

Evolution of the operational doses from the industrial radiography using mobile gammagraphy equipments in Spain (1995-2000) and Nuclear Safety Council future actions in order to reduce them

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1. INTRODUCTION

At present, in Spain there are about 800 industrial and research radioactive facilities and about 130 out of them are in the industrial radiography field. We use to consider as industrial radiography installations that use X-ray machines as well as those using gammagraphy gauges (gammagraphers). This radioactive equipment could work both in enclosure installations and on site.

Facilities with gammagraphy gauges are the most problematic ones. There are 49 facilities using gammagraphy gauges, about 38 % of the total of industrial radiography installations. The most usual radionuclide in gammagraphy gauges is Iridium-192 with a maximum activity of 5 TBq (135 Ci), although no more than 3 TBq (80 Ci) are generally used. The use of Cobalt-60 is lower (it is used fundamentally in enclosure installations) and only in a few cases Ytterbium-169, Cesium-137 and recently Selenium-75 are used.

Historically, this type of facilities had presented the highest risk in the industrial radioactive field, particularly when they use mobile gammagraphy gauges, so these ones show the highest operational doses and the highest number of overexposures and incidents. Given these facts, the Nuclear Safety Council decided to implement in 1993 a plan to improve radiological protection conditions in industrial activities after completion of a cause analysis.

This analysis showed that licensees seldom adopt radiation protection provisions in a systematic way, in the other hand the competent authority has realised that it should struggle to present its requirements in a more clear way.

2. FIRST RADIATION PROTECTION IMPROVEMENT PLAN

Based on the primary cause analysis it was concluded that the following actions should be applied to improve radiation protection:

- To send a circular letter to all facilities with requirements and recommendations in order to improve safety and radiation protection.
- To develop an audit programme to installations that presented highest field gammagraphy workload.
- To carry out a study of the routine surveillance programs of gammagraphy equipment and its accessories

The audit programme results showed deficient knowledge of the operators, regarding the application of the operation procedures in actual situations, as well as other radiation protection aspects, so that CSN concluded the need for adopting new actions:

- To publish a radiological protection Safety Guide on operational conditions of gammagraphy facilities (CSN GS 5.14).
- To establish specific training courses to technical operating personnel, supervisors and operators (included in CSN GS 5.12).
- To review assessment procedures of the Nuclear Safety Council.
- To focus the Nuclear Safety Council control on the application of the ALARA principle for the gammagraphy facilities.

After adopting these new actions, it has been verified that gammagraphy facilities have experienced significant improvement in their written procedures and in the acquisition of radiation protection resources.

The number of incidents reported by these facilities has increased because the reporting criteria had been clarified, not from any increase in the number of incidents. This is considered very positive because incident analysis is one of the most important ways to improve radiological protection conditions in future. Moreover, actual information on incidents will be very important to develop the database on events in radioactive facilities that is being developed at Nuclear Safety Council.

3. EVOLUTION OF DOSES

In order to know how these facilities have improved their operation procedures, a study on annual dose trends of mobile gammagraphy workers has been carried out.

These type of facilities lead their workers to higher doses than any other gammagraphy facilities (in enclosure installations with bunkers).

To carry out this study it has been taken into account the nine facilities with the more significant number of workers exposed to the radiation from 1995 to 2000 both included.

Annual doses below 2 mSv were neglected, valuing that the analysis should not be affected by the use of other equipment with radioactive products that present this level of annual doses, such as density and humidity soil gauges. This was concluded from the fact that many gammagraphy facilities also work with soil gauges.

Data have been distributed considering the following intervals of annual doses, in mSv:

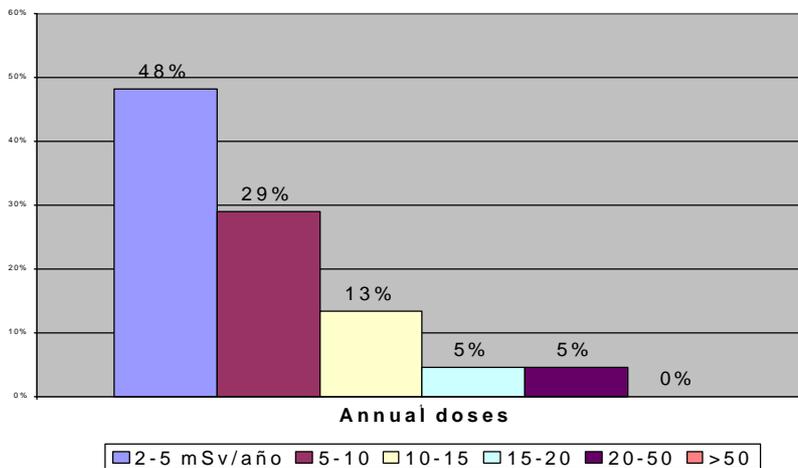
- 2 – 5
- 5 – 10
- 10 – 15
- 15 – 20
- 20 – 50
- > 50

As it is showed in graphics 1 to 6, during 1995, 23% of workers were above 10 mSv/year; in 1996, 27%; in 1997, 21%; in 1998, 30%; in 1999, 26% and during 2000 this value increased to 30%.

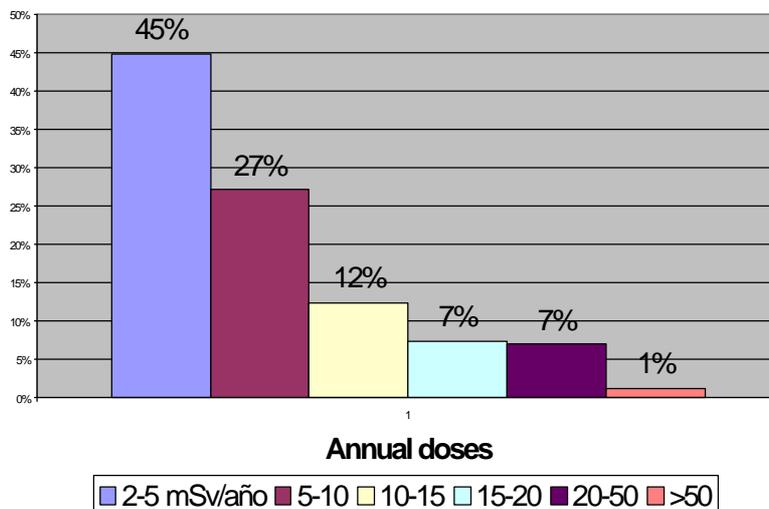
This leads us to the conclusion that workers percentage with high doses, above 10 mSv/year, (overexposed workers included) not only has not remained at the same level but it has increased from 1995 to 2000.

The main problem is that this is a very competitive field, where some customers put high pressure on the gammagraphy facilities owners and these ones over their workers. The result is that written procedures are not applied in an adequate way, protection resources are not adequately used, operators training remains insufficient and, finally, ALARA principle is not the main objective for the managers and, consequently, for their workers.

