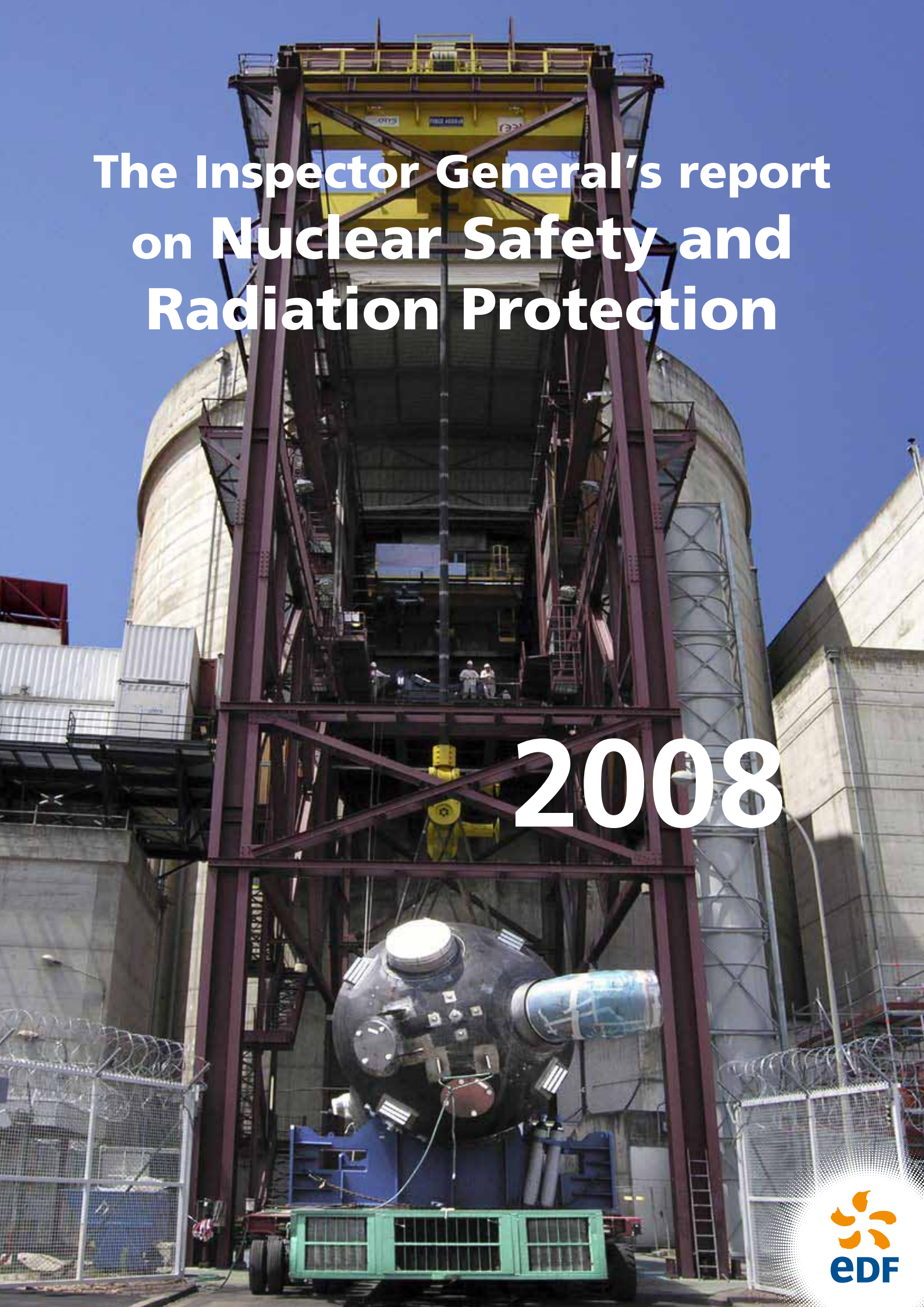
The Inspector General's report on Nuclear Safety and Radiation Protection

2008



FOREWORD

This report to the EDF President is intended to provide him with my judgement on the state of nuclear safety and radiation protection in the company. It will also be my last report, and therefore gives an overview of how nuclear safety has evolved in my seven years at EDF.

This report is also for all those who, directly or indirectly, contribute to nuclear safety and radiation protection as a result of their daily acts and decisions. It will have achieved its goal if it provides food for thought on the performance levels achieved in these areas and ways of improving them, particularly in the present context of the current major projects and the developments of the nuclear activities of the Group outside France.

Emphasis is therefore placed more on difficulties and weaknesses than strengths and progress, which may appear unfair to those working hard at running our indispensable and demanding nuclear power generating facilities on a daily basis.

The present assessment is based on the information gathered and the observations made over the year among the field teams, during my visits to the plants and also during meetings with the main stakeholders, including managers, staff representatives and, of course, medical practitioners and their teams, not to mention subcontractors. It also reflects the results of comparisons made during visits to players in the nuclear field outside France.

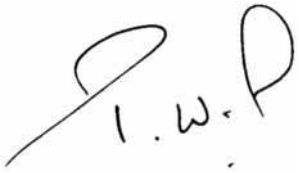
I would like to thank all those who I met, within and outside EDF, in France and abroad. I would like to thank them for their willingness to discuss matters, and for the frankness and richness in our exchanges of views. Their openness, which is vital to the relevance of this report, continues to reflect a spirit of safety culture.

I would also like to thank my staff, Christian Thézée, Gérard Petit and Jacques Dusserre who, once again this year, have provided their unstinting support, particularly during the drafting of this report. I would also like to address a special mention to Professor Kalifa who has just left IGSN after nine years of excellent service.

Finally, although this document has not been written for the purpose of public relations, as in previous years, it will be available to the general public on the EDF internet site in both English and French (www.edf.fr).

The Inspector General for Nuclear Safety and Radiation Protection,

Pierre Wiroth



Paris, 20 January 2009

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MY ANALYSIS AND CONCLUSIONS AT THE END OF 2008

The year 2008 confirmed a widespread regain in interest in nuclear power. A total of 440 reactors in some thirty countries are supplying about 16% of the power generated throughout the world. Major programmes have been launched, and more that 30 reactors are under construction, mainly in South-East Asia, India and Russia. Other substantial programmes are in hand in the USA and the UK.

For EDF, 2008 was another turning point, with the build-up of work on the Flamanville 3 EPR worksite and the preparation of international projects and major investments in China, the UK and the USA, alongside continued operation of its 58 pressurized water reactors.
As the largest nuclear operator in the world, and major driving force behind the return to nuclear power throughout the world, EDF has to be exemplary in terms of nuclear safety, while maintaining a high standard of quality in plant operation and reinforcing its cooperation with the other operators and international organisations involved. This means both increasing its performance in terms of nuclear safety and working with the other operators. It is true that each operator depends on all the others, as a nuclear incident will affect them all, wherever it occurs in the world.

In 2008, the overall nuclear safety and radiation protection results for the EDF plants were generally satisfactory. A number of very promising methodical campaigns were launched. These are expected to eventually produce substantial gains in nuclear safety.
I would like to emphasise that although the media reported a number of incidents during the summer **no major safety-related events occurred in the EDF facilities in 2008**, and there were no cases of exposure exceeding the legal limits or radioactive discharges releases outside the regulatory specifications. In particular, I note that, once again in 2008, no event was graded as high as Level 2 on the International Nuclear Event Scale (INES) which has seven levels.

Contrasting indicators

Most of the safety indicator results are similar to those of 2007, with two exceptions. Firstly, **there was a very sharp drop in the number of reactor scrams**, which decreased by 42% in one year making it a bigger drop than what has been seen over the last ten years. Secondly, the number of events ranked above Level 1 on the International Nuclear Event Scale has increased back up to the 2006 value.
Meanwhile, **the radiation protection indicators have remained stable at excellent levels**, even though the collective dose rose slowly as a result of the greater volume of work involving exposure to radiation, partly as a result of handling the numerous technical contingencies.

The historic drop in the number of reactor scrams results from a methodical campaign consistently pursued by the management for a number of years. The campaign was designed to ensure analysis and correction of all causes of scrams, whether equipment- or behaviour-related. I would like to emphasise the importance of this achievement, as **it is an indicator of overall operation**. It is also a **multidisciplinary result**, as many professions were involved and can share the credit for it.
Emblematic of safety culture, the willpower to progress, careful use of operating experience feedback and regularly calling ourselves into question, the campaign serves a model to be followed.

As regards the other safety indicators, the number of events declared to the French Nuclear Safety Authority (ASN) remained high. This situation is, of course, the result of a desire for openness and is very creditworthy. I do however regret that, all too often, the same causes produce the same effects and same types of events, particularly failure to comply with the technical specifications for operation (the operator's "highway code").

This recurrent difficulty in drawing lessons from past events and correcting them is castigated by the ASN and the operator itself when they upgrade the classification of incidents that reveal lack of safety culture. This partly explains the number of events graded at Level 1 on the International Nuclear Event Safety Scale, which is very strictly applied in France.

While making allowance for the large number of contingencies, which had a negative effect on some indicators, I feel that the world's leading nuclear operator cannot be content when their results appear to be stagnating, even if they are good compared with international standards. The progress made by determined efforts in certain areas has not yet lead to comparable progress in others.

As in the past, **considerable disparity remains** between the results of the different plants. Disproportionate numbers of events occurred at certain plants. We must remember that the weakest link determines overall strength. I observed that a coherent set of measures has been set in place to assists the plants in need. Although these may have stopped the differences becoming greater, these measures have not yet eliminated the differences between the plants, which remain substantial.

This disparity of results and their variability are food for thought.
How can the organisation of the nuclear units, which are technically identical, be brought up to the standard of the best ones, since their strengths are still not sufficiently encouraging to be emulated?
How can mutual assistance between the plants be fostered? In the current climate of industrial relations and corporate culture, I would have thought this would be easier to achieve, but the necessary resources are still not available.

Availability of the nuclear plants

The regular increase observed in the availability of the nuclear plants ended two years ago. The result for 2008 was lower than for 2007, mainly due to the technical contingencies of human and hardware origins.
The drop in availability is not, in itself, a sign of deterioration in nuclear safety. As I emphasise again this year, I observed that when confronted with sometimes even serious technical contingencies, **EDF has always promptly taken protective measures to guarantee safety, even at the expense of production.**

However, this indicator reveals that certain forms of malfunctioning can have repercussions on nuclear safety. It gives a measure of the actual situation that can lead to re-opening questions about fundamental issues affecting equipment life spans and our control over ageing factors, our past investment policies, our industrial plans for tomorrow, and the associated financial resources. It can also lead us to question our partnerships with our contractors, as well as our work organisation in the company and industrial relations issues.
I find that these difficulties give rise to concerted efforts and methodical rectification which should produce concrete results, provided the root causes are tackled and the action is sustained.

Finally, I would like to draw attention to the strong, permanent pressure that this issue generates, and the frustration of those who, despite their best efforts, find that the targeted performance levels are not being achieved. They feel accountable whereas the responsibility is divided between different levels of the company.

A few determining factors

Nuclear plants have a long life cycle, spanning something like a century from the start of the design work to final decommissioning. Civil nuclear power generation is a powerful and effective resource provided that the risks are properly controlled, especially as concerns nuclear safety.
The operator therefore takes a long-term view that is consistent with the life span of the plants, taking care to strike the correct balance between profitability calling for short-term results, and preservation of its means of production requiring more perspective, otherwise players in the field

will fall between two stools. Operators are particularly careful to avoid too great a dichotomy between intentions (announcements and organisation decisions) and reality (as experienced by those in the field).

In the current situation where changes of many kinds coexist with increased efforts to improve performance levels, I consider it is essential that **the management makes sure that all decisions relating to organisation, skills and maintenance actually improve nuclear safety in the long term.** This applies to each decision taken individually. **Management must also make sure their combined effects are also positive.**

It is to be remembered that **EDF's nuclear safety performance is the result of its interaction with all the other players in the nuclear industry.** This year for instance I was again able to see how our technical contingencies automatically become their own, whether they are our service providers or suppliers, or even the ASN and the Institute for Nuclear Safety and Radiological Protection (IRSN). To be able to count on them on a durable basis, we need to be attentive to the problems we cause them, as well as their own specific problems which are often similar to our own, such the renewal of skills, participation in international development and budgetary constraints. **The stronger all the players are, the stronger nuclear safety will be in the long term.**

Finally, I would like to emphasise that all the stake holders (regulators, operators and vendors) need to strike the proper balance between their involvement in international projects and **the safe operation of the plants in service, which remains EDF's top priority**.

Before delving into our main problems to discuss both points that have improved and those requiring further progress, I would like to mention the role and position of the notified inspection bodies that are the ASN and its specialist advisors. In each case, I will strive to place myself in the context of my full 7-year term at EDF, which is now coming to an end.

An extremely active and changing ASN

In a time of major changes, marked by a return to nuclear power throughout the world, **the presence of a strong and credible nuclear safety authority** is indispensable for the safe continuation of nuclear-related activities. This year, I have once again observed how highly our safety authority is regarded for its work and how it serves as a reference, especially among the nuclear power newcomers who frequently consult it.

With the new Nuclear Safety and Transparency Act and its implementation guidelines, the ASN now not only has a stronger platform but also a more formal and detailed mode of action, and its organisational structure has been changed. **EDF is gradually discovering the scale of these changes as it is confronted with them.**
The attitude of the ASN and the IRSN is perceived very differently by the three main divisions of EDF, the levels of management, and even from person to person. Some think that the ASN and its specialist advisors are increasingly fastidious, bureaucratic, unaccommodating and increasingly less technical. Others feel that the interfacing is becoming more complicated and difficult but believe that it will be possible to maintain constructive dialogue if the two parties can plan sufficiently far ahead and if EDF submits cases that are complete and of high quality.

I emphasis that it is indeed **the quality of dialogue and the wealth of exchanges –** as practiced during the ten-yearly inspections and the introduction of new fuel management systems – **that drives safety**. Safety is particularly enhanced as a result of better understanding of the available margins.

Year after year, I have observed that the ASN has contributed to the company's progress by stubbornly demanding quality, even when nuclear safety is not directly involved**.**

In this transitory phase, **the confrontation of differing points of view, and understanding each other's constraints, should make it possible to preserve what has been attained, to recognise priorities, and to simplify the operation processes.** In this context of formal compliance with rules, where the prioritisation of ever more numerous requirements is becoming an increasingly delicate matter, I believe **the operators need to be able to continue focusing on the key nuclear safety issues**.

The main nuclear safety and industrial issues

More EDF business outside France

From a nuclear safety viewpoint, I would like to highlight the involvement of the EDF divisions – particularly the Nuclear Operations Division – in business outside France, not to mention EDF investment in nuclear programmes and in nuclear operators.

I would like to hail and encourage **the efforts of the different plant managements and the Nuclear Operations Division "to see and be seen".** Closer relations with the World Association of Nuclear Operators (WANO) is helping to establish better standards of excellence, to create links of cooperation and, in return, to place ourselves in a position to contribute to the "guarantee of nuclear safety" in international developments.

For their part, the Nuclear Engineering Division and the Research and Development Division have been participating very actively in many forms of international cooperation for many years, which has proved extremely fruitful. Encountering different regulatory systems, cultures and habits in other countries with all the players in the nuclear industry, whether they be regulators, operators or suppliers, is often complicated but always fruitful. **For progress to be made in the field of nuclear safety, doubts need to be expressed and fundamental issues need to be debated.**

Whether it has a majority stake or not, those who invest in foreign nuclear companies need to consider what governance is required when it comes to nuclear safety in view of the particularities of each country (administrative and legal rules, and the manner in which operation is organised), as well as the nature of its involvement and that of the other stakeholders.
It must be made sure, from the outset and over time, that there is a proper system of nuclear safety and radiation protection in place that addresses not only the country's legal and regulatory requirements, but also the overall policy of the EDF Group, making due reference to the standards of international bodies such as the International Atomic Energy Agency (IAEA) and the World Association of Nuclear Operators (WANO).

Substantial plant life extension
Every year I have emphasised the demanding and salutary nature of the safety re-assessment process, with the ten-yearly inspections that punctuate the regulatory lives of our plants. A plant can only continue operating if the ASN gives it clearance to do so for a further decade after these inspections.
It is a field where planning ahead is required, which we know how to do. After seven years of planning, the first two third ten-yearly inspections of 900 MWe plants will take place in 2009. The EDF engineers and operators are already preparing in collaboration with the ASN for the third ten-yearly inspections of the 1300 MWe plant, scheduled for 2015.

I have two general comments to make as we contemplate significant extension of the service lives of our plants:

- As a result of the modifications made during the ten-yearly inspections, the intrinsic nuclear safety of a series of reactors is increased and guaranteed over time, I note that the outlay relating to nuclear safety represents around two thirds of the total cost of a ten-yearly inspection. "**More mature, therefore safer**" is a catchy slogan, it also has highly demanding implications.

- Given these ambitious objectives, the engineering departments of the EDF divisions are certainly not oversized for a set of 58 nuclear units, each of which needs to be watched from the beginning to the end of their service life. Care needs to be taken to **maintain the high standards of expert appraisal, an integral part of any nuclear facility's "life insurance".**

Finally, substantial plant life extension entails overall re-appraisal of the strategies involved in maintenance, component replacement, component obsolescence management, installation upkeep, and preservation of player skills. It would be helpful to make use of operating experience feedback from pressurized water reactors that are older than our own, which have already been licensed to operate for sixty years, notably in the US.

Succeed with the EPR

The year 2008 saw significant advances in design, component construction, construction of the installations and preparation for operation. I witnessed the attention paid to these different phases by EDF and the Nuclear Safety Authority, and saw not only the extreme complexity of the project and the worksite, but also the motivation of all involved and their desire to rise to the challenge even though it means hard work at both individual and collective levels.

Pressure to meet deadlines is only natural, but care must be taken throughout the construction work to make sure that deadlines are not met at the cost of building quality, on which nuclear safety in the future partially depends.

I have already stressed the importance of involving the operating staff in the project at the earliest stages, and I have observed that the same applies to the planning of operations. The team has already been partly formed, and is making preparations with a desire to innovate in consistency with safety culture. The manner in which they take action will be closely watched by the operators of existing French plants.

Decommissioning

Decommissioning is the duty of every responsible industrial operator, and EDF has been engaged in it for a number of years. The task is a complex one, as I observed this year at Creys-Malville Nuclear Plant, requiring EDF and its contractors to possess highly-specific engineering skills that need to be preserved, if not expanded.

I regret that the availability of a repository for long-lived graphite waste – required by law for 2013 – is now being scheduled for 2019 by the National Radioactive Waste Management Agency (ANDRA), which will necessitate altering the gas-cooled reactor decommissioning schedule. **It is important that the administrative and legal decommissioning obstacle course does not discourage the operating organisation.**

Finally, I note that other countries set thresholds for the release of waste which can positively affect waste management strategies, particularly in terms of rigour and improved management. Some find it hard to understand why French legislation does not provide for the same thing.

Fuel

Fuel and its in-reactor management is another major issue for EDF. A number of new fuel management systems (ALCADE and Parité MOX) were introduced a few months ago. I have noted that **experience has confirmed the correctness of the rigorous and prudent approached advocated by the ASN and followed by EDF.**

I would like to emphasise the scale of efforts made by EDF, at the prompting of the ASN, to examine the consequences of the new management systems on the fuel cycle, production, reprocessing and disposal.

Areas where improvement is continuing

Nuclear safety management begins at the highest echelons of the company, where it needs to be made clear that nuclear safety and radiation protection have top priority and that this has to be remembered whenever action is taken. I consider that the presence of Nuclear Safety Council, the complementarity of the checking and auditing systems, and well-organised multiple oversight are all assets that could be used as part of the international development of the EDF Group.

I also observed that nuclear safety has continued to progress and take form in the Nuclear Operations Division, as well as the Nuclear Engineering Division and the Nuclear Fuel Division.
The "independent nuclear safety system" appears to have gained greater recognition, although substantial differences remain between the departments of the divisions. This system needs to focus more on the combined effects of the different projects. However, I regret that some of the positions have been left unfilled for too long.
I would like to again emphasise the importance of asking the Nuclear Inspectorate to assess any projects involving changes in organisation or culture that can affect nuclear safety. This practice merits being extended to all the management levels of the company.

The regular progress in the field of radiation protection over the last ten years, particularly as regards the most exposed professions, **is the result of highly structured and methodical efforts.** For a number of years, this has been carefully applied to identifying the hazards associated with red and orange controlled areas, radiography work and pool bottom work, but has not yet achieved all the desired results.
We need to remain attentive to the situations faced by other operators where, by and large, the levels of radiation protection are not improving. It is necessary to secure the continued involvement of the management and the professions, as well as to guarantee the effectiveness of assistance with which contractors are provided.

Let us have another look at **the beneficial effects of the Everest Project** which has been a major source of satisfaction to me. This project, intended to achieve sufficient radiological cleanness to allow entry into controlled areas in overalls, is emblematic in terms of rigour, radiological cleanness demands, responsible attitudes among workers and simplification of their actions. It is highly appreciated at the three plants where it has been adopted. These convincing achievements need to be emulated.

Fires and outbreaks of fire in French facilities and elsewhere regularly bring home **the importance of controlling the fire risk.** Much has been done in recent years, and the plants, which are well supported at corporate level, have made clear progress. This progress tends to be more in the field of fire fighting than fire prevention. All those involved are very pleased, in particular with the support of a professional fireman officer seconded to each plant.

Protection against malicious acts has been the subject of increased vigilance since 2001. Here again I noted that efforts, recognized by the competent authorities, were being made to adapt and modernise the equipment used. I continue to consider that nuclear security and safety would be mutually reinforced if they were headed by a single national authority.

EDF has decided to increasingly rely on the corresponding government services: **the county accident response services** (SDIS) for fire-fighting, and the **gendarmerie** for surveillance and response. During my term at EDF, **relations have become more operational, more "industrial"**, and the consequence of this must be fully understood by all involved.

In particular, this means two things: any difficulties encountered by our two "partners" have no effect on their commitments, and that progress in organisation brings results in the field, for instance during drills.

Despite the great differences between countries in these two fields, I would like to add that **international benchmarking** is worth persevering and **it should inspire us to continually call our own standards into question**.

Sectors of insufficient progress

Rigour and checking

As in other internal and external checking systems, I noticed **little progress in the checking, rigour and non-tolerance of discrepancies trio**, in a context where lack of time and increased complexity are not making things any easier.

Rigour is still insufficient, even though I have observed progress in areas as different as control room surveillance and the use of personal protection wear. Defence in depth is the basis of nuclear safety and all involved need to understand that **there is no such thing as a harmless discrepancy** when it comes to safety**, and that they can weaken any line of defence which means they must be rectified.** Rigour needs to be seen as a precondition for nuclear safety and technical excellence.

Little progress has been made in checking professional skills and abilities, and results vary greatly between plants. It is true the checking is no longer taboo; awareness of the need to assess knowledge is growing among both "the checkers" and "the checked". However there is actually too great a tendency to get round the strict requirements of assessments, and for the management to turn a blind eye.

As I have always stressed, checking and assessment are the universal rule when it comes to hazardous activities; they should reassure and support rather than being perceived as coercive. **Checking also means engaging in dialogue, identifying difficulties and helping to sort them out**.

As a former aircraft pilot, I am particularly sensitive to plant operators.One can legitimately be proud of controlling a 1000 MWe reactor, it is a major responsibility that requires knowledge, understanding of the phenomena involved, and observance of the related procedures. There can therefore be no equivocation about the assessment of ability.

I have observed with satisfaction that **the managers, and not only the front line ones, are seeking closer contact with the teams** who are increasingly demanding their presence in the field. This results in deeper understanding of the realities in the field, its difficulties and what can go wrong out there. It is a first step, and the management still needs to have the necessary resources to correct the discrepancies detected.

Work organisation issues

Many of these difficulties are also due to **work organisation issues** resulting from the collective bargaining accords governing flexible and shorter working weeks in France.
I cannot help thinking that the current organisation undermines teamwork that is indispensable for production activities that require the greatest attention to nuclear safety and radiation protection, around the clock, every day of the year, for the life span of the plant.

With the staff working in a staggered fashion, the current organisational system makes it harder for them to appropriate the goals, tasks, equipment and facilities. This non-continuity tends to multiply the

interfaces and can dissipate responsibility, which runs contrary to the dictates of nuclear safety. It tends to destabilise the management and contributes to weakening the work teams which are increasingly less able to counteract certain errors. **This situation is detrimental to performance in a number of areas.**

There are few who deny that this is the case, and although the experimental agreement signed in April 2008 may have somewhat improved the situation, **2009 could be a turning point** provided that **the different parties handling these questions engage in responsible collective bargaining**. Proper management commitment at all levels remains indispensable for finding the optimal balance between the safe functioning of the organisation and personal interests. I was able to observe this in a conventional EDF power plant where a sensible work organisation has made it possible to work "more serenely and in greater harmony with the contractors".

Logistics and documentation

Last year I mentioned the shortcomings of our logistics system in its broadest sense, particularly as concern issues relating to **the availability of spare parts**. I have since seen that the scale of the problem has been understood and that a solid project is being put in place which is encouraging those in the field, even though they know that the upgrading process will be a long one.
Meanwhile, **attitudes among the EDF staff and contractors in the nuclear plants are extremely critical**.Once again, this year, there was not a single visit during which the spare part problem was not mentioned. These difficulties have an impact on the effectiveness of site work, and undermine the confidence of the workers in the system. They are sometimes interpreted as being the consequence of an excessive desire to reduce costs, which is now no longer the case.

Much remains to be done as regards **documentation**, but substantial efforts are being made to standardise practices and methods, not to mention Operation Engineering initiatives to organise and standardise the documentary process involving the Nuclear Engineering Division, the Nuclear Operations Division and the plants. **Everyone is now working together and more methodically.** And I have observed general willingness to cooperate in the plants, though this is limited by the workload generated by the process which is still in its early stages and will be put to the test by the ever-increasing rate at which modifications are made.
I would like to stress how important it is for the staff to be able to have confidence in the documentation, as its insufficient reliability is a major cause of events, in both EDF and other nuclear operators. I am glad that **documentation is regaining its prestige though this process**, as it is one of the foundations of nuclear safety.

Points to watch

Nuclear safety and competitiveness
Reconciling nuclear safety and competitiveness is a challenge on everyone's mind.The ASN is particularly attentive to this issue. For my part, I have not seen any conflict between theses two requirements during my seven year term at EDF, **I did not witness a single instance where nuclear safety was not put first**, and none was reported to me. It is still not necessarily clear how things can be made "safer", "better" and "cheaper" at the same time.

We therefore need to make sure that safety and performance are indeed two objectives that remain mutually supportive at all times. Accordingly, decisions to postpone or abandon technical operations must continue to be the subject of systematic analysis and arbitration recorded in the necessary documents.

Confronted with pressure to reduce costs and deadlines, **workers in the field nevertheless have the impression that they have less margin for manoeuvre in all respects**. We must learn to listen to them, and they have to feel they have the right to say "it's going too far".

We also need to be attentive to behaviour induced by the desire to meet goals at any cost, or to avoid disfavour. In particular, I note that time pressure has grown as availability has decreased. Care needs to be taken to ensure that all remain vigilant about compliance with the fundamentals.

More generally, despite massive investments to improve the nuclear safety of the process, workers in the field seem to think that priority is being given to short-term savings at the expense of the situation in the long term. **It therefore appears to be necessary to provide better backing for achieving goals**, to make sure that they can be reconciled with constraints and to avoid wandering off course, whether real or only perceived.
At all levels, the management needs to be attentive to the manner in which it expresses priorities, which notably implies the need for better explaining the way the proper balance is established between nuclear safety and competitiveness and between professional performance and financial performance.

Generation change and the preservation of skills

Since 2007, EDF has taken stock of the need to renew skills owing to the large number of staff that are retiring, the new needs generated by increased international business, and the company's new projects, which will initially place strong heavy demands on talents. **It has taken many initiatives to encourage nuclear-related learning** in our educational system and to encourage young engineers to specialise in the subject. **The hiring of large numbers of new engineers and technicians has boosted morale in the field**.

Nevertheless, the difficulties mentioned last year are still not resolved. "The tap has been closed too tightly for too long". By the effect of inertia, there has been a shortfall in skills because it takes time to form qualified, experienced staff: "experience is not easy to come by".
I note that job transfers remain frozen between units and divisions and that, yet again this year, many managers are complaining that their job offers remain unanswered by the Nuclear Operations Division, the Nuclear Engineering Division and the Nuclear Fuels Division. In the present context, every department is trying to preserve its own pool of skills.

The shortfall of skills should be overcome within two or three years, provided that the recruitment efforts made over the last eighteen months are maintained for a few years, and sufficient properly-qualified instructors are assigned to training.
Our training system should be able to cope with this ambitious recruitment programme; we have been able to upgrade it with the Vocational Academies which are universally recognised as being successful, with the creation of apprentice training schools and even by adapting training techniques for today's intake. It would be a pity if the availability of instructors became an obstacle.

Finally, I emphasise that we cannot allow there to be any "air pockets", particularly in the professions relating directly to nuclear safety. **There is unquestionably a need to create a pool of staff with certain skills** to avoid being caught out and being faced with an unacceptable situation. Here again, margins need to be established.

The contractors
Contractor companies carry out more than 80% of the annual maintenance and modification work. This shows what a large contribution they make to nuclear safety.
Much progress has been made in the last seven years in relations between EDF and its service providers, particularly as regards accommodation and work conditions, in accordance with the provisions of the Charter for Progress and Sustainable Development.
The contractors are being more closely involved in the Nuclear Operation Division's flagship projects so as to ensure fieldwork reliability. Nevertheless, I observe that service quality can tend to drop in some areas as a result of difficulties in recruiting, training and retains staff, and sometimes in providing adequate supervision, a situation that reflects **the unattractiveness of nuclear work due to its demands and constraints.**

Contractor companies also have to compensate for organisational shortcomings (such late and incomplete scheduling) that we are finding hard to rectify. They are also in the front line when it comes to problems with spare parts and special tools.

Contractor companies need to be offered new perspectives of a nature to strengthen them and gain their loyalty, in a context of true partnership, as is already the case with training. They also wish for greater support on the job, as is often the case outside France, and improvement of our surveillance. This is what it will take to secure dependable contractors capable of providing the services we need. I will be carefully monitoring the effects of the new project that is being set in place.

The workers in the company

Rifts that persist

The management and staff of the nuclear divisions are now divided between satisfaction in seeing certain obstacles being removed and annoyance at finding that some of the worst ones are still there. Most find it hard keeping up with all the changes that have been introduced in the last few years, with increasing demands and a multitude of projects. In the system where the tension is high, **it is necessary to take the time to explain, to properly set the priorities, and to make sure that the rate at which the projects follow on from each other is properly adapted to the capacity of the workers in the field to assimilate the changes.**

Last year I spoke of rifts. These are not necessarily being healed, and I would like to reiterate those needing the most attention. It is generally agreed that the workload has substantially increased, but **the new tasks are generally being heaped on the same people.** There are always those who do more than their share, sometimes much more, and they are generally to be found among the management. Then there are those who do less.
There is another rift between those who issue instructions and who organise projects, the "helmsmen", and those who have to put them into effect, "the rowers".

There is also a rift between the new arrivals, who spontaneously adhere to the movement, and the older staff, who are more circumspect, who have experience and perspective, who wonder what status the company will continue to accord them and whether they should continue with their careers.

I would like to emphasise the rift between the junior executives and their managements. These executives are caught between the management and the staff; they are faced with constraints and requirements of all types, which are not necessarily compatible. I note that their positions are often considered "too exposed" and as a result they are hard to replace. Their situation, as is that of the entire management chain, is complicated by **the insidious on-going transfer of administrative duties onto them**

Like last year, I also observe considerable disparity between the way those in the field see things and the way the upper management does. Is reporting well organized? Does it report on the real difficulties?

I once again emphasise the rift between the outside workers and EDF staff. Even though considerable efforts have been made to bring these two worlds together, and even if outside workers are now given more consideration, all too often they still remain the toilers.

Industrial relations and the human factor

Although industrial relations are improving at some of the plants, I am still surprised at how often I observe people having difficulties in establishing constructive relations and sharing goals. Things are so near the breaking point that it is sometime reached… with the consequences that can readily

be imagined in terms of serenity. More generally, the modes of managing industrial relations are in contradiction with the company's ambitions and what it has at stake. **In industrial relations, there is very little margin for ensuring personal and collective flexibility and effectiveness.**

Changes, the current situation, and the pressure of work can sometimes be hard to endure. I would like to emphasise **the efforts made at corporate and division levels to identify and temper psychosocial risks**, whether individual or collective. I hope that this process leads to developing more constructive relations between the management, the staff representatives and the occupational physicians, as it is in everyone's interest. Here, again, there are large differences between the plants, and **there should be no hesitation in emulating the most advanced ones**.

It is to be remembered that, during these times of tension, it is essential to be capable of properly capitalising on the work that has been accomplished, analysing and retaining its positive aspects, and to spare a little time for getting together. This can be an effective way of avoiding psychosocial risks!

Projects promising performance and cultural change

EDF has deployed a number of national and international projects intended to produce changes in practices and culture. Recently, the "Operational Excellence" campaign has given impetus and consistency to this process.

The Nuclear Operation Division has begun campaigns which are being increasingly better understood, accepted and implemented. **They are regarded as springboards to reaching the best levels**, particularly in the field of nuclear safety. They have not yet been accomplished as they imply cultural change.

The considerable progress made in the area of human performance, standardisation and homogenisation seemed unrealistic only five years ago, and now constitutes one of the keys to improving competitiveness and nuclear safety in parallel.
This is also the case for the O2EI campaign – improving facility housekeeping – which is a long-term goal. Major efforts have been made to upgrade the state of the installations, but the differences remain great between plants and there has been little change in behaviour. Any backsliding would be catastrophic, and in any case provisions need to be made in the operating budgets that are equivalent to those in the best plants outside France.

The Nuclear Operations Division is launching projects designed to achieve progress with methods that have proven their worth elsewhere. These are, for instance, the continuous control of unit outages and the AP 913 method aiming to "carry out the right maintenance on the right equipment at the right time, to avoid any surprises, particularly with sensitive components".
I would also like to mention the highly ambitious and eagerly awaited SDIN project for deploying a new nuclear information system in 2012.

These projects are the subject of risk analyses and experiments, and I note with satisfaction that **project teams can be seen in the plants and that there are operating staff included in these project teams**. They will have a powerful impact on organisation, logistics and culture in the plants. I appreciate the fact that the projects imported from the US have not been slavishly copied but have been adapted to fit our own organisational structure and industrial relations.

I have no doubt about the appropriateness of this policy and the cultural changes they will foster. However, I question the ability of the plants to simultaneously assimilate these new projects without neglecting the older ones.
It needs to be made sure that the Production and Engineering Directorate and its units have the necessary resources to implement them: "to reap you must sow".

Some convictions that I have reached

In my seven-year term at EDF, I have reached certain convictions about the principles that need to be observed for safe operation, which I wish to highlight in my last report:

- **Seek simplicity**: whenever clear, simple rules are set in place, people observe them. The rule sets will always be complicated, and we need to make them easier for users to apply.
- **Being present in the field is not everything** but is remains the better part of management.
- **Better understanding what others are faced with** is indispensable, and this is true of all professions (nuclear engineering, purchasing, research and development, and finance).
- **Assisting the weakest link** is everybody's problem. There is a need for solidarity between the teams, departments, plants, divisions and, more generally, between all those involved in the nuclear industry in France and beyond.
- To enable everyone **to concentrate on their profession**, logistics needs to be considered to be a strategic activity.
- **Open up** to other industrial activities and other nuclear operators.
- **Make the system more flexible**: improve our work organisation and industrial relations management.
- Take the time necessary to make sure that **everyone is singing from the same hymn sheet**.
- Work to **maintain trust** between the safety authority, the general public and the operators. Openness is a state of mind, it is important to be able to explain, and to be willing to do so.

In conclusion, as regards nuclear safety and radiation protection, extremely encouraging progress has been made in areas where this may have seemed difficult, if not impossible, only a few years ago. This is the result of the well-designed campaigns led with determination by the management, to which the staff has gradually come to adhere.
Nevertheless, areas of weakness remain, as is shown by the persistence of incidents and discrepancies. **Greater rigour at both individual and collective levels, and acceptance of the need for checking are required to ensure full effectiveness of our defence in depth,** every line of which must be held.

In the present situation where many requirements, constraints and national and international ambitions coexist, **we need to make sure that none of the lines of defence are weakened by the scale and pace of change and the proliferation of projects**, combined with the ageing of installations and the workforce turnover.
Seeking better performance is perfectly legitimate provided that the rate of improvement required is compatible with changes in organisation as well as with changes in human, material and financial resources and, above all, with changes in mind-sets and behaviour.

Today, the margins of manoeuvre appear to be more limited, which is a constant source of tension. To re-establish margins, it is first necessary to speed up changes associated with work timetables, while optimising and rendering more flexible certain aspects of organisation, not to mention fostering responsible industrial relations in the field.

