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EVALUATION GUIDE FOR THE RADIOLOGICAL IMPACT STUDY OF A BASIC NUCLEAR INSTALLATION (BNI) AS A SUPPORT FOR THE AUTHORIZATION APPLICATION OF RELEASES

Mr. Chartier, A. Després, S. Supervil, D. Conte,

P. Hubert, A. Oudiz, D. Champion

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SYNTHESIS OF THE DOCUMENT

At the time of a licence application of effluent releases and water pumping of basic nuclear facilities (BNI), the operator of the installation must in particular provide a radiological impact study of the radioactive effluent releases coming from the installation on the environment and on pubic health. By definition, it is about an assessment (in principle called an impact study *)* corresponding with the future activity of the installation, even if such licence applications relate mostly to existing facilities taking into account the Regulatory requirements.

An impact study of the radioactive releases represents technical and conditional specifications. It was for this reason that the French Safety Authority (ASN then DSIN) and the Directorate-General of Health Services (DGS) requested IRSN (then IPSN), in April 1999, to develop a guide facilitating the review of such a study, as well for the services implied in the examination of the licence applications, as for all the concerned parties in this field.

A first version of this guide was issued (in the form of a project) in August 2001 by the ASN. The present version takes into account all comments collected.

In order to guide the reader and to draw his attention to the major points, a summary is provided hereafter.

The objective of the guide is to take into account the regulatory context which underlies the development of the impact studies. The context is mainly made up of two texts:

- decree n°95-540 of May 4, 1995 (modified by the d ecree n°2002-460 of April 4, 2002) relating to releases of liquid and gaseous effluents and of water pumping of BNFs and their corresponding application texts dealing with documents and procedures as well as the required technical specifications for, in particular, the releases of radioactive effluents;
- The guideline Euratom 96/29 of May 13, 1996, known as “the basic standard guideline”, accompanied by its transposition texts in French law, concerning the basic standards relating to the health protection of the population and the workers against the dangers resulting from the ionizing radiation. These texts specify the concepts and sizes necessary for the assessment of received doses by exposed people, as well as the basic rules of radiation protection to respect, in particular concerning optimization procedures to limit exposure and to respect dose limits.

The guide also shows the recommendations made in January 1997 by a working group created by the Directorate-General of Health Services, concerning the radiological impact study on the population of nuclear facilities under normal operation.

In this precise context, the guide proposes to assess the radiological impact study of a BNF from three different angles:

- the description and the quantification of the produced effluents, by taking account of the triggering processes, of the different processing measures and of the procedures to optimise the reduction of the produced effluents;

- the estimate of the dosimetric impact of the planned releases on the population, taking into account the environmental characteristics of the installation;
- the definition of the conditions to monitor the releases and the environment.

This guide provides a general condition logical framework adaptable to any particular situation met.

1) The description and the quantification of the produced effluents

In the scope of assessing in a realistic way the impact of the radioactive effluent releases of an installation, it is advisable to identify the root cause, to characterize the composition and to describe the effluent release conditions. This information is also used as a support to optimise effluent management.

- ***The origin of the effluents:*** it is important to establish first an inventory of the various effluent producing spots (upstream of any processing before release), specifying the nature, the mode of producing (permanent or occasional), the composition (produced radionuclides and corresponding activities), the physicochemical characteristics, etc of each effluent. Description also refers to the provisions taken to channel the effluents towards installations processing these effluents, while mentioning, if necessary, the possibilities of diffuse emissions of radionuclides. The inventory must also indicate possible contributions of effluents coming from external facilities, as well as facilities being able to lead to an exposure of the public by direct radiation. A summary makes it possible to identify (from a qualitative and quantitative point of view) the various categories of radioactive effluents and consequently determine their management modes before release.
- ***The management of the effluents:*** it is important to describe, for each category of identified effluents, the conditions of collecting and processing, by specifying the selected choice, in particular based on the best available technology at a economically acceptable cost. The characteristics of the effluents before release have to be specified. Lastly, the conditions of analysis and monitoring of the released effluents have to be described.

The result of this description of the conditions is a qualification as precise as possible of the released effluents, providing the necessary elements to assess the impact, as well as an accurate redaction of the license application for the release indicating, for each category of radionuclides, the annual activities likely to be released. In general, the operator includes in his estimate a margin, taking account of the normal fluctuations of the operating installation (please remind that incidental or accidental releases are not taken into account by release authorizations), of uncertainties on the estimate of the expected releases and uncertainties on control and counting possibilities of the radioactivity of the releases. It is important that the selected margin is clarified in such a way that it is able to justify, in particular, the actuality of the release level described in the impact study.

