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OPERATIONAL SAFETY OF NUCLEAR INSTALLATIONS

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ST ALBAN NUCLEAR POWER PLANT

24 October – 11 November 1988

OPERATIONAL SAFETY OF NUCLEAR INSTALLATIONS

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REPORT TO THE GOVERNMENT OF FRANCE

PREAMBLE

This report presents the results of the IAEA Operational Safety Review Team (OSART) evaluation of the St Alban nuclear power plant located near Lyon, France. The results, conclusions and recommendations presented herein reflect the views of the international experts carrying out the evaluation. They are provided for consideration by the responsible French authorities. The OSART's views are based on review of the documentation made available, on oral communication with plant personnel, and on observations of relevant plant activities.

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FOREWORD

By the
Director General

The IAEA Operational Safety Review Team (OSART) programme assists Member States to enhance the safe operation of particular nuclear facilities. Although good design, manufacture and construction are prerequisites, safety also depends on the ability of operating personnel and the conscientiousness manner that responsibilities are carried out. OSART missions focus on operational aspects when assessing safety practices. Comparison with successful practices in other countries are made and ideas for improving safety are exchanged at the working level.

An OSART mission is made only at the request of a Member State, not a regulatory inspection to determine compliance with national requirements. The review can complement national efforts by providing an independent, international assessment of safety practices that may identify areas for improvement. Through the OSART programme, the IAEA facilitates the exchange of knowledge and experience between international experts and plant personnel. Such advice and assistance enhance nuclear safety worldwide.

The mission is an opportunity for experts and operating personnel to exchange knowledge and experience, to update the regulatory personnel of the host country assigned to follow the review, and to train personnel through observation of the review process. This can contribute to the attainment of an international standard of excellence for operational safety, not through regulatory requirements, but through voluntary acceptance of recommendations for improvement that reflect successful safety practices.

The IAEA Safety Series documents, including the Nuclear Safety Standards (NUSS) for nuclear power plants and the Basic Safety Standards for Radiation Protection, and the expertise of the OSART members themselves form the basis for the review. The review is performance oriented. It is recognized that different approaches can be used to achieve a higher level of operational safety that enable an operating organisation to reach its safety objectives. Suggestions for improvements are made that may be based on good practices at other facilities observed during OSART missions.

An OSART review is tailored to the particular need of a facility. A full scope review would cover a number of operational areas: management, organization and administration; training and qualification; conduct of operations; technical support; maintenance; radiation protection; plant chemistry; and emergency planning and preparedness. Depending on individual needs, the OSART review can concentrate on a few areas of special interest. For example, for plant under construction and approaching commissioning, an OSART can focus on plant and organisational preparedness for operation.

The OSART team presents its conclusions including proposals for enhanced operational safety and good practices to the operating organization for consideration. While OSARTs do not provide overall safety assessment, they enable, however, a comprehensive evaluation of a plant's operational safety issues.

In formulating its view, the OSART team discusses its findings with the operating organization and considers additional comments made team members. The OSART Report, which follows, highlights the more significant matters and is submitted to the Member States.

INTRODUCTION

At the request of the Government of France, an IAEA Operational Safety Review Team (OSART) of international experts visited the St Alban nuclear power plant, operated by Electricité de France (EdF), from 24 October to 10 November 1988. Their purpose was to review operating practices at the two unit station, and to exchange technical experience with their counterparts at the plant in pursuit of the common goal of attaining excellence in operational safety. The St Alban OSART mission was the twenty-seventh since the beginning of the IAEA OSART programme, and was the second to a nuclear power plant in France.

The team (see Annex 1) comprised experts from Bulgaria, Canada, Czechoslovakia, the Netherlands, Japan, Spain, Switzerland, the USA and Yugoslavia, and observers from China and the Republic of Korea. Before visiting the plant, the team studied information made available to them by the utility to become familiar with the plant's main features, important programmes and procedures, and the operating results of the past years. At St Alban, the team of experts, using techniques derived from their collective total of over 300 years of nuclear experience, reviewed documentation, observed work being carried out in various areas of review, examined applicable procedures and instructions, and held intensive discussions with plant personnel. Throughout the period of review, there was an open exchange of experience and opinions between station personnel and the OSART experts.

Both St Alban units were operating at varying power during the review and were also shutdown for short periods. In addition, the plant management was coping with ongoing strike of some personnel groups throughout the review period. In spite of their heavy workload, the plant staff provided the OSART all the support needed to carry out their mission successfully

General Comment

Since plant safety and negligible environmental effects during normal operation have widely been demonstrated the attention of both plant designers and operators is focusing on preventing accidents and mitigating their possible consequences should they occur. Particular emphasis is being placed on the lessons learned from the two severe accidents that have occurred in operating nuclear power plants in the United States and the Soviet Union. Each of these events showed the importance of conservative design, effective interlocks and automatic response systems, adequate containment features and adherence to operational procedures.

Most of the lessons learned from these two accidents have been incorporated in upgrades of nuclear power plants. The continuing process of upgrading also draws on positive and negative operating experience which is accumulating worldwide. St Alban has followed up new developments with strong support from the OF Headquarters, and has actively pursued application of state-of-the-art technology.

Plant description

St Alban nuclear power plant consists of two pressurized water reactor, (PWR) units located on the east bank of the river Rh6ne, about 50 km south of Lyon. The site is close to important transport routes and major chemical industry facilities. There are also important agricultural areas in the vicinity, and the population density is relatively high. These site characteristics require that plant features are adequate to cope with external hazards and ensure effective protection of general public and environment in the event of accidents

Units 1 and 2 are practically identical, with net electrical output of 1335 MW. They entered commercial operation in May 1986 and in March 1987. The units are representative of the series of 1300 MW plants designed by EdF with Nuclear Steam Supply System Island from Framatome. At the time of the OSART mission 14 units of this series were in operation and six further units were under construction, all of them in France and owned by EdF.

The plant equipment provided by Framatome includes primary coolant system components and the reactor core. The turbine-generator was supplied by Alsthom Atlantique. Architect engineering work was done by OF and most of the equipment was supplied by French companies. Construction of both units started in 1979, and first grid connections were in August 1985 and in July 1986.

Each reactor core comprises 193 fuel assemblies, each having 264 fuel rods in 17 x 17 configuration. Total uranium weight is 103.5 tons and total thermal output is 4117 MW. Reactor power control is performed by gray control rod banks that minimize axial offset distortion and permit operation in load following mode. The primary coolant system consists of four cooling loops, each having a steam generator and a circulation pump.

Steam is supplied from the steam generators to the 1500 rev./min turbine through four steam lines. The capacity of the turbine by-pass system allows a smooth transition to house load operation in the event of sudden load rejection. The condenser is directly cooled with river water. The feedwater cycle contains three parallel condensate pumps, three stages of low pressure heaters, a feedwater tank, two turbine driven feedwater pumps and two stages of high pressure heaters. The auxiliary feedwater system has a bunkered water tank and two separate feeding trains, each of them with a turbine-driven and a motor-driven group.

