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ELECTRICITE DE FRANCE's ALARA POLICY**Laurent Stricker¹ ; Philippe Rollin² and Raymond Dollo³**

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ABSTRACT

In 1992, Electricité de France -EDF decided to improve the degree to which radiological protection is incorporated in overall management of the utility and set itself the objective of ensuring the same level of protection for workers from contractors as for those from EDF. This decision was taken in a context marked by a deterioration in exposure figures for French plants and by the new recommendations issued by the ICRP. This document describes the policy adopted by EDF at both corporate and plant level to meet these objectives, by :

- setting up management systems which were responsive but not cumbersome,
- a broad policy of motivation,
- the development and use of suitable tools.

The document then describes some quite positive results of EDF's ALARA policy, giving concrete examples and analysing the changes in global indicators.

INTRODUCTION

When one thinks of electrical utilities, France is often viewed in terms of nuclear power, with EDF as the main player.

Electricité de France is one of the largest utilities in the world. In 1993, it had a turnover of almost \$32 billion, clearing a profit of \$520 million. Its workforce consists of approximately 118,000 employees who perform a very wide range of activities, including the design, construction, operation and maintenance of facilities involved in the generation, the transmission and distribution of electricity. These characteristics are quite unique among utilities, making Electricité de France a leader in its field.

Electricité de France is the only utility in France, generating, transmitting and distributing electricity to 29 million customers in 25 million homes and to 600 large industrial clients. In 1993, Electricité de France generated 424 billion kWh. In 1993, exports to neighbouring countries totalled around 61.7 billion kWh, representing around \$2.4 billion.

83 % of electricity generated in France in 1993 came from nuclear power plants, 14 % from hydroelectric facilities and 3 % from fossil-fired plants. Electricité de France operates 56 nuclear units with a total installed capacity of 58,880 MW.

An ALARA approach was first applied at EDF for replacement of the steam generators at Dampierre 1, both during the preparatory stage in 1988/89 and during actual operations in 1990.

Towards the end of the eighties, the ALARA concept was not a clear part of the radiological protection culture in France. This principle only appeared in French legislation for nuclear facilities in 1988[1]. Moreover, this period saw a steady deterioration in dosimetric results for each unit and for each GWh generated at French plants, both in terms of the absolute value, and in comparison with results in other countries (See Figure 1).

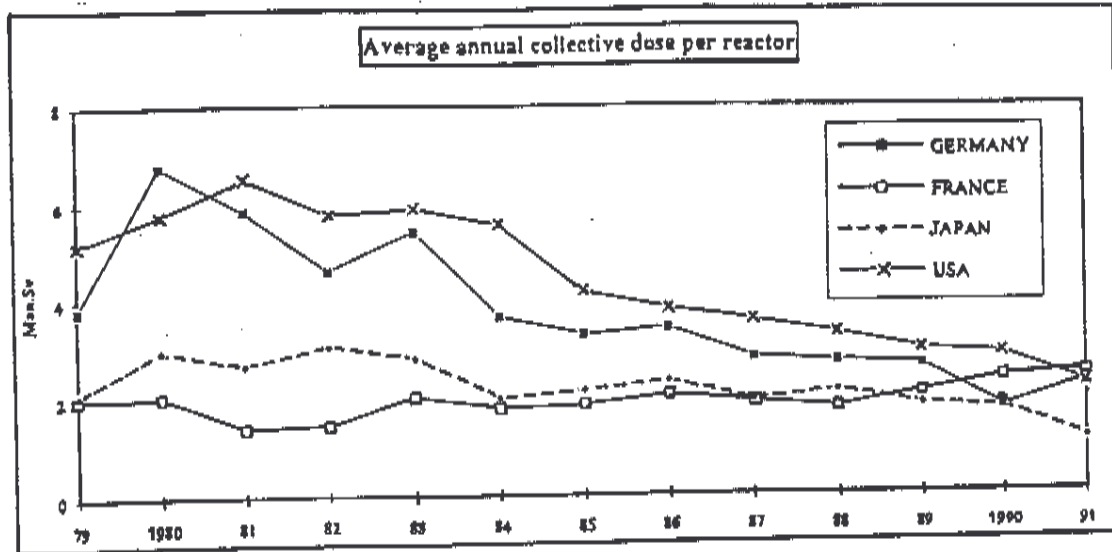


Figure 1 : Average annual collective dose per reactor (Germany, France, Japan, USA)

The results achieved for steam generator replacement at Dampierre Power Plant -2.13 man.Sv over 70 days (see Figure 2)- set a new world record at that time[2], and proved to EDF that application of the ALARA approach permitted an effective transition from the "a posteriori dose-limits-respect type of radiological protection" to a priori management of individual and collective exposures.