Most of the lines of defence primarily depend on **the motivation and skills of the EDF management and workers**. All are sincerely attached to the company and are ready to take up the challenges, particularly those of a technical nature. They also need help to retain, if not rediscover, their frames of reference. It is important not to overestimate there ability to cope with change, nor that of the system, confronted, as they are, with the innovative new developments that are needed. **Strong demands are being placed on the management who need more support and recognition to be able to take the lead in introducing change in the field**.

EDF needs to feel solidarity with all the players in the nuclear field whose actions affect its levels of performance, **particularly the contractor companies, who need more recognition if they are to be able to share our goals**. Physical reality needs to be given to the word "partnership".

Finally, I would like to reiterate that, by its very nature, the nuclear industry must make nuclear safety its top priority. **It is up to everyone, from the President to the field worker, to assert the pre-eminence of nuclear safety and radiation protection** in discourse, decision-making and everyday action. It is also everyone's responsibility to be open about things, even though this is never easy.

It is up to us to correct our weaknesses and to utilise out numerous strengths to do even better in the field of nuclear safety, upon which our credibility in the eyes of the general public depends and hence the ability to continue our nuclear activities both inside and outside France.

NUCLEAR SAFETY MANAGEMENT

The very large reduction in the number of reactor scrams is extremely encouraging and is a sign of greater process control and better cooperation between all the professions involved. Well-organised and highly responsive, the nuclear safety management is maintaining satisfactory standards in a highly constraining situation. It will nevertheless have to make sure that the pace established by the numerous projects in hand remains compatible with the capacity of the organisational structures and personnel to assimilate them.

I can see how much progress as been made in nuclear safety management since my arrival at EDF in 2002. Many initiatives addressing fundamental issues were undertaken and some have produced very tangible results, particularly this year with the drop in the number of reactor scrams.

An example

After seven years of gradual reduction, **the number of reactor scrams has plummeted**.The progress is the result of **methodical campaigns conducted with drive and tenacity by the Nuclear Operations Division at corporate level and in the nuclear plants** in two broad areas: human factors and equipment reliability.

Better surveillance in the control room and extensive work to increase field work reliability, notably by the automation technicians, are now bearing fruit.

A comprehensive analysis of the equipment problems involved has been completed and site work

priorities have been set as a function of the anticipated gains. This is a good example of the operational excellence campaign being properly conducted, as the final cost versus nuclear safety balance is positive.

As the culmination of determined collective commitment, the result is encouraging for all the professions having contributed to achieving it. It demonstrates the correctness of the method used and sows seeds of progress in other areas.

This means it's possible

I note that with these emblematic indicator results, the French nuclear plants are now at the sort of level that one would expect them to occupy in the international operator rankings, despite the operating conditions being more constraining.

In other areas of nuclear safety, the results have not improved, even though I am aware that the number of events of human origins has diminished. Although there is more manager presence in the field and progress is being made with identifying discrepancies, it is my feeling that the resulting effects are not yet perceptible.

Requirements are still not being sufficiently appropriated.Many instances of lack of rigour continue to occur. The work involved in circuit configuration, maintenance and surveillance testing remains the main source of significant nuclear safety events.

The following questions have to be posed: why has progress made in the professions dealing with reactor scrams had so little impact on other areas of nuclear operating safety? Why do the results differ so much from one plant to the next? And why do the levels of performance vary so much over time? What explanations can the nuclear safety management provide? What is its impact on the development of safety culture with the company staff?

Nuclear safety management

As I observed in 2007, **safety management is generally properly conducted and responsive**. It is obtaining progress with nuclear safety in a more demanding context: a more complex nuclear safety rule set, limited resources, rapid turnover in the professions, and a management system that is not yet optimised, either as regards work timetables, organisation of unit outages and units in service, or even as regards logistics.

Solid projects and campaigns

A number of projects/campaigns started in recent years are contributing to increased nuclear safety. Here it is necessary to mention the emblematic actions carried out since 2002 which have made it possible to better organise the field of nuclear safety management, from top management level to the operator in the field.

Some focus on the analyses required before and after decision-making:

- analysis of the impact of organisation changes by applying the INSAG 18 (Managing Change in the Nuclear Industry: The Effects on Safety) principles, which the Nuclear Inspectorate has done a number of times in recent years, as has the operations line management,
- the socio-organizational and human approach (SOH) which applies to all projects involving equipment and documentation changes to identify and deal with the impact of theses changes on the operation of the installations,
- the Nuclear Safety, Radiation Protection, Availability and Environment Watch (OSRDE) which reviews, on a cold-case basis, nuclear safety versus operability decisions made on the spot so as to draw lessons from them.

Others are designed to facilitate the work of the operators, such as:

- practices to provide each worker with the proper tools to "get it right the first time", as part of the Human Performance Project, as discussed in Chapter 11,
- standardisation of practices and methods based on the best ones used in the plants,
- the presence of managers in the field.

Perseverance to ensure culture takes root

I observe that these **progress campaigns**, which are designed to achieve higher quality, are now being better understood and that their beneficial effects are recognised. However, as is the case of any campaign aiming to produce changes in the way of tackling problems, **they need to be persevered if they are to produce results.**

Adapting the professions

As regards operations and maintenance, the Nuclear Operations Division has asked the plants to set up projects for the professions that are consistent with the general methodical review conducted with representatives of the professions, the plant directors and the corporate echelon. These projects are intended to adapt the professions to the requirements of current and future operations and to determine new functions.

In the case of operations, this notably involves the operator in charge of a nuclear unit who handles the overall supervision of activities in the control room and in the field.

In the case of maintenance, this concerns top-level maintenance work needed to address specific requirements in automation and in the professions close to the process, such as testing and chemistry.

These campaigns are generally favourably received by the staff. The policy appears to be appropriate. They should eventually contribute to increasing safety, strengthening the lines of defence, and utilising the skills in the field.

I have however observed that the rates at which they are being implemented differ from plant to plant: some fill the corresponding positions rapidly, other wait until the staff are fully trained before starting. I believe it would be advisable to do everything possible so staff can assume their new duties without delay.

Disparities between plants identified and dealt with

The management of the Nuclear Operations Division assesses the nuclear safety performance of a plant on the basis of results intrinsic to the plant and also as a function of the findings from overall assessments of nuclear safety conducted by the Nuclear Inspectorate, its own plant inspections, ASN follow-up visits, World Association of Nuclear Operators (WANO) Peer Review and International Atomic Energy Agency (AIEA) OSART (Operational Safety Analysis Review Team) inspections.

If needed, the plant is requested to produce an Operating Rigour Plan. Progress is monitored every three months. Exceptional budgets may be accorded to make up for delay, and consultants specialised in organisation are provided to make organisation more effective.

I note that the Operating Rigour Plans in certain plants have achieved the desired results, while they have not been so effective in others, often due to failure to fully understand the fundamental problems at the plant and its limitations, both at corporate level and in the field.

Solidarity: a precious commodity

We do care for our plants, but are we doing enough? How can a company with 58 nuclear units have trouble in finding backup help for a plant in need? It does seem odd. Do the plants that are asked to help lack solidarity or are they just so devoid of resources that they cannot provide help even if they wanted to?

Does thought need to be given as to how resources can be mustered up quickly in order to take action to fix any point of weakness?

Safety checking maintains it course

Each year I regularly meet the main players in the independent nuclear safety body at both plant and corporate levels.

Overall, people seem to be more willing to listen to this safety body. Its recommendations are being followed more closely. Its auditing is becoming more professional.

However, the safety engineers that I met often mentioned difficulties in performing their tasks. The nuclear safety rule set is complicated to apply, and the unit outage schedules offer no margins. Cross analysis of the nuclear safety system and the operations chain is not systematic. When operability is in cause, the arguments of the safety engineers should prevail and enable them to impose their analyses. They are well aware that they need to be extremely vigilant.

I have noticed that the nuclear safety body has not been as carefully preserved as needed against loss of skills: positions remain unfilled in the quality nuclear safety departments at both plant and corporate levels. I emphasise the need to keep adequate numbers of highly-competent staff permanently available, so that the nuclear safety body is in a proper position to notify the management.

A duty to notify

Regarding this last point, I reiterate my questions of past years: **is the nuclear safety body sufficiently independent and forthright? Has it sufficiently widened the scope of its investigations and questioning?**

Make better use of experience feedback

Although well organised at corporate level, **the internal experience feedback system** varies greatly from one plant to the next. Some plants have developed pertinent methods of detecting and dealing with weak signals, others are still having difficulty in setting up a truly effective experience feedback system.

The **international experience feedback** integration loop is improving, including cooperation with operators outside France on the monitoring of major components. But these are recent, which may be why certain difficulties are being resolved curatively, as for example the case of steam generator fouling.

The experience feedback loop needs to be properly closed, and the relevance of the corrective measures made needs to be questioned. This is now the point on which efforts need to be concentrated. The Nuclear Operations Division is well aware of this and is planning a major experience feedback project for 2009.

Foster leadership

If leadership is the ability to embody a vision, to expound its meaning and attract others, exercising leadership in the nuclear plants is, in my opinion, the key to ensuring that nuclear safety is at the centre of all operation-related concerns.

During my visits to the plants, I have witnessed contrasting situations which may explain the disparity of the results obtained. I have visited plants where nuclear safety is a constant preoccupation, at all levels of management. There was one plant is particular where staff shared a clear vision of nuclear safety, which had given rise to **a true fellowship of managers where all could speak freely.**

In a small number of plants, I saw that it was leadership that enabled winning management practices to germinate and bear fruit, such as the system of integrated management and the presence of the manager in the field. This goes to show the importance of detecting signs of leadership early on and fast-tracking those who possess it.

An insufficiently integrated approach to constraints

Organisational and personal margins are becoming narrower with the passage of time. In a context where time pressure is ever increasing, **the combined effects of the projects launched and the proliferation of requirements of all kinds are complicating the exercise of nuclear safety management**. It is hard to get a clear, overall picture enabling priorities to be set while taking everything into consideration.

This appears to be one of the reasons – perhaps the main one – why it is so difficult to strengthen leadership among managers and to make significant, durable improvements in the nuclear safety results, see Chapter 12.

Safety culture

Safety culture arises from the history of nuclear safety management in the plants, which are now accordingly in different situations in this respect. An improvement in culture will, by its very nature, be progressive and will require focus and perseverance from the management.

The level of safety culture is judged in terms of its fundamental tenets.

Safety culture develops via **the priority given to nuclear safety**, and I have noticed that this is effectively the case, particularly when operating problems are handled by the departments of the Nuclear Engineering Division or the Nuclear Operations Division.

Safety culture calls for **openness**, and many plant managers do not hesitate to report an event as a significant safety incident, erring on the side of nuclear safety, as they know that by doing so they are making a clear example of how to respond in such circumstances.

Safety culture reflects the ability to call one's practices into question, and I have found that staff have been **opening up more to the outside** in recent years. Increasing numbers of staff are willing to compare their practices with those of others and, when appropriate, to change their own.

Safety culture implies **acceptance of checking**, which is an area that currently requires more progress. There is still too much resistance to the assessment of skills and the checking of work.

Safety culture means observance of **rule sets**, and I have found that some are not applied sufficiently strictly, often because they are not fully known.

Safety culture means regard for defence in depth, and I consider that **each line of defence** could be better identified from the outset, held more determinedly and re-established as soon as possible if lost.

It is clear to me that all these principles equally apply to the fields of radiation protection, protection of the environment, industrial safety, fire prevention etc. **When progress is made with nuclear safety culture, there is a positive effect in all these fields**. The Vocational Academies cover all these fundamentals from the start, and appear to provide an excellent background for the development of an overall nuclear safety culture.

In conclusion, nuclear safety management is making progress with safety culture and maintaining the nuclear safety levels in a very constraining context. Emblematic progress has been made in the field of reactor scrams, showing that action conducted with resolve and method can enable new standards to be achieved.
All should be able to assimilate the spirit of the current campaigns and projects so as to adopt the attitude and behaviour expected in the field of nuclear safety.

RADIATION PROTECTION

Radiation protection results have been improving for some fifteen years. Work on the underlying factors is continuing and new practices offer scope for further improvement. Persistence and readiness are needed to adapt the organisation and skills at any time to meet the rise in the number of requirements.

Indicators of results

The collective dose stands at 0.66 man-sieverts per reactor (it was 0.63 in 2007).

This very modest increase **does not mark a reversal in the underlying trend which is still positive**. It essentially reflects a far higher amount of radiation work than in previous years. This was due to two technical events: steam generator flushing operations were continued and numerous steam generator tubes had to be treated for plugging.

The organisation and involvement of EDF and contractor staff who have an impact on the radiation protection statistics, as well as the effective and still promising work on the source term, should enable the movement forward to continue.

As regards individual doses: 14 workers received doses between 16 and 20 mSv over any twelve month period in 2008 (the number was 20 in 2007)

Efforts on the most exposed professions have continued successfully, particularly as concerns the welders and heat lagging workers (none received more than 16 mSv). I note, however, that some of the mechanical fitters were among those who received the highest exposures in 2008. This situation is not alarming, but analysis and optimisation work will be needed, as was successfully carried out with other vulnerable professions.

Internal exposure

In 2008, in all the nuclear plants, the 39 whole-body scanning machines available in the occupational health departments that are used to monitor internal exposure were renovated and new operating software was installed, featuring direct transmission of data to the Institute for Nuclear Safety and Radiation Protection.

The events reported correspond to committed effective doses above 0.5 mSv and remain exceptions. Only two events were declared in relation to operations, against more than two million crossings into the controlled areas.
I note however that there were **operating events that entailed medical surveillance of the individuals involved**. I will return to one of these cases (see Chapter 19, Section 3) which involved evacuating the reactor building and monitoring a large number of field workers. This confirms **just how important it is to ensure rigorous radiological surveillance of the reactor building during unit outages**.

Radiological cleanness

The events declared in this field remain few in number and of minor importance. Nevertheless, I consider that radiological cleanness is an end in its own right. Plant managements need to continue focusing on improvement, i.e. to make sure that radioactivity is confined inside areas that are as small as possible, as few as possible, and properly monitored.
For this to be possible, the conditions inside the installations must be well understood and correct behaviour must be encouraged.

The campaign to enable entry into controlled areas without a special protective suit (the Everest Project)

Working towards a better world

Since the start of my mission, I have constantly supported the plants and individuals involved in the campaign to enable entry into controlled areas without a special protective suit, enabling workers to wear standard overall in most parts of the controlled areas.

The Golfech plant was first to reach the "summit of cleanness" under the EVEREST project, followed by the Civaux and then Cattenom. The summit is reached when the vast majority of the nuclear rooms in a plant are clean enough to be entered in plain overalls, even during unit outages.
The three plants are now benefiting from five years of persevering efforts in the fields of organisation, teaching and training. They have the full backing of the management and highly-focused multidisciplinary work teams, with full support from contractors that agree to cooperate.

In the plants visited in 2008, their ambitions were broad-reaching, ranging from "nothing scheduled" to "we are carefully watching what has being going on at Golfech" and "we are planning for it", reflecting the Nuclear Operations Division's policy of not making the issue a priority but leaving action to the initiative of the plants.

However, perhaps the policy should be reviewed in the perspective of significantly extending plant lives?

Apart from the clear progress in radiation protection and radiological cleanness, I noted that as access was easier, considerable amounts of time were saved and access to the nuclear areas substantially increased, particularly for the managers, according to those I spoke to at the plants involved.

The project reinforces the image of rigour and quality of nuclear work, while bringing us closer to the standards generally observed outside France in nuclear units of the same technology.

Radiation protection management

During my visits to the plants, I noticed that **management support of radiation protection was tending to run out of steam**. I hear less and less about it during my meetings with the plant management teams. Although I have no doubts about their commitment, this may be perceived differently in the field.
Backing for the ALARA approach varies considerably from plant to plant, the ad-hoc committees are however properly playing their part as concerns high-stakes work.
I met one ALARA project manager, whose dynamism, charisma and efficiency has brought about tangible progress: his plant is in the forefront as concerns experiments of all kinds (Radiation Protection Surveillance Station, source term work etc.).

Finally, I have noticed that **some of the radiation protection management positions are vacant, including the high-level ones**. This kind of situation is abnormal, and could cast doubt on the priority given to radiation protection.

Risk Management Departments (SPR)

As time goes by, new tasks are being added to the basic tasks of radiation protection and industrial safety handled by the Risk Management Departments. As I have observed in the field, this means coping with prevention in the areas of chemistry, noise, bacteriology, toxicology and even a stronger role in fire risk management.

Restoring prestige

I often hear that these tasks should not be performed by the same people, but I observe that it is often the case! Some say that they are faced with too many different tasks, and find the resulting conflicts irksome.
Meanwhile, though **these departments saw their manpower substantially increased as of 2000 with an injection of highly-skilled staff**, they can nevertheless suffer from heavy staff turnover. In certain cases, the fraction of staff being retrained or working very short hours is considered disproportioned, necessitating increasing numbers of temporary contactor staff.
These departments express the need to be in close contact with the other professions to properly prepare their actions, to capitalise on experience feedback, and to have more time to exercise their good practice skills. At times, they question the ability of the field workers to provide their own protection when the number of Risk Management Department personnel in the field seems insufficient.
I have the impression that the Risk Management Department managers should be present more often in the work areas.

Meanwhile, contractors regularly complain about insufficient support by the Risk Management Departments in the nuclear zone work areas, particularly those who also work for other nuclear operators.

Given their importance, each Risk Management Department mission should be clearly identified, described and resourced, whatever the form of organisation chosen.

The rule set

The **radiation protection rule set**, which was established and introduced at the beginning of the decade, is still frequently being modified. It is **sometimes complex, and still applied differently from one plant to another**, which does not simplify things for contractors.
I witnessed a number of scenes that revealed the difficulty in managing apparently simple rules in the field, e.g. what gloves should be worn in different circumstances.

The Risk Management Department managers consider that the rule set is complicated to apply and difficult to assimilate. They are looking forward to applying the methods and practices standardization campaign (PHPM) launched in 2007 which they expect will rapidly have positive effects. They also wish the new operating modes be more frequently the subject of socio-organisational and human factors analyses before application in the field.

Reducing the source term

From year to year, I observe the relevance of basic, cross-organisational work on the radiation source term. The experts in the engineering units, i.e. the Nuclear Environment and Decommissioning Engineering Centre (CIDEN), the Construction and Operation Expert Appraisal and Inspection Centre (CEIDRE), the Operations Engineering Unit (UNIE) and the Central Technical Support Department (UTO) and those of the nuclear plants, have decided to first improve the radiological conditions of the plants where people are exposed to the highest doses.
At present, the action, which is both pertinent and methodical, is focused on the source term represented by the pipework systems, beginning with those with the highest radiological exposure potential throughout the plants.

It's effective and the winnings are good

I have been watching the results of the test of the zinc injection into the reactor coolant systems of the two Bugey Nuclear Plant nuclear units, a practice already adopted by other operators outside France. The results appear to be positive, with a reduction in the deposited activity ranging between 10 and 15%. This method should reduce the collective dose and offers other advantages, particularly in reducing the risk of distorting the neutron flux and preserving the resistance of materials. It will be broadly deployed from 2009.
I would like to extend my strongest encouragements to the teams working hard to ensure that the collective dose continues to drop.

Situations involving exposure risks

Moving from orange zones to red zones

Much work has been done by the Operations Engineering Unit and the plants to correct the shortcomings observed in the past. Eighteen nuclear plants have now reached a level categorised as "good" and three as "excellent" as per the Nuclear Inspectorate rule set.

Discrepancies that can cost money!

Although I note with satisfaction that **the number of major radiation protection events caused by failure to properly control the red zones significantly dropped in 2008** (with three such events as compared to fourteen in 2008), those relating to the orange zones have increased. This increase is due to signage issues and non-compliance with the requirements governing access to such areas.
This finding raises doubt; it probably signifies insufficient assimilation of the risks by the workers, who are also under pressure to meet deadlines. However, the conditions now appear to be right to achieve progress in 2009.

I note that a certain number of these events relate to work in the bottoms of reactor cooling pools, a point that I will discuss later.

Gamma radiography work

I would like to particularly emphasise the background work that has been carried out in recent years by the parties involved: the Nuclear Operations Division, the Nuclear Engineering Division and the radiography contractors. Fourteen nuclear plants have now reached a level categorised as "good" if not "excellent" as per the Nuclear Inspectorate rule set. Tangible progress visible in the field has been achieved.
Forasmuch, the number of significant radiation protection events has not dropped as much as hoped.

The contractors in charge of the radiography work need to make more progress in a number of fields: rigour in job planning, coordination with plant and contractor bodies, adoption of job reliability tools, which are particularly needed in this type of hazardous activity.
Also, I note that some are faced with major staff turnover problems, while others are being called upon to handle other types of work. **EDF must be particularly careful in this situation and should improve its surveillance which still has its weaknesses.**

Working at the bottoms of reactor pools

Care required: each job is special

For a number of years, I have been stressing the importance of the incidents that have occurred during work on the bottoms of reactor pools. They expose the workers to a number of specific hazards. Once again this year, abnormal situations have arisen. These stem from the same organisational and technical causes as in past years.
Progress with dealing with these risks is sluggish, although the risks have been clearly identified. I expect the ad hoc working group formed in 2008 to lose no time in making its suggestions.

The tools of tomorrow

During my annual visit to the EDF Research and Development Division in Chatou, I was shown some of the work on the project which involves introducing new technologies in nuclear plants in service (INTEP). **I observed that the logic of the quest for operational excellence effectively covers risk management!**

The Radiation Protection Surveillance Station will, for instance, make it possible to monitor the following in real time:

- job sites via fixed video cameras,
- job execution with video equipment mounted on the worker's equipment,
- collective dose and individual doses for certain high radiation risk operations,
- radiological readings at a number of points in the nuclear zone.

This system has long been used in the USA.

This type of new technology is essential if progress is to be made in radiation protection control. It is however necessary to remain vigilant, as these tools alone cannot guarantee the radiation protection of the future; they are only additional lines of defence.

In conclusion, regulatory requirements and management ambitions are continuing to ensure progress with the radiation protection results. There is still scope for progress, as can be seen by the disparities between the plants, and even between the nuclear units. Efforts must be continued in the fields of technology and behaviour, with care to ensure maximum participation of the contractor companies.

A CHANGING RELATIONSHIP WITH THE NUCLEAR SAFETY AUTHORITY

The Nuclear Safety Authority (ASN) determines how the new French Nuclear Safety and Transparency Act (TSN) is to be applied. This Act introduces a new and greater formalism and changes the scope of the ASN. The operators are consulted, and EDF expresses its point of view in a responsive and constructive manner. The change in the regulatory framework fundamentally alters the relationships between the different players on a daily basis, with each settling into their new positions in the best interests of nuclear safety.

I have been very attentively monitoring the re-establishment of the legal and regulatory framework governing the nuclear industry in France and, once again this year, I wish to assess the situation concerning the current changes, which have major repercussions on the relations between the ASN and EDF.

The Nuclear Safety and Transparency Act promulgated in 2006 covers the Licensed Nuclear Facilities (INBs) by addressing all the associated risks, particularly those relating to nuclear safety, radiation protection, health and protection of the environment.

Amongst other things, it gives the general public increased access to information about the risks involved, confirms the role of the government in laying down the applicable regulations and ensuring compliance with them, and unambiguously places responsibility on the nuclear operator for operations and their consequences.

The regulatory structure rises

An implementing decree was issued in 2007, constituting a first major interpretation of the Act, as I mentioned in last year's report. **This implementing decree specifies the content and boundaries for the operation of each Licensed Nuclear Facility as comprehensively as possible.**

The ASN in now working on a set of guidelines intended to translate the provisions of the basic Act into practical measures and, where necessary, to supplement them. For instance, it recently published highly detailed specifications for design and construction applicable to the EPR-type Flamanville 3 reactor.

Visible changes

The new provisions currently being drafted draw heavily upon the wealth of material accumulated from exchanges between the ASN and the operators over the years.
Some thought they would only be seeing a mere change in perspective and the amalgamation of numerous existing provisions, yet the process is been taken much further **and is already changing the form, if not the nature, of relations between the operator and the ASN**.

Here are a few recent examples.

Informing the public

To make sure the public is informed, the High Committee for Nuclear Safety and Transparency (HCTISN), created under the French Nuclear Safety and Transparency Act, is now fully functional. This committee brings together representatives of the government, the tutelary authority, the operators and the general public (politicians, and members of the Local Information Commissions, trade unions and non-governmental associations).
Since its inception, this committee has been asked to rule by the Ministry for ecology, energy, sustainable development and development and by its members on issues brought to the forefront by the media.
The Local Information Commissions (CLI) and the National Association of Local Information Commissions (ANCLI) now have legal force and are assigned their own resources. **The Local Information Commissions are always consulted in the event of substantial changes to the facilities**. Now more visible in the consultation process and better informed, the Local Information Commissions and the National Association of Local Information Commissions will be able to commission independent expert appraisals.

I have also noted that in addition to the above information, the ASN now publishes the consultative findings that it receives from the standing committees of experts that it has asked to issue rulings, accompanied by the summary of recommendations from its specialist advisor, namely the Institute for Nuclear Safety and Radiation Protection (IRSN). The same applies to the reports containing the conclusions issued after the ten-yearly nuclear safety re-assessments of the facilities.
For the operators, **in accordance with the Act, each Licensed Nuclear Facility produces an annual nuclear safety and environmental protection review which is made available to the public**, as well as being distributed to the Local Information Commissions and the High Committee for Nuclear Safety and Transparency.

Transforming the checking process

The new legal provisions allow the operator to increase the scope of its self-checking by extending the internal licensing process. The ASN retains control but focus is placed on those issues that it considers important. This internal licensing system had already been used in a few specific instances and could therefore be extended.

On a number of occasions I have drawn attention to such **organisations operating within EDF on the basis of a system of internal licensing. I have frequently emphasised both how exemplary and demanding this system is,** not to mention how it clarifies and simplifies relations between the ASN and the operator.

However, arrangements of this type require the operators to make sure that the internal analysts, who must be identified and accredited, were not involved in producing the dossiers they are to assess. This requirement imposes the creation of an additional organisation, which must be identified and auditable, in addition to the means already in place. Although such bodies, e.g. the Decommissioning Safety Committee or the official Plant Inspection Services, have proved effective in specific fields, I have my doubts about the physical possibility of substantially extending their scope in the short term. There is also the risk that the process become routine, which would make it meaningless.

Stricter application of the rules

In May 2008, the ASN decided to temporarily halt the pouring of concrete and thus the construction of the buildings important for safety at the Flamanville 3 EPR-type reactor work site although the discrepancies found did not directly compromise nuclear safety.
The ASN felt that the discrepancies, although technically minor, were signs of more serious shortcomings, particularly relating to the arrangements EDF had set up to check contractor work, and that the worksite support provided by the central departments needed to be reinforced.
I discuss these points in greater detail in Chapter 6, devoted to the progress at the EPR reactor site.

The Act is applied

In November 2008, the ASN ordered EDF to upgrade the explosive fluid pipework at the Cruas Nuclear Power Plant within three months so it would comply with the provisions of the corresponding regulations. Inspections carried out at this plant and others had effectively showed that some regulations had been violated, notably in terms of the pipework marking and periodic maintenance. Despite there being no immediate risk, the ASN wished to mark a case of non-compliance with the rule set which is intended to preclude any risks considered substantial.

Meanwhile, the ASN has issued requirements for the management of the explosion risk that are to be applied within three months by all EDF nuclear power plants.

A more formal framework and more stilted dialogue

A new ASN, new procedures, major highly-technical cases under review, and fundamental commercial requirements not always properly prioritised by the operator: these factors now constitute the framework, the context, the tools and the substance of the nuclear safety debate.
Greater formalism in relations and new constraints are now perceptible, such as the requirement to resolve all outstanding issues before submission of a case to the ASN Board of Commissioners.
I observe that all the players (the ASN, the Institute for Nuclear Safety and Radiation Protection, and EDF), both at headquarters and in the field, are gradually discovering all the consequences of the new arrangements as they practice them, and that they had been underestimated. It will be a matter of nothing less than learning, or re-learning, to work together in a new context, and that is going to take some time.

Reconciling formalism and efficiency

These different factors both lengthen and complicate the process of case assessment, while making the associated technical debates more heated. Although a full and consistent regulatory framework is indispensable for nuclear plant design and operation, I remain convinced that **we need to continue avoiding excessive conformity so that the real issues do not fall out of perspective.**
Regarding this point, the ASN and IRSN have the difficult and demanding task of making sure that the nuclear safety debate remains strongly connected to the realm of scientific and technical reality.

In the field

During my visits to the plants, the managers of the main divisions in charge (Nuclear Fuel Division, Nuclear Engineering Division and Nuclear Operations Division) mentioned, more frequently than previously, the difficulties encountered with the examination of their cases. These difficulties generally relate to faults occurring during the operation of plants in service or requests to upgrade equipment, systems and modes of operation. The same also applies to the dossiers on new construction work.

It is to be borne in mind that the operator, who bears the responsibility for nuclear safety, is required to submit proposals which are analysed and often challenged by the ASN and the Institute for Nuclear Safety and Radiation Protection. This involves answering a series of questions that should enable the two parties to not only better understand each other's positions, but above all to properly determine the importance by identifying the issues.

For me, nuclear safety is not a variable that "depends on the point of view", and it is essential the exchanges enable the right solutions to be reached. There therefore needs to be a proper debate, in total confidence, that must go full circle, knowing that in the end **the ASN will be the one laying down the law in the field of nuclear safety**

I am told that this exemplary process is not always followed, no doubt because the quality of the operator case files could still be improved, but also because the counter proposals put forward by the ASN and IRSN are more conservative than the operators feel reasonable, in view of the proofs it has provided and the commitments it has made. This applies to construction, operation and decommissioning.

Concerning this point, I find that the rulings of bodies such as the Standing Committee for reactors or the Standing Nuclear Section, which contains experts from the various stakeholders, could be given more ample consideration.

How new regulations are devised

I think it is worth describing how the new regulations are drafted, considering they will have a significant impact on how the authorities and operators will function.

For each topic, there is a discussion group representing the ASN, its specialist adviser IRSN and the operator. This group meets first and then a drafting group (no operator involvement) is asked to produce a draft regulation; this is then forwarded to the operators for their opinion, particularly in terms of putting its requirements into practice. The new regulations should also contain indications as to how they link up to the existing one, which is not necessarily a simple matter.

In this process, EDF has naturally sought to be involved in the drafting of new regulations as early as possible and to make its own suggestions. I note the highly methodical approach and project-mode organisation that has been adopted. A high-level coordinator is assigned to each of the topics that the ASN will be working on within the new regulatory scope. For reference, these topics are the regulatory pyramid, the General Operating Rules, modifications, fuel, nuclear safety re-assessments, safety reports, the environment, decommissioning, and new constructions. When regulations are proposed, a considered opinion has to be given rapidly as very little time is accorded.

The "decisions" currently being drafted by the ASN are to be presented to the Board of Commissioners in 2009 after incorporation of the West European Nuclear Regulator Reference Levels published in 2008.

The representative case of the General Operating Rules

The General Operating Rules are matter of the highest importance for EDF as they determine the framework of everyday operation.

It is to be remembered that under the former system, the ASN was required to approve the following General Operating Rules: the Technical Specifications for Operation, the management of cases of inoperability, the chemistry specifications, the rules for incident and accident conditions, the surveillance tests and the restarting tests.
Under the French Nuclear Safety and Transparency Act, the definition of the General Operating Rules is extended to the following areas: radiation protection, environmental protection, natural events, on-site events (fire, flooding and explosion) and maintenance of the equipment important for nuclear safety.
The change in scope is thus considerable, requiring the ASN and EDF to review the terms and conditions of approval for the regulations.

An opportunity to change the situation

Discussion in this area appears to be open, with each of the three stakeholders – the ASN, IRSN and EDF – actually seeking a change in the former somewhat unsatisfactory situation (the workload being excessive for the ASN and the approval times being a handicap for EDF).

The ASN envisages only approving doctrine, strategy and scheduling, leaving practical application (embodied by procedures) up to the operator.
Finally, I note without surprise that the ASN would like Flamanville 3 operations to begin under the new General Operating Rules.

Standardisation of regulations

In my previous reports I have described the work of the West European Nuclear Regulators Association, as well as the counter-proposals of European Nuclear Installations Safety Standards initiative. The West European Nuclear Regulators Association Reference Levels relating to reactors in service were published in early 2008 and are intended to serve as a basis for the various action plants for upgrading the national regulations. As mentioned above, the new French regulations are to incorporate these Reference Levels.

In the present situation, conformity of the French nuclear plants with the 300 Regulatory Levels is high..Only three of them have not been verified, and the only real contention relates to the rules for analysing on-site event situations (such as fire) and off-site ones (such as flooding).
It should be remembered that other Reference Levels relating to the interim storage of waste and decommissioning, have currently reached the status of working documentation.

Ambitious but desirable standardisation

In 2004, a draft European Union directive on nuclear safety was abandoned as a result of opposition from certain countries.
Since then, the European Commission has continued to work on the issue with the creation of a High-Level Group uniting the safety authorities from nuclear-equipped countries and similar authorities from non-nuclear countries, as well as the creation of the European Nuclear Energy Forum bringing together the politicians in charge, the safety authorities, the commercial operators and non-governmental organisations.

These bodies are responsible for making proposals while the European Commission drafts a directive. Apart from the fact that, as in 2004, some of the nuclear-equipped countries are not in favour of a directive, the main issue would appear to be the extent and depth of its scope.

Although general agreement on the basic principles of nuclear safety published by IAEA offers scope for cooperation, any sort of practical application of these principles – via the West European Nuclear Regulator Reference Levels – would appear to be problematic.

I will be attentively monitoring this debate because EDF is an active participant via the European Nuclear Installations Safety Standards initiative and a member of the European Nuclear Energy Forum. EDF

therefore is in a position to table proposals. Furthermore, expressing and sharing at least the common principles of nuclear safety in Europe seems to be an important step in preparing for the future.

In conclusion: the re-organisation of both the regulatory practices and the rule set is fundamentally changing the roles and even the attitudes of all the parties involved. All players need to establish their proper relative positions in order to develop a new system to become fully effective. If care is not taken, relations may become too formal and complicate proper assessment of the nuclear safety issues, rendering any technical discussions sterile, which up to now been extremely fruitful.

As is the case for the stakeholders confronted with the same challenges of prioritising the many demands placed upon them, EDF must not turn a blind eye to the problem and must therefore take care to more clearly identify its own priorities.

SUPPORT FOR NUCLEAR PLANTS IN SERVICE

The corporate- and plant-level engineering bodies within EDF provide organic support to the 58 nuclear units. Their modes of action have been restructured to better manage all the services provided, while ensuring that nuclear safety is improved along the way. These support bodies have great potential and responsiveness, but should even better anticipate operator requirements.

The necessary support for nuclear plants in service

Although operating performance is primarily a matter for the plant's own services, increasing the effectiveness of and the ability to anticipate of any outside support provided offers scope for improvement.

The different EDF engineering services are able to interact via an extensive network, which assists the nuclear plants in meeting the everyday challenge of profitability while observing the precepts of safety. As I mentioned in previous reports, the entire system has just been re-organised with the intention of improving the quality of the services provided.

This year, during my visits to the corporate-level departments of the Nuclear Engineering Division, the Nuclear Operations Division and the nuclear plants, I sought to gain a clearer picture of how this plant support system actually worked, in order to assess its pertinence and to gauge its ability to respond to operator requirements.

This involved looking at a complex but rational system consisting of many parts, and in doing so I met focused professionals who clearly understood what their goals were and how to achieve them.

Organisation of the engineering services

The structures and missions of the bodies providing support for the nuclear plants in service reflect the history of the company. EDF is the architect engineer of its nuclear power plants. It accordingly has strong engineering background (the Nuclear Engineering Division), a choice well suited to the design, construction, operation and decommissioning of a large fleet of plants made of the different technical series.
The Nuclear Engineering Division is also in charge of replacing major components (reactor vessel heads, steam generators, turbine stages etc.). It is also regularly called in to help diagnose and solve technical and regulatory problems encountered during plant operation, particularly if they are generic.

Historical choices that remain valid today

The quest for greater nuclear safety in France has resulted in changes to the design and operating rule sets, generally introduced at the time of ten-yearly reactor inspections. The Nuclear Operations Division is also looking to upgrade the installations to facilitate operation and maintenance.

These changes result in both equipment and documentation modifications. Furthermore, it is also the Nuclear Engineering Division's task to design and implement such modifications within the organisation of the Production and Engineering Directorate.

Within the Nuclear Operation Division, a major corporate engineering capability consisting of the Operations Engineering Unit (UNIE) and the Central Technical Department (UTO) is the legitimate body to which technical matters are referred. It is also responsible for conducting expert appraisals and providing plant operation and maintenance support. The tasks of the plant engineering services include relaying and integrating the instructions and material produced by the above two departments. Here I cover in detail the support provided by the Operations Engineering Unit, which I visited this year.