Safety systems needed to cope with design basis accidents include the protection system, emergency power supply, emergency core cooling systems and containment systems. The protection systems initiate a reactor trip or actuate other safety functions whenever the limits of the safe operating range are approached. The emergency power supply system comprises two diesel generators per unit and a mobile gas turbine that can be manually connected to replace one of the diesel generators. The emergency core cooling system consists of four hydro-accumulators and two separate subsystems for safety injection and coolant recirculation. The subsystems are physically separated from each other in different zones of the plant. Each zone has its own electric power supply, ventilation and cooling systems. In addition, the driving devices of valves and pumps needed for recirculation of emergency

cooling water, are located in rooms separated from those of the components, thus facilitating maintenance under accident conditions.

The reactor containment is composed of two separate concrete shells and could be cooled during accidents with a two-train containment spray system. The inner shell, meeting high leaktightness requirements, is a prestressed concrete structure. The outer shell of reinforced concrete is designed to resist external impacts and its leaktightness is adequate to maintain the space between the two shells at slightly below ambient pressure. A filtered venting system was being backfitted to the containment during the OSART mission to enable mitigation of severe accident consequences.

Operational Safety Features

The OSART was impressed by EdF's comprehensive approach to ensuring safe and reliable operation of its nuclear power plants. The provision of expertise and resources from EdF Headquarters to the individual power plants including St Alban is highly effective. There is good performance at plant level. Management and staff discharge their duties in a professional manner. All items important to operational safety are addressed. A more open-minded attitude was observed than at other plants visited by OSARTs: this is probably a result of the unique place of nuclear power in France.

The managerial, approach, reflecting the structure of EdF Headquarters, regional offices and plants, is effective in ensuring good operating results. The systematic organization of St Alban's programmes, procedures, reports and notes is excellent. In some areas, a stricter implementation of established policies was suggested. The full development of the quality assurance function should be given priority. Reinforcement of the plant's fire fighting capability should be considered.

EdF's commitment to a high quality of training is evident throughout the whole organization, including St Alban. Significant resources such as simulator, training facilities and training materials are available. Simulator training offers room for improvement. The maintenance training facility for primary circuit components and refuelling works is representative of the best international practices. Generally, efforts should be made to develop a more systematic approach to the training of the different groups of personnel, particularly in the retraining of operating, maintenance and radiation protection personnel.

The organization of operations is effective although slightly different from that at other nuclear power plants through the shared responsibilities of safety engineer and shift supervisor. Control room activities are carried out satisfactorily. The involvement of operating personnel in outage planning is considered excellent. The existence of uncontrolled documents throughout the plant should be addressed. Good procedures for plant operation and equipment status control are in place. Expedited implementation of the new state-oriented emergency operating procedures is suggested. Equipment labelling should be checked for completeness. The work request process should be streamlined, and the backlog of work requests reduced.

Maintenance activities are well organized and the maintenance personnel.

are qualified. Communication among the various sections is good, and a comprehensive set of maintenance procedures is available. Verification of important work performed should be considered. Material conditions, while good within controlled areas, could be improved in others. An excellent computer-controlled tagging system for isolating equipment is in place. An effective preventive maintenance programme including predictive maintenance and in-service inspection is supported by EdF's centralized maintenance department. The maintenance history file is excellent. Outage management is considered fully satisfactory.

The surveillance activities are carried out following a programme developed by EA headquarters with major input from St Alban as the lead 1300 MW plant. The monitoring of containment leaktightness with a computer, system was found to be excellent. Reactor engineering, main responsibility for this resting with EdF headquarters, is well-managed. Fuel handling is carried out appropriately. Noteworthy are innovative methods and tools for the loading of slightly bent fuel bundles. There were fewer than average numbers of unusual events. Operating experience feedback, with EdF headquarters responsible for external sources, was found to be effective.

Processing and implementation of modifications, including related documentation is sound.

Radiation protection is of a high standard. The results, to be seen in the low collective doses, low radiation and contamination levels in the plant, and a negligible impact on the environment, are remarkable. The personnel are qualified, have good instructions to hand, and discharge their duties professionally. Facilities, equipment and instrumentation are fully satisfactory. Excellent practices were established to avoid the incorporation of radioactive material. Consideration should be given, however, to minimizing the production of radioactive sludges and thereby the potential accumulation of drums containing radioactive liquid waste.

Chemistry was satisfactory, with the plant receiving strong support from EdF Headquarters. This support is in the areas of principal methods, limits and specifications. Facilities, equipment, working schedules, methods and instruments available reflect best international practices. The rigid control of radioactive effluents and their environmental impact by an external service, which also covers the plant's control methods, instrumentation and reporting, is remarkable. The post-accident sampling system is under development.

In emergency planning and preparedness, more responsibility should be given to the Safety Engineer or Shift Supervisor to enable immediate full-scope response. The scope of the Internal Emergency Plan and its implementing procedures should be reviewed for incorporation of all possible radiological conditions. The format of both plan and procedures is excellent. Improvement of dose prediction capability, which is already underway, is endorsed. Emergency facilities may require upgrading to remain operational under severe accident conditions. Training, drills and exercises are carried out in a satisfactory manner, but more systematic followup is desirable. The public information programme is good, and the involvement of the medical profession is an excellent practice.

In conclusion, St Alban is a safely and reliably operated nuclear power plant. It has all the necessary resources at its disposal to support good Performance also in the future: being embedded in the strong EdF organization with capable staff, advanced equipment and a favorable political environment. To preserve these conditions, management should continue its policy of regularly challenging established conditions and dynamic upgrading of plant and performance.

1. MANAGEMENT, ORGANIZATION AND ADMINISTRATION

Management and staff at the St Alban/St-Maurice nuclear power plant are implementing professionally policies and programmes developed by Electricité de France (EdF) headquarters. A key element of the national programme is a Quality Manual which provides the basis for all activities, programmes and procedures at St Alban. Management goals and objectives are established for each year of operation. Indicators are used to follow-up on actual performance.

St Alban nuclear, power, plant is relatively new: Unit 1 has been in operation for four years and unit 2 for three years. Availability of the units was above the French average in 1988, for unit 1 88.3% and for unit 2 42.8% (due to refuelling), Refuelling outages have tended to be longer than those at other French nuclear power plants.

As a consequence of the extended outage in 1988 and the large volume of work carried out, the collective dose of the workforce exceeded the established goal: 2.05 man-Sv against 1.90 man-Sv.

St Alban has experienced less reportable events than the average in the French nuclear industry. The numbers of 1988 are for unit 1, two reportable events, and for unit 2, 12 reportable events, of which 10 occurred during refuelling shutdown.

During the OSART review, the operations personnel at St Alban were on strike. The power level of one or the other unit was reduced several times to 50% or less. Although all regulatory requirements to ensure safety were observed, the obvious interference of the strike committee's orders with the normal lines of authority and responsibility were a source of concern.

Organizational structure

EdF, as the national utility which is operating nearly 50 000 MW of nuclear generating capacity, employs some 1600 persons in its Paris headquarters. They are involved in centralized operating experience collection and feedback, development of operating procedures and instructions and organization of training programmes for operating and maintenance personnel. Unlike 4-unit nuclear generation centres which report directly to EdF headquarters, St Alban with only two units forms part of EdF's South-East region with the regional office located in Lyon.