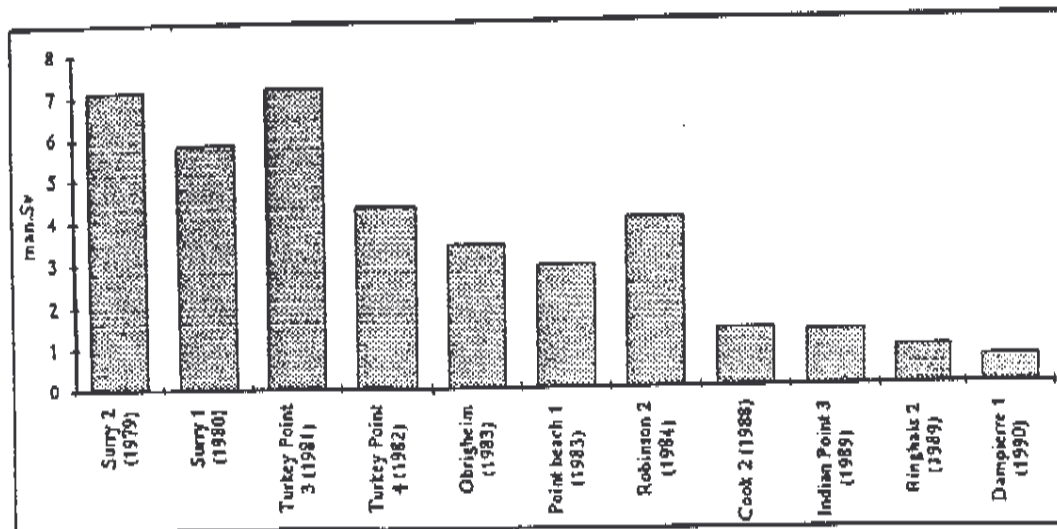


Figure 2 : Steam generator replacement total collective dose per steam generator (in chronological order)

So it was that EDF, with the aim of applying this approach to all operations carried out on the entire population of French plants, set itself an ambitious dual objective in 1992 for reducing exposure, thereby anticipating the changes in individual dose limit :

- a) improve the degree to which Radiological protection is incorporated in overall management of the utility and decrease the average annual collective dose from 2.43 man.Sv per unit in 1991 to 1.6 man.Sv by 1995 ;
- b) provide the same level of protection for workers from contractors as for EDF workers, and as a matter of priority reduce the exposure of those groups of workers with the highest individual dose levels.

In order to meet these objectives, EDF has set up special ALARA groups and committees, is trying to infuse an ALARA culture throughout the utility, has adopted a policy of motivating all players concerned by ionising radiation and is busy developing and using ALARA tools.

DEFINITE COMMITMENT FROM THE MANAGEMENT

EDF management has on many occasions clearly expressed the above objectives and reiterated that one of its priorities was to reduce exposure. This commitment was recently expounded in a forty page document[3], a sort of mission statement setting out the main thrusts and objectives of the utility's radiological protection policy. An action plan has been outlined for each objective to cover the period up to the year 2000. This document, with a foreword by the Deputy Managing Director of EDF, was distributed throughout the utility and outside.

A SIMPLE AND RESPONSIVE MANAGEMENT SYSTEM

EDF operates PWRs in 17 plants across France. The ALARA committees and groups set up, which remain in essence responsive without being cumbersome, are quite naturally divided between corporate and plant level (see Figure 3).