Lastly, the description of the origin and the management mode of the radioactive effluents is used as support to apply the optimization rule concerning exposure of the public, in compliance with the “basic standards” guideline “; in this respect the operator may take actions to reduce the activity levels of the releases, to direct certain radionuclides towards liquid or gaseous releases, to choose processing technologies limiting the release of radionuclides.

The optimization approach leads to choices based on multiple criteria such as technical feasibility, the safety of the process, the economic costs, the annual effective dose for the reference groups, the collective dose of the population, the exposure of workers due to effluent processing, the different kinds and quantities of produced waste.

2) The description of the environment of the facilities

The description of the environment will make it possible to identify the possible pathways of transfer of the radionuclides present in the releases as well as each group of people who, within the population, could form a reference group, i.e. groups for which the exposures coming from the facilities considered are relatively homogeneous and which are representative for people who are receiving the highest doses due to the operating facilities.

The following components of the natural environment should be described:

- weather conditions near the facilities (crucial for the spreading of the gaseous releases);
- the topography of the locations (influence of relief in the spreading of the gaseous releases);
- geology, pedology and hydrogeology in the proximity of the site (characteristics of the soil, in particular in connection with their agricultural interest; characteristics of the ground water, in particular in terms of vulnerability);
- continental hydrology (description of the discharge system of effluents in the case of releases in a river) or marine hydrography and the study of currents (for example by releases at sea);
- Biotopes and sensitive ecosystems, if necessary associated with natural reserves.

The purpose of the description of the economic environment is mainly to identify human activities that could be affected by the radioactive releases (for example tourist activities) or that could lead to radioactive releases likely to expose the same population as those concerned with the releases of the facilities considered.

The description of agricultural practices, breeding, agri-food industry, pisciculture (fish-farming), etc. under the influence of radioactive releases is particularly important because it makes it possible to identify the various pathways to contaminate the human being via food. The same applies to human activities using water likely to be affected by liquid radio active releases, whether it is surface water or ground water, for example water used for irrigation or for the production of drinking water.

Finally the description of the human environment refers to:

- demography around the facilities or in the areas subjected to the influence of liquid releases (situation of residence, occupation, leisure , school, etc… areas)
- characteristics of the habitat, practices of the population (specifying attendance time of the people in the zones subjected to the influence of the releases);
- - data on the dietary patterns (by taking into account as much as possible the local practices) and of the respiratory flows according to the age and the activity of each individual.

3) The estimate of the dosimetric impact on the population

The assessment of the estimate of the dosimetric impact of the releases on the population depends on the one hand on the characteristics of the released effluents and on the other hand on the characteristics of the natural environment from an agricultural, economic and human point of view. It is carried out in compliance with the radiological reference state, established starting from measurements in the environment and representative of the radioactivity level of the environment at the time when the study of the estimated impact is carried out. The main purpose of this reference state is to put in prospect the impact of all future releases of the installation, within the framework of posterior monitoring.

The estimate of the expected impact must also take account of the possible phenomenon of radionuclide build-up in certain areas of the environment, and must therefore be carried out over one period corresponding to the maximum build-up.

The calculation itself requires the use of computer codes identified and adapted to the different inventoried pathways of transfer, namely:

- The atmospheric dispersion of the gaseous releases, by taking into account the weather conditions and of the physicochemical form of the radionuclides. The calculation permits to estimate the exposure by external irradiation due to a plume not only by inhalation, but also by the radioactive rainout on soil and plants;

- The dispersion of liquid effluents released into the aquatic environment (river or sea currents), by taking into account the interactions with radioactive aerosols and radioactive sediments;

- Transfer of radionuclides (and if necessary build-up) in the terrestrial section (a contamination of the soil will start a chain reaction i.e. a plant- transfer eaten by breeding stock animals and transfer to plants and animals eaten by human beings, etc) due to the radionuclides deposited on the surface (via atmospheric fall-outs and possibly via a seawater spray or via irrigation water);

- transfers to the aquatic environment area (transfers to depth or bank sediments, transfers to fish, molluscs and shellfish, transfers to the algae, seaweeds etc) will determine a possible transfers to the human being (via for example drinking water, the consumption of seafood and sea salt)

This approach results in estimating the activity of the incorporated radionuclides and their corresponding doses involved for individuals of the identified reference groups, but also the external exposure of these people (by external exposure due to the plume, to deposits on the ground, to sediments, even by direct irradiation by the concerned installation).