The logic and systematic organization of the station's policies, programmes, procedures, reports and notes is considered excellent. The structure is thorough and comprehensive, and there is reference to the Quality Manual.

The plant organization is well defined, and job descriptions exist for all staff members. Performance is monitored through comparison with pre-established objectives at the unit level. Staff numbers in most areas are adequate, except in the Quality Control Section. This section was reinforced only in 1988 and still needs to develop its full capability to discharge its intended functions.

Station Management

The management team is efficiently involved in the daily plant activities and decision making through a variety of regular meetings and reports by line organization, safety engineers and quality control engineers. If minutes of the various meetings were kept this would facilitate the information flow and enable tracking of commitments made. Based on examples in the areas of personnel qualification, housekeeping (turbine building areas), industrial safety and incident reporting, greater management efforts were suggested to ensure strict implementation of established policies and programmes. In general, worker performance in all work areas should be monitored more closely.

Quality Assurance

The quality assurance programme at St Alban is based on EdF's Quality Manual which defines the various quality assurance activities. A Quality Assurance Mission (MSQ) was recently established and the Quality Assurance Section was attached to MSQ to improve auditing of all these activities. Audits to give line management feedback to help them improve plant performance are still at an early stage. The plant operational safety is closely followed by the safety engineers, but a systematic evaluation is not yet fully developed and implemented. Generally, the development of the quality assurance function should be given high priority. Efforts in this respect should be based on a comprehensive plan for the implementation of the quality Manual, and supported by adequate resources including qualified manpower in sufficient numbers. Systematic follow-up of audit results should also be introduced to ensure timely correction of shortcomings discovered.

Utilities-regulatory interface

The utility-regulatory interface is characterized by a competent EdF organization which administers a strong programme of self-control and various regulatory authorities overseeing the compliance with prescribed requirements to ensure operational and environmental safety. In addition to the regulatory inspections by the Central Service for the Safety of Nuclear Installations (Service Central de Sûreté des Installations Nucléaires = SCSIN), there are inspections by EdF headquarters' personnel and in plant inspections by the Quality Control Section. Inspections, inspection reports and inspection follow-up appear to be less formalized than could be desired. To avoid unnecessary delays and discussions, inspection exit meetings should be held and inspection reports or minutes of the meetings should be countersigned.

Document control

Document control at St Alban was developed in line with the standard approach for all French nuclear power plants. It is well organized and ensures that all documents including procedures of all kinds, vendor, manuals and drawings are current, legible and readily accessible. Document storage, however, is an item of concern due to the fire hazard of temporary housing.

Fire Protection

The EdF fire protection approach stipulates that the simultaneous occurrence of a fire and a nuclear accident can be excluded in a short term period. Therefore the plant's own fire fighting capability is limited to four persons drawn from the operating shift, under the command of the Deputy Shift

Supervisor. External fire brigades would arrive on-site within 30-40 minutes if required. Such a limited preparedness for fast initial response would not be considered sufficient in other countries.

The comprehensive automatic fire detection and localization system is satisfactory, as is the firefighting equipment distributed throughout the plant. Training and retraining of the plant fire fighters is effectively implemented. The use of a special truck for training on different kinds of fire under realistic conditions and employing different fire fighting techniques and equipment was identified as an excellent practice.

Industrial safety

The organizational setup for industrial safety is well developed, within both EdF headquarters, the Lyon regional office and the plant and the overseeing governmental authorities. Responsibilities are well defined, commissions are established to monitor the plant's performance regarding hygiene and industrial safety, and inspections are carried out regularly.

Shortcomings which were observed, for example with respect to some scaffolding, in the implementation of a comprehensive policy regarding the wearing of hard hats, safety glasses and ear protection (where Sound levels exceed 90 dBa) and with some unsecured gas bottles should be systematically attacked because without attention to detail, the best plans may lose effectiveness.

2. TRAINING AND QUALIFICATION

The EdF organization has a strong commitment to high quality personnel. training and the same attitude is evident throughout the St Alban plant. Significant personnel and material resources have been allocated to training in order to promote safe plant operation.

Organization and resources

Responsibility for personnel training is clearly assigned to the line organization. Section heads within the various departments make individual training plans for their staff annually. As guidance they use job specific standard schemes that define the national courses and internal plant training required for initial and renewed qualification. After completion of training they propose certification to be issued by the plant management. Support to line organization is given by full-time training co-ordinators at the plant and by local and national training centres. However, the training centres seem to be not always responsive to expressed training needs. More effort on their part would be needed to ensure availability of the planned training courses and to avoid exemptions when certifying personnel for their duties. Also, additional guidance, management control and formal follow-up might be warranted to ensure that internal plant training is coherent.

Training courses provided by the local and national training centres are generally of a high standard. Instructors are well trained in both instructional skills and in subject matter. A good practice is rotation of personnel between instructor and engineering duties within the EdF organizations. Instructor positions are occupied for approximately five-year periods, including the time spent as instructor trainees. This practice increases the understanding of training matters within the line organization and ensures that the instructors have a sound technical background. In view of the limited time spent on instructor duty, no structured retraining is given to instructors. Nevertheless, it would be commendable to evaluate periodically whether the instructors need strengthening of their technical or

instructional skills, and to provide training accordingly. Each training course is supported by a training package which includes lesson plans, professional visual aids and student reading material. Such training packages increase the effectiveness of the training and ensure that the content of each course is consistent. To improve them further, it is suggested that more specific learning objectives be written for each lesson.

For training of operating personnel EdF has provided state-of-the-art simulation including the use of both part-task and full-scope simulators. In addition, computer-aided training is used extensively throughout the organization. An extraordinary facility has been built to train personnel in maintenance of large primary circuit components and in refuelling works. This facility has all key parts of the main components represented, at full scale and fabricated from genuine materials. Actual working conditions can be simulated when practicing the work.

During a visit to the simulator training facility the OSART identified some issues that should be addressed to achieve maximum effectiveness and quality in simulator training: long simulator modification outages, long delays in implementing design changes into the simulator, no systematic tracking of differences between the simulators and each plant (because of the strong standardization in France), and poor isolation of the instructors' booth from the simulator control room.

Operations personnel

Training required for initial qualification is well defined in plant procedures. Trainees are assigned to shift and the shift supervisor is responsible for the training of new personnel. In addition, the shift supervisor is responsible for the implementation of retraining topics for his shift during the back shifts. Due to the individual nature of the retraining implemented by each shift supervisor, and the lack of long term planning for periodic refreshment of basic knowledge on plant systems and procedures, no coherent minimum programme exists beyond the standard courses identified by the central training organization. An overall annual retraining programme for

operations personnel should be implemented. Methods used to verify technical knowledge for completion of initial training and periodic retraining are subjective and potentially not coherent. Methods should be developed to ensure that coherent minimum standards are met and maintained.

Simulator retraining requirements are met by attending annually one of two alternate simulator courses. Due to the changing content of the course programmes, no coherent annual programme exists for all operations personnel. Team training, which could incorporate the topics of both of the simulator retraining courses, should be implemented annually. In addition, simulator instructors should take an active role in teaching, when necessary, during actual simulation.