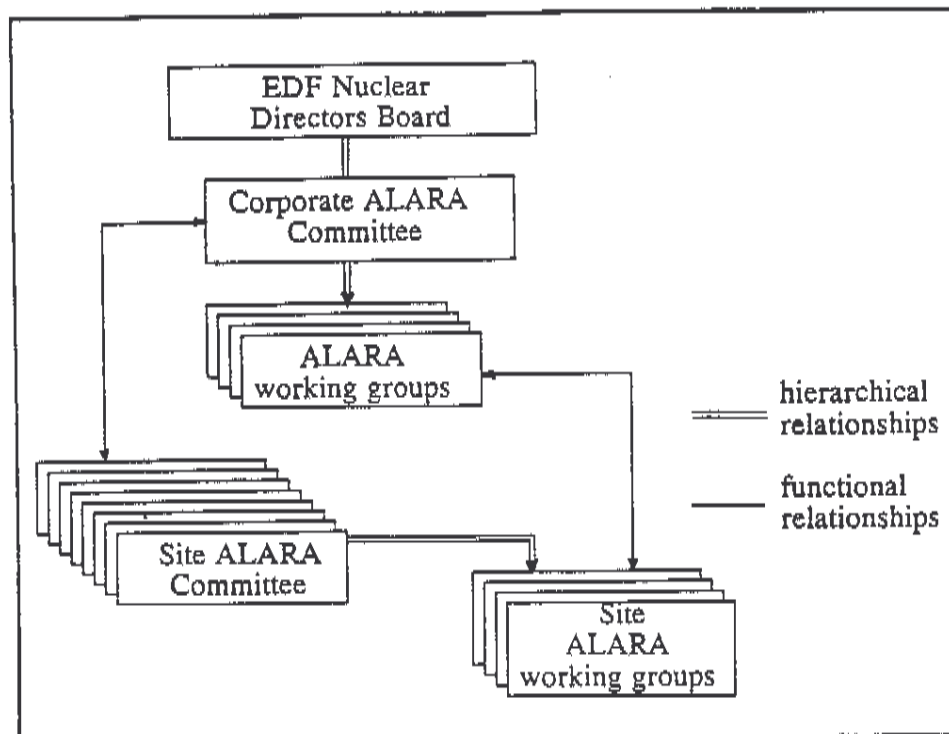


Figure 3 : ALARA management system at EDF

1. CORPORATE LEVEL

a) A Corporate ALARA Committee

This Committee was set up in December 1991 ; it is chaired by a member of the steering Committee of the EDF Nuclear Generating Division and is supported by the EDF corporate Industrial Safety and Radiological Protection Department. It has two types of members :

- standing members responsible for corporate departments (e.g. radiological protection, tool development, design of future facilities) ;
- representatives from the management of the nuclear power plants ; the plants are divided into three groups which take it in turns to be represented on this committee, swapping every eighteen months.

This Committee sets out the major thrust of EDF ALARA policy, ratifies target doses each year at corporate level for each type of reactor with the aim of meeting the objective of an average of 1.6 man.Sv per reactor by 1995, fosters inter-plant emulation to attain this goal, monitors result indicators and promotes experience feedback between plants.

b) ALARA Working Groups

Such groups can be set up when new problems arise at corporate level. In 1992, for example, shortly after the discovery of cracks in pressure vessel heads and in view of the importance of the doses incurred when inspecting, preventing or repairing these cracks, a corporate ALARA group was set up, at the request of the Corporate ALARA Committee, to implement an ALARA programme to remedy the problem. This group included not only representatives from the sites and from EDF head office, but also from the major contractors involved (Framatome, Jeumont Schneider, etc.). A group of the same sort has been in operation since 1989 for steam generator replacements (Dampierre, then Bugey and Gravelines Power Plants).

2. PLANT LEVEL

The local systems set up on the initiative of the plants mainly take the form of systems for co-ordinating the various professions at the plants. They also act as a relay : for relaying corporate policy to the plants and contractors, for relaying information between the plants themselves to promote experience feedback, for relaying experience gained in the field and for relaying plant suggestions to the corporate fora.

Practically all plants set up a site ALARA Committee between 1992 and 1993. This Committee is chaired by the site Director or Deputy Director and has executive powers. It provides a forum for dialogue. It groups together representatives from all the departments (maintenance, scheduling, chemistry, operation, general services department, occupational medicine, etc. not to mention radiological protection) and representatives from the contractors.