The annual doses received by individuals of each reference group are estimated by the total amount of all the doses received due to liquid as well as gaseous discharges. An estimate is also provided of the expected contamination in certain areas involved in the transfer of released radionuclides, the estimate permits to direct the monitoring after the event.

If necessary, the results of this assessment lead to further calculation studies for each parameter that has a significant impact on the final result or that is the most uncertain to define.

4) The definition of the environmental monitoring system

Within the framework of the license application for radio active releases, the assessment study must also specify the monitoring system of the environment around the installation, envisaged by the operator in order to be at the same time in compliance with the regulatory requirements (Ministerial decree of the 26November 1999) and with the characteristics of the releases and the environment of the installation resulting from the impact study.

The objectives of monitoring are the following:

- To detect any failure in the discharge process (vigilance);

- To make sure that the concentrations of radionuclides remain lower than the calculated values estimated by the model of the radiological impact of the release

- To highlight the evolution of the radioactivity of the various environment areas in the course of time.

It includes:

- A continuous or regular monitoring which has primarily a role of alarm and of control;

- periodic inspections making it possible to establish assessments of the contamination environment in order to follow the variations of the concentrations in radionuclides on the long-term; precise measurements will make it possible to supervise undetectable radionuclides within the framework of regular monitoring.

The installation of a monitoring system of the environment implies:

- A selection of the studies to be carried out: immediate measurements or over a period of time giving the average values over one period. These measurements should not be limited to overall parameters, but must also relate to the most representative radionuclides that are released with the effluents;

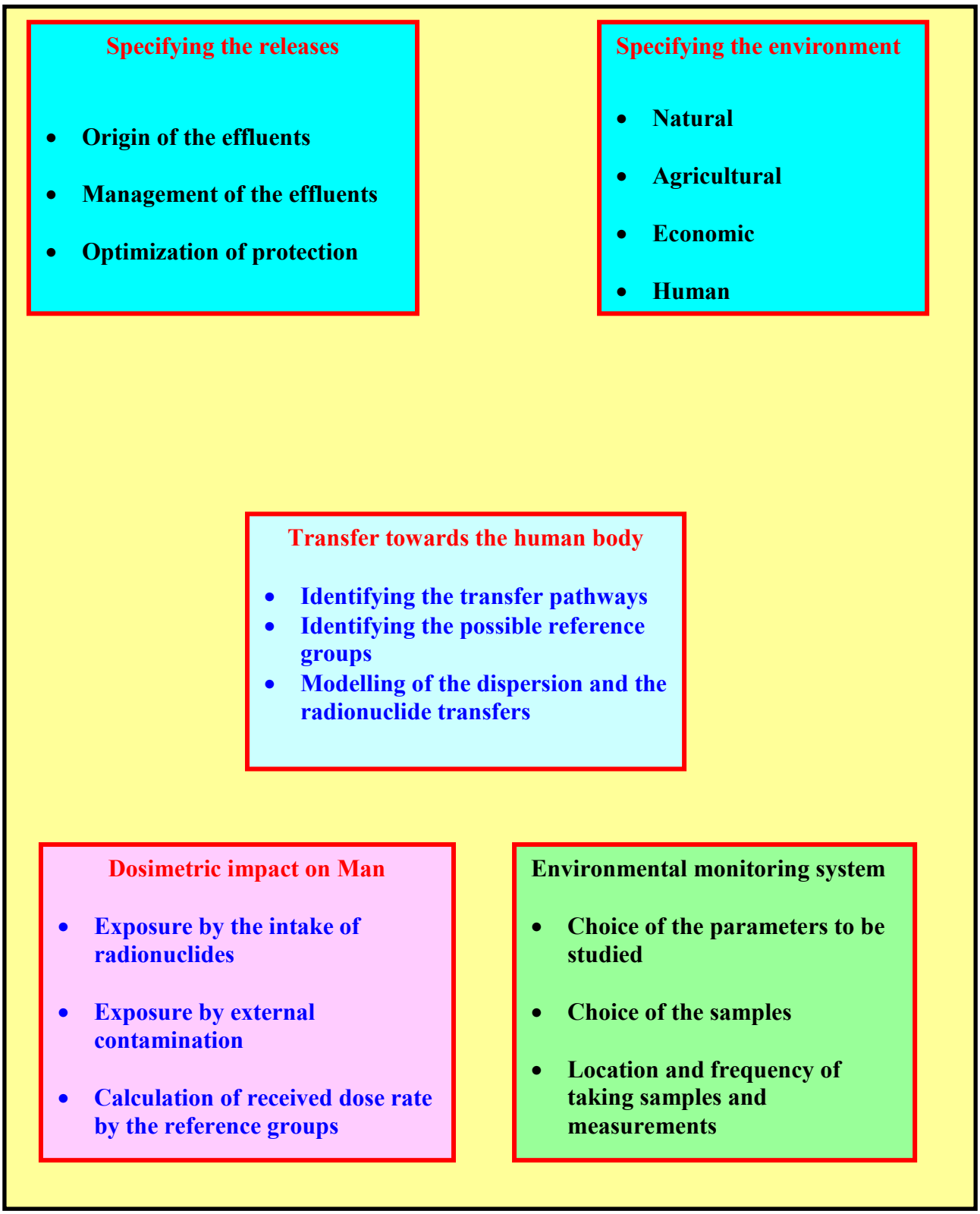
- The selection of samples: the samples must come from different terrestrial areas