Maintenance personnel

Initial training programmes have been established for each maintenance position. Responsibility for the implementation of the initial programme is assigned to the engineers in each work area. Final verification of initial training is subjective and depends on previous experience. Methods should be established to ensure that minimum standards are met for initial training of maintenance personnel.

Retraining of maintenance personnel centres primarily on new topics oriented to specific components. A systematic planned retraining programme to maintain basic technical knowledge should be developed and implemented.

Radiation protection personnel

Initial training of radiation protection personnel was found to be on a level consistent with good training programmes found at other plants. Training records indicated that required initial training was completed prior to qualification. However no systematic retraining programme exists. As in the other programmes, final verification of initial training is subjective and depends on previous experience. Methods should be established to ensure that consistent minimum standards are met prior to final qualification. A systematic retraining programme for radiological protection personnel should be designed and implemented.

Managers and supervisors

Promotion to a management or, supervisory position is based upon a well established selection system that ensures that personnel are qualified for their new positions. Personnel selected for promotion are given a variety of training courses to enable them to meet the additional requirements of their

job. However, no special training in supervisory skills has been provided for shift supervisors, and very limited management training has been identified for managers. Special training in supervisory and management skills should be implemented for each of these positions.

General employee training

Initial training for new employees is well defined and implemented. The programme topics include those found in many other countries, and the technical content of the material is very good.

Biennial retraining is required of all personnel as refreshment of the topics in the initial training programme. Plant personnel are diligent in attending the retraining programme.

No initial training is provided to contractor personnel, but a written exam is used to verify their knowledge of basic radiological requirements. This written examination and pass criteria are not adequate to verify that a person is familiar with safe work practices. Means should be considered to better ensure that contractor employees know the safety hazards and the plant procedures for work administration and industrial and radiological safety adequately.

3. OPERATIONS

Work conducted by the Operating Section gave an impression of professionalism. The section management has developed and implemented policy making, operating and support functions that promote safe and reliable operations. The operators were found to be well qualified and to perform their duties in a calm and efficient manner., paying adequate attention to detail.

Organization and Administration

The responsibilities and authorities of the Operating Section are clearly defined and understood. Minimum staffing levels for operators and other staff are adequate, and the specified levels are strictly followed. The risk of erroneous judgement by the shift supervisor is minimized by a safety engineer who carries out independent review and provides advice as needed. Coordination of Operating Section activities with those of other site personnel is well established through periodic meetings and formal transmittal of documents.

The responsibilities of shift supervisors (Chef de Quart = CdQ) are more limited than commonly seen at other plants, the emphasis being on actual operations and less on other activities such as maintenance, chemistry, radiation protection and emergency planning. However, systematic communications keep the supervisor well informed of equipment status. The benefit of this approach is that it reduces the administrative burden on the shift supervisor. The shift supervisor is not authorized to deviate from permanent procedures, and he cannot decide on restart after reactor trip. Decisions on actions to be taken when procedures are not applicable, and reactor restart decisions, are left with both the operations engineer and the safety engineer. This ensures more thorough consideration and consultation in off-normal situations. However, it was observed that there is a need to better, define and document the method to be followed in deciding on restart after reactor trip.

The operating supervisor has adopted a practice of meeting with each operating crew every six weeks; thus, he conducts one meeting of this sort each week. The topics discussed include future operations activities, plant modifications, new procedures and operating experience. This is a good way to exchange information between management and people at the working level.

Conduct of Operations

The plant was found to be operated in close adherence to written procedures and strict observance of safety regulations. The operating staff were attentive, to plant parameters and conditions. Immediate and efficient response to important alarm signals was noted. Shift turnovers, including discussions and control board walkdowns, were conducted in a business-like manner. A thorough briefing of the oncoming shift by the shift supervisor was conducted after, shift turnover.

Outage activities within the operating section were found to be well planned and implemented. Operations personnel are assigned to the team that prepares schedules, work requests and taggings. An especially good practice is the outage plan report prepared by the operating engineer. This report is used by the operations personnel to discuss and plan the outage jobs and plant configurations and manipulations.

Control room alarms are separated in such a way that the most important are indicated by specific red lights, and others are displayed on video screens (cathode ray tubes = CRTs). Most of the CRT alarms are nuisances and the operators pay less attention to this type of alarm. Consideration should be given to development of methods to ensure that important alarms are not ignored.

An area of concern was the existence of some uncontrolled notes and other operator information throughout the plant. If Such notes are considered necessary, a systematic method should be developed to control their, placement, and they should be equipped with proper signatures and time of validity.

During the OSART the plant operators were on strike and were carrying out only operations necessary to ensure plant and worker safety. Strike actions also included occasional decrease of the plant power and even plant shutdown at the demand of the strike committee. Although the plant was kept within safety limits at all times, a concern arose because plant operations were not under direct control of the plant manager, and he was thus unable to accept full responsibility for plant performance. Authorities and responsibilities under such conditions should be reviewed and documented at the EdF and regulatory body management level.

Operations Documentation

The Operating Section has a comprehensive set of procedures and reference documents that provide adequate instructions for plant operations and equipment status control. The procedures were found clear and easy to follow. Methods and responsibilities for periodic review of documentation and for revising the documents are well defined and ensure good control of operations documentation. Temporary modifications while waiting for permanent ones are also done in an appropriate manner.

New emergency operating procedures are being developed, using a plant state oriented approach instead of current event-based approach. Expedited implementation of the new procedures is suggested.

System and components status control

The facilities and equipment at disposal of the operating staff are considered good. Computers are used efficiently to support operators in controlling systems and component status. In particular, the computer-based work request processing system and the related tagging system are excellent.

The OSART identified some areas where improvements could be made to facilitate equipment status control. The information in red alarm windows is difficult to read, and the design of these windows should be improved. Equipment labelling especially in the turbine building areas is inconsistent, and labels are frequently missing. It is suggested that a review of the

status of labels be conducted to identify the scope of the label deficiencies, and that corrective actions be taken to resolve this problem.

Temporary alterations in the electrical and control circuits were found to be controlled properly, but several alterations are some years old. The temporary alteration log should be reviewed to verify whether all are still necessary, and modification process should be initiated for those that are considered to be needed permanently.

The work request processing system should be supplemented by a sequential logging of all work requests that are initiated. The log should be used to check the status of work requests with respect to their priority, duplication, completion and ageing. Increased emphasis should be given to decreasing the current large backlog of work requests.

4. MAINTENANCE

Maintenance at the St Alban plant was found to be well organized and effective. There is a good maintenance programme, and maintenance activities are carried out by qualified personnel. The assistance from the centralized EdF maintenance service (Département Matériel and Unité Technique Operationnelle) makes a valuable contribution to the effectiveness of the programme. The strictly implemented standardization of EdF plants has also permitted development of programme elements that support high quality maintenance work. Examples of these are the in-service inspection programme, maintenance procedures, spare part programme and facilities for, training maintenance personnel.

Organization and Administration

The Maintenance Department is well organized under the responsibility of a maintenance manager. The supervisors of the different maintenance sections and engineers within sections have clearly defined tasks. In discussions, they demonstrated full understanding of their responsibilities.