On the basis of the plant's own dosimetric objective, these Committees select those high-dose jobs to be most closely monitored and analysed, and decide what resources to use. The majority of the Committees are assisted by multi-disciplinary or cross-disciplinary groups responsible for suggesting cost-effective actions to reduce exposure, by acting both on the dose rates (conditions for implementing outage, oxygenation, development of biological shielding etc.) and on the exposure time (organising scaffolding and heat lagging work, training maintenance workers, development of special tools, etc.).

WIDE-RANGING POLICY TO MOTIVATE ALL PLAYERS

1. HOW TO CONVINCE THE DECISION-MAKERS

Several plants and corporate departments, with the help of experts, organised a day for managers to outline and discuss the ALARA principle and approach and how to implement them at EDF. The same sort of day was organised at corporate level in order to make the heads of external corporate contractors aware of this and to discuss the repercussions of EDF ALARA policy on relationships between the Operator and its Contractors.

The first step in implementing this policy was that of setting dosimetry objectives for each reactor, depending on its specific characteristics (type of reactors, existence of hot spots, etc.) and the work to be carried out (partial inspection, ten-yearly inspection, etc.). These objectives, which must at all times be consistent with the policy (target doses) laid down by the Corporate ALARA Committee, are negotiated between the plants and corporate headquarters before being incorporated into annual management contracts and three-year plans ; the managers of the plants make a commitment to EDF corporate management to meet the objectives in these plans.

2. AN ALARA TRAINING POLICY

EDF then undertook a large-scale programme to train all players and make them aware of ALARA issues ; this was seen as a first step along the road towards changing the culture of all workers in the nuclear generating sector.

a) Targeting Workers Involved in Unit Outages

Exposure during outages accounts for 80 % of the annual dose, and so the majority of plants held two-day training sessions organised by experts from off-site for the unit outage management and preparation teams (outage manager and representatives from the various departments involved) : this training combines theoretical teaching of the basics of optimising radiological protection and practical studies of experience at other plants.

b) Training Instructors

About forty EDF workers (radiological protection workers, maintenance technicians, and design engineers) took part in one-week training courses on how to become ALARA counsellors and instructors at the plant or in corporate departments.

A new training initiative was set out in order to comply with the expectations of management staff from the contractors. This was intended to improve how people worked together, and to train staff to work better together to achieve the objectives of the population of nuclear power plants in respect of maintenance, and to become players in the ALARA approach.

c) Incorporating ALARA into Job Training

All these initiatives, no matter how effective they may be, are only a drop in the ocean when one considers the large number of people involved (tens of thousands of EDF and contractor personnel). In 1992, an ALARA module was therefore incorporated into the radiological protection authorizations for working in a controlled area, and modules of the same type are to be systematically included in job training, also for those persons who do not work in a controlled area, but whose work covers occupational exposure, in particular plant procedure planners or persons in charge of reactor operation.

3. INFORMATION AND AWARENESS

Each plant will develop its own policy in this area, and shall call on the imagination and creativity of its workers : display of objectives, ALARA information days at EDF and at the plant, ALARA posters, videos, articles in site or outage newsletters, competitions between teams, reception of new contractor teams, regular worksite inspections, radiological protection and ALARA items in the Hygiene, Industrial Safety and Working Conditions Committee or unit outage meetings, etc.

Motivating the players seems to be an important factor, both in the preparation stage and during operations themselves, in reducing the large number of anomalies which account for up to 30 % of the dose in France[4]. Motivation should be a constant concern, because experience feedback from certain plants has shown that as soon as the pressure is released, results worsen.

4. SPECIAL MOTIVATION OF CONTRACTORS IN THE CONTEXT OF A CONTRACTUAL PARTNERSHIP

There are no plans to implement an ALARA policy without the active participation of the contractors, since it is their workers who will perform the majority of inspection and maintenance operations and who account for over 80 % of the collective exposure, and since these contractors are developing many processes and tools.

EDF is therefore striving, in this area as in many others, to develop a contractual partnership policy by :

- incorporating ALARA exposure reduction into the specifications for the work to be carried out,
- studying the reasonable cost of contractor proposals in respect of work organisation, process modification or development of tools,
- incorporating dosimetric objectives into orders, without awarding financial rewards for achieving these objectives, but using the effective committed dose as a criterion for selecting the contractor during subsequent operations,
- demanding analysis of experience feedback on radiological protection on closing worksites,
- promoting the implementation of internal ALARA programmes for contractors, etc.