(Air, soil, rainwater, plants, breeding stock and agri- foodstuff, etc) and aquatic areas (water, sediment, fish, molluscs, shellfish etc) likely to intervene in the radionuclide transfers towards the human body;

- The choice of localizing the measurements and the samples: measuring and sampling points are located as close as possible to the identified reference groups or as close as possible to their activity area (fields, vegetable gardens, meadows,…)

Sampling at atmospheric concentration points and with maximum deposits is strongly recommended;

- The sampling and measuring frequency: the frequency must be adapted to the periodicity of the releases and to the activity level related to each monitored area (for example, in the harvest period of vegetables).



Summary of the general assessment approach of the dosimetric impact of releases of a basic nuclear installation, in support of a license application to discharge/release

1. INTRODUCTION

This guide was developed by the Institute of Protection against radiation and Nuclear Safety (IRSN) on the request of the Nuclear Safety Authority (ASN then DSIN)and Directorate-General of Health Services (DGS) in April 1999, in order to facilitate the assessment of the files concerning license applications for releases and water pumping filed by the operators of basic nuclear installations (BNI) especially concerning the discharge of liquid and gaseous effluents and the corresponding study of their radiological impact. Please note that the guide does not cover the Impact of chemical toxic releases however other documents issued by for example INERIS will facilitate the assessment of this particular aspect. INERIS is a French public research body of an industrial and commercial character, founded in 1990 under the aegis of the French Ministry for Ecology, sustainable Development and Spatial Planning.

The first objective of this guide is to permit the concerned public services in charge of the review of these applications to check that the submitted files contain the necessary explicit and conclusive elements necessary to estimate the expected impact due to the radioactive liquid and gaseous effluents. It offers a condition logical base, without however going into the detailed calculation rules as they are already defined by the International Commission on Radiological Protection (ICRP) and included in the computer codes usually used.

In addition the guide will not only provide information but also add to a better understanding for all the concerning parties (operators, elected officials, the population in the surroundings of the installations, associations, members of local information committees, etc) of the general approach on assessing a priori the radiological impact of an installation within the framework of a review of license applications by the authorities.

In the scope of the objectives the guide takes into account the Regulatory context, mainly specified by the decree n° 95-540 of 4 May 1 995 relating to liquid and gaseous effluent releases and to water pumping of the basic nuclear facilities and also by the radiation protection requirements specified in the Euratom guideline96/29 of May 13, 1996, translated into French law is notably specified in decree n°2002-460 from 4 April 2002 relative to the general protection of people against the dangers of ionizing radiation. In addition the guide takes account of the recommendations made in the document “the study of the radiological impact on the population of nuclear facilities under normal operation “, published in 2000 by the Directorate-General of Health Services.

A first version of this guide, under the reference of IPSN/01-18, was given in August 2001 to the ASN and to the DGS, with the purpose to consult the public services involved with the review of the license applications, but also the operators who have the responsibility to forward the studies concerning the radiological impact of their nuclear facilities in normal operation, in support of their license application.

The consultation was concluded by a presentation of the guide organized on May 21, 2002 by the new Directorate-General of Nuclear Safety and Radiation Protection (DGSNR), from now on in charge of the review of the license applications for discharges and water pumping of the BNIs at a national level. The main observations resulting from this consultation were taken into account in the present version of the guide.

Lastly, it is important to highlight that this guide provides general conditions that should be adapted to the particular situations met. Also, for any given installation, the development of the various issues dealt with in this guide must be related to the importance they present for the understanding of the installation's impact on the environment. Elements that do not seem to be important for the concerned installation must however be mentioned but without providing excessive details.