Communication within the maintenance department is good, both between the management and personnel at working level and between and within the sections. Adequate contacts with other departments have also been established. The main channel for communications is regular meetings at the various organizational levels. The usefulness of these meetings could be further enhanced by preparing minutes in which items for action are identified for tracking to completion. A commendable feature of the maintenance organization is the assignment of an engineer to an expert position in the Field Maintenance Section. His task is to assess the level of maintenance work and propose upgrading where appropriate.

Conduct of maintenance

Most of the maintenance work during plant operation is conducted by the Permanent maintenance staff during normal working hours. During night shifts and weekends adequate maintenance personnel are on call. These arrangements ensure that maintenance works are conducted professionally.

A comprehensive set of maintenance procedures is available to provide guidance on work performance. All of the procedures are filed systematically and copies are available for use. When the services of external contractor personnel are required, the plant staff instructs them in an organized manner on topics such as access to work, potential risks, and provision of materials.

Independent verification of work performance by a qualified person who has no direct involvement in the work is not required at St Alban. In some countries such verification has been found worthwhile. Also, consideration should be given to including hold points for, quality checks into selected maintenance procedures, so that work could not proceed without approval by a designated person.

Good material condition of the equipment was observed in the controlled areas of the plant, indicating satisfactory maintenance of the components that are most important to safety. In other areas, the level of material condition and housekeeping was lower. It is therefore suggested that the maintenance manager and the section supervisor's make regular walkdowns through the plant to identify items in need of correction and to promote a caretaking attitude among the maintenance staff.

Work control system

The work control system is well established along lines that are common in the nuclear industry. Work requests are made on forms that also serve work planning and work authorization functions. A completed form with attachments contains sufficient information for work performance, analysis and history file. Work priorities and schedules are agreed at daily meetings attended by maintenance and operations personnel. The OSART found the scheduling adequate

for short-term activities, but another, routine for long-term planning would be needed to reduce the backlog of less urgent works.

An excellent computer controlled tagging system is in use for isolation of systems and components. Chains and padlocks are available to ensure isolation where considered necessary for personnel or equipment safety. However, padlocks were frequently found, both open and closed, in places where they did not serve any purpose. The procedure for the use of padlocks should therefore be reviewed.

Preventive maintenance

An effective preventive maintenance programme has been established with support of the EdF Equipment Department. It includes periodic maintenance and tests, predictive maintenance and feedback of information. Especially noteworthy are periodic vibration measurements of rotating equipment, and a calibration programme for all measuring devices. There is a good system to notify the regulatory authorities, the EdF Equipment Department and other plants of equipment failures and abnormal degradation, so that similar components can be checked for potential generic problems.

Corrective maintenance

A failure notification and work request system is in place for, initiating corrective maintenance actions. Failures are discussed in the daily meetings, thus ensuring prompt action when the plant safety or availability might be directly affected. For less urgent tasks no priority classification or definition of target dates is used to guide work planners. It is recommended that work priority classification be introduced, together with target dates for all corrective maintenance works.

In-service inspection

All periodic in-service inspections are incorporated in the preventive maintenance programme. Inspection procedures are provided by specialists from the EdF "Groupe des Laboratoires" (Chemical and Metallurgical Laboratory). The same specialists, or contractor personnel supervised by them, conduct the inspections during refuelling outages. Inspection results are properly reported and analyzed. This activity is well managed.

Maintenance history

The maintenance history file is excellent. All data are stored in a systematic way and are easily retrievable. Selected information is also stored in a computer system which facilitates analytical treatment of the data. The history file provides a valuable source of information for further development of the maintenance programme.

Outage management

For, each refuelling outage a special organization is set up. The responsible co-ordinators are the same in various phases: outage preparation, outage performance and plant start-up. Planning is done with the help of a computer. Separate files are prepared for each work activity well ahead of time, including work orders and necessary instructions. During the outage, work progress is well controlled with the help of meetings. After the outage, all activities are evaluated and proposals for improvements are made. OSART found outage management to be fully satisfactory.

Stores and facilities

The maintenance workshops, the stores for contaminated tools and equipment, and the decontamination facilities were found adequate, clean and well equipped. The OSART noted especially the laundry for contaminated clothes, which is fully automated and can be handled by two people. This system ensures that the radiation dose from laundry work is reduced to a minimum.

All safety related spare parts are ordered and delivered through the EdF Operational Services Unit. All spare parts are properly inspected and labelled at receipt. The spare part store is well organized, and the parts are easy to track by a sticker and colour coding system. Special stickers exist for spare parts with a limited life time, but it was noted that more careful control of expiry dates should be implemented.

5. TECHNICAL SUPPORT

The safe operation of the St Alban plant is supported by a strong organization with technical expertise in all necessary areas. EdF Headquarters is much involved in technical support functions; but the on-site engineering staff is also substantial.

Surveillance test programme

Surveillance testing is carried out in accordance with a standard programme applied at all 1300 MW plants in France. St Alban is the lead plant for developing that programme. The surveillance test procedures including check sheets and acceptance criteria, and schedules defining test intervals, are developed at EdF headquarters and approved by the regulatory authority (SCSIN). The OSART noted a valuable contribution by the St Alban technical support staff in improving the procedures. There is good co-ordination in this area between plant personnel and external organizations, although some delay occurs in approval of the revised procedures. In the interim, drafts of revised procedures are used for testing.

The overall scope of the test programme was found to cover adequately the equipment most important to safety. In addition, some complementary tests have been introduced locally for further assurance of safety and reliability.

Test scheduling is systematic and ensures timely test performance. Tests which were reviewed in detail were professionally executed. The safety functions and parameters were checked to an adequate extent. Checks before the test, and system return to its normal state after, the test, were done in a controlled manner. Test results are analysed carefully. Trending of test results to enable detection of gradually developing problems has been started recently. Corrective actions to be taken in case of deviation from expected results are properly defined. However, it was noted that the flow of information between various plants about incidents which have taken place during the tests could be improved. For example, an incident causing reactor

trip occurred at St Alban one year after similar incident unknown to St Alban personnel occurred at another 1300 MW plant in France.

Among the individual tests, the monitoring of containment leak tightness with a computer system was found to be excellent. For diesel testing, usually 30% load is used; except for an annual test at 100% load. This differs from the approach commonly used in other countries. The advantages and drawbacks of this method relative to testing at full load, should be further investigated.

Reactor engineering and fuel handling

Reactor engineering activities such as planning the annual refuelling schemes are under the responsibility of EdF' Headquarters. It provides detailed guidance and instructions for refuelling and core monitoring tasks. A specialist from Headquarters also participates in reactor, start-up and physics tests after refuelling. Consequently, there is less on-site expertise in reactor engineering than is commonly seen at plants in other countries. Nevertheless, good detailed procedures, support by shift safety engineers, and a policy of contacting the EdF' central office if any unexpected events occur are considered to provide assurance of safe core operations.

Fuel, handling is carried out by well-trained special staff of the Maintenance Department with sufficient instructions from the Technical Support Section and EdF Headquarters. Good communication is maintained between the main control room and fuel handling crew during refuelling, and all fuel movements are carefully double-checked. Facilities and tools for fuel handling are appropriate and well maintained. Innovative methods and tools have been developed for safe loading of slightly bent fuel bundles. This is a common concern at most PWR plants, and the ideas developed in France are generally commendable.