DEVELOPING AND USING SUITABLE RESOURCES

1. IMPROVING OPERATIONAL MONITORING OF COLLECTIVE AND INDIVIDUAL DOSES TO EDF AND CONTRACTOR WORKERS THROUGH AN INFORMATION SYSTEM

In order to improve operational management of exposure, EDF is gradually equipping its sites with a real-time computer management system (Real Time Dosimetry - known by its French acronym DTR), for the doses incurred each time a worker enters a controlled area, or each time he enters a sub-area.

Furthermore, in order to provide its workers and workers from contractors with the same degree of protection, EDF has set up a computer link between the various plants (the DOSINAT system) ; this allows contractor employees to be monitored by name when they move to another plant, thereby ensuring, both by questioning employers and by investigating the working conditions in the plants, that radiological protection be applied as strictly as possible with regard to dose limits. This computer application was licensed by the French state-run Data-Processing and Civil Liberties Commission (*Commission Nationale de l'Etat Français "Informatique et Libertés"*-CNIL).

In years to come, this database will be extended to the other links in the nuclear energy chain.

Moreover, since mid-1993, a new EDF access log is required for all workers assigned to work in a radioactive area when they arrive at the plant. The first page of this logbook lists the training undergone by the worker, and the third page gives dosimetric monitoring information together with DOSINAT dosimetric results and the results of whole-body-counts.

2. PROMOTING CORPORATE AND INTERNATIONAL EXPERIENCE FEEDBACK

Rapid distribution of operating experience is the key to the success of any ALARA policy. EDF, with a population of 54 reactors of similar design, is striving to increase the effectiveness of exchanges of operating experience between plants. In addition to the training structures mentioned earlier and the databases specific to each plant, corporate working groups have made it possible to :

- select high dose jobs, assign each of these jobs to a plant, apply a common procedure for predicting all job doses and for following up data during the jobs, enter this data into the computer application DOSIANA, draft an operating experience report and provide the other plants with all of this information. This application was first used for all operations linked to the inspection and repair of pressure vessel heads. Eventually, all unit outage operations should profit from this system ;
- build up a corporate operating experience file on radiological protection "good practices" and distribute it to as many people as possible at all sites (see Mr Rocaboy's presentation on scheduling in this Workshop) ;
- create a corporate operating experience file on treating hot spots (see Mr De Guio's presentation in this Workshop) ;
- create a corporate file on the treatment of problems relating to contamination with silver-110.

In parallel with this desire to improve French operating experience feedback, EDF has been an active supporter of implementing the ISOE system [5] to promote exchanges of operating experience between operators in different countries. EDF regularly updates the system with its good practice files and new operations or problems encountered.

3. CONTRACTOR APPROVAL

Quality training is essential for mitigating risks. In 1990, the French Committee for accrediting organisations for the training and dosimetric monitoring of workers exposed to ionising radiation (French acronym CEFRI) was set up. This committee was set up with the full approval of the operators (EDF, COGEMA, French Atomic Energy Commission and the French military), the French ministry for health and the radiological protection authorities, the ministries for labour and industry . This body issues approval, subject to a positive audit, to :

- training organisations,
- temporary employment agencies supplying staff,
- contractors employing staff working in nuclear installations.

This approval covers the quality of training and the management system set up to perform dosimetric monitoring and medical surveillance for field workers. Eventually, only contractors approved by the CEFRI will be accepted into nuclear plants.

In addition, EDF is changing its contractual relationships with contractors and introducing a clause stating that approval will be withdrawn from the contractor should a contract of employment be

rescinded or suspended between this contractor and one of its employees reaching or exceeding a regulatory dose limit.

4. A CORPORATE POLICY FOR AUTOMATED TOOLS

One of the most promising areas for the ALARA concept is that of implementing a corporate development policy for automated tools ; this topic will be covered by Mr Cazin in his presentation at this workshop.