2. REGULATORY CONTEXT

2.1. The decree n°95-540 of 4 May 1995 modified and its regulations

The authorizations to discharge radioactive effluents of the BNF are granted pursuant to decree n°95-540 of 4 May 1995 (modified by the decree n°2002-460 of April 4, 2002), related to the discharge of liquid and gaseous effluents and with the pumping of water by the BNF. These authorizations are inter ministerial decrees (ministers in charge of industry, of environment, of health services) covering at the same time the field of water pumping and releasing radio active and non radio active effluents.

Within the framework of this guide, only the aspects related to radioactive discharges/ releases are assessed, without prejudice concerning requirements specified by the decree of May 4, 1995 concerning water pumping and the discharge of chemical substances present in liquid or gaseous effluents.

The application of the decree modified the 4th of May 1995 is specified by two different texts:

- The inter ministerial notice of May 20, 1998 concerning the review of the license applications within the framework of the decree n°95-540 of 4 May 1995 related to the discharge of liquid and gaseous effluents and to the pumping of water by Basic Nuclear Installations (BNI).

- The inter ministerial decree of 26 November 1999 specifying general technical specifications related to the limits and the terms for Basic Nuclear Installations (BNI) regarding the discharge of effluents and water pumping subjected to authorisation and declaration; comments concerning the implementation of the decree are stated in a notice issued on January 17, 2002.

These various texts have a direct impact on the contents of the radiological impact studies for Basic Nuclear Installations (BNI), specified herein.

2.1.1. Impact of the modified decree (4 May 1995)

The main articles of the modified decree of 4 May 1995 likely to have an impact on the radiological impact study are the following:

Art 8: the application includes:

- *Art 8-3°: "Nature, consistency, the volume and the object of the work, the installation, the works or activities considered, as well as articles attached to the above referred decree n° 93-743 of 29 March 1993 in which they must be classified. Concerning the discharge process, the application indicates, for each installation, the various types of effluents to be treated and their respective origins, their quantity, their chemical as well as their radio active composition, their physical characteristics, the*

processing used, the conditions under which the discharges take place in the environment as well as the composition of the effluents to be discharged ".

The implementation of this article forces to specify the quantities and compositions of effluents, by explaining their origins, and also their treatment and discharge process. When several installations are concerned with the impact study, their above-mentioned characteristics must be provided for each installation separately. (cf §3.2 and 3.4).

- *Art 8-4°): a document specifying the impact of the process on the water resource, the aquatic environment, the water flow, the level and the quality of water, including flooding due to seasonal and climatic variations as well as on each element mentioned in article 2 of the above referred law of January 3, 1992, in function of the processes implemented, the operation or activity process, of the operation of the works or the installations, nature, the origin and the volume of the used or concerned water.*

If necessary, this document also specifies, by taking into account the seasonal and climatic variations, the impacts of the operation on the quality of the air, odours, health or public safety, agricultural production, conservation of buildings and of monuments, or on the character of the sites, and more generally on all the environmental components. Indirect impacts, such as aerosol or dust fallouts or their deposits must also be specified .Radionuclide transfers by the different pathways, in particular the food chain and the aquatic sediments, are assessed and subject of a dose rate estimate to which the population is submitted on a reference group level (decree N°2002-460).

The document specifies, when required, the compensatory measures or corrective actions considered and the justification of the project with the directing diagram or the diagram of installation and management of water in the scope of preserving the quality of water specified by the above referred decree of December 19, 1991.

If this information is given in an impact study, this information will replace the document required in the present 4° ".

The requirements of this article will force the operator to present, in his license application file a document concerning the impact. In addition the BNIs are subjected to the modified law requirements n° 76-629 of July 10 concerning the protection of the environment and the corresponding modified implementation decree n° 77-1141 of October 12, 1977 this document is normally replaced by an impact study, according to the form stipulated in this last decree. In addition, as far as the radiological impact analysis is concerned, the present guide is written in such away that it is equally applicable to the impact document quoted by the decree of May 4, 1995 or with the impact study as defined by the decree of 12 October 1977 already mentioned above.

- *Art the 8-last subparagraph: "… The studies and documents stipulated in the present article concern the whole range of installations or equipment in operation or in development by the applicant which, by their proximity or their connection with the installation subject to authorization, are likely to have an impact on the aquatic environment or on water or on the atmosphere. "*

In addition of what is stipulated above in connection with the article 8-3°), this subparagraph compels to take into account the impact on the aquatic environment or the atmosphere due to the activities carried out near the installation mentioned in the license application of the request for authorization.

In practice, this requirement forces to assess also the radiological impact on the environment due to installations build on the same site.

