

A Nuclear Safety approach for a Radiation Protection issue

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1 The context

EDF power plants, as many other industries use industrial radiography, however, the situation of nuclear industry impose a very high level of the safety standards.

Curently EDF management and the safety authorities target, radiation protection standards must reach the level of the nuclear safety. Indeed, we can approach the risk notion for radiation protection and nuclear safety by the equation :

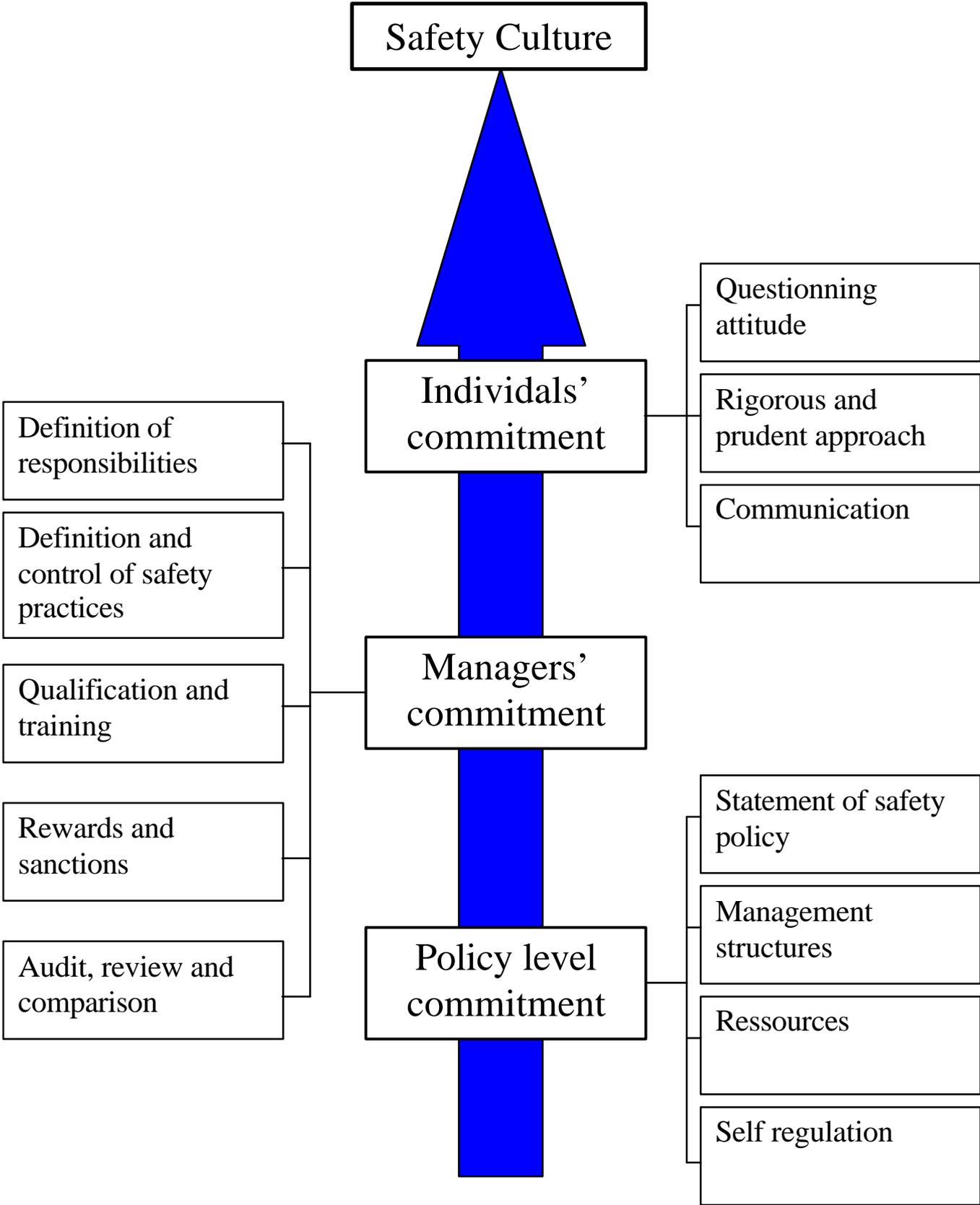
$$\text{Risk} = \text{Frequency} \times \text{Radiological consequences}$$

It is the reason why EDF made the decision to developp a « nuclear safety approach » related to this radiation protection issue.