Operations engineering support

At the request of the Nuclear Operations Division, for the benefit of the plants, the Operation Engineering Unit conducts projects with major implications on operability and nuclear safety. As a result of its internal organisation and position, it provides strategic and technical support to the management of the Nuclear Operations Division, while providing direct practical support to the plants. Although these two forms of support are provided by the same entity, they appear to be highly complementary.
The Unit is also in charge of running the technical networks and certain professions, particularly those involved in nuclear plant engineering. The Unit capitalises on the experience acquired in operations and maintenance at EDF and other nuclear operators.

The Operations Engineering Unit has set up its own Quality and Safety Directorate for the in-house auditing of its activities.

Being a great help to the management and the plants

In all its areas of activity, the Operations Engineering Unit has the capability of making high-grade expert appraisals and case studies.**I was impressed by its powerfulness and its ability to take initiatives**. However, has it been made sure that the plants, on the receiving end of its products and advice, have the ability to assimilate and fully utilise these initiatives?

In a more general context, I wonder about the ability of the overall system to make best use of the know-how that the Unit possesses. Do we know how to harmoniously manage the complementary capabilities of all the engineering services? I believe that cooperation between the Operations Engineering Unit and the Nuclear Engineering Division could be closer.

Responsive support from the Operations Engineering Unit

The design and construction engineering services, often hand in hand with the Research and Development Division, step in when random incidents occur in the plants. **Countermeasures must frequently be devised as events unfold so as to re-establish the level of nuclear safety** while seeking to minimise the impact on plant operability. In previous reports, I have emphasised their ability to respond rapidly.

Once again this year, there were many technical developments and the Nuclear Engineering Division provided support on a number of important issues such as steam generator flushing or how to make constructor work more reliable during the renovation of heavy electrical equipment (transformers and alternators).

On the other hand, I was surprised to observe on a number of occasions that the design engineering service did not devote its powerful capability to improving field work performance.
There are examples of notable success in reducing the durations of scheduled outages (optimisation of surveillance tests, modification of equipment and procedures etc.). I note however that the incorporation of modifications during a unit outage is planned with a view to minimising the impact on the outage schedule critical path.

Preserving the potential of the nuclear units is also an area in which the engineering service is working hard so the plants can continue operating (rationalisation of equipment activation, minimisation of stress induced by operating transients, reduction of the neutron flux impacting the reactor vessels etc.).

Support via a redesigned interface between the Operation Engineering Unit and the Nuclear Operations Division

The Operations Engineering Initiative

I have carefully followed the inception and introduction of the new mode of interaction between the Operations Engineering Unit and the Nuclear Operations Division via the Operations Engineering Initiative. The goal was to render engineering support for nuclear plant design and operation more effective, particularly concerning the design and implementation of equipment and documentation modifications.

Active participation was required from the Nuclear Engineering Division, beginning with the identification of requirements and ending with an accurate understanding of the effect that modifications would have on operations. It was essential to associate the nuclear power plants with the process at the earliest stage in planning and design of the modifications, seeing that these plants were the end users.

This shows the importance, for all the players, of conducting socio-organisational and human factors studies and updating them as a project advances up to the operations stage.

From a successful project to a lasting process

The Operations Engineering Initiative was ended in late 2008, with new structural and organisational arrangements being introduced. Will the desire both to make staff more responsible and to rationalise the relationship between the designer and the operator bring the anticipated benefits for the quality of the products? I will continue to observe the effects with interest, particularly those relating to the cultural changes instilled in the Nuclear Engineering Division and the Nuclear Operations Division.

Towards control over the documentation process

This year, during my visits to the plants and to the joint teams, I observed the practical application of the main innovations of the Operations Engineering Initiative, in particular those relating to the documentation process.

The key role of the First Plant of Series

In 2007, I had already noticed the growing involvement of the First Plants of the Series as the main representatives of the engineering centres and the coordinators and specifiers of the practical operating documentation.

This year, the role of the First Plants in the Series has become even more important, which confirms the decision to rely on them so heavily. In particular, I saw that their "documentation and modification series integration structures" were in place and were functioning as intended.

The operators can state their case at the right moment

The production of common operating documents is organised by the Common Documentation Integration Committee (CIDM) for the series. This is chaired by the director of the First Plant of Series, and includes plant representatives from the same series and from the corporate engineering entities (the Nuclear Engineering Division units and the Operation Engineering Unit) in charge of producing the upstream reference documentation, and the Methods and Practices Standardisation Campaign members.

Where the structures and personnel are properly in place, the advantageousness of this organisational structure is clearly recognised, and I have often heard it said that "the documents were more reliable".

Increasing participation from plants other than the First Plant of the Series

I was more concerned about the manner in which the other plants in the series were adopting the new organisational structure and how they were able to offer their opinions or suggest improvements for this structure despite its real complexity. In particular, I observed cases where the positions of the Local Modification Integrator and the Local Documentation Integrator were hard to fill, although this was finally achieved in all cases.

At the present time, the situations differ greatly, such as regards plant contributions to: files under their responsibility, the Deadlines-Resources-Technology analyses, and the cross-checking required as part of the common documentation process. This needs to be seen within the context of the present economic climate and the more general problems at certain plants.

Some of the plants have successfully made the changes: in these cases, the Local Modification Integrator and the Local Documentation Integrator have become readily-identified recognised players, frequently organising local networks in which all the relevant departments are represented. They are the primary correspondents for the joint teams[1], with compromise more easily being reached where there is mutual understanding.

[1] *Joint teams: in charge of implementing technical modifications in the plants, composed of people from the plant itself and from the Nuclear Engineering Division*

I have observed that when this organisational structure is properly in place, it can detect any difficulties at a very early stage by applying the planned modifications, which is of course the desired result.
Other plants are having more trouble in getting involved, particularly about issues that only concern them in the medium term. But this is an inherent difficulty of the process.

Corporate level leadership

I have found the process of updating documentation to be well organised and operating effectively under the leadership of the Operating Rule Set Amendment Board (DERE). The corporate integrator of the operating documentation leads and supervises the top-down flow of the process, with the assistance of the rule set control unit. **It proposes grouping in batches and scheduling each batch to facilitate deployment in the relevant plant series**. Meanwhile, a documentation batch leader is appointed in the engineering centres or the Operation Engineering Unit.

"A strategic documentation schedule memo" is regularly issued when decisions are made by the Operating Rule Set Amendment Board. **I am particularly satisfied that these memos are being forwarded to the ASN and its advisers**, so the can develop an overall picture of the changes scheduled and determine in advance the extent to which they are concerned.
If future documentation changes remain substantial in nature and number, **it would appear to be advisable for the Operating Rule Set Amendment Board to constitute a counterweight against the "illogical outpourings"** so justly criticised by the plants in the past.
Though the system in place may be onerous and complicated, it seems to be under proper control by those involved, who have all adopted the same Operations Engineering initiative "language". The effectiveness of such a system has to be assessed over the long term but, seen from the plants, the initial results are satisfactory.

Pooled documentation

The Methods and Practices Standardisation Campaign is designed to identify good operating practices and get them universally adopted. For the operating documents (rules and instructions) and maintenance documents (procedures and guidelines), the Methods and Practices Standardisation Campaign staff are managing the drafting of the standardised material, but their revision, which essentially results from operating experience feedback, now takes place under the aegis of the Operations Engineering Initiative.

As regards the operating documentation (surveillance tests, operating rules etc.), the main objective appears to have been achieved in terms of quantity and quality. The effectiveness of the "product teams" that combine engineering and operating skills has been emphasised, as has the need to extend their presence to all the reactor series.
However, the process of revising these common documents has just begun and is proving to be a very slow one. Is this important point being viewed and sorted out with the attention it merits?

For the maintenance documents, the process has only begun on a minor scale with the drafting of some of the corporate maintenance procedures etc. The task is an enormous one, with more than 10,000 documents per plant.
However, to prepare for the introduction of the computerised Nuclear Technical Information System (SDIN) large-scale work has begun. This work involves the standardisation of the maintenance procedures and their integration into the system, which is performed under the Methods and Practices Standardisation Campaign. Some 100 staff will be working on this for at least two years.

The modification process

In the same manner, the Operations Engineering Initiative is covering the documentation and modification processes, and my above remarks largely apply to it. For the modification process, there is no counterpart to the Operating Rule Set Amendment Board, with know-how being divided between the Central Technical Support Department and the engineering centres of the Nuclear Engineering Division. Sometimes, it is the **documentary impact of a modification** that **determines to which batch it belongs**, which appears be a sensible approach as it **thus reinforces the coherence of the documentation**.

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Through sheer necessity, the Central Technical Support Department and the Nuclear Equipment Engineering Department are working to improve their collaboration, focusing on the logistics associated with the modifications and their multi-year scheduling.

For the incorporation of modifications, **the method applied appears to be very comprehensive but also very onerous and the deadlines are often very short**. In this context, the engineering centres are finding it difficult to keep up with the Operations Engineering Initiative milestones when it comes to distributing the material to the First Plants of the Series. I note that a simplified system is being studied for straightforward modifications. Apart from formal compliance with the schedule, the case files need to be substantial and the joint teams have told me that this is not always the case.

Meeting the milestones in form and substance

In this context, I attach particular importance to the Socio-Organisational and Human analyses of the files. It is to be remembered that this involves assessing the impact of the technical and documentary changes on the people and organisations associated as early as project inception, and with feedback on the initial design where necessary. It is no easy matter to make these analyses, as it is necessary to consult the designers and users, which takes time. The analyses must not only constitute the end of the technical review process and I observe with satisfaction that they are now properly assimilated.

Finally, I have observed that **the Nuclear Engineering Division engineering centres are organising "intensive information and training sessions" for the Local Modification Integrators** to enable them to better understand the nature and content of the different phases of case file reviews, in particular their economic implications and allowance for regulatory aspects in light of the Nuclear Safety and Transparency Act.
This system appears to be very worthwhile and I call for these information and training sessions to be mirrored, i.e. that the **Nuclear Engineering Division engineers be "thrown into the deep end" together with their key NPP counterparts**.

In conclusion, if everyday performance is in the hands of the plant operators, the quality of the support they receive to succeed remains a determining factor. A new organisational structure for their support is in place, which is better designed and more methodical. Documentation, the foundation on which operation is based, has been put in a place of honour. Contributions from the different parties are properly exploited; they must fully play their roles in this consistent yet complicated system so further progress can be made with nuclear safety.
To ensure that they can achieve their goals and that their contribution be durably maintained, they need proper support and the necessary resources.

SUCCEEDING WITH THE EPR

Work on the EPR-type Flamanville 3 project went into high gear in 2008, with efforts focusing on getting everything done properly in a tight timeframe. The high levels of quality demanded today at each stage of design and construction must guarantee nuclear safety tomorrow. Its future operators are already getting ready, using thorough, new approaches. The EPR is a highly-complex, demanding project and its success must represent that of the entire company.

A step forward in nuclear safety

The construction of the first EPR-type plants in Finland and France is a tangible sign that Western European countries are turning to nuclear power in their long-term energy planning. This trend has only been made possible because the EPR and other designs of the same generation offer increased potential in terms of cost-effectiveness and **more importantly, innovation in nuclear safety**.
It is to be remembered that the EPR design benefits greatly from decades of operational feedback on pressurised water reactors throughout the world, particularly from those in France and Germany. Crucial advances already made in safety have opened the road to further progress.

2008, a turning point

Every year in my report, I discuss the progress made with the EPR-type Flamanville 3 reactor. I have already described the main technical options chosen, particularly their advantages in terms of nuclear safety, radiation protection and environmental impact.

After the first concrete was poured at the end of 2007, the year 2008 represented the true commencement of the actual construction phase. The impressive industrial machine driving the project is now in full steam, with impressive results in the field.

Quality today, safety tomorrow

I am convinced that tomorrow's nuclear safety, radiation protection and industrial security will largely depend on the quality of the detailed design, equipment fabrication and plant building construction. Planning reactor operations and preparing training courses for future operating staff are two more vital aspects that will determine the success of the project.

A new benchmark for design and construction

It is to be remembered that the Flamanville 3 project aims to set the standards in the construction of a new type of reactor, the EPR, which EDF proposes to build elsewhere in France and throughout the world.

I have observed that the project is progressing well on a wide scope of issues ranging from the nuclear safety case, the detailed design of the systems, factory fabrication and site work.

- At the JSW plant at Muroran in Japan, where I saw the fabrication of heavy components for the nuclear steam supply system (reactor vessel and steam generators), I was able to observe the essential role played by the in-shop inspectors of the EDF Construction and Operation Expert Appraisal and Inspection Centre.
- At SOFINEL, the joint EDF-AREVA design office told me how the detailed design of the nuclear installations (excluding the nuclear steam supply system) was organised; SOFINEL is in charge of similar design work for Olkiluoto 3 and Taishan 1–2.
- At the Nuclear Engineering Division's Basic Design Department, I was shown the calculation methodologies and resources on which the safety case was established.
- At the Flamanville 3 worksite, I was once again able to witness the impressive way in which the project was taking physical form.

More generally, I observed that the synergy between all the parties involved was good, under the leadership of a dynamic project management team and with support provided mainly by the Nuclear Department and the Electromechanical Department from the Nuclear Engineering Division.

Olkiluoto 3 /Flamanville 3, progress in parallel

In the EPR-type reactor family, Olkiluoto 3 has cut the first furrow, but I note that **Flamanville 3 is deriving less benefit than expected from the Finnish project feedback**. It is true that the organisation and the interfaces are not equivalent, and the time difference between the two schedules has decreased, but I also think that the desire to exchange experiences has wearied over time, no doubt due to the difficulties encountered on both sides.
However, I have noticed that the structure set in place by TVO (the Finnish operator) and EDF to harmonise the design approach will encompass aspects of construction and, amongst others, technical exchanges on the reactor in-service inspection programs.

Exchanging more information: a common interest

The French nuclear safety authority's licensing approach differs significantly from that of the Finnish one, STUK, which complicates cooperation. The latter recently organised an ad hoc meeting for other regulators, nuclear safety organisations and businesses in an attempt to share experience it had acquired in its supervision of Olkiluoto 3.

It seems to me that we would both have benefited from doing more together.

Preliminary experience feedback

Unsurprisingly, as Flamanville 3 finds itself in the role of the "co-first-of-series", it needs to confront issues that are specific or even completely new not only in the fields of technology and organisation, but also in the supervision of design and construction work reviews.
Despite the inherent difficulties in such a project, I have noticed that the problems encountered with civil engineering working drawings, the reactor building liner welds, and the construction of the cooling pools were solved after strong mobilisation of numerous stakeholders and strong involvement of the project team itself.
The experience feedback from these events has been well utilised: an organisation charged with prior identification of sensitive issues (technical aspects, coherence of schedules etc.) has been set up, with the relevant professions having been asked to device the countermeasures and organise the skills required.
Furthermore, to adhere to the schedule as closely as possible, the managers of the design bodies and the EPR project carefully screen the requests for design reviews. Such requests are unavoidable in first-of-a-kind engineering, particularly when they come from the future operator, even though it was closely involved in the initial design work.

Licensing

The ASN, backed by IRSN, monitors the complete range of activities that support nuclear safety in the EPR-type reactor.
Apart from examining the design studies for the structures, components and system, it makes inspections on the premises of all the various engineering services and fabricators, as well as on the worksite itself.
According to those I met at EDF, examination of the issues with the ASN and IRSN is going well, notably due to improved methodology: preliminary technical meetings are held so EDF can present its files, thus enabling the analysts at the Nuclear Safety and Radiation Protection to work with as much information as possible.

Off to a good start

However, I consider it highly remarkable that the ASN decided to temporarily suspend the construction of the structures classified as important for safety at the Flamanville 3 site in May 2008. **This decision raised questions at all levels in the company, and left an impression on those working at the site**, whether members of EDF, prime contractors or sub-contractors.
The decision was made after the discovery on a number of instances of sub-standard quality in the building of the structures, notably the failure to correct a number of discrepancies that had been reported. Even though the cases of sub-standard quality did not have any effective impact on nuclear safety, the ASN considered that organisation in the areas of execution and quality control needed to be improved.

After three weeks, the ASN authorised resumption of construction work once action plans to correct the shortcomings identified had been submitted. These action plans also reflected the findings and recommendations of an internal audit; they contained appropriate commitments such as improving the safety culture of all those working at the site, reinforcing surveillance of work carried out by sub-contractors, and providing the site design service with greater support.

Preparation for operation

Innovations

I personally participated in a think-tank on the operation of future nuclear power plants where a number of options were envisaged, some corresponding to current practice and some not.
As regards operation, **I consider that a new project offers an excellent opportunity to shake off old habits**.

Apart from the flexibility offered by the EPR design (redundancy level of the safety systems, access to the reactor building when on power etc.) which will need to be taken into consideration, I note with satisfaction that the terms and conditions of operations are considered to offer scope for innovation and, in this regard, the director of Flamanville 3 has used his discretion to a large extent.
I met with the director and his staff to take stock of the efforts made to plan ahead by the Nuclear Operations Division.

Human factors, training and management

The key management positions at Flamanville 3 have now all been filled. Amongst the first were those relating to the independent nuclear safety system, human factors and change management. This order seems rather symbolic, and I read this as a good sign.

Enthusiasm as high as the stakes!

Demanding management principles (permanent progress, pre-eminence of nuclear safety, sharing of goals etc.) are part of the basic tenets of a management charter that the future Flamanville 3 staff have to respect.

Staffing is in full swing: the positions in the organisation chart are being filled either with people from the company or with new arrivals. At the end of 2008, more than 100 has been recruited. I note, however, that **it is not easy to get experienced staff to move to Flamanville** and it is clear that the historically low levels of staff movements between the plants observed in recent years is also affecting the EPR project despite its attractiveness.
To achieve the levels of professionalism required, they will be "brought up to the level of the industrial facility to which they have been assigned". A special Vocational Academy has accordingly been set up at the Flamanville 3 site with the involvement of the Operations Engineering Training Unit. The opportunity of preparing for operation is being taken to write procedures based on the design documents produced by the engineering side.

As the EPR-type reactor will be the only one of its kind at EDF for a few more years, other plants will not be able to provide their assistance regarding control of the installations. The manpower to be trained and accredited for Flamanville 3 will therefore be greater and require two simulators, not one has first programmed.
Accordingly, I have observed that more engineering staff are expected to be authorised to operate the installation.

Before start-up
At the present time, the future operators are posted to the engineering centres and also to the Operation Engineering Unit and the Central Technical Support Department to be on site where the solutions to certain operating issues are resolved. Most of them will be integrated into the site start-up teams.
I have also noticed the increased levels of skills required in the field of chemistry, with secondment of staff to the Construction and Operation Expert Appraisal and Inspection Centre.

All the preparatory phases leading up to start-up is being organised in close collaboration with the Nuclear Engineering Division whose schedule constitutes the common reference. This arrangement has, for instance, made it possible to highlight and time the key events to ensure availability of the data systems needed.

After start-up

For the Flamanville 3 team, they are already preparing the phases following reactor start-up by determining the conditions for steady-state operation, with the initial milestone being the first refuelling outage.
The team is well aware of its "first of series" status, in particular as regards the modes of operation, with the physical possibility of conducting maintenance during service and gaining access to the reactor building while on power. It is therefore seeking contacts with other operators such as EnBW who already have the same capabilities; liaison has already been established with the future operators of Olkiluoto 3 and I hope that this will prosper.

I hail this willingness to innovate and plan ahead in all areas, from initial planning to handover; it should enable them to feel they have time in hand.

International perspectives

As investor and as investor-operator, EDF is involved in numerous projects featuring the EPR-type reactor outside France (China, the UK and the USA); some of the host sites have already been selected or planned.
In this context, EDF's approach is to use the French model as a basis to pool the material available (schematic and detailed design) and benefit from experience acquired in the construction and commissioning of Flamanville 3.

Relying on a common foundation

However, an EPR-type reactor built outside France will not only need to comply with the regulations and practices of the host country, but also certain technical (building codes etc.), procedural (licensing procedure etc.), and environmental specificities. **Nevertheless, the UK-EPR and the US-EPR will have a large common denominator.**

As regards safety, I am convinced that the EPR concept will end up being stronger and more adaptable each time it is confronted with the nuclear regulations of other countries.
Here are some of the issues currently being debated: the architecture and type of instrumentation and control equipment, the environmental standards, particularly concerning the intake and discharge of water, the scope and design of equipment important for safety, and their weight in the safety case.

In conclusion, the Flamanville 3 project is progressing remarkably well in the design offices, the factories, and the worksite. The ASN and its specialist advisers are fully assuming their responsibilities when it comes to checking of nuclear safety. As expected, the EPR project is proving to be complex, demanding and motivating; all those involved can be proud of it, and aware of the important challenge they are taking up. To succeed in achieving the levels anticipated in terms of design, construction and operation, the project will need to rely on the support of the entire company.

OPERATING THE INSTALLATIONS FOR LONGER

The EDF nuclear plants potentially have very long service lives. Setting long-term objectives implies planning and deploying the appropriate strategies in terms of maintenance, component replacement and obsolescence management at an early stage. The demanding ten-yearly nuclear safety re-assessments that set the pace of license renewal are steadily increasing the safety levels of the nuclear units.

Every year in my report, I like to reflect on the importance of managing installation ageing issues and thus the length of time they are expected to remain in service.

During both their service lives and decommissioning, the plants must remain in compliance with the applicable nuclear safety standards, which are tending to become increasingly stringent, particularly with the Nuclear Safety and Transparency Act in France.
These changes take into consideration current public opinion, but the continuous re-evaluation of standards applicable to nuclear safety, radiation protection and environmental impact mainly stems from the knowledge gained and the design and operating experience accumulated with the existing sets of nuclear plants.

This permanent progress is an integral part of the EDF nuclear safety process.

Regulatory aspects

Here I would like to point out that Nuclear Safety and Transparency Act requires the operators of Licensed Nuclear Facilities to ***"periodically re-assess the nuclear safety level of its installations in light of the best international practices and to provide proof that they are effectively implemented under economically acceptable conditions".***

In France as in other countries, these re-assessments are carried out every ten years following commissioning, and they allow the ASN to decide whether to issue an operating license for the next ten years. In the US, which has the largest number of nuclear plants in the world, the approach is somewhat different, a point I will return to later.

In late 2008, the Standing Committee on Nuclear Reactors met to discuss how to prepare the third ten-yearly safety re-assessment of the 900 MWe series reactors. The methodology proposed by EDF was the result of preparatory work that can be traced back as far as seven years, conducted in close liaison with the ASN and IRSN. This methodology was deemed acceptable. The first ten-yearly re-assessments will take place in 2009, with those of Tricastin 1 and Fessenheim 2. Meanwhile, the first ten-yearly inspections of the N4 reactor series will begin in 2009, and the second ten-yearly inspections of the 1300 MWe series are already in progress.

Future prospects for unit operations

At the start of 2009, EDF must state its objectives in terms of operating its plants beyond a service life of 40 years, as requested by the Nuclear Safety Authority. Even though the French plants are relatively young (the average age being 22.5 years), **I believe it necessary to consider all the implications of the ambitious plant life extension plants as early as possible**, particularly as regards nuclear safety and radiation protection. This issue was examined by the Nuclear Safety Council in December 2008 with a view to assessing all the consequences.

Third ten-yearly inspections of the 1300 mwe reactors: the stakes

As recognised by both EDF and the Nuclear Safety Authority, the third ten-yearly inspections of the twenty 1300 MWe reactors will constitute an important milestone for the application of conservatory measures as a basis for extending their service life well beyond 40 years. The first of the third ten-yearly inspections will be performed on the first reactor of this series in 2015.
An initial review, referred to as the "strategic phase", has begun seven years ahead of the first of the third ten-yearly inspections. Amongst other things, it will seek to integrate all the issues associated with substantial plant life extension.

Consequently, **the ability to manage aging of the safety-critical components and thus operability in the long term** means establishing **a policy to govern the operation, maintenance and replacement of systems and components accordingly.**
Making the right decisions necessitates completing the corresponding supporting studies in due time, which will need to be based on the findings of the Research and Development Division. Regarding this point, in my report last year, I emphasised the clarity and breadth of the Division's work, particularly in relation to the Material Ageing Institute. This is clearly an essential requirement, and any new ambitions will undoubtedly necessitate a change of scale.

Changing targets means re-examining the current logic

As part of the "strategic phase", the operating teams have been questioned about their new needs in the perspective of longer plant service life. I was greatly interested to note that more that seventy requests were made related to nuclear safety, radiation protection, operability and the interface with the environment.

Looking further ahead seems to incite initiative for the operator. In previous reports, I called for the adoption of this type of approach.

This view is also prompted by the work of bodies like the Instrumentation and Control Ageing Watch (OVCC) and I note that its counterpart for electrical equipment (OVME) is to be created in early 2009.
Finally, changes and modifications to be debated with the ASN following the third ten-yearly inspections of the 1300 MWe reactors will be assessed using a "cost versus safety benefits" approach to help prioritise the possible solutions. This was also the case for the third ten-yearly inspections of the 900 MWe reactors.

Understanding the American approach

As regards plant life extension, I am pleased to see that an effort has been made to utilise experience feedback from countries that have adopted this policy on a significant scale, particularly the US.
On a number of occasions, I have compared the ways that issues are being dealt with here to those adopted in the US. **In the field of plant service life, the comparison is particularly meaningful** as the average age of an American plant is ten years older than that of the French ones.
I would also like to point out that half the American plants, i.e. more that fifty reactors of which thirty two are PWRs, have already been licensed to extend their service lives up to 60 years, and it is very probable that most of the others in service will be granted similar licenses.

Even longer service life is already on the agenda in the US

As I once again observed during a recent visit to the US, the announced intention is "**to go well beyond sixty years, while retaining very high operability levels and further reducing the operating costs**".
The stakes are high and the technical challenge a tough one, which explains why the Electric Power Research Institute launched a Long-Term Operation Program to support their approach. This program covers topics such as equipment ageing and uses the INPO AP 913 approach which has already been used successfully to increase the reliability of critical components. It is to be noted that EDF is a member of the Electric Power Research Institute, as are all American operators and all the main non-US ones. The field covered is very broad and includes the behaviour of the main primary- and secondary-side components, heat sinks, civil engineering structures, buried pipes, electrical cables and instrumentation and control.
In this system, the nuclear safety margins are assessed using the "risk informed" approach adopted in the US and largely based on probabilistic assessments.

I have also noticed that at some American plants planning for the future can involve spectacular operations such as the simultaneous replacement of the steam generators, the reactor vessel head and the pressuriser, without mentioning major work on the secondary side of the installations. In most cases, components are replaced with identical ones.
I would however like to draw attention to the fact that **all the lessons drawn from non-French experience need to be seen in light of French regulations** in order to determine whether they can be applied to French situations.

Making allowance for current problems

This year, as in 2007, the operability of the nuclear generating facilities was negatively affected by failures of heavy electrical equipment (transformers and alternators), combined with operating constraints caused by the condition of the steam generators (chemical flushing and treatment to protect against the risk of vibration-induced fatigue in certain tubes), see Chapter 19, Section 2.
I emphasise that **these contingencies were managed in total safety**, as the operator always took the initiative to change the operating profile to regain its margins.

Building ambition on a solid base

I mention these operability problems because they need to be considered in light of the announced intention of operating our reactors beyond their initially programmed service lives.
There does seem to be a gap between what the failure of certain equipment seems to indicate (lack of a precise understanding of their condition or inability to plan ahead to preclude faults) and the desire to operate the installations for longer. These remarks mainly apply to the secondary-side equipment.

These events and their heavy consequence on plant operability ought to be avoided by making use of our strong engineering potential, which is now more focused on operating support by analysing experience feedback and determining countermeasures.
I note that the reactor coolant system, the engineered safety systems and the containment vessel are accordingly benefiting from the attention as their dependability has a direct impact on nuclear safety.

In the past the ten-yearly pace of licensing may have robbed us of our ability to see further ahead, i.e. to optimise maintenance programmes and to renew the main components and systems taking into account the entire plant service lives. **Planning further ahead can help to make certain decisions early and accordingly avoid undesirable situations.** This type of approach is already widely adopted in the countries I have visited.

Managing obsolescence

Extending the service lives of our plants begs the question of how we should manage the obsolescence of equipment and components. I raised this question in last year's report on the basis of often acute problems that are regularly reported to me during my visits to the plants.

Logically, **plant life extension should lead to adapting our approach to obsolescence**. This notably means allowing for the long lead times required to qualify either existing equipment or new equipment used for replacement purposes under normal and/or accident conditions. Management of spare part stocks is also a major issue, directly related to the obsolescence questions.

Plant live extension has the advantage of drawing attention to certain component and system replacement options. As mentioned earlier in this chapter, the Instrumentation and Control Ageing Watch (OVCC) has been functioning for a number of years and its counterpart for electrical equipment (OVME) will soon be created, so why not imagine adopting the same approach for other categories of sensitive equipment?

In conclusion, seeking to substantially extend the service lives of our reactors means proving that "longer also means safer" based on the measures taken and the experience acquired. It will therefore be necessary to accordingly adapt, if not completely re-think, the economic logic of heavy maintenance and the replacement of components and systems. The operator must also consider the "very long term" issue as one of its everyday preoccupations, thus calling its existing practices into question.

FURTHER OPENING UP TO THE OUTSIDE WORLD

EDF has announced new international ambitions, mobilising the forces of the nuclear divisions, particularly the Nuclear Engineering Division. Meanwhile, the Nuclear Operations Division is increasing its international links to improve its levels of performance. Each plant needs to be convinced of the importance of checking what others are up to and being checked out by others. A nuclear safety governance system capable of adapting itself the realities of each country and each subsidiary is being developed in the company.

Article 29 of the Nuclear Safety and Transparency Act states that "the operator of a Licensed Nuclear Facility must re-assess its nuclear safety every ten years, taking the best international practices into consideration".

The Act thus officialises what has long been **the practise of the international nuclear community**, whether operators, regulators or vendors: **seeking to share information, to help each other and to adopt best practises.** It must be clearly understood that an accident anywhere in the world reflects on all the operators and that everyone, operator or regulator, would be somewhat responsible. Every operator effectively has an individual and a collective responsibility at world level, especially EDF.

The Research and Development Division and the Nuclear Engineering Division have long been engaged in international cooperation. In recent years, the corporate management – particularly that of the Nuclear Operations Division – has become convinced that consolidating its presence on the international scene is a basic necessity, improving the performance of its plants by integrating the lessons international of operating experience feedback, creating relationships of cooperation with nuclear operators and nuclear organisations in other countries, and contributing to ensure levels of nuclear safety and operability are maintained in the existing and future subsidiaries.

First of all, I will illustrate my words with a specific example: **the development of relations between the Nuclear Operations Division and the World Association of Nuclear Operators (WANO)**, whose primary focus is increasing nuclear safety. I will then review **the company's ambitions in the international arena and their impact on the governance of nuclear safety.**

Relations with WANO

Collaboration with WANO goes back a long way. The organisation's head office is in London, and it has regional offices in Paris, Moscow, Atlanta and Tokyo. EDF's plants represent 40% of those covered by the Paris office. This relationship has been strengthened by the realisation that EDF plant performance levels could be substantially improved. It is true that EDF's results are often in the second half of the pressurised water reactor field according to the Association's indicators.

Custom services

WANO offers a wide range of services that can be adapted to suit the requirements, for instance:

- Peer Reviews: three-week assessments by peers from other countries,
- Technical Support Missions: these are requested by the plant and involve assessment or support and advice on a specific issue, e.g. housekeeping, human performance etc. ,
- Stream Analysis: a team of experts assists a plant in developing effective action plans, indicating the main options available to them,
- Seminars: for the top management of companies to heighten their awareness of the key nuclear safety issues.

I noticed that WANO is considering additional assistance programmes for plants in difficulty, much in the same way as the Institute of Nuclear Power Operations provides assistance for certain plants in the USA.

What WANO provides

Peer Review

Together with WANO, EDF has developed **the concept of Joint Peer Reviews** to avoid a proliferation of the number of plant assessments. Two teams, one consisting of inspectors from the Nuclear Inspectorate of the Nuclear Operations Division, and the other consisting of international counterparts, are working together with different methods. The Nuclear Inspectorate staff assess the overall conformity of the plant with a rule set based on international standards and reflecting the aspirations of the company. The international team focuses on specific points identified during the planning stage.

With two viewpoints more is found

Having two complementary viewpoints helps in identifying where the French plants are lagging behind, which is generally in the areas of housekeeping, surveillance of the installations and rectification of discrepancies.

No punches are pulled and there is not attempt to use conciliatory language, knowing the reports are only shown to the operator, which I believe is important as the operator needs its own privacy.

Technical Support Missions

Technical Support Missions are a second service available to plants. WANO sees this as a measure of the pro-activeness of the plants.
The Association is working to encourage each plant to host at least on Technical Support Mission per year. EDF is nowhere near this level. Technical Support Missions are of two types: 1} diagnosis followed by recommendations on a specific topic, and 2) training (or a seminar) on given subject. The EDF plants tend to prefer seminars to diagnoses.

The small number of Technical Support Missions seems to indicate that some of the plant managers have not yet realised their potential.

What EDF provides WANO

EDF contribute to the missions described above. The World Association of Nuclear Operator is very selective: only half the international candidates applying for the role of Peer Review team leader are chosen. The Association rightly considers that **the quality and pertinence of a Peer Review depends greatly on the quality of the team and its leader.** The Association also thinks that operators find it difficult to lend out their best and most experienced staff. Meanwhile, it is seeking to professionalize its assessors and needs them to commit to a certain number of Peer Reviews.

EDF participation in the Association's Technical Support Mission teams is low, although the missions are as useful to the team members as they are to the host plants.

I wonder why it is so difficult to supply peers. It is probably partly due to the everyday pressure on the key players, who are those best able to participate. In passing, I note that our Nuclear Inspectorate is also finding it hard to recruit peers for Global Assessments of Nuclear Safety.

Who gives also gains

The benefits of participating in Peer Reviews and Technical Support Missions need to be remembered. **It is often a career highlight and a turning point where personal priorities are re-established.** For example, I remember a Human Performance Campaign leader in a nuclear plant who had participated in an Institute for Nuclear Power Operations assessment in 1998 who suddenly "got the picture" about the effectiveness of error reduction tools. The same is true of housekeeping: only visits to foreign plants can show how much still remains to be done to achieve excellence.

WANO also needs more EDF representatives as speakers or participants in seminars **because their opinions have weight as they speak from experience with a set of 58 reactors.**
I have encountered EDF staff seconded to WANO and found them to be of high calibre, to have gained a marking experience and to be highly appreciated. Their skills need to be fully utilised on their return, which makes this type of operation even more profitable. The same applies to other international functions.

I am persuaded that we need to make sure there is a better balance in EDF's participation. The appointment of plant correspondents from both WANO and from nuclear plants should help with this. They will need strong backing from the plant managers, who need to clearly demonstrate that it is a priority for them, **especially by identifying and preparing high-quality staff for it** who are capable of participating in missions led by the World Association of Nuclear Operators.

Needs reflecting nuclear ambitions at international level

The company has lofty nuclear ambitions at international level, which raises two questions relating to nuclear safety. How can the Nuclear Engineering Division and the Nuclear Operations Division make

human resources of adequate quality and quantity available without negatively affecting the operation of the existing nuclear plants? How can we be sure that foreign nuclear reactors are properly built and run, in total safety?

Participation of EDF staff in international projects

I note the strong but tardy efforts over the last two years to encourage in-house participation. Young engineers fresh from their studies are not ready to immediately become involved in such operations as our foreign partners are very demanding regarding the levels of experience and skill that they are looking for in seconded staff.
It is also very difficult to recruit experienced engineers in France due to the current situation in the job market, neither is it always easy to secure the loyalty of those recruited in the countries involved.

I have taken good note that the Nuclear Engineering Division and the Nuclear Operations Divisions have created pools of staff suitable for international assignments. It is clear that if our programmes develop at the expected pace, there will have to be trade-offs between training intended for the EDF plants and that for international work, that is to say, assignments in France and assignments abroad.
It is to be remembered that **top priority must always be given to the operation of existing facilities, upon which demands can only be placed gradually in full knowledge of the facts.**

Culture shock is good for nuclear safety

Nevertheless, I would like to once again emphasise the usefulness of the nuclear divisions coming into direct contact – through the programmes – with other government authorities, other regulations, other regulators and other suppliers, vendors, manufacturers and clients. Confrontations of different cultures, concepts and techniques are often very rewarding, but often initially difficult as all believe that their ways are best. As for me, I remain convinced that in my field, which is nuclear safety, there are concrete gains for all the parties involved, as Franco-German collaboration on the EPR-type reactor showed in the nineties.

For example, I visited Unistar Nuclear Energy, the EDF subsidiary of Constellation Energy, which is managing an EPR-type reactor programme from its head office in Baltimore. Its staff includes some twenty EDF engineers. Through our meetings, I better understood **the effort needed to penetrate our foreign partners' safety culture and work rules, as well as the letter and spirit of their national regulations.**

I also realised how complicated their task was, being required, in a context of re-discovery for all involved, to face the combined challenges of a multicultural environment, the pressure of multiple owners and shareholders, conflicting demands by regulators etc.I nevertheless observed that, when it came to technical matters with safety implications, it was always possible to find compromises that finally result in increased nuclear safety creating, dare I say it, **"the best of all possible worlds".**

Checking nuclear safety outside EDF SA

The issue of checking such programmes and the oversight that an owner can exercise over an operator is a particularly difficult one. **Before checking, there is a need to discover, understand and attempt to assess what the correct balance is between an authoritarian and a conciliatory approach in the context of other cultures**.

