide this code automatically.

Use of GDOSE

The electronic request of worker's historical dose information has been operational since October 2009. From this time to March 2010, thirty-two (32) lifetime dose record documents have been requested.

The electronic request of registry codes for nuclear and radioactive facilities monitored has been operational since November 2009. From this time to March 2010, one thousand and three hundred (1300) registry codes have been informed. This request provides evidence that it is necessary to develop a new functionality: electronic generation and supplying of registry codes.

IS schedule development predicts that until 2010 year-end, the following functionalities will be developed: the historical data stored with support of the legacy will be migrated to the new database; reports will be available, although the legacy provides support to secure statistical data; and high-dose management functionalities.

CONCLUSION

GDOSE system provides more efficiency as a Brazilian national individual dose database. The IS improvement development is due to the following factors: new available technologies; previous knowledge regarding difficulties in managing working radiation levels IS and integration of data with legacy database.

REFERENCES

1. Comissão Nacional de Energia Nuclear. *Diretrizes Básicas de Proteção Radiológica*. CNEN NN-3.01, D.O.U. No. 04, 06/01/2005 (2005).
2. Agência Nacional de Vigilância Sanitária. *Diretrizes de Proteção Radiológica em Radiodiagnóstico Médico e Odontológico*. Portaria No. 453, 1/06/1998 (1998).
3. Comissão Nacional de Energia Nuclear. *Sistemática para Certificação de Serviços de Monitoração Individual Externa*. Portaria DRS/CNEN No. 1, D.O.U. No. 191, 04/10/1995 (1995).
4. Frasch, G., Petrová, K. and Anatschkowa, E. *Dose registry in Europe: national databases and international statistics*. Radiat. Prot. Dosim. **96**, 273–275 (2001).
5. Julius, H. W. and Bermann, F. *Dose record keeping: a multipurpose tool in individual monitoring*. Radiat. Prot. Dosim. **54**, 321–326 (1994).
6. Hernandez, A., Martin, A., Villanueva, I., Amor, I. and Butragueño, J. L. *The Spanish national dose registry and Spanish radiation passbooks*. Radiat. Prot. Dosim. **96**, 277–280 (2001).
7. Choi, S. Y., Kim, T. H., Chung, C. K., Cho, C. K. and Paik, N. S. *Analysis of radiation workers' dose records in the Korean national dose registry*. Radiat. Prot. Dosim. **95**, 143–148 (2001).
8. Fair, M. E. *Record linkage in the national dose registry of Canada*. Eur J Cancer **3**(Suppl. 3), S37–S43 (1997).
9. Alves, J. G., Martins, M. B., Roda, A. R. and Abrantes, J. N. *Databases in use at the individual monitoring service of ITN-DPRSN*. Radiat. Prot. Dosim. **111**, 27–33 (2004).