2 Main principles

The International Nuclear Safety Advisory Group # 4 assisting the General Director of the IAEA, in charge of safety culture defined the main principles of the safety culture summarized as follows.

Graph 1



The purpose of EDF head management is to apply this policy for on the one hand radiation protection of each level described above, and on the other hand the industrial radiography risk:

Policy level commitment :

The statement of safety policy is exposed by EDF President, Mr Roussely, in the document « radioprotection and nuclear safety policy at EDF ». This document explains radiation protection has to be at the same level as nuclear safety. This document defines EDF units policy, and mainly the nuclear power plant Division.

The management structures : The national committee of radiation protection, managed by the nuclear power plants division deputy manager is in charge of the radiation protection policy definition for nuclear power plants Division.

The ressources : about 650 workers are in charge of radiation protection in the operating NPP. This number does not include researcher and ingeneering departments. Specialised contractors are employed for special operation and mainly during the outages.

Self regulation: Radioprotection EDF Vice President is in charge of decisions coordination for radiation protection.

Managers' commitment :

Definition of responsibilities : If the responsibility of the unit manager is always engaged, the responsibility of each actor of an industrial radiography control is described by the « industrial radiography permit »

CIN DU CONTRÔLEUR		PERMIS DE CONTROLE RADIOGRAPHIQUE			
DESIGNATION DE L'INTERVENTION (A) <i>work description</i>				ASSOCIE AU REGIME N. <input type="text"/>	
DEMANDEE PAR (B) <i>Asked by:</i>				CONSIGNATION (RC) <input type="checkbox"/>	
LOCALISATION <i>work place</i> OUVRAGE CONCERNE (C)				EXCEPTIONNEL DE TRAVAUX (RET) <input type="checkbox"/>	
				INTERVENTIONS IMMEDIATES (RII) <input type="checkbox"/>	
TR	SYST	CODE	DESIGNATION		
LOCAL	NIVEAU	DATE PREVUE		DUREE PREVUE	SERVICE OU ENTREPRISE
		J	M	H	
		(D)		(E)	(F)
CARACTERISTIQUES DE LA SOURCE (activité, nature,...) <i>Description of the radioactive source (Nuclide, Activity)</i>				NOM DE L'OPERATEUR RADIOGRAPHE (H) <i>Name of the operator</i>	
				VISA	
CHANTIERS EN COURS A PROXIMITE DU LIEU DE CONTROLE: <i>maintenance agreement</i> <i>other works on vicinity.</i>				ACCORD MAINTENANCE (I)	
				DATE	
				J M H	
				NOM DU RESPONSABLE	
				VISA	
MESURES DE SECURITE COMPLEMENTAIRES A PRENDRE: <i>HP agreement</i> <i>Safety actions.</i>				ACCORD SRP OU C.M. SECURITE (J)	
				DATE	
				J M H	
				NOM	
				VISA	
OBSERVATIONS: <i>Shift manager agreement</i>				ACCORD DU CHARGE D'EXPLOITATION (K)	
				DATE	
				J M H	
				NOM	
				VISA	
OBSERVATIONS: <i>End of the control</i>				AVIS DE FIN DE CONTROLE RADIOGRAPHIQUE (L)	
				DATE	
				J M H	
				NOM DE L'OPERATEUR RADIOGRAPHE	
				VISA	

radiographic control permit

The description of the way to fill the industrial radiographic control permit is described above:

PERMIS DE CONTROLE RADIOGRAPHIQUE

REF.	Actor → Role ↓	radiography operator	Work preparation (engineering)	Maintenance Department	Shift Supervisor	H.P. Department	REMARQUES
	A, B, C, D, E, F	EMISSION					
H	in Formations - about the source						
I	other works in the vicinity						
J	other actions / agreement						
	Collection of the source out of the storage room						
	installation of the signal system						
G, K	Authorisation to use the source						
	Radiography						
L	Information of the end of the radiography						
	Source back in the storage room						
	Document filing						
	DESTRUCTION						

— 1 Folio

≡ 2 Folios

≡≡≡ 3 Folios

Each actor is so able to know his responsibility, and the management can control the process.