What strikes me in the case of EDF is **the great number of possible scenarios resulting from**:

- the diversity of the countries in which we plan to work and the differences between our and their regulatory systems, each government and regulator being extremely protective of its privileges when it comes to nuclear safety,

- the many different roles that EDF is playing, sometimes with a majority shareholding, sometimes a minority one,
- an architect engineer package that varies greatly from case to case,
- involvement from very early stages of programmes, with the possibility of managing certain principles of nuclear safety and certain key functions on a contractual basis,
- investment in an operator that has had its own nuclear safety system for many years, which can raise questions associated with equipment diversity (as in the case of British Energy's advanced gas-cooled reactors).

In short, the situations vary greatly, as do the responsibilities. The International Atomic Energy Agency is helping to bring order to this type of situation, which is liable to become increasingly frequent, working on the respective specifications of the owners, shareholders and utilities, who constitute nuclear operators in the field of nuclear safety.
The demands of nuclear safety mean that the licensed nuclear operator must be an independent legal entity, headed by a "boss" with primary responsibility for nuclear safety and radiation protection.

For EDF, the objective is twofold: 1) verification of how the EDF SA bodies build nuclear safety into major projects, and 2) specifying its nuclear-safety related demands to its partners and checking that they are met, while seeking to play a positive role that is understood and accepted as such.

Concerning this point, on the basis of a few examples and visits, I saw how difficult it was for an owner to get involved in the process of operating a foreign subsidiary, particularly when one of its first moves is to tighten up on manpower and budgets.

The question is: "what sort of control would an investor in a nuclear or non-nuclear project wish to exercise once it had taken over a nuclear subsidiary"?. I would first answer "**high-level strategic control"**, making sure that the company possessed a nuclear safety and radiation protection system meeting the legal and regulatory requirements of the country, as well as the basic policy of EDF, on the basis of certain international rule sets (of the International Atomic Energy Agency etc.). **This control would need to be exercised from design and construction and throughout operation**.

Accordingly, it must first be made sure that the countries are signatories of the appropriate international treaties and conventions and the **subsidiaries are actually using international-grade nuclear safety arrangements** (IAEA guidelines (INSAG series) and Operational Safety Analysis Review Team (OSART) inspections, WANO peer reviews etc).

There still seems to be a need to **instil greater awareness of other nuclear safety cultures by increasing the number of staff exchanges**, including exchanges of designers, operators and in-house inspectors on a long-term basis. Mutual inspections could also be organised.

Get to know and understand each other first

Meanwhile, **favourable conditions need to be created to organise exchanges between all the parties involved in nuclear safety: the nuclear safety authorities** and their specialist advisors, government authorities, the local information commissions (or their equivalents) and trades unions.

The managers of the EDF Group companies, or the administrators representing EDF, who should have nuclear training, could be affiliated to bodies such as the EDF Nuclear Safety Council, particularly during the nuclear safety review made at the start of each year. Common tools for measuring safety culture could be deployed at Group level, to avoid imposing specific practices and associating "neutral" consultants from other countries with the process. A common nuclear safety oversight system could be gradually introduced, with due allowance for the reactor technologies in question.

In conclusion, our increased involvement in international nuclear projects will call for the divisions to contribute and further develop international exchanges. The confrontation of ideas, cultures and practices results in questioning the status quo to the benefit of nuclear safety.

Concern about nuclear safety and how it can be assessed is a common denominator in all programmes, but national realities must not be lost in the process. **The International Atomic Energy Agency, like the World Association of Nuclear Operators, are having an increasing role in determining and promoting the values of the global nuclear community.** It is in the interest of EDF SA and its daughter companies to provide them with all the support it can.

RENEWAL OF SKILLS

After a short pause, the company is recruiting again in an effort to renew its skills. This strategy will ensure the availability of skills to match EDF's ambitions. A properly organised and well-funded training system will be required to supply the skills to meet the nuclear industry demands.

The year 2008 marked a turning point in terms of the unprecedented efforts and mobilisation to find and develop skilled staff. However, the drop in hiring in recent years is still making its effects felt in the field.

The education system

For the past two years, the company has undertaken a number of initiatives to encourage the development of teaching programmes focusing on the nuclear industry, to get engineering students to specialise in the field, and to clarify its policy about recruitment in the future.
The European Foundation for the Energy of Tomorrow was created with the goal of developing and utilising learning relating to renewable and sustainable sources of energy, including nuclear. Furthermore, the campaigns set up to organise and develop energy-related teaching in the main engineering schools and top universities are now bringing results.

The National Institute for Nuclear Science and Technology, upon which EDF largely relies, has doubled the yearly intake of atomic engineering students.

According to its director, new teachers and lecturers need to be found, mostly from the pool of former operating staff. Meanwhile, the range of industrial internships available to students will also need to be expanded. He also hopes that the main player in the nuclear industry will adopt a common approach designed to increase the productivity of training.

Amongst other measures, an **International Master's Degree** has been created to meet the foreign demand for training. This course has been running since the start of the 2008 academic year; some twenty students are now attending the course, half of whom are foreign. The course is eventually expected to cater for around 250 students per year.

Regulating tensions in the job market

Skilled staff are needed in all areas of the nuclear industry: operators, suppliers, contractors, regulators and specialist advisors. The new situation has created tensions in the associated job market.
In the current competitive climate, there is a common need for an adequate supply of suitably-trained engineers while **observing a policy of non-poaching** so that the system can maintain its overall effectiveness and coherence.
EDF, for its part, has agreed not to hire its contractors' staff. Reaching prior agreement with the plant contractors appears to be the general rule although, during my visits, I have noticed that this principle is not always recognised.
At the Nuclear Engineering Division and the Research and Engineering Division I heard complaints about the departure of extremely skilled contractor experts that they were relying on for highly-specialised studies. Replacing them will take time, which is confirmation that expertise will have to be paid at the going rate in this increasingly competitive market.

Loyalty must be won

Although few EDF staff resign, greater attention to staff concerns will be necessary. Apart from salary levels, **their loyalty to the company depends on a range of factors such as how interesting their work is, the manner in which they can exercise their professions, the responsibility given, and the scope for career advancement.**

Recruitment

Recruitment from outside

Over the last eighteen months, the pace of recruitment of engineers and technicians has increased.
The company, which I hope will continue its efforts in this area over the next ten years, is now taking the initiative in convincing graduates to join it, exploiting the attractiveness of the EPR-type reactor projects and international programmes.
The number of engineers hired in 2008 corresponded to the goals set. The nuclear plants have however encountered problems of attractiveness due to their geographical locations.
I note with satisfaction that the company is also regularly taking action to recruit high-level technical school graduates. However, though apprenticeship is particularly well suited for certain field professions, it needs to be further promoted by joint action between the education system and EDF. I say this because many plants have told me how hard it is to find candidates for their skilled technician apprentice schemes.

The internal job market is stagnant

The situation that I described in my 2007 report has not improved. Rates of personnel movement between plants are lower than expected, as each plant tries to retain its skilled staff due to the difficulty in finding suitable replacements.

The Nuclear Engineering Division, which was hitherto a net importer from the Nuclear Operations Division, is suffering from delays in filling skilled positions, having to take on outsiders instead of bringing in experienced in-house personnel.

I have noticed other effects of this situation in the Nuclear Operations Division: promotions have been put back, key positions have remained vacant for months and managers have held multiple posts simultaneously. We need to consider the consequences of this situation on motivation, serenity and effectiveness.
All internal recruitment necessitates disproportionate investment by the management, as the great majority of the positions on offer have no candidates. The same applies when it comes to retraining workers, as the internal constraints in the company are particularly onerous.
The elimination of a firm cut-off date for retirement has introduced another variable into the already complex equation. Staff can now take retirement with shortened notice (three months) or alternatively stay until they are 65.
I this context, **I am surprised that a policy for utilising the skills of seniors has not yet been deployed**, as is already the case in many large companies.

Status of skills

During my various visits, I enquired whether the skills actually available met the requirements.

Research and Development Division

The Research and Development Division's capabilities derive from both their own skills and those of their contractors. I have observed that its capabilities enable it to satisfy the overall needs of the Nuclear Engineering Division. However, a number of engineering centres have told me that they have had to find support elsewhere as the Research and Development Division had abandoned certain specialties.
I would also like to point out again that **the "skills pool" at the Research and Development Division is essential for the Nuclear Engineering Division and the Nuclear Operations Division**.
These divisions were not supplied as planned in 2008. I regret that the idea of hiring graduate engineers to work on projects ordered by the Generation Technology Division, so they can then be transferred to the same division to follow up the finished products was not actually put into effect.

The Nuclear Engineering Division

The numerous high-quality hirings in 2007 and 2008 will be a breath of fresh air for a number of Nuclear Engineering Division projects. It will, however, take one or two yeas for the new arrivals to be fully operational. **Efforts must be sustained if the tension in the system is to be durably dissipated.**
The scale of recruitment has made it necessary to introduce a special professional training scheme. For the engineers destined for design work, I noted that it would probably necessary to supplement the knowledge transfer process by contact and mentoring, backed with more specialized training.
It is my hope that if they cannot be put through the Vocational Academies of the Nuclear Operations Division, new Nuclear Engineering Division engineers should have more contact with the nuclear plants.
I appreciate the fact that new joint team staff can attend the Vocational Academies, as they will rapidly be able to establish contact networks which will facilitate their work in the future.

The Nuclear Operations Division

The Nuclear Operation Division needs to make allowance for constraints specific to the operation professions: extensive training and lengthy apprenticeships are required before staff can work in the nuclear installations. Recruitment must accordingly be planned further ahead.

The department heads and team leaders regularly tell me that they do not have all the required skills when and where they need them.
There are a number of reasons for this. Both internal and external skills are in short supply, though many skill-greedy projects have nevertheless been launched, e.g. the Methods and Practices Standardisation Campaign, the Nuclear Technical Information System, the EPR-type reactor project, international projects etc. The process skills needed for these projects were not adequately planned for in advance. Furthermore, occurrences such as the unit-outage and plant-in-service projects also call for the same skills.
In this context, I observe that **skill management of three professions directly affecting nuclear safety has become extremely delicate**: shift supervisors, safety engineers and instructors. I note that resources will be insufficient in number by 2010 for the safety engineers and by 2011 for the shift supervisors. I consider this situation to be unacceptable **and all the appropriate conclusions need to be drawn**.

Bank on training

I have also noticed that most of the Operations Engineering Training Unit training departments were lacking the resources to satisfy all the requirements expressed by the plants and that 2009 would be a difficult year. For 2008, the priorities were set to guarantee the necessary training needed to renew nuclear safety accreditation. Much of the other training demands were outsourced. I would like to draw attention to this situation; we cannot fail to meet our training targets at a time when we have to rely on experienced instructors.

New training approaches

Vocational Academies

A good launching ramp

I visited a number of plant-based Vocational Academies that handle the basic training of the new arrivals every year on behalf of two or three plants. I would first like to emphasise **the very strong commitment from the management, operating staff and training personnel of the Operations Engineering Training Unit**. All are fully aware of the importance of succeeding with this first step.

The trainees, whom I met on numerous occasions, were generally highly satisfied with the training, the commitment from management, the resources provided, and the dynamic modern methods used. They appreciate the fact that the Vocational Academies enable them to rapidly become operational.
The Vocational Academies are also universally hailed by the management, as they directly address their need for rapidly training numerous recruits. The staff trained in these Vocational Academies become self-sufficient more quickly, have more rigorous attitudes and veritable team spirit.

The Vocational Academies are a great success and need to be maintained. Particular care needs to be paid to sustaining the availability of the management and the various contributors who already have many other things to do.

Enactment training schools

All the plants are to be rapidly provided with enactment training schools to focus on worksite organisation and individual and collective behaviour.
During a recent visit to a plant, I appreciated the quality of the system available to the mangers and their teams and, in particular, the numerous work situations that can be recreated. The tool is available and the management wants to use it.
I can only encourage the opening of enactment training schools by contractors. The organising of joint training sessions should make it possible to learn how to work together better by enacting situations that will actually be encountered.

Acting as a training service provider

New issues, new resources

In my 2007 report, I noted the delays in providing numerous organisational aspects of training such as keeping training files, forwarding files to trainees, or integrating experience feedback etc. Such slip-ups were having a negative effect on the quality of the training provided. I observe with satisfaction that this has become a priority issue.
The Generation Technology Division has accordingly appointed a training director to coordinate matters between the service consumers and the service providers.
The Operations Engineering Training Unit has opted to invest in new methods of teaching by developing e-learning. I greatly appreciated the quality of the teaching products that I was shown and emphasise the efforts made to develop methods well suited to match the habits and expectations of the upcoming generations.

When I met the management of the Operation Engineering Training Unit, I was able to visit the Bugey Power Plant training centre maintenance base. I was impressed by the quality of the instructors and facilities, which meet the highest international standards. The teaching methods focus on highly realistic maintenance and operating situations through role playing.

The installation constitutes a remarkable training facility; let us hope that it has the capacity to meet the demand.

In conclusion, the action taken to rise to the challenge of skill renewal now appears to be working well. Yet the situation has not yet stabilised at the expected level, mainly due to certain professions that directly affect nuclear safety levels. The training system has been re-designed and re-positioned, so now it needs to continue receiving the necessary resources.

LABOUR RELATIONS

Management and staff are confronted with an increasing accumulation of high-paced change and constraints that are difficult to assimilate. Despite the efforts made, little improvement has been made in boosting the peace of mind and motivation of personnel upon which nuclear safety depends. We need to focus on such tension, particularly among the executives, and to re-establish margins for manoeuvre in labour relations by mitigating certain structural impediments.

Major changes

When I joined EDF in 2001, it was still a nationalised industry. Few sectors of industry have gone through as many changes in seven years: the creation of the incorporated company EDF-SA, the opening of its capital to outside investors, the introduction of staff shareholdings, the opening of the French electricity market to competition, the growth of its international activities, the changes to staff representative bodies, the changes to the retirement system and the legal age of retirement. In parallel with these changes, EDF has had to cope with large numbers of staff taking retirement, requiring renewal of skills.

We must not lose our bearings

The impact of the scope and pace of these changes must not be underestimated. In many areas, they have upset the familiar old balance, or possibly imbalance, encouraging self-questioning and sowing confusion in many minds. This loss of landmarks is an important factor, especially for the older staff who sometimes say "they no longer feel at home in the company", though they are deeply attached to EDF and its role as a public service.
It is my impression that they have a better understanding of the company's goals but **that there is too great a distance between their concerns and corporate policy statements.** They feel corporate policy accords too much importance to financial matters and not enough to industrial and social matters. To them, this disproportion appears particularly great between the announced investments in billions of euros and their own everyday budgetary concerns. Care must be taken about this apparent contradiction which can result in the staff losing their bearings, if not their confidence in the company.

Finally, for various different reasons **the workload has greatly increased in recent years**, especially for the management **in the nuclear departments of the Production and Engineering Directorate**, e.g. ageing of the installations, various technical contingencies, renewal of skills with major recruitment and training drives, and the fast pace of introduction of projects and processes. I would like to add that this workload remains unevenly divided between those who do too much and those who do much less.

Meanwhile, little progress has been made with certain outstanding issues, deep-seated difficulties in personnel management, degraded work organisation since the collective agreement in 1999 and recurrent logistics problems (availability of spare parts and special tools etc.).

The concurrence of these underlying trends and the chronic inability to rectify certain weaknesses should be addressed. At best, it is a source of stress; at worst, it risks weakening both individuals and teams.

Increasing problem in availability

The drop in the availability of the nuclear units is a new phenomenon, which is only exacerbating tension in the departments, particularly within the Nuclear Operations Division. It is resulting in strong, constant pressure on the different levels of management, as I was able to observe in the field. It is causing everyone to question the appropriateness of the actions taken in the past.
This pressure can give rise to feelings of guilt in the operating staff, whereas the responsibility often lies elsewhere. At a plant where an outage was behind schedule, I observed that some of the people in charge and the field workers were in a state of stress that could not have been conducive to efficiency and nuclear safety.

Everyday difficulties

Industrial relations in the field

As I emphasised last year, I have difficulty in understanding the poor state of our industrial relations in the field whereas in other countries I have seen communities seek to solve their problems together through dialogue, as they share the same goals. There are not enough constructive relations in the field, where the breaking point is so close that it is sometimes reached.

Safety rhymes with serenity

Once again this year, I was at a plant where a scheduled outage was halted at the very beginning for some ten days. This totally disrupted the outage organisation, with a negative effect on nuclear safety amongst other things. I encountered the different protagonists of the incident, and heard that "nobody was proud afterwards".

Work organisation

The work organisation system that came into place as a consequence the collective agreement in 1999, whose drawbacks I mentioned in 2002, has never really been improved. The main consequences are **odd working hours** (all too many are now almost working like "temp" staff) and an overload of work for the management that has to maintain continuity and compensate for the situation.
The different levels of management continue to emphasise, at each of my visits, the disadvantages of a working week of less than 35 hours on average. Team members work alternate days, arrive at different times, and eat at different hours, going to great lengths to get things done in the short intervals when everyone is present. **Acting as a team means working together and sharing the same goals**; the way in which work is currently organised is largely responsible for the waning in team spirit.

Working together more effectively is possible

Although I have seen progress at some of the plants, I have the feeling that all too many are just waiting for the storm to pass… Yet change is possible, as I witnessed at a conventional EDF power plant where the management was able to re-mobilise their forces and strengthen team spirit. I have met representatives from the different professions, some of whom were staff representatives. Many were fiercely opposed to any change at first. Finally, **the great majority told me that they felt more serene and effective and "that they were happy to follow contractor working hours"**

I hope that the experimental agreement signed in April with the trades union representatives combined with the effect of the "industrial democracy" act promulgated in August will offer an opportunity to make progress in this matter which is an obvious impediment to improving performance in many areas. I observe with satisfaction that another experimental agreement was signed at one of the plants at the end of the year. I will be following with interest the local effects to see if it imparts dynamism in the nuclear plants.

The flood of administrative work

Another growing problem is resulting from the overflow of administrative work that managers and staff are having to handle on all echelons and in both the Nuclear Operations Division and the Nuclear Engineering Division. **The management is distracted from doing its main job by being required to perform administrative and logistical tasks**, which often prevents them from being in the field.

What can be gained from a manager performing secretarial, logistical and computer-related tasks when he is already overloaded with work? It seems that "Having a million little tasks to do makes it hard to concentrate on anything", and it is certainly urgent to boost the worth of administrative staff and management assistants, who are "operators" too. I have no doubt that a "back office division" offers a way of inversing this trend and reducing the administrative burden.

Logistics problems

Once again this year, the list of unsolved problems includes the issue of the availability of spare parts and special tools. **It is hard to imagine to what extent logistics problems preoccupy the players in the field.** They are a source of tension and stress in a context where there is a call to reduce outage times and achieve higher availability.

Having had to adjourn a visit to a work area postponed at the last minute due to a missing spare part, I was able to gauge the feelings of powerlessness of the workers, and how much energy had to be devoted to re-scheduling. I would like to add that such problems poison the atmosphere and make it necessary to repeat actions such as risk analysis, pre-job briefings etc.

The worst outcome would obviously be the increasing resignation about such problems that the system finds hard to rectify. **We need to send out clear signals of the will and ability of the management to address the problem.** This is now the case as a coherent ambitious "spare parts" plan known as the AMELIE Project is beginning to improve the situation in the pilot plants.

Projects that are good for moral

This is also the case of the campaign to bring facilities up to an exemplary state (O2EI), of which the underlying message goes far beyond simply refurbishing the facilities. It is very stimulating to be able to see ever-increasing improvements in the upkeep of our means of production . This is confirmed by many remarks and reactions.
It is a pity that this message is still muted by the presence of so many uninviting changing rooms and shabby management buildings, which can be interpreted as an unwillingness to invest in the nuclear plants that are to remain in service for so many more years.

Messages to hear

The above constraints are being felt perforce by the various parts of the nuclear departments within the Production and Engineering Directorate. Like last year, I would like to focus on those that seem the most worthy of attentions.
First of all, the executives. Many are chronically overloaded with work and have to cope with conflicting requirements that are further complicated by personnel management issues, the burdensomeness of which they think of as unavoidable. A department manager needs great reserves of physical and mental strength. And some are better at coping than others.
A given management level may seek to off-load its problems onto the level below, while being aware that the latter does not have the resources to handle them, and the problems are thus passed on down the management chain. In such circumstances, how can we expect feedback on basic organisational, labour-related and human problems to be passed up the chain?

Again this year **I took a detailed look at the front line managers**, which I made a point of meeting during all my visits as they are caught between the management on one side and the operatives on the other. **They are strongly motivated and enterprising**, but have to reconcile workforce and budget constraints with the increasing requirements associated with the numerous projects being carried out simultaneously. They feel frustrated about having to zigzag from one urgent subject to another, often before any stable outcome is achieved. But, confronted with these difficulties, they are forced to conclude that "there will be few really effective means of action as long as the company is devoid of sufficient margins in industrial relations".

Give the management more support

Some front line managers told me that they would like to change jobs, **but it was hard for replacements to be found.**Field workers and technicians are indeed becoming reluctant to accept exposed, demanding positions (front line managers, job supervisors, foremen etc.) as they consider that the lower management echelons are not highly regarded enough to make up for the weight of duties.
Another group needing attention is the **engineers and experts**, particularly those in the Nuclear Engineering Division who, once again this year, told me of their difficult in prioritising the numerous tasks entrusted too them with insufficient warning. They regret not being able to carry out certain studies in depth and seeing their suggestions rejected for budgetary and scheduling reasons.

Next I would like to mention the case of the **maintenance personnel**, as many are worried about their future and sometimes feel left out. The same applies to the surveillance staff, who always find it difficult to get used to their profession, especially the older members.

Before ending, I should mention **the contractors**, even though a chapter is devoted to them later. For although much attention has been given to the psychosocial risks faced by EDF staff, there is probably

less interest in those faced by the contractor staff, although they are in a weaker position in the current economic situation. Is the question being raised about the long term effect of the present crisis?
The dichotomy between words and reality remains substantial, and I regret that organisations such as the Inter-Contractor Work Conditions and Safety Commission, in whom much hope was placed, are not operating with the effectiveness expected. Their situations appeared to vary greatly in the different plants I visited. Some are active, while in other plants contractor representatives have little to say.
More attention needs to be paid to the human and professional difficulties of our contractors as these difficulties persist and constitute, as I see it, the Achilles' heel of our organisational system in the field of nuclear safety. I will be carefully watching the implementation of the project to introduce attractive labour relations policy with regard to contractor companies (MOPIA).

Focus on people first

I have observed, at all echelons, increasing awareness of these difficulties and their consequences on morale.
They have been identified and solutions are beginning to be found. This is notably the case for **psychosocial risks. Numerous initiatives have been launched at corporate, division and department levels**, e.g. the creation of a working life quality watch which has begun an in-depth review, the forming of a special advisory group in the Central Occupational Health Department (SCAST) to assist management in the event of problems, the signing of a specific agreement between the Nuclear Operations Division and the unions for the management of such problems, and the introduction of a training day for salaried staff at certain plants. **Some of the departments have made substantial progress and can already serve as examples.** Nevertheless, these risks arise in the context of general change in the overall atmosphere of labour relations, and the root causes need to be treated.

For my small contribution to the process, as usual I take my cue from the field. I visited a number of nuclear plants where the morale and workplace relations have somewhat improved. Here is a short list of strong points which I hope all the plants will embody one day:

- Strong leadership by the top managers, who are able to see ahead and establish proper priorities, and who have strong presence in the field even if it means neglecting certain tasks, **a leader who is ready to get his overalls on and to say "well done"**.
- A proper balance between processes and professions, with, dare I say it, **tipped more in favour of the professions** with emphasis placed on the man or the team rather than the structures,
- The will to recognise the individual, the team and the group, and the encouragement of team spirit, particularly among executives. **Everything possible is done to ensure that difficulties are expressed and communicated up the management chain,**
- Heavy involvement in the creation of events that bring people together and foster team spirit. **There is still manoeuvring room in terms of goodwill**, if we are willing to use it,
- Finally, and this is an issue I consider essential, **strong collaboration with the occupational physicians and the trade union representatives** on the different projects and their involvement at the earliest possible stages.

I would like to add that I met the management team in charge of the future operation of Flamanville 3, and they seem to be doing interesting work on changing labour relations and developing group cohesion. I hope that its projects bear fruit, as they could be forerunners of a new style of management and labour relations in the company.

In conclusion, the accumulation of changes and constraints is tending to increase existing tensions in the system, where personal interests sometimes trump collective ones. The management chain is having to compensate for this at the cost of overwork and the risk of burnout. There is a need to show a way forward that can reconcile personal development with collective needs. The outcome will be greater nuclear safety.

THE DRIVING FORCES OF CULTURAL CHANGE

The Nuclear Operations Division's STEP 2010 initiative includes four projects with particular potential for increasing nuclear safety. Take up in the field would appear to be good, but the results vary greatly from project to project and from plant to plant. To ensure that they achieve their goals and that their contributions are durably maintained, they need proper support and the necessary resources.

The Nuclear Operations Division has been busy with the STEP 2010 initiative for three years, and each of the ten projects forming this initiative addresses one of the Division's key issues. I will be discussing four of them in this chapter, which I find particularly interesting in the field because they are designed to bring about changes in culture and behaviour conducive to greater nuclear safety. These projects are the Better Housekeeping Campaign (O2EI), the Human Performance Campaign (PPH), the Methods and Practice Harmonization Campaign, and the Nuclear Technical Information System (SDIN).

I cover other projects important to safety such as those relating to fire, contractors, operation engineering and the renewal of skills in later chapters of this report.

Better Housekeeping Campaign

This project, which I have called for, is taking form. I have observed that things are gradually changing in the way people are thinking and acting.
Accordingly, **in many places the facilities are taking on a more pleasant appearance, encouraging workers to take care of them**. For instance, I noticed that the operatives were better protecting floors before laying down tools and equipment in work areas to avoid leaving marks.
Turbine halls have been entirely cleaned, including the piping and steelwork, with the repainted walls looking like new, if not even better as the lighting has often been improved too.
I have observed radical treatment to eliminate causes of deterioration in installations located on the coast, particularly additional protection to contain saline atmospheres in the pumping station rooms.

Communication about the Better Housekeeping Campaign is of high quality and its corporate-level management is dynamic. The project team visits the field to give advice and make sure that action is progressing properly. Setting precise, progressive objectives for each plant and cross-checking between plants makes it to possible to obtain dependable results, facilitating comparisons and fostering emulation.

Impetus must be increased in the field

Nevertheless, much still needs to be done. The initial changes are encouraging, but **the "critical mass" of renovated facilities needed to win over hearts and minds is far from being reached**. Changes in behaviour have not yet reached the majority, and the process is often closely associated with the trends in each plant. Backsliding cannot be ruled out yet.
The deployment strategies should focus more on refurbishment where the greatest numbers are affected (such as the changing rooms) to influence the behaviour of all workers, whether EDF or contractor personnel, and to convince even the most sceptical.

The situations in the plants vary greatly, in terms of the results obtained and the impetus created. Managements are convinced of the advantages of the campaign but are not all promoting it with the same enthusiasm.
I encountered a majority of campaign managers and teams that were dedicated and motivated, enjoying the support of their management. This was not, however, the case everywhere.
During a visit to one plant, I was surprised to observe that the campaign manager was on duty in a unit outage. This campaign requires dedicated full-time personnel for the time it takes.
In the current situation where the plants are facing many constraints, I note that conflicting priorities mean that some of the aspects of the Better Housekeeping Campaign are proving hard to implement. This is particularly true as regards rectifying discrepancies. Some department heads confessed that they were tempted to put off certain jobs such as those relating to steam, water and oil leaks, due to the need to manage resources and adhere to schedules.

The campaign had aroused high expectations in the staff I met. They recognised that considerable efforts were being made but were worried that the campaign would not be seen through for lack of resources. I also heard campaign managers say the same thing, as the initial cost estimates of certain renovation work are showing to be undervalued.

The determination of the management is the decisive factor and it must create an impression. I witnessed "clean-up days" dedicated to housekeeping at the Calvert Cliffs Plant in the US. Everyone is asked to participate four times a year. All get busy painting, cleaning etc. for a total of five hours. These clean-ups are very effective, giving rise to greater feelings of ownership of the installations.

I once again emphasise the points requiring vigilance noted in my 2007 report:

Reconquer lost ground and hold onto it

- **Provide operating budgets making it possible to hold reconquered ground** following the initial investments. Waning enthusiasm will otherwise have a disastrous effect on personnel, whereas their support is vital.
- **Give priority to passageways and accommodation areas in particularly poor condition**, such as the controlled area changing rooms. Certain cases of bad housekeeping can be particularly harmful if they set the example for EDF and contractor staff entering controlled areas.
- **Seeing how things are done elsewhere can help to change behaviour.** Every time staff visit foreign plants, they return convinced that it is possible to do far better.

Human Performance Campaign

I can only support a campaign that promotes the presence of management in the field so professionals can get things right the first time by teaching tried-and-tested practices that can increase work reliability.

Seven years ago, it was considered socially and politically incorrect to speak of "human performance".

Everything in the toolkit is useful

I have observed that the first phase in deploying practices to increase reliability (pre-job briefing, the one-minute wait, self-checking, cross-checking, secure communication and debriefing) has been conducted with speed and determination with regard to the EDF and contractor staff concerned. **Strong mobilisation from the management** has notably been confirmed through numerous benchmarking drives, experience sharing between plants, four World Association of Nuclear Operator Technical Support Missions, and mentor training. The plant human factors consultants have also played their parts to the full.
Up to now, **only pre-job briefing had really become standard procedure**, while the other practices requiring deeper commitment were floundering. As a general rule, I found that young people are more readily inclined to use these practices, understanding their value and finding them reassuring. The enactment training centres set up at plants can contribute to the take-up of these practices.

Management presence in the field is necessary to explain, to set the example, and to convincingly demonstrate how useful the practices are in the long run. Their increased presence is being organised. At one of the plants I visited this year, all the organisational arrangements were re-thought with the goal of furthering manager presence in the field. Assistants have been asked to take over certain tasks for them, and the meeting timetable was changed. This is not the case everywhere, particularly as concerns the supply of assistants.
But according to the managers, finding time to visit the field remains difficult owing to heavy workloads. Furthermore, they fear not being able to supply the right answers or being unable to deal with incidents reported to them. Yet everyone is now fully convinced of the importance of "taking the plunge".

The plant managers consider that changing behaviour is a long-term venture. **The Human Performance Campaign will therefore require persistence and continuity, as well as unwavering support** from the different levels of management and active participation from the staff.

Methods and Practices Standardisation Campaign

One of the things that surprised me when I arrived at EDF was the multiplicity of methods, organisational structures and documents in a set of plants renowned for its technical standardisation. This project therefore caught my attention as soon as it was announced.
Good progress is being made with standardisation of the main operating documents, which has improved the quality of the surveillance test instructions, even though certain imperfections may remain.

Less progress has been made with maintenance, pending the availability of the Nuclear Technical Information System. This will involve a substantial increase in the planners' workloads in coming years. Those I met had doubts about their ability to complete the job in a reasonable timeframe.

I note that standardised documents are now being reviewed within the scope of the Operation Engineering system I discussed in Chapter 5.

Rethinking good practices, assessing them and finally retaining the most effective ones and deploying in all the nuclear plants is extremely important. Once again this year, the annual challenge organised by the Nuclear Operations Division was a success in terms of the number and quality of the innovations proposed, not to mention the wide participation of the nuclear plants, the Nuclear Engineering Division engineering centres and the foreign operators with which EDF is in liaison.

I would like to commend the harmonisation and standardisation work completed, also noting that it facilitates acclimatization at a new plant. The progress achieved is recognised by all working in the field. The process is demanding in terms of time and skills. It has re-established margins of manoeuvre by minimising the risk of error and making it easier for professionals to communicate, while greatly contributing to increasing nuclear safety.
However, much remains to be done in certain areas (risk management, chemistry etc.) still being insufficiently involved in the system. I encourage this process, which is indispensable if we intend to further develop asset pooling and mutual assistance by the plants.

Nuclear Technical Information System

During my visits outside France, I have observed that nuclear operators equipped with efficient data systems generally make significantly faster progress in performance levels, particularly in nuclear safety.

With the passage of time, the data systems used by the nuclear divisions have become increasingly complex. A system is being developed that will be common to all the divisions (Nuclear Operations Division, Nuclear Engineering Division, Nuclear Fuel Division and Power Plant Maintenance Unit Service Division). This system is expected to be deployed between 2011 and 2013.

I have observed that this new data system can ensure full effectiveness of the profession-centred campaigns in progress. It can host all the technical management processes. All the work processes have been re-assessed. **This "intelligent system" will compile and manage nuclear safety and radiation protection data**. I noted that nuclear safety will be taken into account at all stages of the project.
I was able to meet the operating staff who are involved in validating the principles and mode of operation proposed. They are located, as are all those on the project, in a single open-plan office aiming to generate greater efficiency in view of the many ramifications of the task. **All are experts, recognized as such in their professions, proud to be participating in this important project, and fully aware of the responsibility they bear**. This will clearly be a good investment for the departments from which they have been seconded when it comes to deployment in the plants.

As regards the plants, I appreciated that installation of the Nuclear Technical Data System would be customised for each plant. This will take into account the status of the databases, clearing them if necessary, and the ability of each plant to receive the data system.
The fact that the upgraded data system covers the nuclear technology management system, with no link with the process control data system, seems to properly protect the operating parameters.

A technological leap in favour of the operator

I observed with satisfaction that the installation can be extended, for instance, with applications developed as part of the project to introduce new technologies into the plants in service (INTEP). Two of these were presented to me at the Research and Development Division, designed to simplify the professions while making them more secure. It comprises a thin client terminal for operation control (circuit alignment and set points etc.) and the radiation protection supervision station.

This project offers high potential in terms of performance and modernisation for all operators; it is a highly coherent design and needs to remain so.

In conclusion, these projects represent a springboard to attaining the performance levels of the best operators and passes on the baton to the upcoming generation. They depend greatly on changes in culture and behaviour, which are mutually sustaining and foster the development of nuclear safety culture. **It will take time to complete them as they demand perseverance and continuity on the part of the management and staff.**

PROMOTE CHANGE AND REGULATE ITS PACE

The current projects in the Nuclear Engineering Division and the Nuclear Operations Division are creating tension within the work teams; many of these projects promote cultural changes which take time to implement. New projects are also being launched which are pertinent and demanding. We must overcome the current obstacles if we are to successfully mobilise skills and gain adherence of the players, rising to the challenges without compromising nuclear safety.

In my previous reports, I have emphasised just how much the new situation has modified the working conditions and frames of reference of the personnel; they find themselves faced with hard competition, the opening up of the company and a series of regulatory changes. **The various projects launched by the Nuclear Technology Division have resulted in tensions in the plants, which are having difficulty in keeping up with the pace of change.**

New projects keep rolling in and they all make sense on an individual basis because they foster motivation. Management and staff clearly understand what is at stake, but are concerned that they will not be able manage all of them at the same time, and therefore be unable to benefit from as much as hoped.

These projects will also deplete the remaining margins for manoeuvre in terms of organisation and skills. According to managers, the margins are slim because human and budgetary resources have been greatly restricted in recent years without having resolved certain structural and labour relations issues.

A system under tension

During my visits to the nuclear plants and engineering centres this year, I was able to clearly assess the very heavy workload of teams faced with the task of durably improving nuclear safety and operability while keeping costs within the expected limits. These tasks will necessitate substantial investment over a long period of time.

Size the skills pool correctly

For the Nuclear Operations Division, the STEP 2010 Initiative is a set of projects that can be qualified as structuring, ambitious and highly pragmatic. The process-related skills and those of the planning professions are in particularly high demand in this context, complicating skills management. There are perceptible tensions due to **the need to simultaneously provide manpower for projects, operations and training**, the later being so important in this time when a new generation is arriving. Developing new skills in these fields will take time, money and determination.

In my 2007 report, I detailed how the engineering profession was coping with the numerous challenges thrown at it. I mentioned that compromises would be necessary that nevertheless must guarantee nuclear safety and radiation protection in the plants in service regardless of the situation.
This year, the technical problems encountered in the plants in service confirmed that adequate structural support was necessary to be able to properly handle contingencies.
On a number of occasions, I have noted that the engineering centres were finding it increasingly hard to meet the demands of units in service in a timely and quality-assured manner.

Demanding new projects

Following on from the Altitude Programme conducted over the last three years, which was designed to rationalise the human and budgetary resources, the Operating Excellence Programme is intended to durably increase overall performance. We are on the lookout for initiatives from the field and the management. The Nuclear Technology Division departments are responding with **numerous projects to increase operability levels and prepare for the future**. They are increasing the pace of existing projects and creating new ones.

A tough trio

In the field, staff and management have the impression that they are being asked to "always work faster, at less cost but with higher quality". They are concerned about repercussions on nuclear safety.