INITIAL RESULTS

1. THE TREND INFLEXION IN 1992-1993 (FOR DOSES)

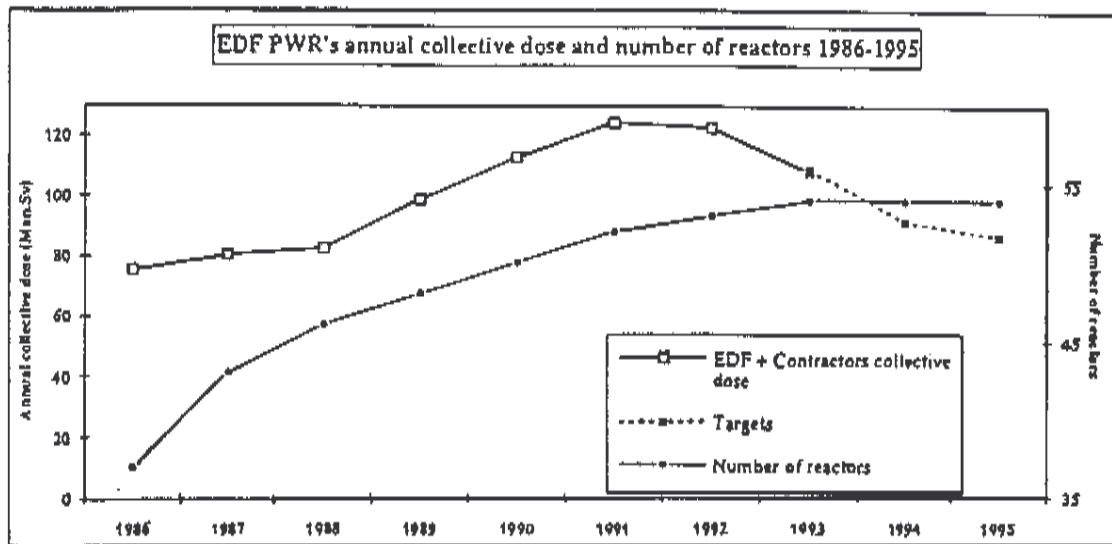


Figure 4 : EDF PWRs, annual collective dose and number of reactors (1986-1995)

Between 1983 and 1989, the average dose per unit per year ranged between 1.8 and 2 man.Sv. In 1990, this figure was 2.35 man.Sv, and in 1991 it was 2.44 man.Sv, owing to a large number of ten-yearly inspections that year. Promotion of the ALARA principle from 1992 onwards reversed this trend : from 2.36 man.Sv in 1992 to 2.04 man.Sv in 1993.

The target of 1.6 man.Sv which EDF has set itself remains very ambitious.

2. LARGE OPERATIONS OPTIMISED

a) Steam Generator Replacement

Steam generator replacement operations systematically give rise to planning work, monitoring and experience feedback in accordance with an official ALARA approach in the framework of a working group combining the EDF Engineering and Construction Division and the Operator.

The ALARA programme adopted for steam generator replacement operations is mainly centred on ;

- a study of how to optimise protection initiatives : water levels in the steam generators, biological shielding, decontamination of the ends of reactor coolant pipework ;

- strong motivation of the workers ; theoretical and practical training before steam generator replacement operations ; close relations between the ALARA team and workers during site work, making use of the many media and supports (readouts, projected dosimetry curves produced, worksite meetings and experience feedback, etc.).

The results of steam generator replacement operations at Dampierre 1 and Bugey 5 have been very satisfactory. Last results at Gravelines 1 in 1994 are still better..

STEAM GENERATOR REPLACEMENT

	projected dose (man.Sv)	dose achieved (man.Sv)
Dampierre 1 (1990)	4.5	2.13
Bugey 5 (1993)	2.6	1.55
Gravelines 1 (1994)	1.41	1.32

The work at Dampierre 1 showed, according to surveys of field workers carried out during work, the positive effect of ALARA initiatives, especially in the field of motivation.

b) The pressure Vessel Head Incident

The accumulated dose for the vessel head incident until end 1993 is as follows :

	annual dose (man.Sv)	Cumulated dose (man.Sv)
1991 dose	1.9	1.9
1992 dose	9.0	10.9
1993 dose	7.0	17.9

An analysis of the years 1991 and 1992 gave a total forecast to the end of 1992 of 16 man.Sv without the ALARA programme. The figure of 11 man.Sv achieved over the same period represents a saving of 5 man.Sv which can be attributed to applying the ALARA principle at vessel head worksites.