Definition and control of safety practices :

More than 99% of industrial radiography controls are achieved by contractors which must be registered. The safety practices are described by contractors documents included in EDF contracts. After the plant outage, each contractor is controlled by EDF staff, through a standard file. These files include radiation protection data. The EDF national operational unit is in charge of annual data use and analysis of contractors files, in order to extend or not the contractor agreement, regarding its current performances (including doses, incidents,...). Site controls are carried out by radiation protection teams, and by the EDF technical staff in charge of industrial radiography controls.

Qualification and training :

- The French regulation sets operators in charge of industrial radiography controls must be trained for this job. They must obtain a certificate called « CAMARI » (*capability certificate for industrial radiography apparatus handling*).
- EDF rules set all workers in controlled area must be qualified « radiation protection accreditation second level » (RP2 : which takes two weeks training and working experience in NPP) .

Rewards and sanctions :

Rewards are not in the French culture, and few contracts include reward clause. Sanctions are clearly defined- : in case of major problem, EDF agreement with contractor can immediately be canceled.

Audit, review and comparison :

These actions are first carried out when a contractor applies for registration. The sites observations are collected and analysed every three years.

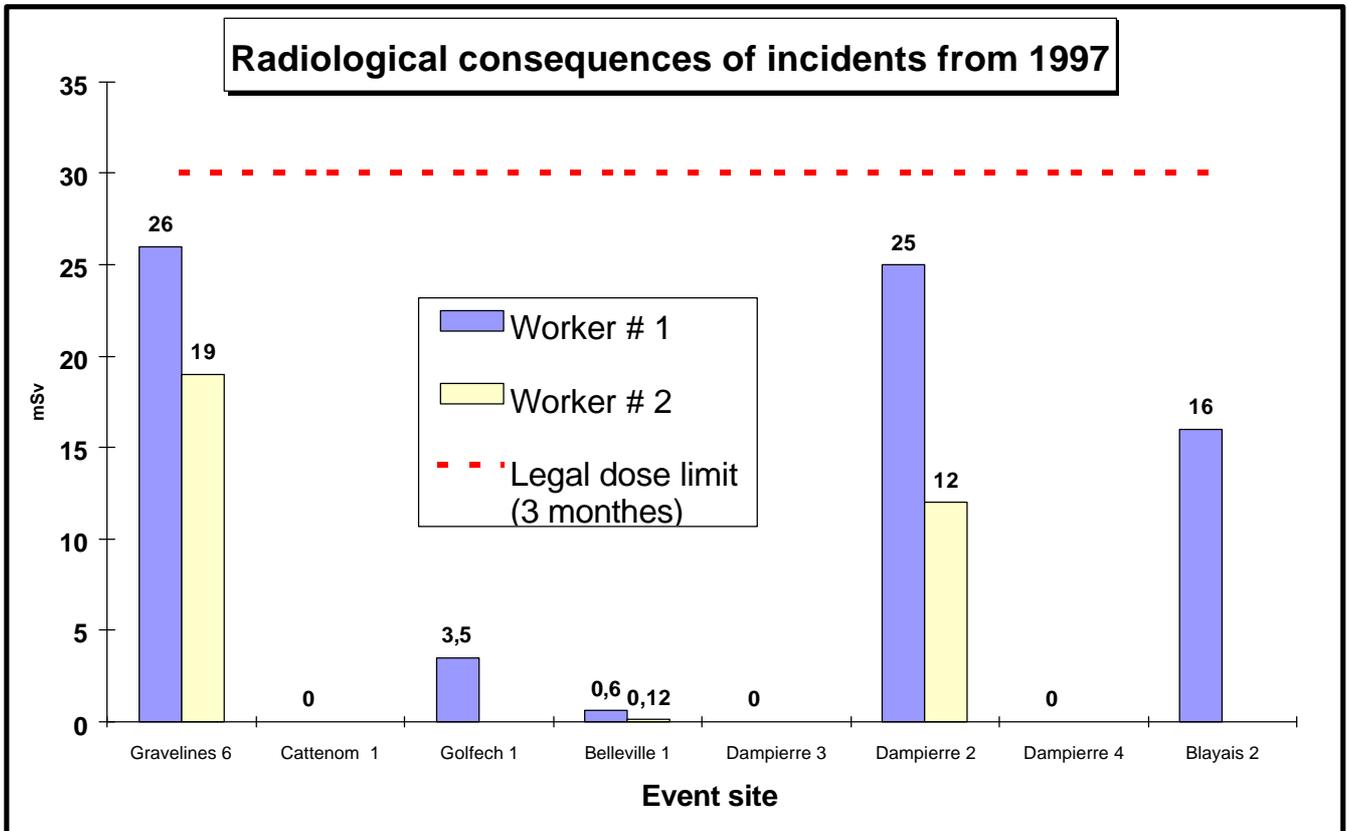
Individual's commitment

Questioning attitude / Rigorous and prudent approach / communication .

All these items are presented and discussed during the trainings, mainly the « QSP » training (Quality – Safety – Contractors) : two weeks training at first, then, every three years, one week training.

3 Incidents in EDF NPP's

Since 1997, eight events or incidents have been registered in the EDF NPP (about 20,000 to 27,000 radiographic control are yearly achieved in EDF NPP). Below (graph 2) the dosimetric consequences of these events. Only three of them exceed 5 mSv individual dose.



Graph 2

The analysis of these events showed the most important factor is the « human factor » : the influence of night shift work on human behavior is evident (see [Garrigou] presentation).