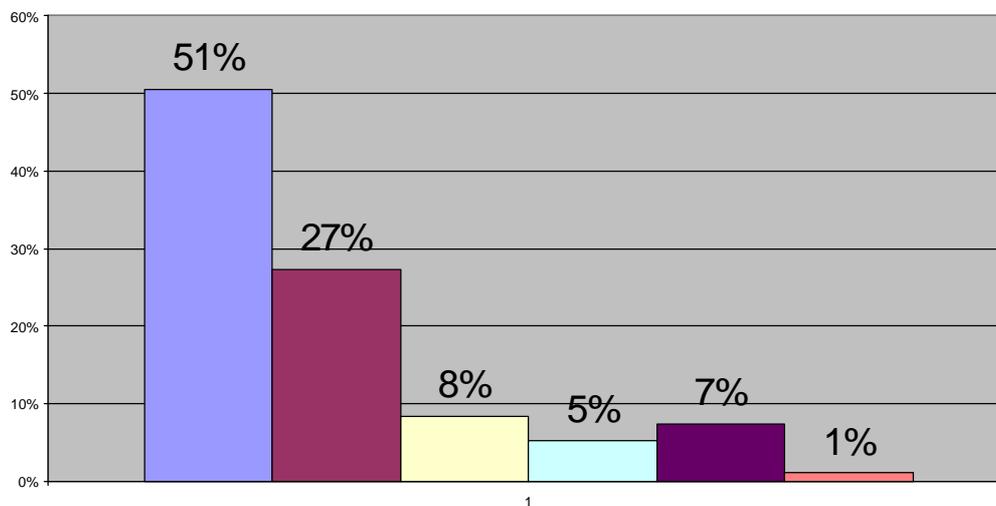
1995



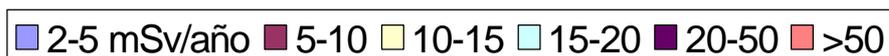
1996



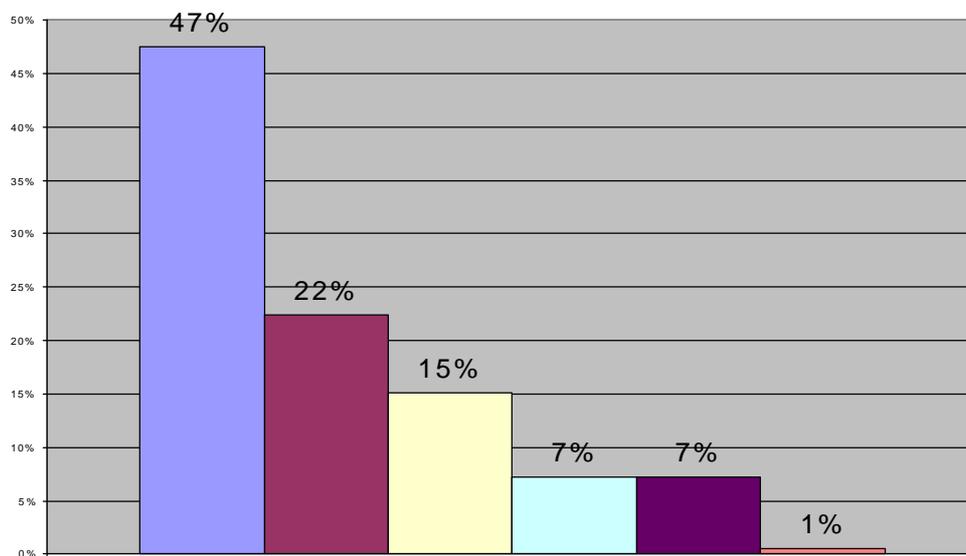
1997



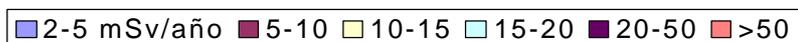
Annual doses



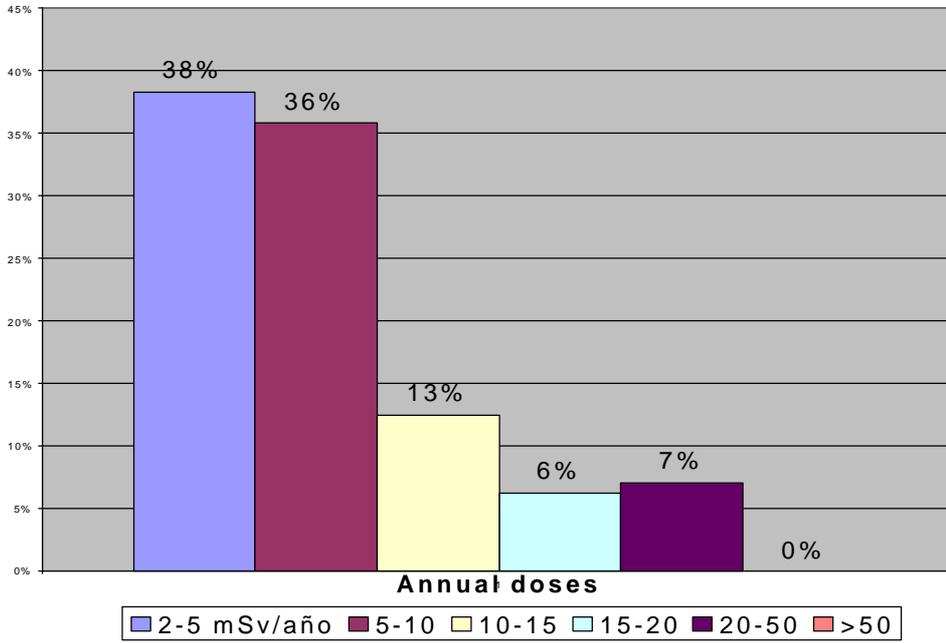
1998



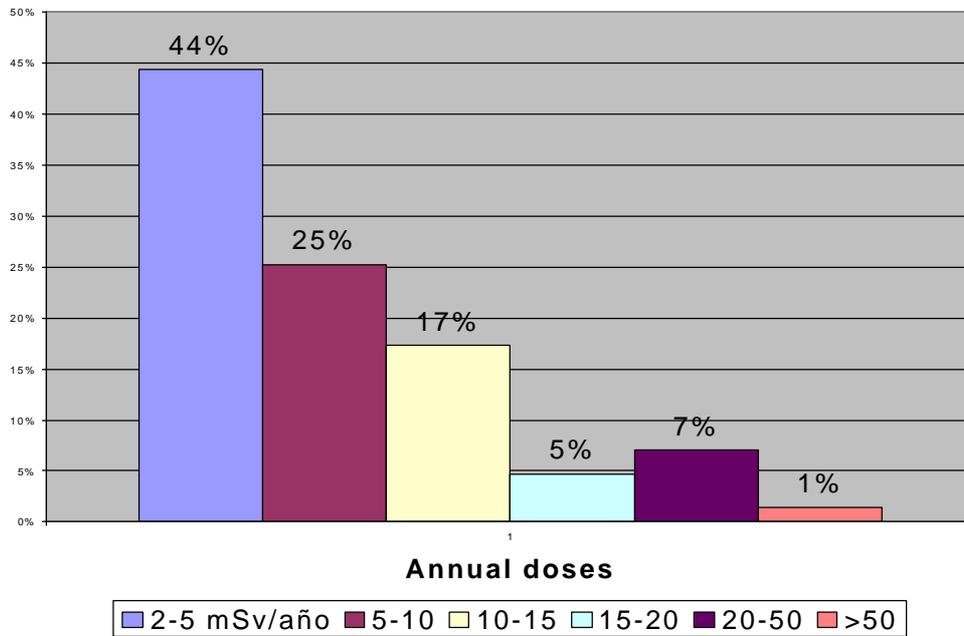
Annual doses



1999



2000



4. SECOND RADIOLOGICAL PROTECTION IMPROVEMENT PLAN

Until now, results obtained are far from getting personnel operation dose reduction to ALARA objectives, which shows the need for keep CSN working in that sense.

Next it is presented the radiological protection improvement plan, approved by CSN on 31/05/2001 after taking into account licensees comments.

• ELEMENTS USED IN THE SECOND ACTUATION PLAN

- A. Send to the licensees gammagraphy facilities complementary technical instructions (Art. 6,4 of the Regulation governing nuclear and radioactive installations) with the objective to increase their commitment with the ALARA principle, in order to involve the customers with the safety of gammagraphy workers that they contract.
- B. To increase the control actions of CSN and the implementation of coercive actions in case of non-compliance.
- C. To increase information to owners on lessons learnt from events occurred in other facilities both national and foreign.
- D. To establish co-operation between CSN and gammagraphy companies for implementation of the proposed actions and the study of additional complementary actions.

A.- COMPLEMENTARY TECHNICAL INSTRUCTIONS

- ◆ The owners of the installations have to develop and send to the Nuclear Safety Council an adequate INSPECTION PROGRAM.

This inspection program:

- Will include the surveillance by a supervisor of the performance of each operator or assistant during actual operations of radiography, at least every six months.
 - Will assure that, operator performance will be surveyed in case that an operator or assistant has not participated in a radiography operation during a period up three months.
 - Will include the record by the supervisor of inspections on each operator or assistant performance, and it will be noted in the operating records book.
- ◆ With the purpose of dose optimisation, the supervisor has to develop a GAMMAGRAPHY OPERATION TASK PLAN including the following aspects:
 - It will have to define the anticipated dose per operator, task and day, that should not be exceeded, this should be made taking in account the operation experience, the type of radiography, activity of the source, etc.