Significant event reports

The general impression resulting from the review of the significant event report system is positive. Criteria used for their identification and

classification are clearly specified in the organization manual. The criteria are well understood by personnel of each department concerned. Procedures for reporting and processing significant incidents and safety-related events are well defined in administrative procedures.

Significant incidents are reported by telex, within 24 hours, to SCSIN and a report is submitted within two months. Examples of significant event reports were reviewed. The root causes of the events were found to be identified clearly, and the appropriate actions properly addressed.

In practice, investigation and analysis of an upset condition are completed before restart of the unit concerned, but a written general procedure or guidance would be useful to ensure consistent decision making.

Operating experience feedback

The system set up to disseminate operating experience feedback is the responsibility of the Nuclear Safety and Quality Assurance Department. An administrative procedure gives the philosophy and the general functioning of operating experience feedback. The document also defines objectives, fields of application and overall responsibilities. The Safety Review Committee periodically examines the objectives of the system and the summary of the actions completed, and makes proposals to improve it.

In-house operating experience feedback is from various sources and the people involved have the required experience and are aware of safety involvement. In the Maintenance Department, operating experience feedback was found to exist, but a specific guideline or reference document would be useful to make that activity more structured. Off-site operating experience feedback comes mainly from EdF's Equipment and Operations Departments of the Thermal Generation Service (Service de la Production Thermique = SPT), which provide sustained technical support in the operation of the power plant, working in close collaboration with the plant organization.

A good method of fostering a safety culture and of providing information on safety-related events, both on-site and external, is the "MSQ info" published weekly and distributed to the staff.

Modifications

Modifications are strictly controlled by EdF' Headquarters to keep the 1300 MW plants similar to each other. Each proposal for modification is thoroughly evaluated before design and implementation can be started.

The Maintenance Resources Section of the Documentation and Modification Branch controls all on-site processes of the modification, from the modification request to installation on-site. Other sections of the operations and maintenance departments are adequately involved at various stages of the modification, to study the documents and to ensure that everything is compatible with the installation. The modification process includes update of plant documents and staff training when this applies. The entire modification process was found to be sound; the people involved have the necessary knowledge of all safety aspects.

6. RADIATION PROTECTION

The performance of the radiation protection organization at St Alban with respect to personnel and environmental protection was found to be of good quality. Radiation protection personnel discharge their duties in a professional manner. Facilities, equipment and instrumentation are adequate. Radiation and contamination levels in the plant are remarkably low. The respiratory protection policy is considered excellent. Improved dose accountability for contractor personnel was recommended, as was the development of additional procedures to implement the basic radiation Protection guide developed by EdF's Safety, Radiation Protection and Environment Department (Département Sûreté, Radioprotection et Environnement = DSRE).

Organizational matters

The basic requirements of an effective radiation protection organization that is, independence from organizational units directly or indirectly responsible for electricity production and adequate professional qualification are fulfilled. The head of the Industrial Safety and Radiological Protection Section reports to the Deputy Plant Superintendent. He participates in the weekly and most of the daily management meetings.

Radiation protection personnel do not work on shift, but one of their technicians is always on call outside of normal working hours. The plant's decision to put a second radiation protection technician on call during normal operating periods is endorsed. Their duties under emergency conditions should be defined.

Policies and procedures

EdF has established a uniform radiation Protection policy for all its nuclear power plants including St Alban. DSRE has developed a set of practical guides on radiation protection, radioactive effluents and

radioactive waste which spell out the general principles and how to apply them in pressurized water reactor plants.

To make full use of this excellent technical basis, however, it is desirable to develop implementing procedures for guidance in day-by-day work in the field. Particular topics to be addressed include the radiation and contamination level monitoring programmes which are in place but not adequately documented. Such procedures should define the criteria for the selection of the check points, the processing of the data obtained, and follow-up actions to be taken including those for the refuelling shutdown periods.

Although individual aspects of the ALARA principle, particularly with respect to waste and dose reduction, have been addressed in technical notes, no general document on how to keep collective doses and radioactive effluents as low as is reasonably achievable is available.

Each radiological event (overexposure, contamination) is documented in a special report. These are rare events, indicating a good record of personnel training, radiation protection, work quality and cleanliness in the plant.

External radiation exposure

Radiation dose levels in the plant are routinely checked each week at 97 Locations. They are low on average, partly because the plant has been in operation only for a comparatively short time, but also as a result of good radiation protection practices.

Entrance to controlled areas requires prior passing of a written examination. More than 50%, for example the figure is 65% in other countries, correct answers should be a prerequisite for demonstrating adequate familiarity with good radiation protection practices. The records of these examinations should be kept for a reasonable period and not destroyed as is the case at present.

Internal radiation exposures

Good practices are adopted at St Alban to keep contamination levels low and to protect the workforce against contamination and incorporation of radioactive material. Protective clothing is used routinely when entering controlled areas. Smoking, drinking and eating inside controlled areas is not permitted: this is consistent with international practice.

Whole-body counting is carried out in accordance with internationally accepted practices. The results (in 1987, one person exceeding 1/30 and in 1988 none exceeding 1/100 of the maximum permissible body burden [quantité maximale admissible]) demonstrate good performance. The importance given to the use of dynamic and static confinement to avoid the spread of contamination and the exclusive use of positive pressure breathing apparatus to ensure worker protection is an excellent practice.

Personnel dosimetry

Two independent dosimetric systems, direct-reading electronic dosimeters and film dosimeters, are used. The electronic dosimeter system is used to account for job-related collective doses, to support efforts to keep exposures ALARA. The highest individual dose in 1988 was 16.8 mSv, and the collective dose for, the last refuelling outage was 1.72 man-Sv, values which are considered low in international comparison.

The dosimetry of contractor personnel, who are not considered occupationally exposed and move from one facility to another, appears somewhat weak. The current limit of 2 mSv for exempting personnel with lower doses from a closer follow-up is higher than in other countries. Consideration should therefore be given to possible improvements to ensure comprehensive dose registration for contractor personnel.

Facilities, equipment and instrumentation

Necessary radiation protection equipment and instrumentation is available in sufficient numbers, kept in good operating condition and calibrated

Regularly. Calibration is carried out by contractors, often the supplier of the instruments.

The range of instruments and devices available is capable of covering normal operating conditions. For accident conditions, some instruments with an extended measuring range are on order. A thorough review was suggested to ensure that they would satisfy the needs of preparing for emergency situations.

Waste and effluent control

Programmes and procedures for processing radioactive waste are well defined and worked out in detail. Liquid waste is grouped into cleaning fluids, low-level liquid waste, chemical liquid waste and high-level borated waste. A programme for the reduction of radioactive liquid waste, including some design and operating modifications, has been initiated and is endorsed.

Consideration should be given to limiting the production of radioactive sludges, because of the problems arising from the storage of a large number of drums containing radioactive liquid waste.

Facilities for solid waste collection, conditioning and storage are kept in good condition. They are clean and adequately shielded, and have adequate ventilation and filtering systems. Solid waste management follows well defined EdF guidance and plant procedures, and is considered satisfactory.