In the Nuclear Operations Division, the STEP 2010 Initiative projects are fully consistent with the Operating Excellence Programme. Large projects have been added to help achieving corporate goals, such as **AP 913 and the continuous monitoring of installations during unit outages (COPAT)**. Their principles have already been successfully applied in nuclear plants in the US. I had these presented to me when I visited the Operations Engineering Unit: they appeared to be pertinent and have potential for increasing nuclear safety, though remain very demanding to implement.

AP 913 is a method developed by the Institute for Nuclear Power Operations. It aims to increase the reliability of systems and equipment that are sensitive for nuclear safety and operability reasons. It is based on analysis of the behaviour of equipment and operating conditions so as to ensure that "the right maintenance is carried out on the right equipment at the right time". This is how nasty surprises can be avoided. It is generally agreed that this method will fundamentally transform current practices and require the involvement of professions that are already extremely busy elsewhere, particularly the maintenance planners. It represents **a new culture to assimilate, as well as new professions and**

specific skills to be created. Time and resources with be needed to bring about this change. At the Calvert Cliffs Nuclear Power Plant in the US, I was told that it had taken five years to implement the method and obtain the desired results.
The three nuclear plants that I visited have experimented with **continuous monitoring of installations during unit outages.** They considered it to have considerable potential for addressing the expectations that I have often heard expressed during my visits by outage managers and operatives. But it does appear to be difficult to put into practice, mainly due to the special skills required, and these need to be mobilised. Furthermore, trouble with the French labour regulations has been encountered, whereas legislation is generally more flexible outside France with two twelve-hour shifts per day being allowed, which is vital during unit outages.
The project will lead to profound changes in work practices and a new division of responsibilities which will have to be managed with particular care, especially during the interim stage. In particular, it will be necessary to take care to maintain proper balance between unit outage priorities and in-service unit priorities. The nuclear plant management needs to see this in proper perspective. In this context, it seems essential that the head of the Nuclear Safety Advisory Unit step well back from this initiative.
The Nuclear Engineering Division's Operating Excellence Programme is designed to increase the effectiveness and responsiveness of the projects in hand. For the EPR-type reactor project, this involves avoiding changes in the timetable and the capital cost of Flamanville 3, while optimising the cost of future EPRs on the international scene by standardising the Flamanville 3 design.
The goal is to **maintain close contact with the plants in service** that require engineering forces to handle any operating contingencies (see Chapter 5).
The various goals necessitate **the availability of sufficient numbers of appropriately skilled staff.** Large numbers of new staff were recruited this year. They will need to be trained and assisted before they can start acquiring experience.

The field is buying it

During my visit, I questioned the "staff responsible for nuclear safety" about the effect of the Operating Excellence Programme on their activities.
As they see it, operating excellence is a legitimate goal, but those in charge are expecting too much from it. They would like to be consulted more often, considering themselves to be better placed to determine the possible scope in terms of nuclear safety and competitiveness.

They believe **results will be obtained, but that patience will be needed**, as cultural changes need to be made and the conditions of success are not all present. In the plants, they often mention the condition of the databases, and the many delays in completing jobs.
Finally, I have observed that not all groups are equally involved, as **the planning professions are already very busy with the projects in hand**.

Brakes that need releasing

Re-establish margins for manoeuvre

I note that nowhere near all the shortcomings emphasised in past years have been rectified.
The management of spare parts is still problematic; it wastes time and energy at the expense of the work teams and the overall effectiveness of the system. During my visits to the nuclear power plants, the subject is still spontaneously mentioned to me and remains an ever-present concern for them.

The corporate project AMELIE aims to guarantee the availability of spare parts, to increase nuclear safety and operability, and to improve the quality of service for the maintenance workers. This corporate project should provide urgently needed answers to these questions.

The problem of the accelerating work pace has not been solved everywhere. Despite some amelioration, the issue is as pressing as ever and remains a major obstacle to achieving the operating

excellence goals. However, I note with satisfaction that an initial "experimental" agreement was signed with one of the nuclear power plants at the end of 2008.

Apart from the impact of the work pace on the group, individual behaviour is also questionable, as staff tend to work too hard to make up for lost time. This situation is harmful, as all the skilled staff now need to be mobilised. **In this regard, EDF work organisation appears to be too permissive in my opinion**.

Also, as I mentioned in my 2007 report, the regulations defining EDF labour relations constitute **a straitjacket that immobilises the managers;** they are most unsuited to the structural and organisational changes needed in order rise to the present challenges.

The transfer of administrative work to frontline staff represents an increasing load at all company levels and distracts the staff from doing their main jobs.

All of these obstacles must absolutely be sorted out in the next few years as they are contributing to increasing tension in the system, whereas responsiveness and flexibility are needed to improve our performance levels.

In conclusion, these projects are innovative and come at the right time. For certain professions, they imply cultural revolutions. Such transformations will take time. All the skills are required, and their mobilisation must not be hindered.
Creating excessive tension in the system is only counter-productive, especially in terms of nuclear safety. At all the levels of company management, we need to be willing to listen to the problems of those under us, even though we may ourselves be trapped in the constraints from above.

THE CONTRIBUTION OF THE MEDICAL STAFF

Both the corporate and nuclear plant medical services are contributing the operating quality. Apart from their preventive and curative role, they also take the pulse of the workplace, on both an individual and a collective basis. The management and the occupational physicians need to find a better balance between necessary medical independence and collective effectiveness.

For a number of years, I have been stressing the importance of physicians, particularly in nuclear activities. I therefore made a point of meeting all the medical services in the company, from the Group Health and Safety Department (DG2S) which had just been formed, to the medical units of the plants in service, as well as the corporate medical support bodies.

The corporate medical support bodies

The EDF Group Health and Safety Department

Health care is being reformed by the Health and Safety Department as part of the company health and safety policy. This reform must reflect the consequences of the complete separation of EDF and GDF, now EDF SA and GDF-SUEZ respectively. It must also simplify the associated processes and procedures,

while introducing new modes of operation for the remaining joint structures, e.g. the Medical Studies Department, in order to preserve them. This appears to be of a nature to **foster better-coordinated and more cross-linked functioning, which should improve collective effectiveness.**

Since 1 April 2008, the Health and Safety Department includes members from the medical council of the divisions, the Central Occupational Health Department (SCAST), and the Medical Studies Department, as well as occupational physicians working for EDF SA.

The Central Occupational Health Department, the Medical Studies Department and the occupational health centre of the Nuclear Operations Division.

The corporate services are listening more closely to the plants

Year by year, I have generally observed increasing concern about health issues in industry, as in everyday life.
The corporate medical services sometimes find it difficult to cover all topics and respond to the different plant requests, as has been reported to me a number of times by the plant medical services. It is also their feeling that, in certain fields, their levels of skill are not as high.

We must remember that these corporate services deal with a very wide range of subjects. The Central Occupational Health Department provides assistance in first aid, toxicology, ergonomics, detection of the use of intoxicants, and the hazards associated with noise and chemicals. The Medical Studies Department focuses more on emerging technology and social trends, as well as on external health risks such as those associated with bacteria, electromagnetic fields and nanotechnology. Finally, the occupational health centre of the Nuclear Operations Division is in charge of the medical aspects of radiation protection.

The expectations in the field are high, but corporate dynamism is felt to be patchy. Although difficulties may have been encountered at the plants with installing the mobile installation called Mercure designed to package resins used for radioactive effluent treatment. I was given examples of cases where corporate level action has enabled increased industrial effectiveness.

- The work of the Medical Studies Department on legionellosis and the effects of electromagnetic radiation was facilitated by good operations-level organisation.
- Corporate support was the deciding factor in the accreditation of whole-body scanning in the plants. Every plant I visited this year mentioned it! I note that the plants having progressed the furthest in the programme are generally those where cooperation between the medical team and the management is the greatest.
- Lastly, I would like to mention the involvement of the plant physicians and the Nuclear Equipment Engineering Department for the rapid deployment of the steam generator flushing operations.

What is possible in such difficult cases should also be possible in more ordinary ones.

The medical units of the plants in service

The overall atmosphere is tending to improve

As regards organisation, the relations between the managements and the plant medical services vary greatly and are very unstable. The arrival of a new plant director or a new physician can change the relations completely, for better or worse.

Most of the physicians that I met were very open and anxious to improve the situation. There are many signs that there is a desire to liaise more with the management, through regular meetings and invitations to management meetings for instance. The thirst for dialogue has even led one plant to go as far as assessing the mutual expectations of the management and the medical team in order to make progress.

Collective effectiveness needs reinforcing

These changes, which I consider positive, do not threaten the physicians' independence. It is to be remembered that an occupational physician's position is theoretically at the centre of the equilateral triangle of which the apexes are the staff, the staff representatives and the management. Should a physician get too close to any of these parties, the result is distrust, if not hostility, on the part of the other parties.
I observe that maintaining the proper distances is profitable to all four parties and helps to maintain a calm workplace atmosphere.

Where vigilance is required

From the discussions I have had with the plant physicians, I note certain health-related points that merit special attention.

I have observed that there are great differences between the plants when it comes to detecting the use of intoxicants, whether alcohol or drugs.
As regards **drugs**, some plants perform checks during the hiring process, whereas others prefer random testing which is negotiated locally on a case-by-case basis. In some cases, no checks are made at all.
I note that the **alcohol** tests provided for in IN120 are being taken up in certain plants. However, there was a case where the workplace inspectors were reluctant to back a physician who wanted to introduce them. Some physicians have been able to include such tests in a more general and consensual approach, facilitating their acceptance. I believe corporate experience feedback would be extremely helpful in harmonising practices, overcoming difficulties, and winning over the reluctant.

Make the practices more consistent

As a general rule, such tests can correspond to situations where operatives are in trouble, making it possible to take care of them. This is, to a certain extent, a win-win situation that needs a concerted approach.
During my visits in foreign countries, such arrangements tended to be universal which seemed to satisfy all concerned.

The chemical hazards associated with the products used in the plants in service **are a growing source of concern**. We need more knowledge on the doses and durations of exposure to properly assess the risks. Issues of traceability and tracking exposure appear to have medical liability implications.
A number of physicians expressed their concerns to me, considering that certain colleagues and other practitioners have been faced with lawsuits about occupational illnesses. The growing litigiousness of French society is particularly perceptible in the medical domain. **What can be done to make sure that concern for the patient guides the doctor's hand, not fear of justice?**

Being ready to listen

Psychosocial risks are now the subject of great preoccupation for all involved, including the physicians. Without any real deterioration in the situation in 2008, there is a pervasive feeling that staff morale is generally not so good. For individuals already challenged by outside problems, workplace pressures can have powerful effects, especially when people loose their bearings.

Objective quantification of such situations nevertheless remains difficult, even if appropriate indicators are used, such as loss of sleep, behavioural problems, feelings of anxiety and depression, and loss of motivation. The commonest symptom is loss of motivation, with the centre of interest moving away from work to other activities.

I once again emphasise the importance of the social barometer that the medical and paramedical teams ensure in the nuclear plants. **The management needs to recognise that the teams' unique position enables them to accurately perceive new trends, often at a very early stage. This is extremely useful, not a liability.**

The paramedical staff

My attention has been drawn to the difficulties in recruiting nurses, as their special role in the nuclear professions must not be disregarded. Their status varies from plant to plant, going as far as outsourcing nursing work to the local hospitals. I came across this solution during one of my visits, and it may well offer a remedy to recruitment problems. Elsewhere, temporary secondment arrangements are made with hospitals. Such setups can simplify the management of accidents with hospitals where there are agreements, as they might have to take irradiation and/or contamination victims.

The Health On-Site Emergency Plan

Coordinate and harmonise deployment

Some plant physicians have shown me the work they were doing on the revision of the Health On-Site Emergency Plan, which relates to the organisation of relief work in the event of an accident involving a number of casualties exposed to irradiation and/or contamination. In France, the County Accident Response Services (SDIS) are called in. They have access to the appropriate mobile intensive care unit and ambulance services (SAMU or SMUR), as well as other regional emergency response organisations.

The new version of the Health On-Site Emergency Plan involves changes in organisation and skills. People have very different ideas on how much extra work this will involve for the plants. This is a reflection of the quality of relations between the plant management and its medical service. Some medical services have taken the initiative in dealing with the problem. Others are awaiting instructions form the plant management. This being the case, would not greater corporate level control be indicated?

In conclusion, working in the nuclear industry means having to be able to rely on dedicated corporate and plant level medical services. I have encountered the players, and their commitment is perceptible. **It nevertheless remains necessary to achieve greater synergy between the plant medical services and their corporate counterparts, as well as between the plant managers and the occupational physicians.**

RELATIONS WITH CONTRACTORS

Relations between EDF and its contractors are improving. However, the pressures and demands, which never cease increasing, can result in harmful cases of sub-standard quality and gradual discouragement of contractor staff. Progressing towards a true partnership would make it possible to engage in a quest for excellence together, fostering performance and nuclear safety.

The company is making increasing use of contractors, and this was particularly true in 2008 with the many technical contingencies that occurred in the plants.

The well-considered strategic is objective consists in **relying on battle-hardened professionals** who are familiar with our installations. Meanwhile, EDF needs to **create durable win-win commercial relations with its partners**. The living and working conditions provided for their staff need also to be designed to facilitate their operations and **encourage the willingness and motivation indispensable in all those who "build nuclear safety".**

The EDF SA context

In the last few years, EDF SA has made an increasing effort to organise its outsourcing policy. In France, the company-wide agreement concerning **corporate workplace responsibility** took the form of an ad hoc agreement relating to **outsourcing with due regard for contractor staff** that was signed in

October 2006. This agreement sets out to provide contractor companies with medium-term prospects and a framework where work can progress in a win-win approach.

EDF SA's commercial and outsourcing policy was presented at a central employees' association meeting in November 2008. This policy establishes a general framework that can be adapted for each profession. The Nuclear Operations Division refers to this document as **The Charter for Durable Development between EDF and its Suppliers**.

In this context, **the Ethics Committee** reports annually to the board of directors, making extensive use of findings from visits to the nuclear power plants. Its viewpoint provides a different perspective.

The nuclear business situation for EDF

To sum up the situation in 2008, I would say that it was not too bad for the big companies and vendors, though it was not too good for the companies regularly working at the same plants, and it was often tough for the small companies working in a number of different regions.

Nuclear safety, a constant in a world of change

My first finding is that **business has greatly changed in recent years**. The strategies for maintenance, purchasing, outage organisation, work scheduling and outsourcing have all been completely transformed, as have the regulatory requirements.

Also, EDF is now not the only player in the field of industrial maintenance. The contractor companies are feeling the adverse effects of fluctuating demand in other sectors, such as petrochemicals or shipping, not to mention the fluctuating demand from other French nuclear operators. Finally, I noticed that an increasing number of operatives from other European countries are working in our plants.

In this context, I observe that there are differences in the ways EDF and its contractors view the effects of the changes. I have sought to assess the extent to which progress has really been made, and what problems remain to be solved.

Skill management by the contractors

The nuclear plants regularly complain that contractor staff skills are declining, and sub-quality contractor work actually resulted in loss of production in 2008.
The contractor companies are, themselves, faced with loss of experienced staff as they take retirement, often belatedly. They also highlighted their problems with the rapid turnover of new arrivals.

Joint action on the skill front

EDF is trying to help them deal with this situation. I have observed that **the desire to enhance the status of contractor companies** is finding its expression through longer contracts in certain fields. However, contractors still do not feel sufficiently secure to invest in equipment and manpower.

In EDF, the policy intended to **preserve contractor human resources** by not poaching their staff is universally supported by the upper management. However, I have observed on a number of occasions that these good intentions are not always followed through in the nuclear plant.

Contractor companies can benefit from the apprentice training scheme used by EDF in its own facilities. This initiative is an outward sign of a budding partnership. Recently introduced, it is still not universally acknowledged by the EDF staff.

Lastly, I note with satisfaction that **in 2009, a first Vocational Academy will be opening its doors to contractor staff.**

Relations with EDF buyers

Upon meeting representatives of the regional purchasing agencies once again this year, I found that the situation was gradually improving. **The pairing of plant technicians and regional buyers** is functioning well even though both sides have the impression that the deadlines are constantly getting shorter.
The buyers regret not having the time to have more contact with the contractors in the field, to properly keep track of contracts, and to derive all potential experience feedback from them, enabling them to better assess service prices.
Meanwhile, technicians still frequently complain about not seeing the buyers in the field more often. They are all calling for the buyers to properly use the Job Assessment Records (FEPs) and Periodic Contractor Assessment Reports (FEPPs) by the buyers.

Exactly what constitutes a best bidder remains unclear to both contractors and EDF staff, and remains a delicate matter. As I have written in the past, the nuclear safety requirements – now included in the invitations to tender – constitute a best-bidder criterion, which are actually sufficiently discriminating.
EDF sent a series of new proposals to a panel of contractors focusing on a number of criteria promoting the concept of "a good corporate citizen". However, these criteria remain complicated to apply and are frequently considered overbearing by the relevant company managers.
Work to reach a consensus is in hand. **Simplifying the process for establishing the best bidder would be a sign of a relationship of mutual confidence, worthy of an authentic partnership.**

A contrasting situation for the General Work Area Assistance (PGAC) system

A General Work Area Assistance with a lot of potential

A General Work Area Assistance covers a set of integrated field work services such as work on scaffolding, heat lagging, radiation protection assistance, cleaning up, general services etc. Experiments have been rapidly conducted in a number of plants of intentionally different sizes which have led to different types of organisational structures being proposed, including joint ventures. The results were considered inconclusive, resulting in the Nuclear Operations Division not making the strategy universal. Nevertheless, the experiments now being conducted are still being very closely monitored.

I am totally convinced of the usefulness of the General Work Area Assistance system. I have visited nuclear plants and contractor companies which seemed to be on the right track, or at least where things seemed to be going very well. On two occasions this year, the managers of the plants I visited unambiguously expressed their satisfaction after work was begun on unplanned heavy maintenance work: "without the General Work Area Assistance system, we'd never have done it".

EDF must recognise that it is asking others to do what it has never been able to do properly! Some companies have invested heavily to achieve success, I have seen it.

I think that EDF has nearly reached its goal, but that attaining it will involve rectifying the difficulties at the outset. I remain convinced of the value of such organisational arrangements for advancing in the fields of nuclear safety and radiation protection.

How contractor personnel are received in the plants

I always make a point of meeting representatives from various different contractor companies during my visits to the nuclear plants, whether in service or under decommissioning.

Conditions of reception

I observed **improvement in plant access and accommodation conditions**, and most of the contractors would agree with me.

It's also a question of respect

However, I regret that **renovation of the changing rooms it still not a priority in some of the plants**. Some of the changing rooms are in a deplorable state, in total contradiction with the goals announced by the company. How can contractor personnel and EDF staff who use them then be expected to have regard for rigour, quality and cleanness needed in the nuclear industry?

Job planning

The criterion of "four months before the day" for passing orders has been changed to "four months before the day" for the volume of orders passed. This means that **on average only 60% of the work actually performed is ordered four months before the outage**. This does not make it easy to plan work, form the work teams, prepare the special equipment, and synchronise the schedules; all actions upon which proper execution of a job depends.

I have observed that contractor involvement in the improvement drives of the Nuclear Operations Division is increasing, particularly with the Human Performance Campaign. I see this as **implicit recognition and integration, particularly for contractors that are residents at the plants.**

Relations in the field

In the field, the encounter between client and service provider is an opportunity for 1) ensuring that the latter are fully aware of their jobsite responsibilities, 2) checking cleanness, 3) preparing equipment packages, and 4) lending and getting back special equipment. I have noticed that **insufficient importance is being paid to issuing the appropriate reports when starting and ending jobs.**

Creating the conditions for quality

Contractors face two recurrent difficulties: their EDF contact is often hard to identify, new to the job, and rarely available. More generally, EDF staff timetables do not correspond to unit outage schedules, with the attendant difficulties in terms of coordination, surveillance and assistance.

They deplore that it is virtually impossible for the job supervisor to handle the numerous administrative, organisational and technical requirements before beginning work, and prefer to concentrate on the technical aspects. **They generally feel that EDF is not making the necessary resources available (spare parts, special equipment, miscellaneous support etc.) in view of the constraints on the unit outage schedules**.

I have observed that contractors in other countries are provided with more support during unit outage work, which facilitates the jobs and results in calmer, smoother and more effective work.

Surveillance has still not been fully mastered. It requires know-how, technical knowledge and special training. The main impression gained from my encounters with numerous field surveillance staff is that their backgrounds vary greatly, as do their skills and motivation, the older ones being unenthusiastic about their job and the younger ones not feeling ready for it.

In-house service providers: the Joint Maintenance Agencies

I visited one of the Production Engineering Directorate's Joint Maintenance Agencies that carries out, in certain highly-specific areas, maintenance and checking work for the Division's nuclear plants. They are therefore in a position to pass an uncompromising judgement on the way the system is organised.

Their findings correspond to those of outside contractors and spotlight the inadequacy of unit outage schedules, particularly as concerns provision for any technical contingencies, which are commonplace, and the growing shortfall in technical skills in certain specific areas. Finally, they regret that the backup teams are not up to standard, and that EDF staff not are good at coping with momentary overloads of work, particularly during the initial stages of unit outages.

This seems to beg the question as to whether the abilities of the Joint Maintenance Agencies, which are in direct contact with the equipment and the manufacturers, are sufficiently appreciated by the operators.

Necessary change

While planning the new Nuclear Operations Division project on outsourcing (MOPIA), diagnosis revealed that EDF has not yet achieved the objective set for relations with contractor companies. **This project is centred on a more integrated approach** to commercial policy, purchasing and relations with contractors, which seems to offer greater potential for finally solving these perennial problems.

In conclusion, members of contractor companies currently feel that they are given more consideration and paid more respect, but are also being placed under greater pressure. As they are deeply involved in EDF's action in all areas, relations must be better organised to improve planning, scheduling and action. All contractors need to be convinced that it is everyone's interest to act accordingly. The new MOPIA project is intended to catalyse this process.

THE FIRE HAZARD

Once again this year the partnership between EDF and the County Accident Response Services has proved its worth. With strong support at corporate level, the different nuclear plants are making good progress with the many varied aspects of fire prevention and fire fighting. The Nuclear Operations Division and the Nuclear Engineering Division need to complete the numerous actions in hand, especially in the field of prevention, while making sure to apply the lessons learnt from fires elsewhere.

Ever since I started these annual reports, I have always devoted an entire chapter to the fire hazard, a field where many developments have been made. Firstly, the Nuclear Engineering Division and the Nuclear Operations Division have carried out a major programme of technical improvement in the installations. Furthermore, thorough background work has accompanied the fire fighting strategy, with EDF wishing to completely rely on the County Accident Response Services.

A “hot” year

The year 2008 was marked by two important events and several other less important ones. In every case, the EDF and County Accident Response Services teams were mobilised and properly executed their tasks.

A fire occurred on the shaft line of a turbine generator in a non-nuclear area of the Saint Alban Nuclear Power Plant. The hydrogen cooling system of the alternator rotor was the root of the cause. Like any such fire, it was impressive but rapidly dealt with by the EDF teams, who immediately shut off the hydrogen supply to limit the damage, which was nevertheless severe.

Another fire broke out at Dampierre Nuclear Power Plant. This occurred in a secondary-side condensate re-circulation pump motor. It was as brought under control by prompt action, once again by the EDF and County Accident Response Services teams. The fire in this heavy motor located in the turbine hall resulted in extensive smoke logging, which greatly complicated the task of the response teams.

Orphan systems still exist

A case of "overheating with smoke release" occurred in an air conditioning fan unit located inside a reactor building with the reactor on power. It was caused by friction between the electrical terminal block on the motor cooling vanes. This incident revealed that the Basic Preventive Maintenance Programmes (PBMPs) for the ventilation equipment had not been respected by the plant. An inventory made in the plants confirmed that further action was needed. **This event confirmed that the ventilation systems had not been the subject of sufficient attention.**

Apart from these major incidents, I note that in 2008 the number outbreaks of fire remained stable, though disparity was high between the plants and between nuclear units of the same series. I would like to add that **some of the outbreaks of fire were associated with disorder in work areas.**

Furthermore, I observe that, outside France, there has been an increasing number of fires involving heavy electrical power production and transmission equipment outside the nuclear areas.

Fire prevention

Proper care needs to be paid to fire prevention at all stages of the nuclear installation life cycle: design, construction, operation and decommissioning.

Design

As part of planning the third ten-yearly inspections of its 1300 MWe series plants, EDF has begun an overall review of the design and organisation of the fire hazard.

The methods used by EDF, which were established by the Basic Design Department (SEPTEN) for the probabilistic assessment of fire safety in the 1300 MWe nuclear units, were based on those established by the Electric Power Research Institute (EPRI) in the US which are recognised throughout the world as setting the standard. The entire system is to be analysed as part of the 1300 MW Reactor Probabilistic Fire Safety Project. The lessons learnt are to be used in conducting a probabilistic fire safety assessment of the EPR-type reactor. I find this useful as **comparison of rule sets is always instructive.**

Training, exercises and drills

Training of EDF staff has been the subject of special attention, relying on the highly effective teaching methods of the Safety and Protection Training Institute (IFOPSE).

Closer monitoring of exercises and drills

The exercises and drills performed by the EDF and County Accident Response Services staff are now subject to the regulatory General Technical Environmental Protection Rules (RTGE). Work to ensure conformity is accordingly in progress. Also, I observed that the scenarios needed to be tougher and more varied, with the intensity of the training being more closely checked; trained observers are to organise experience feedback and the treatment of any discrepancies.

Meeting the response time limits is another weak point, and I hope that training will enable progress to be made in this area.

During an exercise, I was able to assess the extremely positive effects of having a seconded fire brigade officer at hand who can reassure and motivate the response teams with his advice and remarks.
Finally, **the Vocational Academies are promoting a highly integrated approach to risks to instil nuclear safety culture**: this includes covering the fire issue with the attention it merits, which should ensure greater involvement by everyone, particularly as concerns prevention.

General state of the installations

I have observed in the field that the load parking rules have improved and are being more closely monitored, facilitating access by mobile fire-fighting equipment and the progress of response teams. In certain plants, I notice that the situation has also improved thanks to new rules for the interim storage of fire loads, and the fenced-off areas for general loads.
All these actions are ascribable to the Risk Management Project (MRI) and the Better Housekeeping Campaign (O2EI).

Fire zoning

A line of defence that must be strong

The EDF strategy is also based on classifying rooms into fire zones so as to separate the nuclear safety systems, to assess the fire load in each zone, to provide suitable means of detection, to vent any smoke, and to prepare fire-fighting means should fire break out. **Proper fire zoning is an essential line of defence**, but I all too often see fire doors left open and unsealed ducts.

Appointing a fire zone supervisor should enable progress to be made at the plants. I have observed that this is not the case everywhere. The supervisor's mission would be greatly facilitated by the presence of a fire chief who could centralise information on the integrity of the fire zones and the associated detection systems. The pilot plant fire zoning supervisor showed me this arrangement. This is essential for him to be able to properly manage all the ramifications of the system.

Fire permits

I have observed good practices in the field: here a single manager looks after all the fire permits and handles administrative and relational matters concerning the operatives on a continuous basis, with day-end management checks sometimes performed daily.
I have observed general improvement, but the process is still not fully complete. Also, I observed the large numbers of fire permits issued during a unit outage: they were the consequence of modification work and checking of the installations.

In the American plants I have visited, not more than some thirty fire permits were issued and the execution of the corresponding work always took place in the presence of a fire watcher whose **only duty was to monitor the fire risk during work on the job and apply preventive measures during suspension or completion of the work.**

Fire fighting

EDF's strategy is to make use of the internal resources permanently available in the plants, mainly drawn from the nuclear unit operating teams, and the County Accident Response Services.

Operational cover

The term "operational cover" refers to the ability of the County Accident Response Services to deploy fire-fighting means at a nuclear plant within a relevant timescale (nature of fire, distance from response centres etc.). Five plants are to benefit from increased operational cover. I visited one of these, where the situation was properly and responsively handled. The four others are in the process of devising response systems suited to their situations with the County Accident Response Services.
I note with satisfaction that the Nuclear Operations Division's highly rational approach is taking form.

Relations with the County Accident Response Services

EDF counts on them, and they count on EDF

These links are growing stronger in all the plants in all domains: secondment of fire brigade officers to the County Accident Response Services, joint training and drills at the plants, fire scenarios developed together, and co-ordinated manning of fire-fighting equipment.
Only three or four plants were still without a fire brigade officer at the end of 2008. The positions are to be filled in 2009.

During many of my visits, I met the leaderships of the local County Accident Response Services. I found that the desire to make progress was mutual. For instance, I had a very interesting visit to the County Accident Response Services centre near the Civaux Nuclear Power Plant, which demonstrated what good cooperation between the two parties can produce.

Many of the County Accident Response Services have voiced their difficulties in recruiting and retaining volunteer firemen, with turnover levels generally being high. Finally, it is to be noted that fires represent less than 10% of the County Accident Response Services work, most of which relates to traffic accidents and public health incidents. The situation concerning this point appears to be critical in rural areas.
These difficulties should be food for thought for EDF as they have a direct impact on its fire-fighting system as a whole.

Second-line response teams (E2I)

The new emergency team supervisor training course is better adapted to its complex, vital mission. It is proving to be very satisfactory according to the few who have already taken it.

There are generally very few EDF staff who are also volunteer firemen, and little use is made of their skills in most of the plants. I have observed that some of the plants recognise and value their skills, and even encourage such vocations.

Nuclear power plant fire-fighting equipment

The basic static equipment corresponds to the EDF fire doctrine, which is upgraded in the light of national and international experience feedback. By way of example, I would like to mention the dry risers in the turbine halls in the aftermath of the fire under the alternator in the Blayais Nuclear Power Plant in 2005.
I would again like to draw attention to **the general state of the fire-fighting system pipework in the nuclear power plants**.
As the pipework from the technical series is concerned, the corporate-level operation consists in replacing the corroded sections. This work is progressing satisfactorily, even though it has been hampered by the failure of some of contractors that were awarded the contracts.

As regards the local overhead and buried pipework that does not correspond to the above operation, I note that repair work has been carried out here and there with no overall plan.

Risk Management Departments (SPRs)

For more than two years, **the mission of the Risk Management Departments regarding fire has been substantially expanded, and observance of the fire regulations is considered a highly complex issue.** During my visits to the nuclear plants in 2008, I found considerable variability in the way this duty was handled.

How other nuclear operators cope with the fire hazard

Make assessments to raise questions

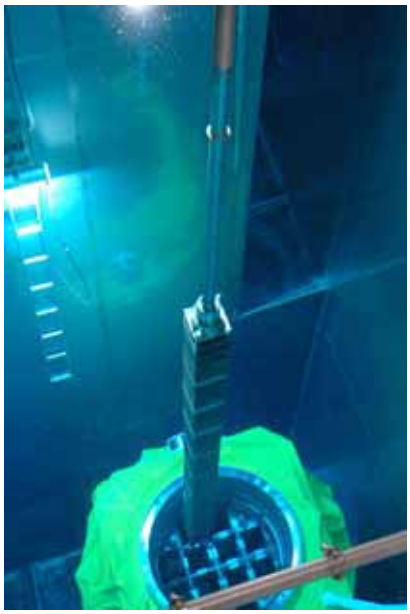
In 2008, the Nuclear Safety General Inspectorate accompanied the Nuclear Operations Division during an international benchmarking initiative in 2007. After observing a number of organisational systems in foreign plants, its conclusion was that **the system adopted by EDF to manage the fire hazard is a particular one because it corresponds to a particular national context.**

The year 2008 was devoted to the American plants identified by the World Association of Nuclear Operators as having organisational systems similar to those of EDF. Although the underlying principles were indeed similar, the actual situations were very different. The players were the same but **the plants consider it important to be as independent as possible from outside support**. The plant fire teams are far larger, remaining on-call to assist the operations second-line response teams, and all have their own professional fire-fighting gear. They receive fire-fighting training every year and claim that they have themselves put out major fires (transformers, shaft lines and oil chests).

As regards mobile equipment, there are very few vehicles though they do tend to be very sophisticated and highly effective (transportable, programmable water cannons).
The static fire-fighting equipment is state-of-the-art and installed in a very large number of rooms. Sprinkler systems are almost universal, and many carbon dioxide and halon gas fire suppression systems have been installed. It seemed to me that **the operatives felt reassured by the presence of the dual static and mobile resources.**
I would however like to point out that the fire zoning of the facilities is far less extensive than in the French plants, which may explain these differences in some way.

Finally, the stations containing suitable equipment are installed nearby high-risk installations such as power output transformers and the turbine generator sets, which seemed a worthwhile precaution.

In conclusion, a lot of important plant work has been done in the last few years, as regulatory requirements have become stricter. The work has been carefully managed and properly supported by the Nuclear Operations Division at corporate level.
Nevertheless, there remains a need for finalising and consolidating all that has been begun in the field of fire prevention and fire fighting, particularly efficient cooperation with the County Accident Response Services.
We must also remain alert and watchful: a set of fire hazard rules needs to be updated with experience feedback and cross-comparisons.



NUCLEAR FUEL

Innovative core design and adequate resistance of the fuel assemblies in service are the determining factors in nuclear safety and cost-effectiveness. Industrial performance is satisfactory and experience has confirmed that relying on methodical, prudent methods is the best way. The ASN and IRSN are highly active in these fields, and though the corresponding technical debates may be long and heated, the final outcome is always beneficial to nuclear safety.

On a number of occasions in my earlier reports, I have touched on issues relating to the nuclear fuel used in EDF plants: evolving technology, changes in the utilisation strategy, and operating incidents.
It was a busy year, marked by the completion of work on a number of technical and regulatory issues reaching back a number of years.

In a context of increased focus on competitiveness of nuclear power, fuel efficiency is a factor of the highest importance. However, when seeking to optimise its use (by increasing burn-up, extending the cycles, improving the use of plutonium derived from reprocessing etc.), **it is vital to make sure the margins are preserved** and that the level of nuclear safety continues to be guaranteed.

Fuel: clearly assigned roles in EDF

The Production and Engineering Directorate calls upon a number of different bodies which all play specific roles in the field of nuclear fuel. This year, I made a point of visiting them to better understand their respective duties and to get an overall view of the situation. I accordingly met:

- the Nuclear Fuel Division, which has overall control, guarantees consistency of the full fuel cycle and is in charge of the fuel supply;
- the Nuclear Engineering Division's Basic Design Department, which studies the different core configurations and which establishes the calculation methodology used to establish the safety case;
- the Operation Engineering Unit/ Core Design and Engineering Group, which carried out the reload nuclear safety calculations for all the EDF reactors;
- the Research and Development Division, which develops the calculation tools for the cores, fuel assemblies, rods and fuel pellets as requested by the Production and Engineering Directorate;
- the nuclear power plants, i.e. the end-users of the fuel.

The first thing I noticed, in this complex system, was the **specific role of each body and the way their interfaces were clearly laid down.**.However, although they seek to attain the same objectives of effectiveness and nuclear safety, I observed that their efforts were not always harmonised.

These meetings with the different nuclear fuel players also offered the opportunity of assessing the associated regulatory changes and how to adapt to them, as well as a number of current issues.

The safety case approach

The "fuel management system" concept

In the French approach to nuclear safety (reiterated in the Operating Order of 2 December 2007), fuel changes are assessed a highly formal manner in which the following are established: type of fuel, degree of enrichment, burn-up, and the number and configuration of the fuel assemblies in the core. Together these variables constitute a "fuel management system". The latest ones, which have been deployed for one year, are Parité-MOX (900 MWe series) and ALCADE (1300 MWe series). At the start of 2010, a nuclear unit is to be operated with the GALICE fuel management system (1300 MWe series) for the first time.

I have frequently mentioned the safety debates that take place in nuclear licensing circles when a "new fuel management system" is to be introduced: every time, this has proved to be a long-drawn-out process (lasting at least five years) during which the operator has to supply the ASN with a large number of proofs in a highly formal context. **It is all about demonstrating that the "new fuel management system" is consistent with the nuclear safety criteria** that apply in all normal, incident and accident conditions.

A wide range of operator responsibilities

The same applies to the various aspects of the backend of the fuel cycle (transport, interim storage, reprocessing and disposal. Considered by the ASN to be the main player in the cycle, as operator EDF must effectively guarantee its overall consistency and compliance with the limits placed on the fuel characteristics for the installations involved, including, for instance, provisions governing operating waste disposal.

In view of the shear scale of the studies required, introducing a "new fuel management system" amounts to conducting a complete review and update of the safety case for the nuclear installation.

I have observed both the broad scope of the safety cases and the degree of detail required, the depth, the formality and, at times, the heated debates between the experts of IRSN and EDF. This produces work of the highest technical and formal quality **which is spurred on by nuclear safety, well beyond the problems associated with the fuel management system itself**. This additional benefit is, to my mind, not valued enough by the parties involved.

The concept of "flexibility"

At the same time, I have noticed during my visits to other nuclear operators, that the safety cases relating to technical changes in the fuel or its mode of utilisation are more pragmatic and that the concept of the "fuel management system" (as it is understood in France and defined above) is simply absent.
Their approaches appear to be more straightforward, frequently focusing on analysing the most representative cases. **This results in a "nuclear safety envelope" within which the configuration can be chosen (number of fuel assemblies reloaded, length of operating cycles etc.),** thus facilitating adaptation to power grid requirements.