The operation to replace the vessel head at Bugey Power Plant was carried out at the start of 1994 at a cost of 0.2 man.Sv compared with the projected value of 0.45. This projected value was of course very imprecise because it was the first time the work had been carried out at a plant of this type. Nonetheless, the small risk incurred must be attributed to the good ALARA preparation of the plant in collaboration between the plant, the corporate departments and the various contractors.

3. REFUELLING OUTAGES

Golfech 1, a 1 300 MW reactor commissioned in February 1991, achieved dosimetry figures of 0.47 man.Sv for the year (0.45 man.Sv of which was due to the unit outage). This result is the best to date for a French reactor and shows that our reactors can aim for an average level of performance which will bring them close to the best in the world.

EDF corporate policy for the past several years has aimed at improving safety and competitiveness. This policy has produced good results and the analysis of these results shows that the most efficient units are the best in terms of safety, availability, cost and radiation protection. The feedback experience demonstrates that quality, efficiency, safety and radiation protection are closely linked together : any improvement of one of these items leads to progress for the others, being therefore a very important motivating factor.

CONCLUSION

The main objective in radiological protection is of course to protect man ; the main way of doing this is to monitor the doses received.

However, the introduction of the ALARA principle into corporate culture is changing the philosophy behind the initiative and behind behaviour ; to really protect man, we also need to implement residual risk management i.e :

- a predictive approach : anticipate exposure and the means of reducing it,
- an effective approach : reasonable use of resources given over to protection,
- an evolutive approach : one which takes account of changes in the technical, financial and social context.

For such a management system to succeed, all workers involved must be motivated. Operating experience has shown that such a consensus is easier to reach if it is based on a policy of openness with regard to the residual risks due to ionising radiation and the means of making it as low as reasonably achievable.

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Author Biography

Philippe Rollin, born in 1939, is a civil engineer from the Ecole CENTRALE de Paris (1962). He joined Electricité de France in 1964. He has been working in thermal and nuclear plants, then was in charge of environmental questions for more than 10 years. He is presently Secretary General of EDF's "Radioprotection Committee," which deals with the general politics of EDF in that field. He is also, as of 1992, the first president of the Steering Group of the ISOE set up by OECD/NEA.

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PAPER 4-1 DISCUSSION

- Andersen:** You talked about the behavioral and cultural changes that were necessary to put this program in place. Now that you have had a few years of experience, are you getting much feedback from the work force? Is this being received favorably by the workers? Are they now motivated, or are you still having to work on that?
- Rollin:** Yes, of course. As I said at the beginning of my talk, people were not at all aware of ALARA. They did not ask themselves any questions. They were satisfied with the results. Then they began to see the improvements, especially after the Dampierre steam generator replacement. This presented an opportunity to spread the ALARA culture all over the EdF. We had meetings with all the persons responsible for the maintenance programs. At first, many of them were not convinced. When they saw the results, they became interested. They saw that ALARA programs were going on everywhere in the world, and they formed programs. This formation spread all over the company, and it has been interesting to see the progression of the idea. More and more people feel involved, and when they get involved, you are sure they are getting the point. It is very effective.
- Burholt:** Please explain the interface between the site ALARA committee and the conventional radiation protection services. Can you describe the management responsibilities?
- Rollin:** I mentioned the site ALARA committee and the site ALARA working group. In the site ALARA committee, the committee head is the deputy manager of the plant. You find in the ALARA committees all of the main departments of a nuclear plant. You find maintenance, chemical, operation, and, of course, the radioprotection personnel. They participate in all the jobs at the level of site ALARA committee. Then, they are better accepted by all the staff because they participate and they give advice on the job. If there is a special group set up to study a special problem, they also participate in that group. Perhaps, in France, the general management for radiation protection is different than in other countries. That means, for the moment, that the responsibility remains at the level of manager or deputy manager, and perhaps there is not enough authority for the radiation protection staff. We are considering giving the radiation protection staff more weight in decision making.