2.1.2. Impact of the notice of May 20, 1998

The notice of May 20, 1998, pursuant to the decree of May 4, 1995, deals specifically with the review of the license applications within the framework of this decree and does not treat, as such, directly a radiological impact study. However, this notice contains certain precise details being able to have an impact, in particular on the perimeter of the study:

- from chapter I, one is requested to use in priority the possibility, offered by the decree of May 4, 1995, "*to gather in only one application all the operations subject to an authorization or a declaration, should be carried out by the operator at the same site,"* ,in order not to divide the file and to allow the administration, the elected officials and the public to have an overview of the expected operations on the same site, and consequently their environmental impact;

- in chapter III § 2, it is specified that, if the request concerns a modification on an existing site, the renewal of an authorization or a situation requiring a regularization*, "the information should be provided in the file pursuant to article 8 of the decree of May 4 1995 and must as well concern the whole site"* , including operations already authorized, at least with regard to their direct proximity or functional link; the objective is to be able to evaluate the impact of the operations stipulated in the application in relation with the rest of the site, especially if the effluents go through various installations inside or outside the perimeter of the BNI before being discharged;

- The same chapter, stipulates also that "the *level of detail"* to provide in the license application file must permit the department charged with the review and the various government administrations and services consulted, to assess the project, and the detailed description must *be in proportion with the importance of the impact of the discharged effluents"*.

2.1.3. Impact of the decree of November 26, 1999 and its implementation notice of January 17, 2002

Articles 8 and 15 of the decree of November 26 1999 set similar general principles, respectively on gaseous effluents and liquid effluents.

Please find a reminder and some comments on the effluents hereafter:

- Uncontrolled radioactive discharges are prohibited;

- The installations are designed, operated and maintained in order to limit their effluent releases in the environment. The notice of January 17, 2002 specifies that "*this principle must lead the operator of a BNI to privilege clean technologies, substantially limiting, as much upstream as possible, the production of polluting releases. The implementation of this principle must be in such a way that actions resulting in reducing the quantity or the harmfulness of the produced effluents do not generate waste of a nature or a quantity more inconvenient than the elimination of the effluents";*

- These effluents must, as far as possible, be collected at the source, channelled and, if necessary[1], processed so that the corresponding discharges are maintained as low as reasonably possible. The notice of January 17, 2002 specifies that "*this principle*

forces the operator to reduce these discharges based on good practice of effluent management. Apart from the use of adapted technologies, this principle applications a permanent control of the effluent management system. This principle is stated in such a way that it allows the operator to take into consideration all the factors (economic, safety of processes and of people and in particular the dose rates likely to be received, pollution transfers,…) in order to determine the way to manage the effluents within reasonable limits";

1 Article 11- of the decree stipulates that all radioactive gaseous effluents are to be filtered or treated before release.

- The decree of authorization specifies discharge limits based on the use of the best available technologies at a cost economically acceptable and the particular characteristics of the site environment. The notice of January 172002 specifies that "*generally, this principle leads to set release limits based on good practices in force for effluent management; that requires a good knowledge, on behalf of the operator, of the production mode and of liquid waste processing according to the various operating states of the installations… The reference to the acceptable economic cost introduces a relative dimension that becomes logical by comparing several solutions based on techno-economic study. In the case of an existing installation, this approach may be applied in order to reduce the importance or the harmfulness of certain releases, by evaluating the technical feasibility and the economic impact of the different possible pathways; as far as new installations are concerned only the most recent state of the art in the considered field will be taken into account* ";

These general principles have direct consequences on the way of describing the installations at the origin of the effluents as well as the conditions of management of the produced effluents, upstream from the assessment of the impact of the released effluents. This has been taken into account in chapter 3.

In addition, articles 9 and 16 of the decree of November 26 1999 specify the different categories of radionuclides for which a limit is set. The license application file must therefore provide all the relevant information concerning these different categories of radionuclides, as a reminder of paragraph 4.1 of the notice of January 17, 2002.

The decree of November 26, 1999 sets also different rules concerning the conditions of effluents discharges, which are likely to influence the radiological impact calculation.

Lastly, the articles 14-I and 22-II stipulate the monitoring of the radioactivity in the environment to be ensured by the operator, in particular to monitor the real radiological impact of the installations. Therefore the license application file must specify the planned monitoring conditions within this framework. The notice of January 17, 2002 (§ 9) states three objectives for this monitoring: to ensure a close monitoring of the effluent releases and of their dispersion in the receiving environment; to monitor the possible contamination of the environment; to contribute to the estimate of the dosimetric impact of the releases on the human being, in complement of the controls carried out by the authorities.