Re-establish the technical margins in total safety

I note that EDF is currently developing the concept of "flexibility" so as to customise fuel reloads once a generic nuclear safety case has been defined.

Nevertheless, it appears to be clear that allowance for all the constraints currently considered in France in the nuclear safety analysis could restrict the scope desired.

Recent changes and future prospects

When it comes to fuel, I carefully follow the projects, developments, the operational performance levels and sometimes also the performance shortfalls, concerning which I have noted certain points, associated with experience feedback and plans for the future.

Deployment of new fuel management systems

As seen from the control rooms, the initial experience feedback on the Parité MOX fuel management system seems to be relatively neutral compared with that from the previous GARANCE MOX system. On the other hand, the control margins for the ALCADE fuel management system are somewhat reduced regarding certain protection systems activation criteria. Studies are underway to re-establish them.
I note that, although the fuel management system impact study appears to have been comprehensive as regards compliance with the nuclear safety criteria, the socio-organisational and human factor aspect has probably not been fully considered, particularly as regards ease of reactor control.

Innovations in fuel assembly technology

As concerns fuel cladding, AREVA's M5 alloy was introduced into the plants in service because of its intrinsic properties (reduced oxidation, less swelling under flux, better reaction during pellet-cladding interactions, etc.), though it has not yet exhibited sufficient reliability in operations. The problems encountered appear to be well understood, what remains to be found are suitable solutions that are technically sustainable in the fabrication processes involved. The defects discovered during use are constraining for the operator, but do not have nuclear safety implications.
Westinghouse's Zirlo alloy is now widely used in 900 MWe units (Parité MOX fuel management system) and in 1300 MWe units loaded with Westinghouse fuel.
Again in the field of cladding, a first fuel reload using "optimised Zirlo" might be experimented in an EDF reactor next year. The qualification programmes necessary for the commercial utilisation of this alloy are in progress. They are currently being examined by the ASN.

As concerns fuel assembly structures, AREVA has developed a new type of grid for AFA-type fuel in order to diminish the risk of catching other fuel assembly grids during handling; this is to be made universal in the reactors next year after first being used in 2008.
"Double grid" fuel assemblies, never used before, were rapidly developed and deployed as an effective solution against the increased risk of fretting (cladding wear by flow-induced vibrations) observed after having extended the operating cycles in the 1300 MWe series.
The risk of catching proved to be greater with the double-grid assemblies, but the new design should eliminate the problem.

Studies and tests but also confirmation by experience

Also, a new MOX pellet design improving the uniform distribution of plutonium is to be tested by 2009.

Overall, I clearly recognise the difficulty in predicting the exact details of fuel behaviour at design level, despite the sophisticated simulation tools and full-scale test loops available. Here, it is only utilisation that can provide confirmation.
We need to find the correct balance between an empirical and a immobile approach and, in the light of experience, I do not consider the attitude of the ASN to be excessively prudent concerning the introduction of new fuel types, even if they correspond to extrapolations from those already in service at EDF or with other operators.

Re-racking of fuel building pools

In the nuclear plants, the fuel building pools are used for the interim storage of fuel assemblies before loading into the reactor and after unloading so that they can cool down before being transferred to the pools at the AREVA plant at La Hague pending reprocessing.
As concerns the availability of space in the pools, I have been hearing for many years that the situation is difficult to manage, and the introduction of new fuel management systems will not make things any better.

In the short term, the use of waste racks should free up space for the interim storage of fuel, as some cells are currently holding operating waste. The waste is then to be moved to the Activated Waste Interim Storage and Packaging Facility (ICEDA) when is operational.

In the medium term and combined with other solutions, the increased number of cells available for fuel elements (by re-racking) without requiring pool structure changes or without modifying safety levels, should significantly increase the capacities of the fuel building pools. Such operations are routinely performed outside France.
The work is complicated and special attention must be paid to the radiation protection aspect; it also requires considerable logistical planning to reduce to a minimum the number of fuel assemblies remaining in place, as well as the amount of waste arising from the removal of the existing racks. 2011 is the target for an initial operation in a 900 MWe series unit.
The bottom line is that such operations are extremely worthwhile because they restore substantial physical margins for the operator. The licensing process is already progressing satisfactorily.

In conclusion, any change in methodology or technology is a lengthy process in the field of fuel. Even with careful foresight that must always cover the entire fuel cycle, it is not always possible to keep up with the economic requirements.
For my part, I see two reasons for this mismatch. Firstly, the intrinsic difficulties of the discipline which, I am told, involves all the professions. Secondly, the prudent and rigorous attitude of the ASN, which is nevertheless fully coherent with the safety culture principles as it is a matter of assessing the possible impact on nuclear safety.

DECOMMISSIONING

EDF is purposefully pursuing its programme of decommissioning in a regulatory and societal context that is increasingly more difficult. To maintain the momentum of this long long-term programme, EDF and its contractors need to preserve their skills and develop their synergy. The French National Radioactive Waste Management Agency (ANDRA) is behind schedule in the construction of its long-lived low-level radioactive waste repository. EDF is facing the consequences.

A vast decommissioning programme for nuclear units having reached the ends of their service lives has been in progress since 2001. It currently covers eight Generation I reactors: a heavy water reactor at Brennelis, a pressurised water reactor at Chooz Nuclear Power Plant and six gas-cooled reactors at Chinon, Saint Laurent des Eaux and Bugey Nuclear Power Plants. The Superphénix fast reactor at Creys-Malville is also being decommissioned.

This large, ambitious programme reflects an ethical approach intended to close the life-cycle loop of the industrial facilities. I have observed that our foreign counterparts are surprised at how much the programme has progressed and are interested in its content and the initial experience feedback. Although they are setting aside funding for future work, most have not yet established precise technical and commercial strategies.

Ambitious projects, a complicated context

Decommissioning is an industrial activity in its own right that involves dealing with a number of delicate problems. The complexity of these problems and their context need to be put into perspective. Decommissioning requires:

- **the necessary financial resources**, which are now placed in special funds,
- **a set of licenses** obtained after going through lengthy procedures that are increasingly convoluted and are regularly being changed,
- **regularly informing the general public of progress made with the projects**,
- **a dedicated engineering capability**, hence specialised skills, as the technicians required often need to be trained and the associated nuclear safety and radiation protection problems are specific ones,
- **contractors capable of making long-term commitments** to highly specialised work, each worksite now constituting a special case,
- **a spent fuel repository**, if the fuel has not been reprocessed before the decommissioning work is begun,
- **casks, transport means, repositories, and possibly interim storage facilities, that are appropriate for each category of radioactive waste**: very low level, low and medium level, long-lived low-level and long-lived medium-level.

Paradoxically, **numerous new installations have to be created** (buildings, utility systems, a range of technical installations etc.) to ready the plant facilities for the different stages of its decommissioning.
I would like to add that the reactors currently being decommissioned are almost all of different technologies, which further complicates the situation. When the time comes, the decommissioning of the pressurised water reactors – which EDF is already preparing – will benefit from the fact that they are standardised.

In 2008, I visited Creys-Manville Nuclear Power Plant where the decommissioning of the Superphénix fast reactor is in progress. I also met the manager of the CIDEN, the engineering centre belonging to the Nuclear Engineering Division in charge of the decommissioning work, in order to get an overview of the vast scope of this activity.

An overview

The units under decommissioning

Each plant is a special case

At the Brennilis Nuclear Plant, decommissioning of the nuclear part was discontinued when the State Council cancelled the decommissioning license decree in June 2007. The Nuclear Environment and Decommissioning Engineering Centre rapidly compiled a new application, which will become a reference in the field as it is the first complying with the Nuclear Safety and Transparency Act: comprehensive information is required, particularly as regards the risk analysis and impact study, as well as been very open and accessible to the general public. The application for a license for complete decommissioning of Brennilis Nuclear Plant was submitted to the authorities on 31 July 2008. The public enquiry and consultation phase is scheduled for early 2009, making it possible to expect a new license by the end of 2009 or the beginning of 2010.

Work is continuing normally in the fuel building cavity of the **Chooz A nuclear power plant**. Chemical decontamination of the steam generators will make it possible for the heavy components to be classified as very low level radioactive waste.

For **Bugey 1**, the first of the gas-cooled reactors, the decree authorising final closure and greenlighting the complete decommissioning of the installation was published on 18 November 2008.

The work programme has been finalised, and the reactor is to be decommissioned underwater. The key stage of immersion is programmed for 2013, provided that the long-lived low-level waste repository is available on time. The extent and the special nature of the work has required close involvement from the ASN.

The preparatory work on the **Chinon and Saint-Laurent-des-Eaux gas-cooled reactors** is continuing. The procedure to be used for decommissioning will depend on the experience gained from Bugey 1, particularly for the Saint Laurent des Eaux reactors. The fact that this work will be carried after an interval raises the problem of preserving plant decommissioning knowledge.

The **silos containing the fuel element graphite sleeves from the Saint-Laurent-des-Eaux gas-cooled reactor** will be protected by a geotechnical barrier in 2010. AAlthough the concept has been selected and confirmed, the ASN has asked for a series of additional studies on the levels of certain natural events covered in the design case.

Post-decommissioning disposal (excluding fuel)

A repository for each type of radioactive waste

Decommissioning requires a number of repositories for the different types of radioactive waste. In France, the French National Radioactive Waste Management Agency is responsible for such repositories. At the present time, **a long-lived low-level waste repository** is still lacking, especially needed for gas-cooled reactor piles and fuel sleeve graphite.

The design of this repository has not yet been completely finalised. The National Assessment Committee has, for instance, raised the question of the reversibility of the disposal. A law passed on 28 June 2006 stipulated the construction of a repository to be ready by 2013, but this repository will more likely become available in 2019. The search for a site began in 2008. The Nuclear Environment and Decommissioning Engineering Centre has organised the Bugey 1 decommissioning schedule on the basis of this new date.

The Active Waste Packaging and Interim Storage Facility (ICEDA)

This EDF installation will be built at the Bugey Nuclear Power Plant. It meets the interim storage needs for pressurised water reactor operating waste (control rod clusters etc.), as well as for the packaging and interim storage of certain reactor components resulting from plant decommissioning, e.g. Brennelis. It will be used to temporarily store such components before their disposal. As such, its availability is also intended to answer the need for synchronisation with the decommissioning of the installations involved. Progress with the studies should make it possible to obtain a construction license decree by the first half of 2009.

Creys-Malville Nuclear Power Plant (Superphénix)

The decree authorising the complete decommissioning of the Superphénix reactor was signed in March 2006. The first phase of decommissioning has therefore begun.

Eventually, what will remain on the site will be an interim storage facility for the waste resulting from the treatment of sodium and an interim storage facility for fast reactor nuclear fuel. The latter, referred to as the Fuel Interim Storage Facility (APEC), will constitute a licensed nuclear facility.

On schedule

The five major jobs begun in 2008 are: 1) commissioning of the sodium treatment installation, 2) treatment of the main components, 3) continuation in the unloading of the reactor's lateral neutron shielding, 4) final closures of the former pumping station and commissioning of the new one, and 5) construction of the building for the interim storage of the concrete blocks resulting from the sodium.

The decommissioning workers

I encountered highly-motivated EDF and contractor teams, coping pragmatically with extremely varied situations, major financial implications and, above all, very specific nuclear safety and radiation protection conditions.
The skills needed to carry out the work at the site for the next two years are already available there. I observed that the geographical situation and the nature of the technical missions made recruitment difficult.

Some of the contractors working at the site have a long history of working in nuclear industry. They felt completely at home. I even heard talk of partnership!
They greatly appreciate the synergy between EDF and its contractors when dealing with future projects, **many aspects of which have to be determined jointly**.
I observed that the contractor companies were invited to participate in identifying avenues of progress. Work safety is given a high priority by the management. A results-related incentive scheme is in place extending to both EDF and contractor staff.
Like in the plants in service, I observed the same difficulties concerning surveillance of the jobs and work areas.

The state of the installations

Overall, the installations are in a relatively good state. I would however like to draw attention to the general condition of certain buildings and rooms which could be the subject of better maintenance programmes as they are still to be used for decades. **The concern about maintaining the condition of the installations therefore also applies to the facilities under decommissioning**.

The reactor cooling system and its auxiliaries

Now that inside the reactor building, the reactor dome, the intermediate heat exchanger and primary pump bunkers have been dismantled, the resulting panoramic view makes it possible to see **the amazing density of the equipment**. Also in the reactor building, the work on the **compartment that will be used for cutting up the main components** before shipping to the waste repositories is in progress.

The Fuel Interim Storage Facility (APEC)

The work on Fuel Interim Storage Facility is separate from the other decommissioning tasks as it is destined to produce a self-contained facility, particularly as concerns nuclear safety. It has therefore been the subject of monitoring, maintenance and surveillance texts, like any other Licensed Nuclear Facility. Many nuclear safety-related modifications are being and will be made to achieve a different technical purpose from that which it was originally designed to perform. I have observed that the fast reactor fuel interim storage installation and rooms were in good condition.

Sodium treatment

Build to dismantle

The **sodium treatment installation** has been set up in part of the turbine hall previously containing the two turbine generator sets and electrical auxiliaries. This completely new installation consists of two "drop-by-drop" parallel sodium treatment lines.
The sodium will be transformed into sodium hydroxide by a chemical reaction. The sodium hydroxide will then be mixed with concrete and made into block which, once dry, will be placed in interim storage in a suitable building. A first concrete block, made with sodium-free water, is about to be produced for testing.

I was impressed by the state-of-the-art control room and the overall design of the treatment process, which builds on the experience acquired with the decommissioning of the prototype fast reactor at the Dounreay reactor in Scotland.

The start-up tests on the two treatment loops were in progress at the end of the year. The license to transfer the sodium for the initial tests is to be granted by the ASN in early 2009. Secondary cooling system sodium is to be used for the tests. This has been re-liquefied ready for the treatment to begin. The primary sodium will soon replace it, as its treatment will make it possible to continue decommissioning the reactor vessel.

The sodium will be processed continuously (three 8-hour shifts seven days a week) whereas the cementing will be discontinuous (two 8-hour shifts seven days a week). Operation of the installation will be handled by a group of contractor companies. Treatment of the primary and secondary sodium is currently expected to take around four years.

Interim storage of the concrete blocks containing sodium

The **concrete block interim storage building** is being built; the foundations and anti-seismic walls are heavily reinforced, and are truly massive! The weight of these blocks, which will be very slightly radioactive, is estimated at 70,000 tonnes. I noted that interim storage is to be reversible.

In conclusion, even though the national context of decommissioning is complicated, EDF is determined to make concerted progress on all fronts. At the Creys-Malville Nuclear Plant, I found that progress was methodical, rigorous and achieved with real awareness of the nuclear safety and radiation protection stakes.
The most complicated work however remains to be done in the different installations under decommissioning. To rise to this challenge, EDF must remain mobilised and be able to rely on a network of specialised, properly qualified industrial partners, while taking care maintain and build on its own engineering skills.

EMERGENCY RESPONSE MANAGEMENT

Every nuclear operator is responsible for implementing procedures and an organisational system to cope with any incidents and to mitigate their consequences. Over the years, EDF has developed a coherent organisational system which needs to remain simple. It is regularly tested in exercises organised with the French ASN in which other relevant parties participate. The preparedness and the commitment of all of the players, at all levels, are determining factors for reliability and credibility of this organisational system.

For every nuclear operator, organising and managing emergencies constitutes last line of defence in depth. The International Atomic Energy Agency (IAEA) pointed out once again this autumn in the International Nuclear Safety Advisory Group Publication 22 the basic principles to be complied with for the "nuclear safety infrastructure" of any country that has decided to commit itself to a nuclear programme. In its own words ***"a robust emergency preparedness program should be initiated before a decision to launch a nuclear program is taken, but fully implemented during the commissioning phase and considerably improved and exercised periodically during operation".***

The French organisational system, which involves not only the operator but also the local, regional and national authorities and their specialist advisers, in particular IRSN, **is now a tried and tested one**. For the operator, this takes the form of special arrangements for emergency management at corporate and plant level, notably the issuing of an On-Site Emergency Plan for each plant.

This year, in view of the current work involved in re-writing the On-Site Emergency Plans and certain difficulties in implementing them in past years, I opted to visit the various links of our internal emergency management system during exercises and at other times. I also raised the subject during my visits to nuclear plants outside France.

Corporate-level organisation

EDF SA top management level

The need for emergency preparedness is deeply anchored in corporate culture, one of the results of which is the strong involvement from the top management. We must remember that the exercises make it possible to see people as they really are, and not as they are supposed to be. **It is therefore essential that those who would normally be in charge during a real emergency are also put in charge during exercises.** It is a comprehensive way of preparing and it lets everyone know just how important the exercise really is.
Such participation also serves as an example for the numerous external players, some of which find it hard to make themselves as available as desired. It is to be noted that, in some of the countries that I have visited it is the Prime Minister himself, or his deputy, who heads the main nuclear emergency exercises.

I emphasise **the efforts made to diversify the scenarios of the exercises and to devise more innovative ones**, in liaison with the ASN and its specialist advisors. Any exercise can test the procedures, put if it is wished to widen the scope, dispose of richer experience feedback and maintain the interest and motivation of those involved in emergency management, imagination is required. Accidents are frequently due to improbable combinations of probable events.

Exercises that leave the beaten path

This type of exercise also enables the **Quick Think-Tank (FFR)**, created within EDF and consisting of a number of original thinkers, to practice coping with the unexpected. AAlthough the system appears to be ready in terms of the technical basics, this think-tank plays an important role in terms of fleshing out the strategy, policy and communication issues.

I believe it is still necessary to carry out **some major exercises extending further into the post-accident phase**. This phase is, indeed, regularly passed over in the exercises, whereas it could make emergency management extraordinarily complicated, if not conflicting. Exercises could involve sets of nuclear units and/or plants, addressing common modes such as floods and earthquakes.

Another point requiring attention is **use of experience derived from each exercise**. This experience feedback is indispensable for identifying errors, learning lessons and improving the system. And I believe this area could be improved, both by properly involving all the relevant parties and also by sharing good practices with all those liable to participate in emergency management teams, not only with the small circle of regulars that remain mobilised.

Finally, I would like discuss how the corporate management is involved in the emergency response organisation and exercises implicating **foreign nuclear subsidiaries**. I observed that one of the first measures taken by the top management of a large foreign group having bought a nuclear subsidiary in another country was to invest in an emergency exercise.

The Nuclear Operations Division

The Nuclear Operations Division's corporate emergency response team boasts dedicated, modern facilities and staff members – e.g. the accident specialists – selected for their ability to perform certain key functions.

During the visit, I noted the following points:

An effort to clarify and simplify

• The On-Site Emergency Plan rule set and the ways in which it is applied are intelligent, comprehensive but complex. Properly applying them, particularly in stressful situations, implies that the manager at plant level (No. 1 Management Command Post) must be fully trained and well drilled; regular refresher training courses for the emergency management directors must be made the rule. More generally, it is indispensable that, at all times, all those likely to be involved have sufficient experience in applying the principles of the On-Site Emergency Plan doctrine, at both plant and corporate levels.

- This rule set is complex and is expected to change in the future, particularly in the light of the application guidelines resulting from the Nuclear Safety & Transparency Act. I have taken good note of the fact that EDF and the ASN are working together on this subject. **We must remember to encourage any action that helps to clarify, simplify and harmonise this rule set**. Care must be taken not to go to far and lay down procedures that may be perfect in theory but are difficult to implement in the field. Trying to cover every little detail may overwhelm the emergency teams on the big day.
  I would like to add that the nuclear power plants face a large amount of revision work on the procedures if all the players are to be ready in time.
- I observe with satisfaction that new technical resources have been introduced, notably the Reflex Phase Population Alert System (SAPPRE), which automatically sounds the alarm. I also note that **a programme for renovating the measuring devices equipping the On-Site Emergency Plan vehicles is in progress** (and I saw the first one available at the Dampierre Nuclear Power Plant), in order to make them more robust and to improve their communication capability. It was about time, as the fleet was ageing and falling further and further behind the new equipment fielded by IRSN, which I mention at the end of this chapter.

Our primary responsibility is to have an organisational setup that is credible for all concerned. The decision requiring the Nuclear Inspectorate to review the implementation the On-Site Emergency Plan during its assessments of the nuclear plants will now make it possible to compare situations.
Our credibility also depends on **the diversity and redundancy of our resources**, as was notably shown by the temporary inoperability of the Groups top-level situation room or, on another scale, the lessons drawn from the earthquake that affected the Kashiwasaki Kariwa Nuclear Power Plant (see Chapter 20, Section 1).

As concerns exercises, I would like to emphasise the importance of **exercises that address both industrial security and nuclear safety concerns**, as it has become clear to me, particularly in the light of my visits outside France, that the two are not necessarily easy to reconcile as problems relating to prerogatives and priorities appear.

The plants

During a number of visits, I met the corporate emergency management correspondents. I got the impression that they were not all receiving the same support from their managements and many felt somewhat isolated. **Nevertheless, they all emphasised the high-quality of the corporate-level leadership**, but regretted that the corporate emergency management correspondent network was less effective than before due to high turnover.

Turnover affects the members of the EDF teams and some of the other parties, for example the directors of the county governors' staff, hence, the incentive for EDF to provide the different bodies with competent senior technical advisers.

One difficulty that was emphasised was the complexity of the On-Site Emergency Plan rule set, considered to be baffling with (too) many requirements to reconcile.

Being able to rely on a multidisciplinary team

Emergency management updates commonly result in further demands on the different professions who are already busy. One corporate emergency management correspondent confided to me that "it is not easy to find motivated staff who can devote a little time to thinking and planning". In view of the cross-organisational nature of their responsibilities, **it is indispensable to have experienced correspondents with more visible profiles.**

Staffing the teams can prove difficult, particularly in the two-unit plants which can find it hard to fill all the positions provided for in the On-Site Emergency Plan organisation charts. I would once again like to emphasise **the value of presentations given at the Vocational Academies** in increasing the awareness of emergency management and the On-Site Emergency Plans from the outset.

Another concern relates to the implementation of the Health On-Site Emergency Plan, which I discuss in Chapter 13. I have observed that the degree of involvement from the management differs from plant to plant.

I would also like to mention the similar views spontaneously expressed by the corporate emergency management correspondents and the managers of the County Accident Response Services, and even the police (gendarmerie) that can be summarised as follows "**EDF is too focused on the nuclear risk and not sufficiently on the conventional risks (chemicals, gas etc.)**".

I also think that too little thought is still given to emergency management in the longer term and that preparations need to be made for the logistical aspects which would assume primary importance (as can be seen from lessons of the Hurricane Katrina disaster), taking care not to focus exclusively on the functioning of the command posts.

Other essential players

Many other players participate and assist in emergency management. Inside EDF, I visited the situation room of the Basic Design Department, which is small but well equipped. The duty team can make radiological and thermal-hydraulic simulation calculations there. The team I met was highly motivated, but I have the feeling that it had taken a lot of energy and initiative to obtain the resources.

During my mission at EDF, I believe that I have visited most of the players involved. In the situation room equipped by AREVA in accordance with an agreement, I was able to meet certain highly-skilled experts with long experience of exercises, who regretted that the turnover was somewhat too rapid among their EDF counterparts. In view of the stakes, **ensuring the continuity of certain functions requiring knowledge and experience**, needs to be one of the primary management concerns.
I have already discussed IRSN and its emergency centre. **This year, I visited its Field Work and Environmental Division (DEI)**. It has made considerable efforts to tackle the still insufficiently-studied immediate post-emergency phase and to develop its expertise in post-accident conditions, particularly as regards its mobile response and measurement equipment. It has undertaken to renew its fleet of emergency response vehicles as well as those intended for measurements in the environment and on people. **I was greatly impressed by the extremely modern technology, making it possible to cover a broader field of investigation**, and I naturally hope that the equipment upgrade programmes will help them reach their objectives.

I strongly encourage the coordination of these resources with those of accident response robot group INTRA which jointly belongs to EDF, AREVA and the French Atomic Energy Commission (CEA).

An organisational system in which every link in the chain is important

During exercises, as in actual emergencies, **all those involved need to properly play their roles.**Some are well trained and highly capable, while others have less experience, but all are equally indispensable in emergency management. Here, once again, **it is the weakest link that determines overall strength**. I cannot encourage EDF enough to take a proactive attitude with the latter and attempt to raise awareness of these issues, and delegate its best technical advisers to them. I have observed that it is a permanent goal to develop relations, particularly with the "Prefectures". This is a necessary investment.

Finally, **during visits to plants outside France**, I have taken an interest in their emergency management systems (see Chapter 20, Section 2). I have noticed the emphasis placed on this line of defence, the involvement of the players, as well as the originality of certain technical measures. Beyond organisational differences, here again, benchmarking can be extremely useful and assist us in further improving our ultimate line of defence.

In conclusion, organisation and management of emergency situations relies on a set of skills, procedures and resources which all need to be continually upgraded. The rule sets are changing and the turnover of certain players is frequently rapid, **we need to regularly check the adequacy of the skills and to test the strength of the organisational structure** by means of exercises reflecting the diversity of the possible scenarios. Concerning this point, the experience feedback loop needs to be properly closed, not only in EDF emergency planning but also on a national level.

EVENTS AT EDF

19.1 – Unintentional extraction of two fuel assemblies at Tricastin Nuclear Power Plant

While lifting the reactor vessel upper internals prior to fuel unloading, two fuel assemblies got hooked to them and were partially extracted from the core. The fault was detected at a very early stage by a camera used to monitor the operations so the lifting operation was halted while the lower parts of the fuel assemblies were still within the core.

Ever since a similar even occurred in the Nogent Nuclear Power Plant in 1998, cameras have been specially installed in the bottoms of the pools to enable surveillance of the operation.

After the incident, the reactor building was evacuated as a precautionary measure in view of the radiological risk represented by possible damage to the fuel assemblies if they broke free. The containment of the reactor building, required during the fuel handling operations, was maintained.
Pre-alert measures were rapidly deployed to assess the potential radioactive consequences of such a situation, to determine what protective measures needed to be taken, and to muster the appropriate teams to handle the situation if either of the fuel assemblies were actually to fall.

The Basic Design Department (SEPTEN) demonstrated the absence of any criticality risk should the two fuel assemblies fall into the existing core. In collaboration with IRSN, it was also proved that there would be no external radiological impact. If the fuel assemblies were to be damaged, any radioactivity released from them would remain contained in the reactor building.

Protective measures were taken, notably permanent surveillance of the fuel assembly positions and operation of the pool cooling pump. These measures made it possible to lift the pre-alert arrangements.
It was then necessary to quickly make and prepare special equipment to securely maintain the two fuel assemblies in position and eliminate any risk of dropping. To determine the best solution, three contractors were given the task of developing the special equipment and the procedures necessary for the different phases of the operation. After analysis, not one but two contractor solutions were adopted in order to have a Plan B. The two procedures were then qualified at the PWR Nuclear Steam Supply System Fieldwork Technical Validation Experimental Centre (CETIC), with approval from the ASN and IRSN.
A mistake in the distance measured between the mating plane of the reactor vessel and the lower plate of the upper internals required modifying and requalifying the special equipment, with the result that the schedule had to be extended by two weeks.

The operation to secure the fuel assemblies was completed without difficulty, and they were separated from the core upper plate then removed in the normal way to the fuel building with no consequences of any kind.

Here I describe the manner in which the event developed and the technical problem was solved, as I consider them to be exemplary due to proper regard for nuclear safety requirements. Despite the strong impact of the event on the unit's operability (outage extended by 9.6 weeks), nuclear safety

always took priority. The different teams of experts were mobilised and the contractors consulted were particularly responsive.
However, when such an event occurs, consideration needs to be given as to how it arose. Detailed examination of the French and international experience feedback has shown the abnormal binding to the upper internals was due to excessive friction between the core upper plate pins and their housings in the tops of the fuel assemblies.

Instructions had to be issued in the light of experience feedback on an event that occurred at the Nogent Nuclear Power Plant. These required checking that at the end of refuelling in the previous cycle, the clearance between adjacent fuel assemblies in the core did not exceed 10 mm. This criterion guarantees that the pins can be inserted into their housings without force. A procedure involving a video camera was devised for checking that the criterion was met.
On viewing the corresponding video recording, it became apparent that, in the case of the two fuel assemblies involved in the event, the clearance criterion was not met.

Remote video examination of the reactor vessel internals after the event revealed the origin of the excessive clearance between the two fuel assemblies. One of the two was incorrectly positioned in its housing when loaded into the reactor core because a foreign object (a bearing ball) had lodged there, causing the fuel assembly to tilt slightly, resulting in excessive clearance relative to the neighbouring fuel assembly.

It is clear that full and rigorous use of the experience feedback on the event in 1998 would, no doubt, have made it possible to avoid the unintentional extraction of the fuel assemblies, even though the check was on the critical path for reactor restarting.

19.2 – Steam generator behaviour

I return to the issue of nuclear safety versus operability in the case of the steam generators, as the subject remains topical.

It is to be remembered that, in a pressurised water reactor, the heat released in the core is transferred to a secondary cooling system via a heat exchanger/ boiler referred to as a steam generator, which produces the steam that drives the turbine. In the steam generator, reactor coolant circulates in U-tubes, which together make up the tube bundle. Secondary-side water circulates outside the tubes, by which it is heated and transformed into steam.

Last year, I detailed the issue of **the partial clogging of the spacer plates in certain steam generators** with metallic oxides resulting from secondary-side corrosion and erosion. This year, I will be concentrating on the technical response to this difficult problem.

I will then consider the unconnected problem of **vibration-induced fatigue affecting or liable to affect certain steam generator tubes** which has resulted in large-scale conservatory measures.

I note that, like many of the other heat exchangers used in industrial processes, steam generators are intrinsically sensitive components. Their in-service behaviour depends on the care with which they are designed, built and operated. Any shortcomings or omissions in any of these areas will have repercussions. To re-establish all the nuclear safety margins, it has become necessary to reduce steam generator performance levels by de-rating and tube plugging.

Clogging of steam generator spacer plates

In a steam generator, the tube bundle is a tall structure that is held rigid by spacer plates at regular intervals.

The plates must allow the circulation of the steam and water mixture outside the tubes and are therefore provided either with holes of four leaf clover shape where the tubes pass through them or with holes in the other parts of the plates.
Clogging corresponds to the partial or total blockage of the circulation holes with erosion-corrosion products from the secondary-side circuits, which degrades steam generator operation with a perceptible impact on its thermal efficiency and potential consequences in terms of nuclear safety.
I have observed that, in this case, the company took the full measure of the problem and undertook to solve it completely with due regard for nuclear safety and the industrial safety of its operatives, at the cost of reduced plant operability in the short term.

Chemical flushing of the steam generators

Chemical flushing is used to eliminate, or at least very substantially reduce, the clogging of the spacer plates. This is the only process that is truly effective. Two chemical flushing processes were developed, one by AREVA and one by Westinghouse , and ten of the fifteen nuclear units involved had been treated by one or the other by the end of 2008.

During my visit to a nuclear plant affected by steam generator fouling, I came to realise the sheer industrial scale of such flushing operations and how the simple expression "chemical flushing" did not convey the complexity of the procedure.
Flushing steam generators actually involves building a large temporary industrial installation inside the plant. This installation has its own power supplies, control systems and storage capability for the reagents used and the effluents created. Extensive work is required to set it up: apart from erecting the main system components which necessitates freeing up a substantial amount of space, the troughs and ducts need to be built to install the impressive pipework connecting the flushing installation modules together and to the steam generators to be treated.

Flushing takes place in successive stages (copper removal, deoxidation, lancing etc.) followed by re-qualification tests. Between two and four tonnes of magnetite and some one hundred kilograms of copper are commonly removed from a fouled steam generator by dissolution. Such operations are carried out during unit outages and have a substantial impact on their duration, extending them by thirty days.
Finally, **I am not surprised that these operations have attracted the close attention and the vigilance of the Nuclear Safety Authority,** as chemical flushing involves challenges for nuclear safety, industrial safety and protection of the environment.
While it is necessary to dissolve the deposits clogging the plates, flushing must not harm either the steam generator tubes or the pressure shell walls. Furthermore, the operation must not represent any chemical or radiological risk for the environment.

In view of the dangerous nature of the reagents and the industrial process involved, special precautions are taken which notably require the presence of firemen on the spot.

The plant I visited was getting ready to implement the Westinghouse process for the first time in the EDF facilities. I was able to meet the joint task force composed of people from the plant and the Nuclear Equipment Engineering Department of the Nuclear Engineering Division which was formed for the occasion and I appreciated the cohesiveness, professionalism and dynamism of the members.

State of progress, state of the art

At the end of 2008, seven 900 MWe and three 1300 MWe nuclear units out of fifteen had been treated. For those to be treated in 2009, 2010 and 2011, their temporary de-rating will make it possible to re-establish the nuclear safety margins.

Special video devices have been developed to better assess the scale, nature and location of fouling in the steam generators and to subsequently determine the effectiveness of flushing.

In the fouled steam generators of the 900 MWe series, the scale of the fouling, its distribution and the quantities of copper and magnetite removed by flushing provide a clear overall explanation of the behaviour of these devices before treatment. Flushing makes it possible to re-obtain their rated characteristics.
Examination of the units treated in 2007 after one year of operation has shown good states of cleanness and has provided overall validation of the approach. However, during the cycle that follows flushing, copper can be re-deposited on certain tubes and result in perturbing the results of periodic eddy current testing. If doubts subsist, testing using ultrasound probes can provide additional indications, but the ASN requires additional guarantees. Accordingly, it has requested that some of the tubes affected by copper re-deposition be removed for examination.

In the fouled steam generators of the 1300 MWe series, compared with those of the 900 MWe series, plate clogging is apparently less extensive and is distributed differently. Correlation is weaker with pressure loss across the secondary side of the component of which the recirculation ratio, which can be calculated, gives the overall measure. Flushing brings this ratio back into the operating range.
Apart from plate clogging, video examination has shown the fouling of certain tubes and the presence of debris in the four leaf clover shaped passages due to the fouling scaling off.
This debris could still be observed after flushing, although there was less than before. It may possibly offer a better explanation for the behaviour of the 1300 MWe series steam generators.
I shall be closely following the current studies intended to gain a closer understanding of the phenomena and to better assess their impact.

Prevention

I have observed with interest the rising interest in international experience feedback on steam generator fouling and clogging. Although little data is available, it shows that equivalent situations to those in the French plants are occurring. **Other operators appear to practice regular mild chemical flushing as part of the preventive maintenance on steam generators** and it is therefore not the subject of special reports. This treatment at the source seems to be a particularly effective solution for problems such as fouling and clogging.

Sharing experience with other operators shows that fouling can initially be prevented by operating at a high pH (depending on the type of secondary-side materials) and especially maintaining the water chemistry within a narrow range (particularly as concerns the iron content).
Experience sharing has also revealed the difficulty of circumscribing the physical and chemical phenomena of erosion and re-deposition in the systems and components that result in plate clogging and tube fouling.
I have taken good note of the fact that mild chemical flushing processes are already being considered for the French plants, either for treating steam generators exhibiting limited clogging or as a regular maintenance practice.

Player synergy

I once again observed that when confronted with such a situation, the operators, the EDF engineering services and the vendors have their finger on the pulse. Their responsiveness in analysing the situation

and rapidly applying robust, effective industrial-scale countermeasures has been a determining factor in solving this difficult problem, without nuclear safety being compromised.

The ASN and IRSN were kept informed in real time and took an active part in assessing the potential consequences of steam generator problems for nuclear safety, as well evaluating the countermeasures proposed by EDF.

Lessons to be learnt

These mainly concern the quality of operation as they once again highlight the need to be attentive to weak signals combined with a questioning attitude.
The operating parameters need to be more pertinent in the light of experience feedback that should be more widely researched and the conclusions more scrupulously observed, e.g. the secondary-side water chemistry must be monitored more frequently and more accurately.

As concerns the steam generators of the EPR-type reactor and the steam generators that are to be used as replacements in the existing facilities, I have taken good note that clogging experience has been taken into consideration, as far as progress with design and fabrication has allowed, in particular as concerns the inspectability of the spacer plates.

Vibration-induced fatigue in certain steam generator tubes

The steam generator tube bundle guiding provided by the spacer plates in the standard sections is supplemented with a set of anti-vibration bars at the top (the U-bend).
An event that occurred in a foreign plant in 1991 revealed the risk of vibration-induced fatigue fracture of certain steam generator tubes in the upper part of the bundle in the area where the anti-vibration bars were ineffective because they were not correctly positioned.
It is to be remembered that incorrect positioning of the anti-vibration bars can be caused by incorrect initial installation or by their movement during transport or the maintenance of the steam generators.

In the light of this event, a review of the tubes in similar situations was made in the French steam generators. Analysis of the risk of cracking due to vibration-induced fatigue was then made and some of the tubes were plugged as a preventive measure.
However, it was among the tubes identified as not being supported by anti-vibration bars and not being plugged as they were found to be risk-free by vibration analysis, that a leak recently occurred in one of the steam generators of the 900 MWe French plants.