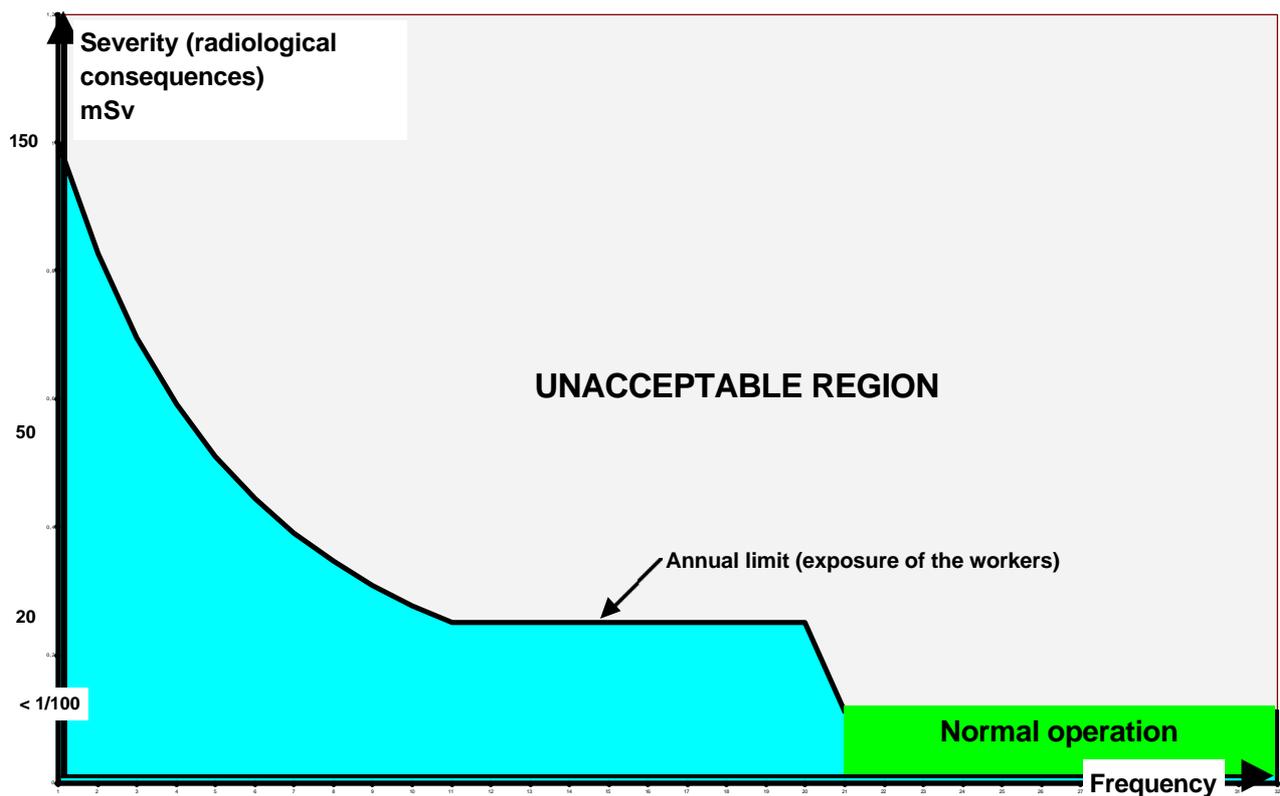
4 The actions

The nuclear safety principles application sustains three kinds of actions :

- Regulation implementation
- Safety of the industrial radiography environment
- Safety of the industrial radiography operators

connected with two targets : (see graph 3)

- Reduce events frequency
- Reduce incidents (radiological consequences) gravity.



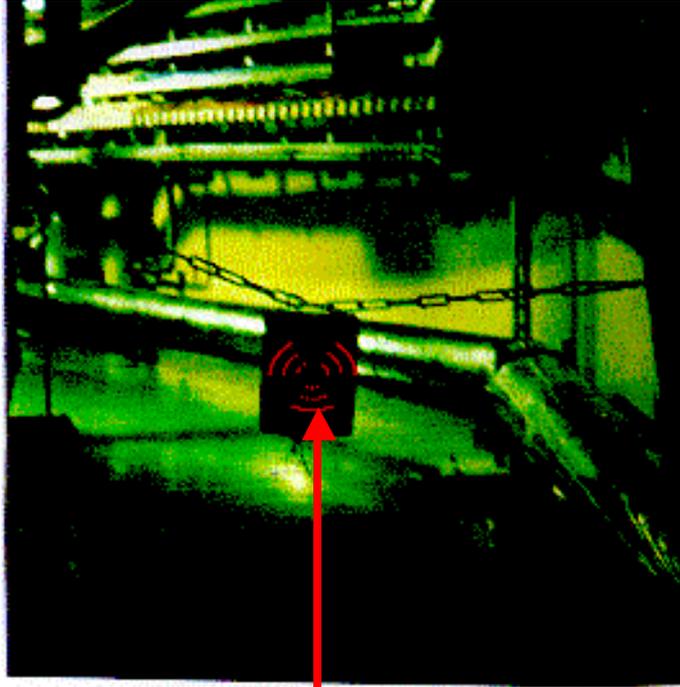
« If the consequences increase, the achievable frequency is lower »

Graph 3

The main corrective actions envisaged

In addition to the French regulation and standards compliance, a complementary action plan is being implemented :

- Tools improvement :
 - Use of sound alarm electronic personal dosimeter for source transportation and industrial radiography operation, even if this one is processed out of the controlled area. The alarm level is set at 4 mSv.h^{-1} . The alarm level must be much higher than usual gamma background in controlled area, and lower than dose rate induced by a source out of shielded container.
 - Use of gamma alarm monitor with flash lights (without sound alarm) disposed at proximity of the source



A french company is developping this kind of material.

- To keep a high supervision of industrial radiography: in addition to the internal contractor quality assurance, special control must be carried out by EDF HP technicians. Data of these controls must be recorded.

- Improvement of « industrial radiography permit » (see § 2) :
 - Each site files up a document describing the local rules in compliance with the national rules.
 - Notice boards at the entrance of each building are dedicated to « industrial radiography permit » in progress.
 - Use of plans of the buildings as appendix of the « industrial radiography permit »
- Workers training : HP technicians are aware of emergency actions in case of technical problems (ie : radioactive source jam).

5 Conclusion

All technical actions described above could be efficient only if each actor (from the industrial radiography operator to the local manager) is completely concerned and involved in this improvement EDF action plan which concerns all the radioactive sources.

In EDF NPP's, about 5,200 radioactive sealed sources are used. To upgrade the safety of the use and the storage of these sources, the Risk Prevention Group has defined a « system of reference » including, in addition to the regulatory requirements, internal rules adapted to our practices. From this document, all the processes using radioactive sources must be under « quality insurance » procedure.