Among the comments stated in the notice of January 17, 2002, it is also important

to mention the following (§ 1.4): "*when the effluents are not discharged by the producing BNI, but transported towards another installation outside the site to be discharged there, a discharge authorization will not be necessary for the producing installation. On the other hand, the transported effluent is a liquid waste to be treated in*

a specialized installation (BNI or ICPE), duly authorized for this purpose ". The precision means that, in the assessment of the radiological impact of the releases of a BNI, only the effluents actually released into the environment of the installation are taken into account, this excludes all effluents transported to and treated in an installation of another site.

2.2. Book II title 1 of the environmental Act (law on water) and the application texts

In addition to the modified decree n° 95-540 of 4 May 1995, other texts coming from the modified Water Act n° 92-3 of January 3, 1992 on water are likely to have an influence on the contents of the radiological impact study. This Water Act is responsible for the creation of notably, 2 new planning tools: the SDAGE (control planning and water management) and SAGE (development plans and water management).

The SDAGE specifies, for each catchment area basic guidelines of a balanced management of water resources concerning the quality and the quantity, in the public interest and in compliance with the principles of the Water Act; the second diagram (SAGE) specifies in particular, if necessary in a way compatible with the SDAGE relating to them, the general objectives of the quantitative and qualitative protection of surface and underground water resources. Decisions taken by the administrative authorities with regard to water and aquatic environments must be compatible or be made compatible with the provisions and guidelines of the SDAGE and the SAGE. This applies in particular to the discharge of liquid effluents of a BNI towards an environment covered by SAGE or a SDAGE, as stipulated in article 8 of the modified decree n° 95-540 of 4 May 1995.

In practice, in the event of liquid radioactive releases, the license application file must provide a demonstration of compatibility with the SDAGE and the SAGE, in case one of these planning tools stipulates specific provisions on radioactivity present in the aquatic environment of the surface or underground.

2.3. The guideline Euratom 96/29 known as "basic standards" and its transposition texts

The Euratom guideline 96/29 of May 13, 1996, known as the guideline "basic standards", specifies the basic standards concerning the health protection of the population and the workers against all dangers resulting from exposure. The guideline replaces the former guidelines dealing with the same issue and imposes the implementation in the Member States before May 13, 2000.

In France, the transposition of this guideline is about to be completed (current situation: the transposition of the guideline is completed); concerning the present guide, it is appropriated to mention the order n° 2001-270 of March 28 2001 introduced into the French texts, in particular the public health code, the legislative provisions coming from the guideline, and the decree n°2002-460 of 4 April 2002 concerning the general protection of the public against the dangers of the ionizing radiation, replacing from now on the decree n° 66-450 of June 20 1966 covering the same issue.

Radiation protection regulations stated by the guideline and included in the French legislative and regulatory texts are the following:

- The exposures are maintained at the lowest reasonably possible level, taking into account the economic and social factors (principle of optimization);

- The sum of the effective dose received by a public person because of different practices will not exceed the limit of 1 mSv per year (principle of the individual dose limit);

- The assessment of the effective dose is from now on based on the values and correlations defined by the guideline. These values are about to be adopted in France through ministerial decree in preparation in accordance with article R. 43-5 of the public health code;

- The doses are estimated with an approach as realistic as possible for the whole population and for their corresponding reference groups, by including in particular: 1) in the event of doses due to external exposure with an indication of the quality of the radiations in question; 2) the intake of radionuclides with an indication of their nature and, if necessary, of their physical and chemical state and activity and concentration specifications of the concerned radionuclides.

The guideline, just like the decree of April 4, 2002, defines the public as people, who are not exposed to ionizing radiation:

- In the purpose of a diagnosis or a medical treatment (patients or people who are voluntarily exposed for their health benefit);

- In the purpose of medical and biomedical research programs;

- In the purpose of their intervention in the event of an emergency, to which apply particular provisions;

- For professional reasons requiring the use of ionizing radiation.