This leak led to reassessing the conclusions of the vibration-induced fatigue analysis made at the time. The reassessment showed that the numerical model used as a basis for calculation had been extrapolated from another type of steam generator and that its application was not meaningful in the case of degradation mode studied.

Consequently, a set of preventive measures were first applied in the unit affected and then in all the units of the 900 MWe series in order to maintain the level of safety.
This constitutes a major tube plugging campaign which is carried out at the time of refuelling outages. Pending the next outage for refuelling, de-rating has been introduced in the units in service with the intention of reducing the vibration-induced fatigue risk. Surveillance has also been stepped up to detect any leaks from the tube bundle as early as possible.

I note with satisfaction that when **faced with a technically challenging situation, the Nuclear Operations Division and its specialist advisers moved quickly to present the ASN with an assessment of the situation indicating qualities and quantities,** as well as a coherent set of solutions for re-establishing the nuclear safety margins.

The ASN has thus been able to rapidly obtain a set of up-to-date calculations used as a basis for proposing a tube plugging campaign with different provisions for the different types of steam generators in the 900 MWe facilities, which actually do not have the same margins available in terms of vibration-induced fatigue.
However, I would like to point out that a technical consensus has not yet been reached despite the voluminous dossiers submitted by EDF. Consequently, the ASN has requested identical treatment for all the 900 MWe unit steam generators, i.e. massive preventive tube plugging except in the nuclear units whose steam generators have been replaced.

I observe that the practical consequences are significant as, after such a campaign, the percentage of plugged tubes in certain steam generators has become substantial. To meet the nuclear safety criteria, this will result in earlier replacements, reducing the power levels of certain nuclear units and, in one particular case, in not implementing a new fuel management system.

Compared to the steam generators of the 900 MWe series, the others have intrinsic margins by design with regard to vibration-induced fatigue of the tubes. These margins are high in the 1300 MWe series and slightly lower in the 1500 MWe series.
Despite the existence of unsupported tubes, these margins should make it possible to avoid preventive tube plugging. This is EDF's opinion on the matter, which has been submitted to the ASN though no final decision has been issued as yet.

In conclusion, finding the optimal balance between nuclear safety and operability is vital for the steam generators, which stand at the interface between the primary and secondary cooling systems. It is in such situations, which by nature are difficult, that meaningful dialogue between the ASN and the operator can enable common ground to be reached in total confidence.

19.3– A case of reactor building evacuation

There is currently an average of 140 reactor building evacuation alerts during unit outages per year. About 80% of them are false alarms caused by radiation monitor faults and do not result in the actual evacuation of the building.

However 20% correspond to actual radiological situations that are grounds for evacuation. I would like to mention an event that occurred in Unit 4 of the Tricastin Nuclear Power Plant because much can be learnt from it.

The situation

During outage work in the reactor building, radiation levels are permanently checked by monitors that measure the dose equivalent rate and the specific atmospheric contamination in the building. Some ten monitors are installed. These monitors continuously measure the parameters, one being relayed to the control room and the others being used locally. Three alarm thresholds are set to enable a staggered response: warning of the situation, followed by to a request for investigation, and finally a call for immediate evacuation of the reactor building. The alarms are signalled locally by flashing lights and hooters.

The steam generator tube inspection work area has a high contamination potential, as the steam generator water boxes are open. After draining the reactor coolant system, moisture and deposits may remain on the tube surfaces. Air circulation can activated materials on the tube surfaces of the tubes coming into suspension and being carried away.
To reduce the dose equivalent rate and contamination of operatives during the work, the reactor coolant system is treated before being drained. The operatives work in the water boxes for very short periods of time and wear bubble suits. Airlocks are installed at the water box manholes. Special equipment is installed to establish a negative pressure differential in the space consisting of the airlocks, the water

boxes and the U-tubes. These systems are connected to the main reactor building ventilation system, with the air being filtered and monitored before being discharged into the atmosphere. This system prevents radioactivity escaping from airlocks into the reactor building where other work is proceeding.

The event

On Tuesday 22 July, Unit 4 was shut down for maintenance. The core was unloaded and the level in the reactor coolant system was reduced to the inverts of the primary pipes. This standard configuration makes it possible to carry out checks on steam generator tubes.

The initial signals (first threshold) transmitted by the No. 3 steam generator atmosphere monitor were received as of 21:00 then another monitor installed at Level -3.50 m in the reactor building detected contamination corresponding to the first threshold. These signals indicated the presence of radioactive aerosols.
Early the next morning, the aerosol monitor located at Level +20 m in **the reactor building** "failed", apparently for technical reasons (power supply batteries flat and logger problem). It was replaced. The same phenomenon occurred in the **No. 2 steam generator bunker**. These alarms were independently assumed to be monitor operating faults by two different operatives. They did not mention the matter to each other or make a connection with the events on the previous evening.
Later in the morning, another aerosol monitor located at **Level +20 m in the reactor building** set off two more alarms. The first was attributed to a nearby operation involving handling of radioactive equipment. The second related to the aerosol spectrometry process. An ambient dose rate check on the spot "confirmed" that the cause probably was a monitor fault.
A number of alarms were then triggered in the reactor building, **in the No. 2 reactor coolant pump bunker**, in the **No. 3 steam generator bunker**, at **Level +20 m** and finally **the inter-shell gap at +8 m**.
The different areas concerned were locally evacuated on each occasion when operatives where working there. It is to be noted that the alarm thresholds were still all below building evacuation level. As it was still early, there were few operatives working the reactor building.

The fact that one monitor was persistently indicating a level above the first threshold (although lower than the evacuation threshold), as well as all the different events that had occurred during the night, then a led a radiation protection technician to initiate evacuation of the reactor building at 09:30. At 10:00, ninety seven operatives who had begun work in the meantime were evacuated and given whole-body scans.

Analysis of the causes of contamination

A search for the root causes of the alarms was made. Containment of the No. 2 and 3 steam generator work areas was suspected. After checking, the pressure differential equipment was found to be incorrectly installed and badly used. Low-intensity contamination was able to escape throughout the night.

I consider this event to be a sign of disorderliness in the work areas and failure to properly use the radiation monitoring systems in the reactor building.

The aftermath

In view of the contamination levels measured, the event had no consequences either on the health of the operatives or on the environment. It was therefore graded Level 0 on the International Nuclear Event Scale by the Nuclear Safety Authority.

The emergency team sent information about the event to the Nuclear Safety Authority, the county council, the Local Information Commission (CLI), the town halls in the area and the local press in accordance with the sub-On-Site Emergency Plan instructions in the event of reactor building evacuation. A plant medical team was mobilised for support.

What are the lessons of this incident?

First of all, it seems to me that we need to **find ways of reducing the number of events that result in the evacuation of work areas, or at least the entire reactor building**. This means increasing the reliability of the monitors and the way they are used. **In the event of an alarm, a questioning attitude needs to be maintained**, and it is not sufficient to make assumptions and cancel the alarms of the measuring, monitoring and alerting equipment. The alarms need to be credible, and need to be accepted as such.

In a reactor building during a unit outage, there is clearly a need **for centralised supervision throughout the day** which is capable of on-the-spot analysis and collation of information on all radiological events. It therefore needs to be supplied with **radiological data concentrated on a single point of utilisation on a continuous basis**.

The work areas involving risks of contamination should be more orderly and checked more rigorously, particularly as concerns the conformity and proper operation of the radiological protection devices (sealing of airlocks and ventilation systems, proper functioning of pressure gradient equipment, the watch over alerting devices etc.).

Out of the approximately one hundred operatives that were checked as a preventive measure, only **around twenty were the subject of additional monitoring by the plant physicians' medical services**. This back-up of a psychological nature appears to be helpful in such situations, even though actual contamination may be low.
Finally, I think that the situation would have been identified and processed faster by the Radiation Protection Surveillance Station (PSRP) which is being developed by the Research and Development Division as part of the project to introduce new technologies into plants in service (INTEP) (See Chapter 3).

VISITS ABROAD

20.1 – Japan

This year, I visited the Kashiwasaki-Kariwa Nuclear Power Plant at the invitation of the Japanese operator TEPCO. During my trip to Japan, I also visited the Hamaoka Nuclear Power Plant operated by CHUBU EPco and the Japan Steel Works (JSW) plant in Muroran.

Kashiwasaki-Kariwa Nuclear Power Plant

This is the largest nuclear power plant in the world, with five 1100 MWe boiling water reactors and two 1350 MWe advanced boiling water reactors commissioned between 1984 and 1997, located on the Sea of Japan, north-west of Tokyo. I had already visited this impressive plant in 2003.
In July 2007, it was struck by the powerful Chuetsu-Oki earthquake and since then, **the seven nuclear units have still not been re-started.**
In my previous report, I described this remarkable event, which can be summarised as follows. This earthquake was rated at 6.8 on the Richter scale, and its hypocentre (point within the earth where an earthquake rupture starts) was only 23 kilometres from the site.
The damage in the region was heavy, as well as in certain non-nuclear parts of the plant, and impressive footage of an electrical transformer on fire was shown non-stop by the media throughout the world.
The nuclear islands and the turbine halls resisted the earthquake well and the reactors on power were shut down normally, with no significant consequences for the environment. However, recordings of the accelerations measured at different points in the plant indicated that the seismic values used in the design basis had been substantially underestimated.

My observations

I was welcomed at the plant by TEPCO officials in charge of the post-earthquake phase. In June 2008, the site was buzzing with activity; repairing the parts affected and carrying out investigations intended to identify and quantify the damage caused by the earthquake, particularly in the nuclear parts of the installations.

I followed the route prepared inside the site so that visitors, particularly the local inhabitants, can come and see the damage for themselves. Every day, some 200 people take this route which runs outside then inside the buildings, leading as far as one of the reactor vessels; even though the limits of such an approach are clear, it is a sign of TEPCO's desire for openness.

The impact of the earthquake is still clearly visible outside and has created spectacular steps in certain corridors between the buildings; it is also impressive to see the bent steel framing of a shelter protecting the water circulating pumps of one of the intakes. One 600-tonne transformer broke free and moved more than 60 cm, necessitating its return to the factory for repair.

The surveillance cameras permanently watching the pools inside the reactor buildings recorded a spectacular wave that was produced during the earthquake. However, inside the turbine hall and the reactor building that I visited, I was surprised by the total absence of any visible damage. One can only be struck by the difference, even though it may just be a first impression that needs to be subsequently qualified.
During my visit in 2003, **I was particularly impressed by the quality of the design and construction of the installations** (masonry, components, pipework and cabling) and I can only associate this finding with their excellent resistance during the earthquake.
More precisely, the general layout of the equipment and systems, originally intended to facilitate their operation and maintenance, as well as the very high level of housekeeping (the installations are clean, well-lit and accessible, with heat insulation that is easy to remove and lay aside) is greatly facilitating the current investigations.

Restarting of the installations

The economic importance of the plant is perfectly clear, as it represents 10% of Japanese power generation, not to mention the guarantees that will be necessary before it can be put back in service.
Of course, the installations could be re-started without first making a detailed assessment of the actual consequences of the earthquake. Amongst other things, this needs to cover the integrity of the nuclear systems and components, as well as simulation calculations to determine the actual loadings to which they were subjected.

Another equally important aspect of the case is re-assessment of the seismic loading. This requires full understanding of the active faults in the region, as well as their possible combined effects. A new seismic level has thus been established which is considerably higher than that used in the initial design basis. This will therefore require making new design basis calculations and providing reinforcement where necessary.
As a result of the proximity of the hypocentre and size of the plant, **the seven nuclear units did not feel the effects of the earthquake equally** and differences were considerable. This particularity makes is it possible to envisage selective restarting. This principle has been accepted by the national and local authorities.

Other lessons

In my 2007 report, I explained the initial lessons learnt from the event relating to nuclear safety and environmental impact. Apart from the direct implications of taking into account the earthquake in the design basis of the installations, other points were emphasised: fire prevention and fire fighting (resistance of fixed installations and difficulty of response by outside resources already in high demand elsewhere), increasing the reliability of emergency management logistics (resistance of connected networks and facilities, and the availability of paper documentation as a backup) and the quality of communication with the outside. Those I spoke to said that specific arrangements had been made concerning these points.
It should be remembered that, in the spring of 2008, an international conference on earthquake engineering was held in Niigata, a town close to the plant which served as the backdrop reminding us of the importance of dealing with such violent earthquakes. EDF specialists and managers participated in this event.

I will be following with great interest the efforts made by TEPCO, which is not seeking to minimise the scale of the task or the obstacles that need to be overcome before restarting the reactors in total nuclear safety.

Hamaoka Nuclear Power Plant

Hamaoka Nuclear Power Plant is operated by CHUBU EPCo. Situated South-East of Tokyo on the Pacific Coast, it comprises five boiling water reactors commissioned between 1974 and 2005. They represent the different technical series of this type of reactor, the last being an advanced boiling water reactor rated at 1350 MWe. A projected sixth nuclear unit has to face the lack of space on the site. Amongst other things, I observed that the plant was preparing to load MOX fuel into Unit 4 in 2010, and that it desired to develop contacts with operators with corresponding experience, such as EDF.

A "pedagogic" interface

The plant is very well maintained and **the level of housekeeping appeared to be excellent** in the parts that I visited, as is the case everywhere in the Japanese nuclear industry.
The visitor reception centre is spectacular: there is a lofty belvedere offering a panoramic view of the site with Mount Fuji in the background, and a cut-away full-scale model of a 1100 MWe boiling water reactor and the containment vessel. The level of detail makes the model remarkably realistic, and makes it a valuable teaching resource, even for professionals.
This visitor centre, which is extremely popular, also shows other sources of energy. It should be pointed out that only 18% of the power generated by CHUBU EPCo. is of nuclear origin.

Constraining seismic standards

As part of the seismic design review (begun after the Kobe earthquake in 1995), the review relating to the Hamaoka site was revised upward after reassessment of the potential harmfulness of certain known faults. Consequently, the first two units have been shut down for a number of years. In the three other units currently in service, **substantial reinforcement work has been undertaken** on the basis of hypotheses that are more stringent than the regulations require.
The plant engineering manager showed me the logic of the new paraseismic approach and reinforcements that were necessary. Some of these are highly visible, such as the structures supporting the high discharge stacks.
This proactive approach has made it possible to offer a credible response to opponents calling for closure of the plant due to the seismicity of the region.

The plant in its environment

To provide support for operations and maintenance, the plant makes wide use of outside contractors. It seeks to maintain local loyalty in the skills necessary for continued operation and better assure their renewal. This concern extends to contractors, in view of the importance of their role. At the same time, to rebuild the workforce, which is currently at a historical low, the plant is once again recruiting and intends to maintain this policy in the medium term.
Accordingly, a "Hamaoka, my Plant" campaign targeting the general public was launched by the management with the staff and contractor workers as spokesmen.
The values stressed are respect for nuclear safety standards and the need for openness about plant operation. Successfully passing on skills from one generation to the next is another clearly announced objective.

In this context, the desire to keep staff and contractor fully informed is clear, especially so that they can bear witness; staff not directly involved in the issues covered are encouraged to participate in internal meetings, particularly one held every morning that is broadcast live on the internal television network. Technical and economic data that re-situate the plant and company activities in the local context are also communicated.

Operations

To run the installation, five teams work two 12-hour shifts (two on duty, two resting and one in training). For every nuclear unit, there are eight staff per shift, four of whom are permanently posted to the control room.
The local training centre has three simulators which are exact replicas of real control rooms, corresponding to the three technical series at the plant respectively. These make it possible to train the operating personnel and maintain their skills. Initial training takes place in a national boiling water reactor centre, but it is the company that issues the final authorisations.
There is also a maintenance training centre with an enactment training facility available to contractor staff.
Surprisingly but very interestingly, there is what is called a "study room of technological transfer", which contains **records and mementos of the consequences of operating errors** (explosion and electrical hazards) **that have occurred since plant start-up**. Cutting from the local press telling of the events can also be found there. This exhibition is an excellent teaching tool, intended to avoid the repetition of errors and remind the operator that industrial-scale operation requires vigilance at all times.

The visit was extremely instructive and particularly well prepared by our Japanese colleagues, who wished to openly discuss a wide range of technical, organisational, managerial and also societal issues, particularly local acceptance of nuclear plants.

JSW forges and foundries at Muroran

In Hokkaido, I visited a one hundred year old factory which alone represents the future of nuclear engineering worldwide. The forge, the place where everything begins!
I was received by a team of managers who were particularly proud to give me the latest news and show me their projects. With cutting-edge capability and know-how, combining the traditional with the modern, and solid experience in the different construction codes (ASME and RCCM), **JSW will**, for a long time to come, **remain the key player when it comes to fabrication of certain heavy forgings** used in the construction of primary and secondary equipment for most nuclear power plants with high ratings.

The increasing number of projects in this field has encouraged JSW to bring forward **a major investment programme** (extension of the steelworks, construction of a new high-capacity press, significantly increasing the pre-heating facilities, doubling the machining capability etc.).
I visited an impressive factory where the available production capacity was being used for fabrication work relating to major nuclear projects (new and replacement equipment) for Japanese, American, European and Korean clients. It is to be noted that JSW is making certain parts of the EPR-type reactor pressure vessels for AREVA (Olkiluoto 3, Flamanville 3 and Taishan 1 and 2) and components for EDF plant replacement steam generators for Mitsubishi and AREVA.
JSW sees the demands of its clients as a spur to progress, but nevertheless made the point that complying with certain aspects of the French regulations (notably those related to the nuclear

pressure equipment order) is extremely constraining technically and can involve know-how, which may be problematic. Such difficulties have been encountered with the parts destined for replacement steam generators but not for the EPR-type reactors.

In the factory, I met one of the representatives from the Construction and Operation and Expert Appraisal and Inspection Centre (CEIDRE) responsible for the EDF in-shop inspection on the Japanese contractor's premises. On this occasion, I saw how important this job is in getting EDF's requirements met, and I noted the high regard that his Japanese counterparts had for him.

Like many other industrial concerns, JSW is having to cope with the retirement of highly experienced staff and needs to maintain and develop its skills. These were actively and (conservatively) maintained during the long period of empty nuclear construction work order books, by passing on the know-how of successive generations of experts to ensure its permanent availability.
JSW has a regional recruitment policy which it continues to find fully satisfactory.

In conclusion, JSW has achieved international excellence by maintaining a long tradition of continuous progress.
Sabres, the first products of the factory in the nineteenth century, are still produced at the Muroran site, using ancestral techniques and I was able to see the smiths at their work. This example of the transmission of the best techniques and the permanent quest for the highest levels of quality is emblematic of JSW's success in its broad industrial field.

20.2 – Slovakia

In Slovakia, nuclear facilities are being built, operated and decommissioned. I visited the headquarters of Slovenske Elektrarne, the Slovakian electricity company at Bratislava, and the Bohunice and Mochovce Nuclear Power Plants, as well as the company JAVYS in charge of decommissioning the facilities that have been finally closed, as well as of radioactive waste treatment and disposal.

Visit to Slovenske Elektrarne headquarters in Bratislava

The Slovakian electricity company (66% ENEL and 34% the Slovak state) produces 90% of the power consumed in Slovakia, of which 70% is nuclear origin and supplied, amongst others, the electrical power distribution company Stredoslovenska Energetika-SSE, a 49% subsidiary of EDF.
Slovenske Elektrarne operates two nuclear reactors at Mochovce Nuclear Power Plant and two at Bohunice Nuclear Power Plant, where there are also three awaiting decommissioning. There are two uncompleted reactors at the Mochovce site, construction of which began in 1985. ENEL has made a commitment to completing their construction.

Organisation of nuclear safety

The 2006 Atomic Act re-organised nuclear safety. In accordance with the Act, a license for operation was granted to the Slovenske Elektrarne Board of Directors . Another Act provides for free access to information for the public and specifies the conditions under which the operator provides information on events relating to nuclear safety.

Internal inspection is handled by a dedicated body dubbed "NOS" which stands for nuclear oversight. This is an independent unit for review of nuclear safety of the company, and consists of eight peers with operating and regulatory experience and one ENEL representative. It is outside the line management, making assessments and performance reviews, as well as issuing recommendations to the production facilities.

It also produces an extremely condensed monthly report for the Chairman of the Board of Directors, the ENEL inspector-general for nuclear safety and the Nuclear Safety Advisory Committee consisting of external foreign personalities.

Throughout the year, the Slovakian nuclear safety authority makes scheduled and unannounced inspections. It has resident inspectors at all the plants.

Training of accredited staff

Training is provided by a company that is independent of Slovenske Elektrarne (VUJE Training Centre). The training process is approved and checked by the safety authority. A training license accorded to VUJE for five years, on condition that it possesses qualified instructors and operational simulators for the period.
The safety authority issues three-year licenses to the main players in the field of operations (shift supervisor, unit supervisor, operator, fuel core engineer and safety engineer) after they have passed a series of written and oral tests, as well as a simulator test.
I observed that **extremely demanding psychological tests** are carried out during recruitment which are then repeated every three years to assess ability to withstand stress.
The operator is required to provide training for subcontractors in the fields of operational nuclear safety, radiation protection, emergency preparedness and industrial safety. This training is conducted by VUJE, partly in the plant. General information on the plant is supplied on the occasion.

Engineering

Slovenske Elektrarne has a nuclear engineering team of around one hundred people that provides the plants with support in improving their levels of profitability and nuclear safety, and assesses the technical performance of the installations. It handles interfacing with the vendors.
The new plant lifespan goal is sixty years.

Maintenance

The company's goal is to **optimise not only maintenance** but also investments and modifications, notably by predictive maintenance and proper use of experience feedback.
Maintenance was centralised in 2005-2006 and will now be decentralised in 2009, with responsibility being entrusted to the plant directors.
Maintenance staff are based in the plants and move from plant to plant as needed.

As concerns subcontracting, I noted that the current trend is for **the re-internalisation of certain activities** as the plants have had difficulty in finding good subcontractors that are available.

Plant security

Security is provided by around one hundred armed guards. There are agreements with the local police. Biometric checking will be operational by 2009 in Mochovce Nuclear Power Plant and by 2012 in Bohunice Nuclear Power Plant. I observed that dogs were widely used.

Fire

For fire fighting, each plant has a fire station that is heavily equipped with mobile response equipment and has a team of some sixty firemen. Response times are extremely short: not more than five minutes for the most distant installation.

Bohunice Nuclear Power Plant

Bohunice Nuclear Plant is situated in the west of Slovakia, in the district of Trnava. It comprises three nuclear facilities: A1, V1 and V2.

Nuclear Facility A1

Nuclear Unit A1 is rated at 150 MWe and was commissioned in 1972. It was finally closed in 1977 after an accident rated Level 4 on the International Nuclear Event Scale during reactor refuelling. It is currently being decommissioned.

Nuclear Facility V1 (EBO 1 and 2)

This consists of two Russian first-generation VVER (V230 model) 440 MWe (gross) pressurised water reactor units commissioned in 1978 and 1980.
Final closure of the two nuclear units was as a condition for Slovakia's admission to the European Union. The formal decision was made in 1999. Although the two units were the subject of a major refurbishment programme costing 300 million dollars, they were abandoned as planned, Unit V1 being finally closed at the end of 2006 and Unit V2 at the end of 2008.
Those I spoke told me that this was a political decision that was not justified on safety grounds, and that the nuclear safety authority had renewed their operating licenses.

Nuclear Facility V2 (EBO 3 and 4)

This consists of two Russian second-generation VVER (V213 model) 440 MWe (gross) pressurised water reactor units commissioned in 1984 and 1985.
Major modernisation work, particularly on the reactor protection system has been carried out on the two units. In 2008 power on Unit 3 was increased up to 104 % and in 2009 both units will reach 107% following completion of modifications to the secondary side including cooling towers. The two units operated in 2007 with an average operability of around 72% mainly caused by prolonged outages associated with the modernization programme.

The number of significant safety-related events declared has risen, as the criteria for declaring events have changed. On average, there has been one scram per year for the two units combined. None occurred in 2007.

The collective dose is low: 0.30 man-sieverts per unit in 2007.

Decommissioning

After studies were made, the fast decommissioning option was adopted. The first decommissioning phase for Facility A1 began in 2007. For the nuclear units of Facility V1, this is planned to begin in 2012.

The national company JAVYS (Jadrova Vyradovacia Spolocnost) was formed in July 2005 to plan and carry out the decommissioning of nuclear plants and handle the treatment of radioactive waste from all nuclear facilities.

A legal link was established between decommissioning and waste, and a management strategy for the different categories of waste was determined and implemented, with exclusion of long-lived high-level waste for which a solution remains to be found. JAVYS considers itself to be a forerunner in the field in Eastern Europe.
Accordingly, a repository for medium and low level waste has been operational on the Mochovce site since 2001. An interim storage facility for fuel in containers was built at Bohunice Nuclear Power Plant in 1983 and has been operational since 1987.

I noted that there is a release threshold for very low level radioactive waste.

JAVYS is responsible for the treatment of operating waste. Treatment and packaging is carried out for sub-surface disposal. Different techniques are used: incineration, super-compacting, concentration, decontamination and vitrification. JAVYS also handles the treatment of liquid effluents from the Bohunice and Mochovce plants.

Mochovce Nuclear Power Plant

Mochovce Nuclear Power Plant is located in the south of Slovakia, near the town of Nitra, 120 kilometres from Bratislava. It consists of two twin-unit facilities:

- Mochovce 1 and 2, two VVER Model V213 pressurised water reactor units. Their initial rating of 440 MWe was increased to 470 MWe in 2008.

- Mochovce 2 and 3, two units of the same type as Mochovce 1 and 2 of which the construction was never completed.

Mochovce 1 and 2 (EMO 1 and 2)

The construction of these two reactors began in 1983, and they were commissioned in 1998 and 2000 respectively.

Availability reached 90% in 2007, with significant progress having been made in reducing the durations of the unit outages (25 days in 2008). Although nuclear safety is claimed by the management as being the top priority, the middle management is highly focused on availability.
The number of significant nuclear safety events declared has been regularly decreasing for ten years. The results concerning scrams are just as good, being around **one every two years for the two units combined,** although none occurred in 2007.
The collective dose has fallen for three years in a row as a result of a decontamination programme. It is particularly low: 0.16 man-sieverts per unit in 2007.

The plant was the subject of **an Operational Safety Analysis Review Team evaluation in 2006**, and the follow-up visit took place this year. I noted that the plant provided a strong contingent of candidates for the WANO Operational Peer Reviews and the IAEA Operational Safety Analysis Review Teams.

The housekeeping is of a very high level. The installations are recent and constant efforts are made to keep them as good as new. The control room is spacious and modern. The auxiliary shutdown panel, located nearby, can be used to control the unit after dropping of the control rods.

Two operators and a reactor control assistant are on permanent duty in the control room to monitor and control the unit. The twin-unit facility has a simulator, an exact replica of the unit installations.

I spent a while visiting **the emergency management centre where I found the arrangement particularly interesting.**
The management teams regularly train at the emergency management centre during the weeks when they are on call. An annual seminar attended by the members of the emergency team and the plant management ensures that the latter are fully aware of the emergency management related activities. **To foster cohesion in the emergency management team, and to combat stress, an annual mountain self-sufficiency course is organised**, which is a veritable team-building exercise.
In the emergency management centre, all the procedures are available both on-screen and on paper. This reflects the experience feedback from the Kashiwasaki-Kariwa Nuclear Power Plant earthquake in Japan, of which the emergency management team has fully exploited all the lessons.
There are quarterly meetings with the administrative authorities involved in emergency response, and the nuclear safety authority is invited to attend. These enable the different players to get to know each other better and to make proper use of experience feedback.
Finally, **calendars are distributed to the local inhabitants** with explanations and practical recommendations about the action to be taken in the event of an incident.

Mochovce 3 and 4 (EMO 3 and 4)

The masonry was only 70% completed when construction was suspended in 1992. ENEL has recently made a commitment to resume work. Units 3 and 4 are to be of the VVER Model 213 type rated at 440 MWe, with substantial design upgrades compared with Units 1 and 2.

- improved surveillance, monitoring and protection functions,
- substantially reduced impact of the reference accident on nuclear safety,
- reduced on-site risks (fire, allowance for experience feedback),
- reduced off-site risks (earthquakes),

A group of six independent members, all from different countries, was given the task of assessing the nuclear safety concept of Mochovce 3 and 4. It submitted a report that was basically positive containing recommendations relating mainly to project management.
The European Union has also pronounced itself in favour of the project, provided the containment is reinforced against external risks.

Apart from accepting these recommendations, the nuclear safety authority has recently requested an additional study of the environmental impact, which will need to be made before an operating license is granted.
I made a very thorough visit of the technical installations of this twin-unit facility. **My hosts made a point of showing me the state of progress and conservation of these installations from the lowest levels up to reactor slab.**
Although the external finishes of the buildings have aged, **the interior where the primary components are installed still looks new.** The steam generators were in place, while the other main components, i.e. the reactor vessel and the reactor coolant pumps, are being stored in a site building and on the upper reactor slab respectively. Measures have been taken to preserve the equipment. The electrical power and the instrumentation and control systems have not been installed.

Compared with our pressurised water reactor units, these installations are bulkier and the civil engineering structures are larger, with an imposing building containing the sparger systems making it possible to discharge pressure above 1.5 bar in the immediate vicinity of the reactor via a bubble condenser.

According to my hosts, the major difficulty of the project resides in finding staff with the necessary engineering and construction skills.
As concerns operations, start-up of the two reactors is planned for 2012 and 2013, **and recruitment has been in progress since 2007 for all categories of staff**, particularly the instructors and operations staff. I noted that 70% of the candidates for the operator positions were turned down after psychological tests and that a university master's degree will be required for the operators, in the future.

In conclusion, the visit was particularly fruitful, and the managers I met had a real desire to explain their objectives and win over with their arguments. They showed me how a company with a small number of nuclear plants can solve, at its own scale, all the equations of the nuclear industry, and how local governance of an international group gradually becomes organised.

20.3 – The USA

In 2008, I visited the American nuclear operator **Constellation Energy**, the company on which EDF has based its strategy for the development of its nuclear business in the USA.
In mid-September, I went to the head office of **Constellation Energy**, then **Clavert Cliffs Nuclear Power Plant**, and finally the headquarters of **Unistar Nuclear Energy**, an EDF joint venture with Constellation Energy working on EPR-type reactor construction projects in the USA.

Constellation Energy (Baltimore, Maryland)

Constellation Energy is the foremost supplier of electrical power to large industrial and commercial clients in the competitive American market and the largest bulk supplier of energy. Its generating capacity is around 9000 MWe.

Its energy mix is 61% coal and 35% nuclear, plus 4% renewable energy and small oil- and gas-fired facilities. Its means of production are located in six States, in the East (including three nuclear plants) and the West of the USA.

Constellation Energy has three nuclear plants.

- **Nine Mile Point (**New York State) with **two BWR units (General Electric)**:
  one rated at 621 MWe commissioned in December 1969 which, from August 2009, will benefit from a 20-year license extension (August 2029) granted in 2004. This unit had an availability of 90% in 2007.
  one rated at 1135 MWe commissioned in March 1988. The unit had an availability of 94% in 2007, and belongs to Constellation Energy (82%) and Long Island Power Authority (18%).
- **R.E. Ginna** (New York State) with a **PWR unit (Westinghouse)** rated at 581 MWe commissioned in July 1970, which since September 2008 has benefited from a 20-year license extension (September 2028) granted in 2002. Its electrical power rating has been increased by 16%. This unit had an availability of 100% in 2007.
- **Calvert Cliffs** (Maryland) with **two PWR units (Combustion Engineering)**:
  one rated at 873 MWe commissioned in May 1975 which, since 2005, benefits from a 20-year license extension (July 2024) obtained in 1998. This unit had an availability of 98.7% in 2007.
  one rated at 862 MWe commissioned in April 1977 which, since 2007, benefits from a 20-year license extension (August 2027) obtained in 1998. This unit had an availability of 90.2% in 2007.

All these units have 24-month fuel reloading cycles, except Ginna which has 18-month.

EDF has both created a joint subsidiary on a 50-50 basis with Constellation Energy in July 2007 to develop the EPR-type reactor in the USA named **Unistar Nuclear Energy**, and has been building a

stake in Constellation Energy. After having increased its share to 9.51% in September 2008, EDF signed an agreement of principle for acquiring at 49.99% share of the Constellation Energy's nuclear assets in December 2008.
The joint development projects notably relate to the construction of EPR-type reactors, the first of which would be located at the Calvert Cliffs Plant.

The strategic plan for Constellation Energy focuses on five topics: **operational excellence**, an **optimisation drive**, **individual development**, **commercial development**, and **increasing the availability** of the generating facilities. Work on each is headed at all hierarchal levels and in each body by an "owner".

Nuclear safety management

A Committee on Nuclear Power, which audits nuclear safety and performance, watches over safe and effective operation on behalf of the shareholders. This committee has the particularity of being open to personalities outside the company. I noted the presence of top managers from other companies that operate nuclear reactors (such as EXELON) and also a representative of the Institute for Nuclear Power Operations, as well as the regional representative of the Nuclear Regulatory Commission (the safety authority). The members of the committee visit the field and meet plant staff of all hierarchal levels.

In the field of nuclear safety, I was particularly interested by the **Employee Concern Program** which involves a sort of hotline available to the employees of Constellation Energy of which only the nuclear safety and quality director, who is attached to headquarters, is informed of the input. The action taken as a result of alerts is handled face-to-face in the body concerned, and the treatment of the matter remains confidential. The nuclear safety authority is kept informed.

Mirror organisation
The technical branch of the company's central management is organised to mirror the organisation of each production plant and candidates for corporate management positions must have previously occupied the equivalent function in a plant. This **push-pull** system is intended to simplify general management and to foster synergy between the managers in the same fields. It also contributes to maintaining safety culture at the highest echelons of the company.
This form of organisation is also, according to those to whom I spoke, used by other American nuclear operators.

Human resources management

Constellation Energy has set up a major cooperation programme with the public education system. Sandwich courses (traditional schooling combined with plant training) is taking place, and specialised training is provided in education establishments by company staff.
For the professions central to the process (operations, maintenance, chemistry etc.), each nuclear plant has **its training programme accredited by the Institute for Nuclear Power Operations every four years**. The programme is updated using experience feedback on events that have occurred at the plant and in the facilities belonging to other nuclear operators. The approach is more responsive as each technical event can result in rapid adaptation of the training programmes for the professions concerned.

Human resources management is considered to be a key factor behind performance. A major mentoring programme is deployed from the moment of hiring. **Coaching by mentors** on the internal web facilitates opening up to other parts of the company and the supervision of new arrivals.

I observed that personal performance was assessed throughout the year, and any weaknesses or faults need to be corrected within the following quarter, otherwise the future of the employee in the company may be reconsidered.

I also observed that **Constellation Energy calls in retired staff** to assist in periods of peak activity, such as unit outages in particular.

Management by processes

The process operating loop is highly responsive. Any discrepancies are rapidly identified seeing that the result and trend indicator system is standardised and recognised by all. Checking is simple and frequent.

Service lives of the nuclear facilities

For the company like all other nuclear operators, plant service life is a strategic parameter. The approach is highly pragmatic. **The strategy is to "keep the nuclear units identical to the specification for which the license was granted" insofar as possible**. Modifications to the process are therefore minor. On the other hand, those that can be rapidly exploited are the subject of special attention and responsiveness once the decision is made.
Accordingly, the excellent technical performance and low cost of digital control systems rapidly resulted in the eventual replacement of the electromagnetic relay based systems.

As at EDF, controlling the ageing of nuclear building concrete is subject of in-depth studies by research centres.

Calvert Cliffs Nuclear Power Plant (Calvert Cliffs, Maryland)

Calvert Cliffs Nuclear Power Plant is located some one hundred kilometres south of Baltimore, on the Chesapeake Bay coast.

My visit was specially organised so that I could experience life at the plant, including attending scheduled operational meetings.

Some special features of the plant organisation are described.

Some major topics

As is frequently the case in the USA, **the operations staff** are either former operations technicians, operators from other companies, or from the US Navy. During their recruitment, the Nuclear Regulatory Commission organises personalised theory checks then individual checks on a simulator as part of a team. It also monitors the refresher training that takes place every two years. Specific simulator training is organised by handling major operating transients on a just-in-time basis, such as unit outages and restarts.

The simulator instructors are rotated every two years between training positions and operational missions.

As is the case with the other American nuclear operators, **unit outages mobilise all the forces at the plant,** everyone is involved and rises to the challenge, even the office worker!
The units operate in baseline mode with 24-month fuel cycles, which makes it possible to plan well in advance and schedule the outages ten years ahead. Planning work begins fifteen month before.
The stakes are high, the operations are carried out around the clock, and all the parameters of the outage are controlled in real time, including the budget. The current duration of an outage is 19 days and the goal is 16!

I noted that outage success was sometimes rewarded by substantial bonuses, corresponding to between one week and one month's pay. A party is usually held at the end of the outage and the contractor personnel are invited.