- It will have to establish the necessary operator number, the number of radiographies by operator, the working time, shifts, radiation protection resources, etc.
 - Once finished the task, the supervisor will make a comparative study of the actual doses, received by the operator and known from the direct reading dosimeter, with the anticipated doses.
 - If anticipated and actual dose difference is significant, an assessment should be performed from the supervisor. So that it will be evaluated whether procedures improvement, increase of resources of radiation protection personnel, training, etc. are necessary.
 - Licensee should maintain records of planning, doses and latter performances, and this have to be referenced in the Operating Records Book.
- ◆ With the objective to improve the OPERATION PERSONNEL TRAINING, the following actions will be taken:
- It will be request to all the gammagraphy facilities licenses, the presentation of a CONTINUED TRAINING PROGRAM for all the operating personnel, directed to improve the implementation of the working procedures and follow the ALARA principle.
 - The training courses should be performed every two years, the supervisor of the radioactive facility may act as trainer and records of the accomplishment must be taken.
 - Accreditation of having received this training should be presented for the next renewal of the operator license.
 - The training program should be incorporated in the Operating Organisation Manual of the facility.
 - All operators relapsed in bad operation and high doses will be tested to be able to renew the licence.
- ◆ The complementary technical instructions will include ACTIONS ON THE CLIENT COMPANIES.
- CSN will send an informative letter to client companies to remember their implication in the safety of the gammagraphy workers that they contract.
 - The contracts between client companies and gammagraphy licensee must include the licensee compromise with the workers and public safety.
 - These contracts must include the compromise of the client companies to provide the means for the work to be performed in such conditions

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The gammagraphy facilities licensees should incorporate the requirements of these complementary technical instructions in their Operating Organisation Manual.

B. INCREASE THE CONTROL AND COERCIVE ACTIONS BY THE CSN

The control and strict surveillance by the CSN of the operation of the gammagraphy facilities will be increased, so that:

- ❑ An inspection campaign on site (field operations) will be carried out. The detailed plan of monthly work will be requested to the licensees.
- ❑ When as a result of bad operation, high radiation doses by the operation personnel are derived, a proposal of penalty will be initiated.
- ❑ In those radioactive facilities in which a relaxation takes place, which in most of the cases will be consequence of a bad supervisor management, CSN will set out the temporary suspension of the installation operation permit, until the owner presents a plan to correct the situation. The solutions will go directed to measures such as:
 - To increase time devoted by the supervisor to radiation protection tasks. The functions of radiation protection should be separated from other functions such a administration or management of the company. The supervisor will be devoted basically to radiation protection functions.
 - If this is not possible, support the supervisor functions with another supervisor will be necessary, in which case functions and responsibilities of each one should be clearly defined in the Operating Organisation Manual.
 - To increase the number of operators to establish turns between the operation personnel in the gammagraphy work.
 - If the size of the licensee company allows it, an external entity or an own specific internal service can be requested by CSN, to carry up with the radiation protection of the facility.
- ❑ In extreme cases of bad performance of the operation personnel, the CSN will suspend their operation license.

C.-INFORMATION ON OPERATING EXPERIENCE AND OPERATIONAL PRACTICES

To increase information to owners on lesson learnt, the following aspect will be carry up:

- CSN will send informative letters to the licensees of these companies when events in gammagraphy facilities occur, from which lessons of radiation protection are learnt.

- CSN will search of good practices on radiation protection, practices used in other countries and give information to the licensees.
- CSN will participate and promote participation of licensees at international work groups for improvement of radiation protection and application of conclusions and recommendations.

D.- ESTABLISHMENT OF SYSTEMATIC CO-OPERATION BETWEEN CSN AND GAMMAGRAPHY COMPANIES IN RADIATION PROTECTION MATTERS

For the implementation of the proposed actions and the study of additional complementary actions, following aspects had been consider:

- CSN have sent complementary technical instructions of the improvement plan for commentaries before its application.
- CSN will organise technical meetings with the licensees.
- CSN will organise a Forum of work with professional associations in order to get solutions to reduce the doses

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- [4] Real Decreto 1836/1999, de 3 de diciembre, por el que se aprueba el Reglamento sobre instalaciones nucleares y radiactivas.
- [5] Real Decreto 783/2001, de 6 de julio, por el que se aprueba el Reglamento sobre protección sanitaria contra radiaciones ionizantes.