7. CHEMISTRY

The position of St Alban's Chemistry Section within the OF organization is somewhat different from that in other countries. Due to the traditional centralization, it does not stand alone but has strong ties with the Laboratory Group (Groupement de laboratoires = GDL) in Paris. Principal methods, limits and specifications are developed by GDL and issued to St Alban among others for implementation.

In the case of the St Alban plant, this appears to work well. The equipment of the laboratories and sampling rooms, detailed working schedules and analytical methods and reliable instrumentation contribute to the impression of excellence.

With respect to radioactive effluents, the Central Service for Protection against Ionizing Radiation (Service de contrôle et de protection contre les radiations ionisantes = SCPRI) exercises rigid control. This is not restricted to environmental monitoring, but includes the plant's control methods, instrumentation and requirements for daily reporting.

The plant chemistry can be qualified as good. Adherence to strict specifications, which represent the state-of-the-art, has been demonstrated. Long-term results are expected to justify the choices

Organization and Administration

St Alban benefits from a special situation: a large number of similar plants, a centralized organization and a uniform organizational structure. The GdL plays an important role in research and development, collects and compares the data from all nuclear power plants, and provides for training and advice as required by the individual nuclear power plants.

EdF's Safety, Radiation Protection and Environment Department (DSRE) is concerned with radiochemistry, radioactivity control in the systems,

environmental surveillance and waste treatment. St Alban's relationship with DSRE is less close than that with GO, but it is consulted on matters such as oxygenation during refuelling, and new waste treatment methods. DSRE also co-ordinates generic modifications and upgrades, e.g. the installation of redundant stack monitors.

The Laboratory Branch at St Alban forms part of the Technical Support Section, which also includes a Testing and Statistics Branch primarily concerned with core physics and nuclear data. Responsibilities and duties of the Laboratory Branch's staff of 25 are defined in detail.

During off-hours, sufficient personnel are on call. They comprise four or five persons who also come to the plant during holidays and weekends to carry out basic analyses and chemistry checks. The overall system is considered to be adequate. Personnel qualification appears to be adequate, being based not only on diplomas but on the actual performance of the individual. Co-operation with operations personnel is good. The shift personnel are kept informed of any changes in chemical parameter values and of corrective actions they should take.

Chemistry procedures

In accordance with EdF's general guidance, detailed procedures are available. They are based on the technical background developed by the GdL. A daily log sheet is printed out by the computer which specifies work to be carried out on each day, the limits to be observed and corrective actions to be taken in the event of deviations. This is considered to be an excellent practice.

Records and reports

In addition to the local recording of chemical values on log sheets, these data are fed to computer terminals which communicate with the central laboratories. The on-site software is presently not user friendly but allows consultation of the data by the foreman. Efforts are underway to improve this situation.

Data from the on-line instrumentation are available on recorder's and on a computer terminal in the main control room. The same information is provided to terminals in the chemical laboratory, but only a day later. Reports on unusual events such as oxygenation of the primary coolant prior to shutdown and water ingress into the condenser are prepared.

Facilities, equipment and instrumentation

The general impression is excellent. Good sampling facilities are provided, including laboratory space for sample preparation and analysis. They comprise vented and shielded boxes for liquid and gas sampling which are adequate even under conditions of high activity in the primary circuit.

The post-accident sampling system is still being developed. Liquid samples can be taken, although not in a safe manner since no rinsing of the lines is provided for and no automatic sample dilution is possible. The sampling of the containment atmosphere at pressures below 1.5 bar is possible, but only for non-condensable gases. This unsatisfactory situation is not different from that in other countries.

St Alban's laboratory is divided into cold and hot zones and is equipped with all the necessary instruments. Standards are available where needed.

In addition to the normal laboratory instrumentation, two atomic absorption spectrometers, one ion chromatograph, one gas chromatograph, two gamma spectrometers and liquid counting and beta counting equipment are at the Laboratory Branch's disposal and are widely used. A special SCRPI laboratory is used for effluent control.

All important chemical parameters are analyzed on-line by modern instruments which are well maintained and are calibrated regularly. Important values are displayed and recorded in the main control room. Some of the recorders can record different parameters depending on choice. This could lead to confusion if the attribution is not recorded properly. The important parameters have dedicated records, most values are recorded automatically on the computer and are easily retrievable anyway.

Addition of chemicals such as hydrazine, morpholine and lithium hydroxide is carried out by the shift personnel, but the preparation of the solutions is the responsibility of the Laboratory Branch. Although the solutions are not analysed, the concentration in the various circuits is checked to verify the results obtained. This approach is considered adequate.

8. EMERGENCY PLANNING AND PREPAREDNESS

Emergency Planning and Preparedness at St Alban should enable an effective site response in the event of an incident or accident.

The OSART also covered the interface between on-site and off-site organizations. Although no detailed review of all aspects of the off-site emergency plan and implementing procedures was performed, adequate support was found for the conclusion that they are adequate for environmental monitoring and protection of the general public.

During the review of the emergency planning and preparedness arrangements both good practices and room for improvements were identified. Although most possible improvements had already been identified by the responsible authorities and are being reviewed by CF, a greater initiative at the St Alban plant is considered necessary if adequate improvements are to be implemented rapidly and effectively.

Organizational structures

Within the national emergency response organization, which involves several ministries and co-ordinating committees, special responsibility rests with the operating organization (EdF) and the Plant Superintendent of St Alban. Details of this organizational setup are found in the Internal Emergency Plan (Plan d'Urgence Interne = PUI). St Alban's main responsibilities in the event of an emergency include the recovery of the control of the plant, ensuring protection of the plant personnel, assessment of plant and environmental conditions and information of EdF headquarters and public authorities.

The organizational provisions for alerting and informing the public authorities in the event of an emergency are such that these activities are the responsibility of the management representative on-call. The shift Supervisor and the Safety Engineer are not authorized to declare an emergency

even if the situation calls for urgent action. To avoid any possible delay in the implementation of Protective measures, one of them should be given the authority to act as Site Emergency Director until relieved by the management representative on-call assuming the command function in the Management Control Centre (Poste de Commandement des Directions = PCD). This authority would include the declaration of emergency and notification of the public authorities if required.

Emergency plan and implementing procedures

The Internal Emergency Plan and its implementing procedures are considered to be excellent. A special feature is the method of presentation, using flow diagrams to facilitate decision making and remedial actions, it is particularly valuable because it allows for easy use and orientation in the initial phase of an emergency, when a high stress situation may be assumed.

A similarly excellent practice is the system of marking escape routes and the location of emergency equipment. The use of a complete system of pictograms is judged to be an effective means of enabling fast and accurate orientation in the event of an emergency.

Present planning and procedural provisions do not cover the whole range of possible radiological conditions in the course of a plant emergency. It is therefore recommended that the emergency plan and its implementing procedures be reviewed once more to determine whether high-level radiation and contamination could affect emergency control posts and emergency response teams. Included in this review should be the questions of access of emergency personnel to the site in the event of major airborne activity or site contamination habitability of the emergency control centres under adverse conditions, protection of the emergency response teams at particular recovery operations and prevention of contamination of backup control centres.