Most of the maintenance work is subcontracted, though with some use of Constellation Energy's own staff, who are pooled between the plants, somewhat like the EDF Power Plant Maintenance Units (AMTs). Constellation Energy manages its equipment and maintenance using the Institute of Nuclear Power Operations **AP913** method, which EDF has begun to deploy in its plants. This approach was introduced over a period of five years and has made it possible to substantially reduce the amount of corrective maintenance, while the unplanned inoperability factor has almost been halved.
This method had made it possible to increase nuclear safety and unit availability while reducing maintenance costs. I note, however, that it necessitates special skills in the field of maintenance (responsive, multidisciplinary analysis of technical data by equipment type and by function). My hosts all emphasised **the necessity of contribution from all the professions and strong management involvement.**

Operational meetings

I was invited to attend a number of technical meetings on very different topics.

- **Plan-of-the-day meeting**: this daily meeting at eight o'clock lasts 30 minutes, all the managers are present, and the first to speak is the manager in charge of safety and health. Apart from a description of the technical situation of the day provided by different professions, the medium term outlook is outlined. Every day, two managers who have spent time in the field the day before, outside the field of their own professions, report their findings the following day. Any discrepancies are shown in a positive light: they are either useful or they are processed. **Looking at issues from different viewpoints can be extremely fruitful**. Accordingly, the observations made by the plant engineering director on the control room operations were extremely apt.
- **Management Review Committee Agenda**: intended to ensure continuous progress by looking at long-term technical issues, this meeting is attended by the department heads with the goal of examining the projects set up to improve organisation, or certain technical issues (modifications for instance). The departments' ability to implement such projects is also assessed during this meeting. Decisions are made by vote of the attendees.
- Reporting of the **independent oversight loop**. The mission is performed by a small team, consisting of highly-experience company staff. This team is well versed in the concerns of the Institute for Nuclear Power Operations and the Nuclear Regulatory Commission. It is attached to the Baltimore management. It sends an independent monthly report to the Baltimore management, which does not require approval from the plant management but to whom the report is presented. Once a month, the quality performance evaluation director, who leads the teams, meets the plant director face-to-face to assess any significant findings, any positive or negative trends, and the progress achieved. I was invited to observe such a meeting.
  A few examples with which EDF can identify illustrate the concrete and useful nature of this exchange and the scope covered: repeated leaks over a period of two years in chemistry-related activities without action having been taken, departure of an emergency plan manager without it having been properly planned, insufficient forward planning of recruitment of simulator instructors etc.

The plant is remarkably neat and tidy, the large administration building, which is modern and functional, also accommodates for the contractor companies.

As is the case everywhere in the USA, we were accompanied by a proper escort and only left after a detailed briefing of the situation in the units and an assessment of the current nuclear safety situation, particular care being paid to personal protection (helmet, goggles, earplugs and gloves).

The **control room** is common to the two units and is very strictly maintained. The operations staff present wore personalised causal clothes, corresponding to their duties. The shift manager dominates the scene from the bridge, a sort of control tower. The teams work 12-hour shifts. There are a minimum of three operators and one shift supervisor in the control room.

In the control room, I chanced to see the initiation of a routine reactor coolant dilution operation. I was impressed by the careful planning of the operation, with double-checked rehearsal of the actions, then a call for vigilance, visibly acknowledged by each of the operating staff, including those of the neighbouring nuclear unit. The operation itself, including the debriefing, was also **an illustration of the practical application of a range of a human performance tools.**

The **housekeeping** was amazingly good for a plant of its age. The basic objective, which applies to everyone, is to leave the work area cleaner than as they found it. "Good housekeeping promotes a safe workplace."

Our visit took place on a Wednesday, which is clean-up day, an some of the staff were therefore assigned to cleaning and painting duties. All the plant workers are, indeed, required to devote four day a year to housekeeping work. I also met operatives and executives happily working on such simple tasks. As concerns painting, for instance, on assistant told me that she had received basic training covering industrial and fire protection implications. The morning ended with all being invited to the plant canteen.

The **plant security measures** were extremely thorough and omnipresent. The site is surrounded with a bulky barrier consisting of large concrete blocks, checking at the access points is painstaking (search for explosives, biometric checks, assignment of permanent escorts to visitors etc.), heavily armed guards regularly move between the armoured observation posts, and are highly visible, both and inside and outside. The Nuclear Regulatory Commission inspects the guard accreditation and training processes every two years.
I also noted that random drug and alcohol checks were made. In addition, all are required to report infringements noticed inside the plant.

I met one of the two **resident Nuclear Regulatory Commission inspectors**, whose office was in the plant. Their mission, which is limited to five years, is concerned with checking nuclear safety, radiation protection and site security.
The inspector visits the control room every day and meets the representatives of the professions. The findings made in his inspections are made known at the plant. I noted, on this occasion, that the reports on the visits by the Institute for Nuclear Power Operations, which are not made public, are only transmitted to him orally.
Finally, the resident inspectors regularly meet to exchange notes with their colleagues in other plants.

In conclusion, I was particularly impressed with the overall mastery of operation and organisation. The baseline operation of the installations and the 24-month fuel cycle strategy certainly contributed to this situation. Calmness reigns, deepened by the prevailing positive attitudes; the desire to jointly find solutions and to rigorously apply them is perceptible everywhere.

Unistar Nuclear Energy (Baltimore, Maryland)

Unistar Nuclear Energy is a joint venture formed in 2007 by EDF (50%) and Constellation Energy (50%). Governance is set up by a combined Constellation Energy and EDF team with a Strategic Council and different committees focusing on the commercial, technical, financial, and project issues.
The goal of Unistar Nuclear Energy is to develop and build nuclear reactors of the EPR type in North America, then to operate them with its customers in a range of possible commercial relationships.
The joint venture is composed of subsidiaries, and these form Unistar Nuclear Energy Holding. Project Companies have correspondents or support entities in the following areas: marketing, services, purchasing and engineering, training and infrastructure, operations and project leadership for clients.

The EPR-type reactor for the USA

The US EPR is the American version of the EPR under construction at Flamanville. Its power rating will be 1600 MWe. In 2007, AREVA applied for certification by the Nuclear Regulatory Commission. Processing should last until 2012, or possibly 2011.

In the USA, four combined licenses for the American version of the EPR-type reactor were applied for in 2008, two by Unistar Nuclear Energy (for Calvert Cliffs and Nine Mile Point Nuclear Power Plants), one by AMEREN, a power company operating in the state of Missouri, (for Callaway Nuclear Power Plant) and one by Pennsylvania Power and Light Co. (for Bell Bend Nuclear Power Plant).

Management of the project to market the EPR-type reactor in the USA by Unistar Nuclear Energy focuses on three aspects: **standardisation, responsiveness of the decision-making process, and the managerial approach to risk management**. The desire to standardise the EPR-type reactor marketed in the USA corresponds to the ambitions of EDF and AREVA for EPR-type reactors installations elsewhere in the world. The level of benefits expected is extremely high (see Chapter 6).

As for the development of the US EPR, the Unistar Nuclear Energy teams are taking action concerning the technical, regulatory and financial aspects of the project, as well as the industrial scheme.

The engineering team benefits from close links with the Nuclear Engineering Division engineering centres working on the project involving the EPR-type reactor in France and worldwide.

The Calvert Cliffs 3 project

Unistar Nuclear Energy is working on a project to build a first reactor at Calverts Cliffs Nuclear Power Plant, which is to constitute the model for the US EPR.
Unistar Nuclear Energy has not applied for an Early Site Permit but has carried forward the environmental study of its combined license by submitting it to the Nuclear Regulatory Commission in August 2007 and the application was docketed in March 2008.
In June 2008, the Nuclear Regulatory Commission agreed to examine the application for a license for the US EPR submitted by AREVA: this licensing process should end in 2012 with the combined license being issued in accordance with the Nuclear Regulatory Commission's schedule, for the first implementation of a US EPR at the Calvert Cliffs Nuclear Power Plant, with a commercial operation date set for 2016.
The initial phase of consultation of the public was completed with highly successful results in the vicinity of Calvert Cliffs.

With the goal to get the Final Environmental Impact Statement, which is expected in 2010, Unistar Nuclear Energy is preparing an **environmental impact assessment** for the US EPR , specifically for Calvert Cliffs 3.

A visit to the Unistar Nuclear Energy team at Calvert Cliffs Nuclear Power Plant

I also met the preliminary Unistar Nuclear Energy team at Calvert Cliffs Nuclear Power Plant. Its offices are in a building with a panoramic view of the existing installations, from which the future plant and its facilities can be visualised. This situation facilitates public relations and receiving visitors, and is a veritable information centre on the current project and its environmental aspects, in particular protection of flora and fauna. The team actively contributes to organising debates with the public.
The exact manner in which the US EPR is to be installed in the plant was described to me.

Meeting with EDF staff

I encountered some twenty EDF employees seconded to Unistar Nuclear Energy. They are all ready to confront the American architect engineer and vendors. They are all passionate about their missions in the forefront of EDF development in the USA, and are highly satisfied with the functioning of the Nuclear Engineering Division and Nuclear Operations Division backup in France. Their greatest difficulty has been to harmonise the demands of Constellation Energy and EDF as concerns project monitoring (timing and content of the reporting etc.).

The approach of this engineering team working on the US EPR-type reactor made a very favourable impression on me. It is multicultural, it is Franco-American. Confronting the respective dogmas of the American vendors and of EDF is beneficial to both parties. For instance, the ongoing discussions mainly focus on the secondary side, the nuclear auxiliaries and the general organisation of the installations. The friction, which is sometimes heated, make it necessary to consider each others' basic concepts. This can result in the emergence of innovative technical solutions, particularly in the field of nuclear safety.

In conclusion, my visit to **Constellation Energy** revealed a strong desire to exchange information and to have me participate in its everyday work so as to understand its perspectives at both plant and corporate levels. This visit was particularly well organised and covered a maximum number of issues of common interest. It was extremely fruitful in a context where the Nuclear Operations Division is taking a close interest in certain concepts already implemented in the USA and at Calvert Cliffs Nuclear Power Plant in particular. It fully met all my expectations.

APPENDICES

Indicators of results

	1998	2001	2002	2003	2004	2005	2006	2007	2008
Number of noteworthy events, per reactor[2]	1,00	0,86	0,86	0,95	1,03	1,10	0,98	-	-
Number of events classified on the International Nuclear Event Scale as 1 or greater, per reactor	1,00	1,10	1	1,20	0,88	0,76	1,22	0,80	1,15
Number of significant events in terms of nuclear safety, per reactor[3]	6,50	7,30	7,70	8,14	7,62	9,54	10,21	10,80	10,34
Number of cases of non-compliance with technical specifications for operation, per reactor	2,60	1,40	1,30	1,57	1,16	1,48	1,55	1,70	1,70
Number of alignment errors per reactor,[4]	1,00	0,76	0,74	0,93	0,50	0,66	0,69	0,57	0,62
Number of scrams, per reactor (and 7,000 hours of criticality)[5])	1,02	1,06	1,19	1,13	1,01	0,93	0,89	0,87	0,51
Average collective dose in operations, per nuclear unit in service (in man-sieverts)	1,42	1,02	0,97	0,89	0,79	0,78	0,69	0,63	0,66
Exposure of individuals: • number of individuals with doses above 20 mSv	17	0	0	1	0	0	0	0	0
• number of individuals with doses above 16 mSv[6]	-	250	154	74	73	28	17	20	14
Number of significant events in terms of radiation protection per reactor	-	-	-	160	177	173	112	99	107
Availability (%)	81,1	81,1	82,2	82,7	82,8	83,4	83,6	80,2	79,2

[2] *Events with a potential for significant consequences particularly terms of nuclear safety. These are selected from the safety-related events using precise criteria. For these events, the conditional core damage probability is calculated. This process is initiated by the operator and enables, amongst other things, corrective action to be determined. As the data for 2007 was being consolidated at the time the report was being finalised, the value for noteworthy events is not provided in the table.*

[3] *Each "generic" event is counted as 1 for all the reactors affected.*

[4] *Any system configuration or system auxiliary that differs from the expected conditions, and which is also the cause or one of the causes of a significant event.*

[5] *The average value for all the reactors, not the median value adopted by WANO.*

[6] *Maximum number of operatives who, during the year, received a dose higher than 16 mSv in any period of twelve consecutive months.*

EDF NUCLEAR PLANTS

Number per type	Pressurized Water Reactors				GCR	HW	FBR
	300 Mwe	900 Mwe	1300 Mwe	1450 Mwe			
Operation		34	20	4			
Decommissioning	1				6	1	1

Technical key dates for each of the nuclear units

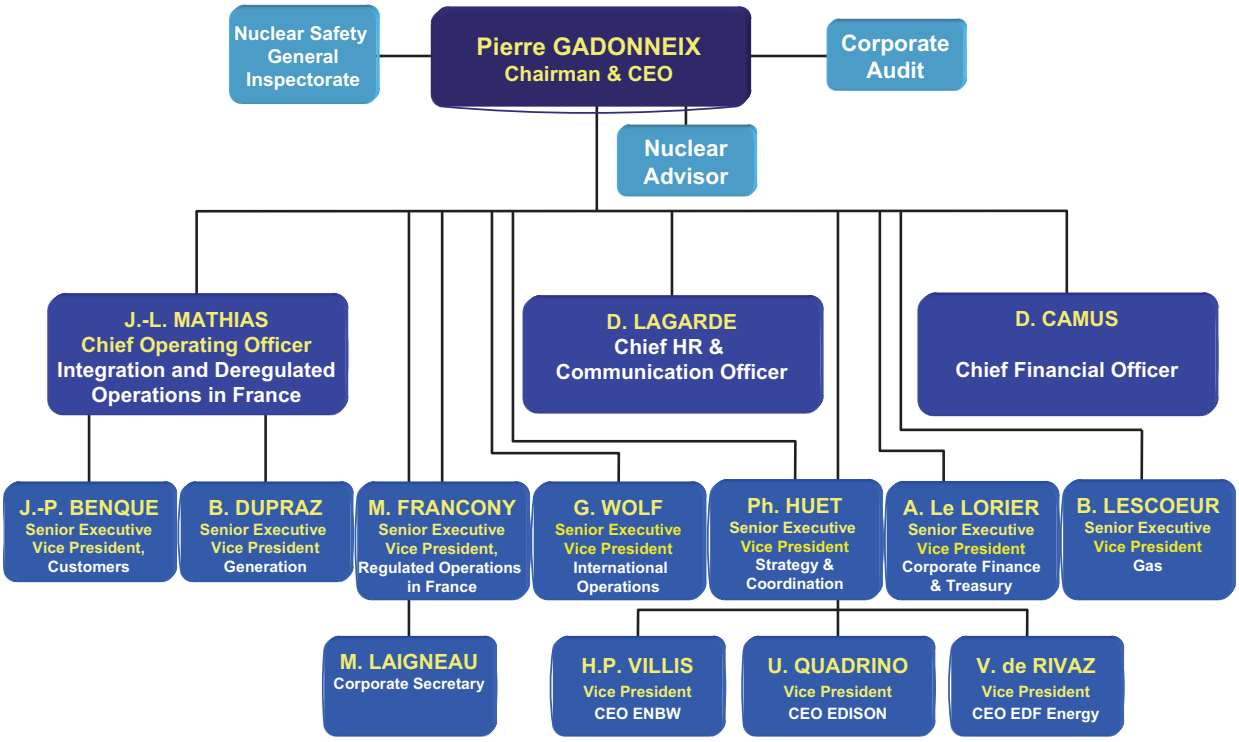
Year Commis-sioned	Nuclear Unit	Rated Power (MWe)*	VD1	VD2
1977	Fessenheim 1	880	1989	1999
1977	Fessenheim 2	880	1990	2000
1978	Bugey 2	910	1989	2000
1978	Bugey 3	910	1991	2002
1979	Bugey 4	880	1990	2001
1979	Bugey 5	880	1991	2001
1980	Dampierre 1	890	1990	2000
1980	Dampierre 2	890	1991	2002
1980	Gravelines 1	910	1990	2001
1980	Gravelines 2	910	1991	2002
1980	Gravelines 3	910	1992	2001
1980	Tricastin 1	915	1990	1998
1980	Tricastin 2	915	1991	2000
1980	Tricastin 3	915	1992	2001
1981	Blayais 1	910	1992	2002
1981	Dampierre 3	890	1992	2003
1981	Dampierre 4	890	1993	2004
1981	Gravelines 4	910	1992	2003
1981	St-Laurent B1	915	1995	2005
1981	St-Laurent B2	915	1993	2003
1981	Tricastin 4	915	1992	2004
1982	Blayais 2	910	1993	2003
1982	Chinon B1	905	1994	2003
1983	Blayais 3	910	1994	2004
1983	Blayais 4	910	1995	2005
1983	Chinon B2	905	1996	2006
1983	Cruas 1	915	1995	2005
1984	Cruas 2	915	1997	2007
1984	Cruas 3	915	1994	2004

Year Commis-sioned	Nuclear Unit	Rated Power (MWe)*	VD1	VD2
1984	Cruas 4	915	1996	2006
1984	Gravelines 5	910	1996	2006
1984	Paluel 1	1330	1996	2006
1984	Paluel 2	1330	1995	2005
1985	Flamanville 1	1330	1997	2008
1985	Gravelines 6	910	1997	2007
1985	Paluel 3	1330	1997	2007
1985	St-Alban 1	1335	1997	2007
1986	Cattenom 1	1300	1997	2006
1986	Chinon B3	905	1999	-
1986	Flamanville 2	1330	1998	2008
1986	Paluel 4	1330	1998	2008
1986	St-Alban 2	135	1998	2008
1987	Belleville 1	1310	1999	-
1987	Cattenom 2	1300	1998	2008
1987	Chinon B4	905	2000	-
1987	Nogent 1	1310	1998	-
1988	Belleville 2	1310	1999	-
1988	Nogent 2	1310	1999	-
1990	Cattenom 3	1300	2001	-
1990	Golfech 1	1310	2001	-
1990	Penly 1	1330	2002	-
1991	Cattenom 4	1300	2003	-
1992	Penly 2	1330	2004	-
1993	Golfech 2	1310	2004	-
1996	Chooz B1	1500	-	-
1997	Chooz B2	1500	-	-
1997	Civaux 1	1495	-	-
1999	Civaux 2	1495	-	-

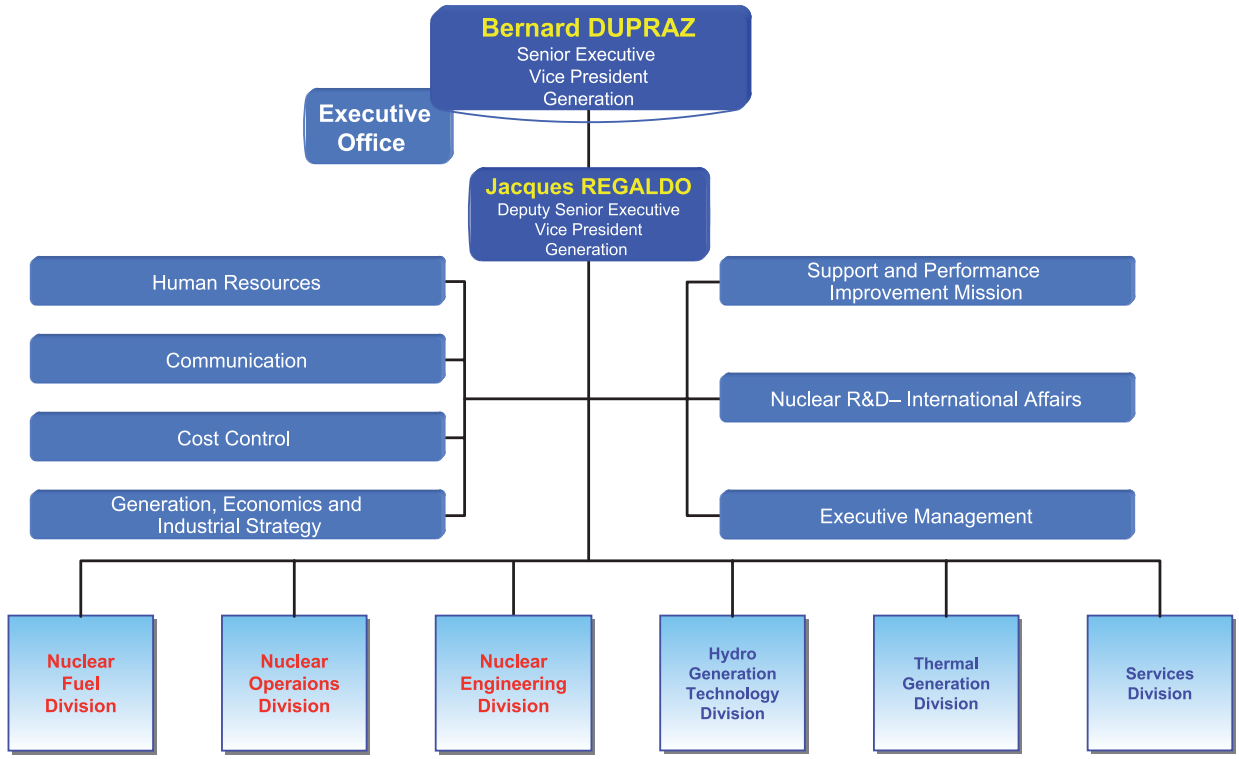
VD1: First ten-yearly inspection
VD2: Second ten-yearly inspection
*Net continuous power

ORGANIZATION CHARTS

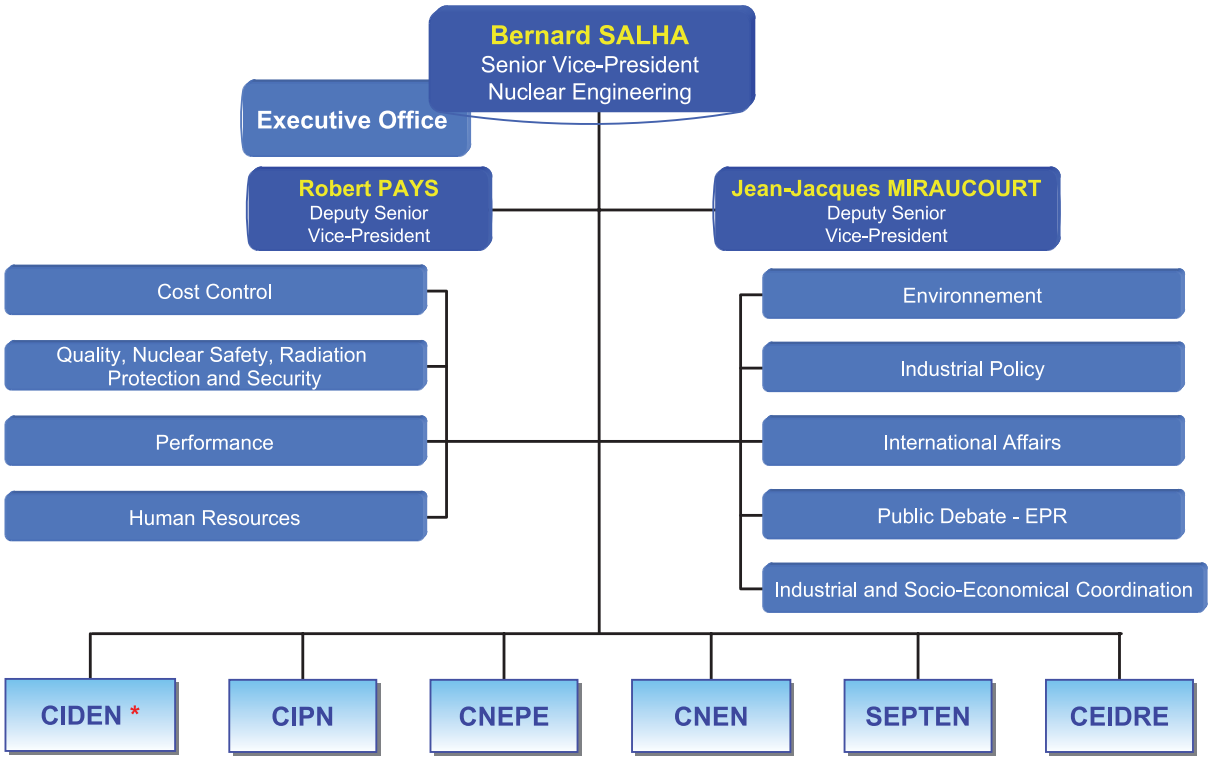
EDF GROUP



PRODUCTION AND ENGINEERING DIRECTORATE

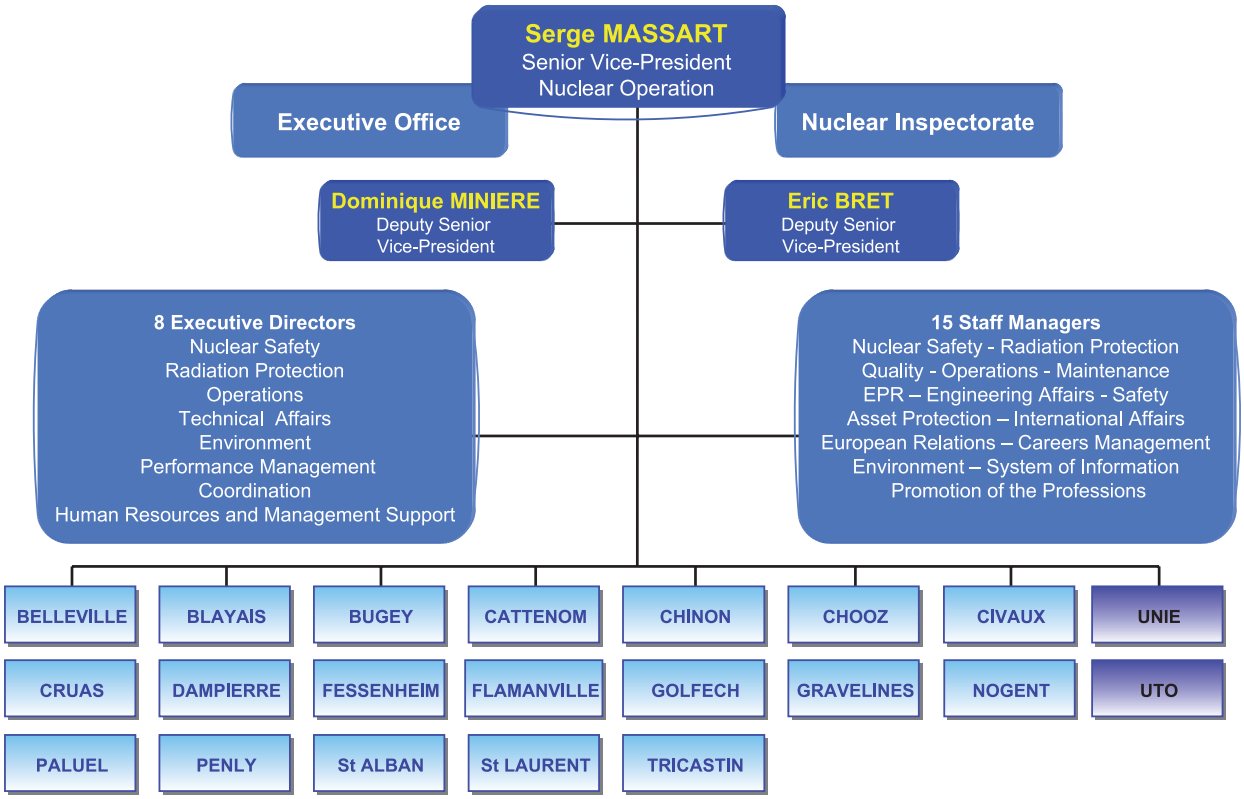


NUCLEAR INGINEERING DIVISION



* Including the Brennilis and Creys-Malville dismantling sites

NUCLEAR OPERATIONS DIVISION



NUCLEAR FUEL DIVISION

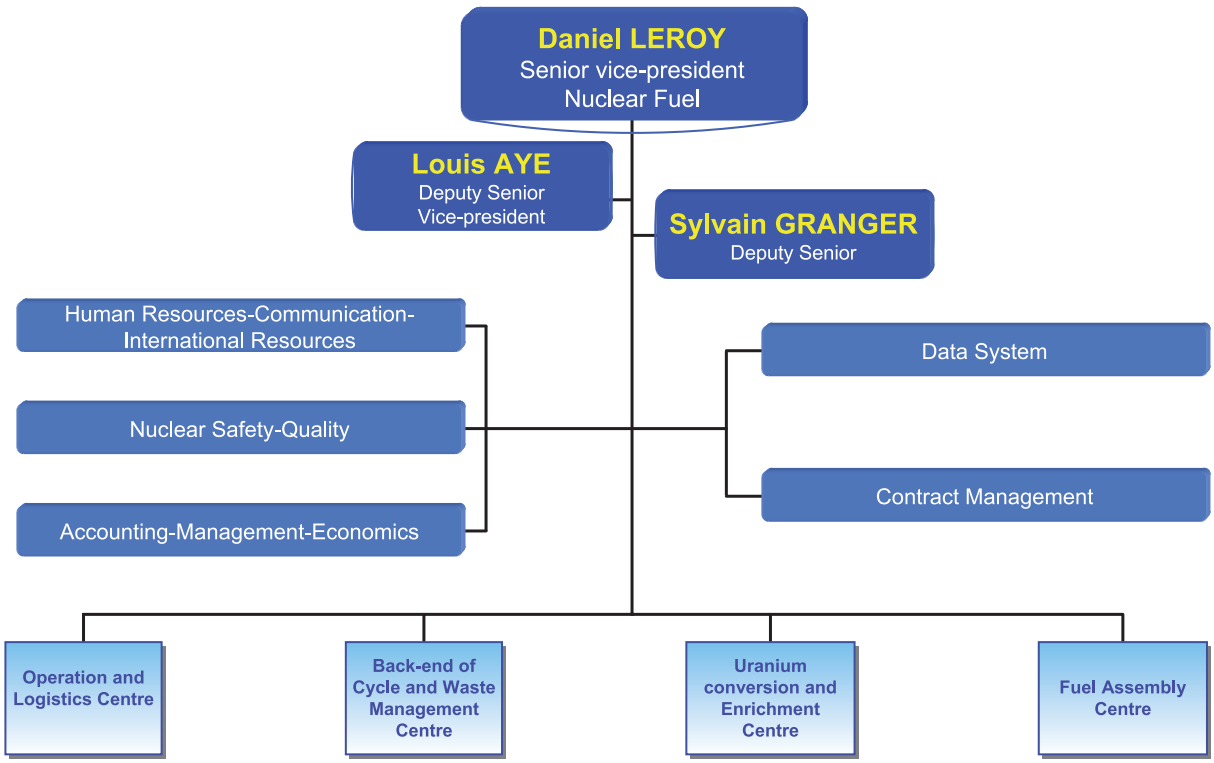


TABLE OF ABBREVIATIONS

A

AAR	Reactor scram
ABWR	Advanced Boiling Water Reactor
AIEA	International Atomic Energy Agency (IAEA)
ALARA	As Low As Reasonably Achievable
ALCADE	N4 plant fuel management system allowing longer cycles
AMELIE	EDF project intended to improve spare part logistics
AMT	Joint Maintenance Agency
ANCLI	National Association of Local Information Commissions
ANDRA	French National Radioactive Waste Management Agency
APEC	Fuel Interim Storage Facility
ASN	French Nuclear Safety Authority
AT	Unit outage

B

BAV	Anti-vibration bar
BR	Reactor building
BK	Fuel building

C

CETIC	PWR Nuclear Steam Supply System Fieldwork Technical Validation Experimental Centre
CIDEN	Nuclear Environment and Decommissioning Engineering Centre
CEIDRE	Construction and Operation Expert Appraisal and Inspection Centre
CIDM	Common Documentation Integration Committee
CIESCT	Inter-Contractor Work Conditions and Safety Committee
CIPN	Nuclear Equipment Engineering Department
CLI	Local Information Commission
CNEPE	Electromechanical Department
CNPE	Nuclear Power Plant (NPP)
COD	Commercial operation license
COGIC	Interministerial Emergency Management Operations Centre
COL	COmbined Licence
COPAT	Unit Outage Operational Control Committee
CSD	Decommissioning Safety Committee (within the Nuclear Engineering Division)
CSN	Nuclear Safety Council

D

DAIP	Industrial Support for Production Division
DCN	Nuclear Fuel Division
DEI	Response and Environment Division
DERE	Operating Rule Set Amendment Board
DG2S	EDF Group Health and Safety Board
DIN	Nuclear Engineering Division
DPI	Production and Engineering Directorate
DPN	Nuclear Operations Division
DS	Services Division
DSP	Back Office Division

E

ECP	Employees Concern Program
EDF-R&D	Research and Development Directorate
EGS	Overall Nuclear Safety Assessment
ENEL	Italian power generating company
ENEF	European Nuclear Energy Forum
EPIC	State-owned company
EPR	European Pressurised Reactor
EPRI	Electricity Power Research Institute (USA)
ESPN	Nuclear Pressure Equipment
EPS	probabilistic safety study
ESR	Significant radiation protection event
ESS	Significant nuclear safety event
EVEREST	EDF campaign to enable entry into controlled areas without a special protective suit

F

FA VL	Long-lived low-level (radioactive waste)
FEP	Job Assessment Record
FEPP	Periodic Contractor Assessment Report
FH	Human factor
FRR	Quick Think Tank

G

GALICE	EDF 1300 MWe nuclear unit series fuel management system
GARANCE	EDF 900 MWe nuclear unit series fuel management system
GME	Pooling of contractor resources
GTA	Turbine generator
GV	Steam generator

H

HAVL	Long-lived high-level (radioactive waste)
HCTISN	High Committee for Transparency and the Supply of Information Concerning Nuclear Matters

I

ICEDA	Active Waste Packaging and Interim Storage Facility
ILD	Local Documentation Integrator
ILM	Local Documentation Modifier
IN	Nuclear Inspectorate (part of EDF Nuclear Operations Division)
INB	Licensed nuclear facility
INES	International Nuclear Events Scale
INPO	Institute of Nuclear Power Operators (USA)
IOP	Operations engineering
IPG	Pellet-cladding interaction
INSAG	International Safety Advisory Group (AIEA)
INTEP	EDF project to introduce new technologies into the plants in service
INTSN	National Institute for Nuclear Science and Technology
IRP	Staff Representation Body
IRSN	Institute for Nuclear Safety and Radiation Protection

M

MAI	Materials Ageing Institute
MARN	Nuclear Hazards Support Team (French Interior Ministry)
MA-VL	Long-lived medium-level (radioactive waste)
MOPIA	EDF Nuclear Operations Division project to introduce attractive labour relations policy with regard to the contractor companies
MEEDAT	Ministry for Ecology, Energy, Sustainable Development and Public Works
MOX	Mixed-oxide: nuclear fuel containing a mixture of uranium and plutonium oxides
MPL	Frontline manager
MRI	Risk management

N

NOS	Nuclear Oversight Safety (Slovakia)
NRC	Nuclear Regulatory Commission (USA)

O

ONC	Corporate Emergency Response Organisation
O2EI	EDF Better Housekeeping Campaign
OSART	Operational Safety Analysis Review Team (AIEA)
OSRDE	Nuclear Safety, Radiation Protection, Availability and Environment Watch
OVCC	Instrumentation and Control System Ageing Watch
OVME	Electrical Equipment Ageing Watch

P

PBMP	Basic Preventive Maintenance Programme
PGAC	General Work Area Assistance
PHPM	Methods and Practices Harmonization Campaign
PPH	Human Performance Campaign
PSRP	Radiation Protection Surveillance Station
PUI	On-Site Emergency Plan

R

REB	Boiling water reactor
REP	Pressurized water reactor
REX	Experience feedback
RGE	General Operating Rules
RL	WENRA Reference Levels
RNR	Fast neutron reactor
RPS	Psychosocial risks

S

SAPPRE	Reflex Phase Population Alert System
SCAST	Central Occupational Health Department
SDIN	Nuclear Technical Information System
SDIS	County Accident Response Services
SEM	Medical Studies Department
SIR	Official plant inspection services
SMUR	Ambulance Service
SOH	Socio-organizational and human approach
SPR	Risk Avoidance Department
STE	Technical Specifications for Operation.
STEP 2010	Internal improvement programme ending in 2010, dubbed the STEP 2010 Initiative
STUK	Finnish nuclear safety authority

T

TEM	Unit in service
TFA	Very low level (radioactive waste)
TNA	Installation for the treatment of sodium from the Superphenix plant at Creys-Malville
TRD	Deadlines-Resources-Technology
TSM	Technical Support Mission (WANO)
TSN	Nuclear Safety &Transparency Act
TSO	Technical Safety Organisation

U

UFPI	Operations Engineering Training Unit
UNE	UNISTAR Nuclear Energy – Joint Venture between Constellation and EDF
UNGG	Gas-cooled graphite-moderated reactor
UNIE	Operations Engineering Unit
UNIE/GECC	Operations Engineering Unit Core Calculation and Studies Group
UTO	Central Technical Support Department

V

VD	Ten-yearly inspection

W

WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association

Gérard PETIT, Christian THEZEE, Pierre WIROTH, Jacques DUSSERRE, Gabriel KALIFA
around the WANO NUCLEAR EXCELLENCE AWARD,
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E.D.F. - Présidence IGSN
21, avenue de Messine - 75008 Paris

Cover photo : Changing a steam generator.