Initial assessment of on-site and off-site radiological consequences by the Analysis Control Centre (Poste de Commandement des Contrôles = PCC) is carried out manually using graphs, tables and nomograms together with selected plant data. The introduction of computer-aided accident assessment

techniques, which has begun, is endorsed and should be accelerated to the extent possible.

Facilities, equipment and resources

The main emergency response facilities on-site, the plant off-site evacuation/assembly facility as well as the other off-site facilities have adequate equipment for effective notification, communication, decision-making, control and response for the protection of the general public in the event of an emergency. Whether their response capability could be maintained under severe accident conditions appeared questionable (see above). Acquisition of additional equipment such as air monitors, respiratory apparatus with replacement bottles, survey meters and self-reading dosimeters would be desirable.

Means for the provision of food and drinking water, for the on-site emergency personnel should be considered, as should the establishment of criteria for the withdrawal of the emergency personnel to the back-up facilities. This merits attention in the future.

The site medical facilities including resources for, first aid, of contaminated persons and available equipment got good marks. Thyroid prophylactics are in stock for, distribution to the emergency personnel. Additional iodine tablets are available for possible distribution to the general public, although the national medical authorities have not yet decided how to deal with this issue.

The preparedness of the off-site fire brigade to act upon a plant emergency is impressive. The specific role of the mobile assessment and intervention units and their response capability was particularly noted.

Training, drills and exercises

The training programme for the emergency response personnel at St Alban includes other plant personnel and off-site assistance, so that they can become familiar with alerting and evacuation procedures. Responsibility for

the plant-specific training programme is assigned to the respective group leaders. Although the training programme is not formalized, preparation is comprehensive and results are satisfactory.

Drills and exercises are prepared both at the national level (EdF headquarters and responsible authorities) and at the plant/response team level, including integrated exercises involving several emergency response functions. The various aspects of emergency response are covered adequately and frequent exercises are held. Exercise critiques are carried out, and follow-up is provided for (although not systematically). It would however be desirable for identification and implementation of the lessons learned to be formalized by developing a procedure to use feedback for updating PUI and implementing procedures.

Records of personnel participating in emergency drills and exercises should also be used to ensure that participation of all emergency personnel is uniform.

Public information

A good public information programme was found in place, covering all major aspects of emergency planning and preparedness. Organizational provisions are adequate and sufficient resources are available.

A special information programme involving the medical profession in the Département de l'Isère has been implemented. This programme is considered excellent because it has two desirable features: the fact that medical doctors in the region have professional information on how to cope with a radiological emergency; and the fact that relevant information can therefore be provided to the general public on nuclear risks, emergency response, radiological injuries, etc. from the medical profession which is a highly credible source.

ACKNOWLEDGEMENT

The Government of France, the Central Service for the Safety of Nuclear Installations (SCSIN), the Institute of Protection and Nuclear Safety (IPSN), the Electricité de France (EdF), through its Paris Head Office, the St Alban nuclear power plant and regional and national operational training centers and the EdF/Framatome Maintenance Training Center (CETIC) provided valuable support to the St Alban OSART, France has been providing significant contributions to the OSART programme as well as other Agency activities including sending experts to other OSARTs and providing support to the development of the OSART documents. Such a wide involvement in OSART activities greatly assisted in the preparation of OSART mission through preparatory meeting in Paris and at the St Alban plant and the development of the advance information packages for, the team members.

Throughout the whole OSART mission, St Alban management and counterpart were open-minded, co-operative and supportive in creating a productive working atmosphere. The review occasionally extended to 'the external organization and beyond working hours to challenge a deep and wide exchange of experience. The efforts devoted by SCSIN, IPSN, EdF headquarters and St. Alban personnel, the interpreters and the secretaries were outstanding. They enabled the OSART mission to accomplish their review in a satisfactory manner. The IAEA, the Division of Nuclear Safety and its Operational Safety Services wish to thank all those concerned for the prior efforts and for the smooth and productive working conditions throughout the St Alban review.

ANNEX I: COMPOSITION OF THE ST. ALBAN TEAM

Experts

BERANEK, Jiri – CZECHOSLOVAKIA
Czechoslovak Atomic Energy Commission
30 years of nuclear experience
Review area: Management, Organization and Administration

CANOVAS, Juan – SPAIN
Central Nuclear de Asco
15 years of nuclear experience
Review area: Radiation Protection

DULAR, Janez – IAEA
Division of Nuclear Safety
22 years of nuclear experience
Review area: Operations

HAYDIN, Michael – USA
Division of Nuclear Safety
21 years of nuclear experience
Team Leader

JORDANOV, Jordan – BULGARIA
NPS Kozloduy
13 years of nuclear experience
Review area: Radiation Protection

KARUZA, Yadranko – YUGOSLAVIA
Institut za Elektroprirodu
20 years of nuclear experience
Review area: Emergency Planning & Preparedness

KOBAYASHI, Ichiri – IAEA
Division of Nuclear Safety
16 years of nuclear experience
Review area: Technical Support I

LAAKSONEN, Jukka – IAEA
Division of Nuclear Safety
16 years of nuclear experience
Review area: Training

LADOUCEUR, Maurice – CANADA
Hydro Quebec
Centrale nucléaire Gentilly 2
20 years of nuclear experience
Review area: Technical Support II

QUERIO, Robert - USA
Commonwealth Edison Co.
20 years of nuclear experience
Review area: Operations

SAMUEL, Thomas - SWITZERLAND
Kernkraftwerk Beznau
21 years of nuclear experience
Review area: Chemistry

UTSUNOMIYA, Seigo - JAPAN
Shikoku Electric Power Co., Inc.
16 years of nuclear experience
Review Area: Maintenance

WILLIAMS, Lee - UNITED STATES OF AMERICA
Alabama Power Co.
22 years of nuclear experience
Review area: Training

WHITTEMAN, Case - NETHERLANDS
Dodewaard Nuclear Power Plant
11 years of nuclear experience
Review area: Maintenance

Scientific Visitors

CHEN, Kai Hui - PEOPLE'S REPUBLIC OF CHINA
Guangdong Nuclear Power Joint
Venture Co. Ltd
26 years of nuclear experience
Training area: Technical Support I

KIM, Hyo-Jung - Republic of KOREA
Korea Advanced Energy Research
Institute
8 years of nuclear experience
Training area: Technical Support II

NOVAK, Stanislav - IAEA
Division of Nuclear Safety
27 years of nuclear experience
Training area: Maintenance

ANNEX II SCHEDULE OF ACTIVITIES

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|----|--|----------------------------------|
| 1. | Official invitation from French Mission in Vienna for an OGART mission to St Alban Nuclear Power Plant | 9 December 1987 |
| 2. | IAEA confirmation of OSART mission | 11 January 1988 |
| 3. | Preparatory meeting in Paris (SCSNI and EdF) and at St Alban NPP | 25-27 April 1988 |
| 4. | Recruitment of external experts | April/October 1988 |
| 5. | Advance information package sent to OSART experts | August 1988 |
| 6. | Operational Safety Review of St Alban Nuclear Power Plant | 23 October –
10 November 1988 |
| 7. | Submission of Summary Report | February 1989 |