2.4. Recommendations of the report concerning “radiological Impact study on the workers of a nuclear installations under normal operation “

Recommendations concerning the assessment of the dosimetric impact of liquid and gaseous radioactive effluent releases of the BNI were issued in January 1997 by a working group created by the Directorate-General of Health. The report issued by the working group was submitted and discussed within the section “radiation protection” of the French Superior Health Counsel and the report was officially published[3] in 2000. These recommendations emphasise in particular the following points:

- The dose, in practice the effective dose, is the indicator of the best adapted medical impact;

- There are two main dosimetric impact studies: estimating impact studies carried out upstream starting from the expected future release and impact studies carried out *afterwards* ,starting from the measurement of the actual released radioactivity complemented if necessary by measurements of radioactivity in the environment;

- The assessment of the impact of a nuclear installation concerns not only the releases by the identified outflows (chimneys, water discharge pipes into a river or the

sea) but also the type of release (liquid or gaseous) and of the existence of radiation sources present in the installation;

- The source of exposure must be specified in the best possible way and as complete as possible concerning all qualitative and quantitative characteristics. It must in particular contain the main actual released radionuclides and not only a conventional list. The working group strongly recommends assessing the impact of direct radiation coming from the installation;

- Groups that may form reference groups (farms, villages, cities…) should be selected among the actual groups of people; by taking into account all the different impact modes and all the different exposure pathways. The composition, the location, the size and the way of life of the reference groups must be selected in a realistic way; however, efforts spend on data acquisition must correspond with the importance of the expected dosimetric impact;

- The calculation and probabilistic traceability should be ensured by the use of a realistic approach and not a conservative approach; in order to place the impact of the concerned installation compared to the annual dose limit , it is advisable to take into account the impact of other related human activities likely to expose the public to ionizing radiation and all the possible exposure pathways;

- Special attention must be paid to the process of possible build-up on the long term of certain radionuclides in the ground and in sediments;

- Te file issued by the operator must show that the operator has planned the necessary means and devices to reduce ,the dosimetric impact of the installation, to values as low as reasonably possible, taking into account the economic and social factors. The operator must in this respect justify each choice by taking into account the average individual effective dose in the different reference groups, the collective dose (calculated over a circumscribed zone and over a suitable period of time), doses received by the workers, the volume and the radio activity rate of produced solid waste and investment and operating costs.

The working group recommends strongly a development of the impact studies by taking into consideration the following requirements:

- The traceability of the assessment (by checking if the measurements in the environment are representative, if the reference groups and their corresponding habits are valid as well as the relevance of the models);

- The contribution of the doses (contributions of different radioactive sources and of different exposure pathways).

3. DESCRIPTION OF THE INSTALLATIONS AT THE ORIGIN OF EFFLUENTS AND OF THE TREATMENT, CONTROL AND DISCHARGE CONDITIONS OF THE EFFLUENTS - JUSTIFICATION OF EFFLUENT PROCESSING AND EFFLUENT MANAGEMENT RULES

3.1. Objectives of this part of the file

The file as a support for the license application provides the description of the installations at the origin of effluents and the conditions of collection, treatment, control and discharge of effluents, in order to be able to address the requirements specified in the 3° of article 8 of the decree n°95-540 of May 4 , 1995. This description relates particularly to:

- he identification, the description and the location of installations, works and activities at the origin of effluents, to be considered in the requested authorization;

- A characterization of the radioactive effluents expected to be released and their management mode;

- A description of all the outlets and in addition in the case of liquid effluent releases into the aquatic environment, an identification of the receiving areas.

The file provides the justification of the characteristics of the expected effluent releases, considering the processes that are implemented based on the best technologies available for economically acceptable costs and the sensitivity or the restrictions related to the direct environment of the installations.

Of course, the descriptions provided in this part must be in conformity with the safety requirements for the installations in question (safety report, general operating rules, general presentation of the safety of the establishment). When the file refers to an installation already in activity, the different descriptions and justifications will specifically be taking into account the operating experience feedback of the concerned installation.

Obviously all the probabilities must be, generally speaking, clearly exposed; the accepted options as well as the negligible character of certain aspects must be explained and proved.

Note: the license application file should give: a description of installations producing non radioactive effluents, of water pumping activities and more generally speaking a description of the installations, works, or activities justifying an authorization pursuant to the decree of May 4, 1995 and its corresponding texts. However these aspects are not considered in this guide, because the guide only deals with the radiological impact on the environment and on Man.

3.2. Description of the installations at the origin of the radioactive effluents

The file provides a description of each situation for example:

- Installations at the origin of effluents;

- Effluents coming from other installations of the same site (not concerned by the licence application given in the file) and going through the installations concerned by the application (for example, in the case of a liquid waste treatment station);

- Installations that, although they do not produce radioactive waste, involve however an exposure of the public by the radiation they emit (for example, the storage of radioactive sources).

N.B.: In accordance with the indications of the notice of January 17, 2002, the used effluent term in this guide indicates the liquid or gas products intended to be discharged, normally after treatment, in the immediate environment of the site where

these effluents are produced, by the installation given in the file or another installation at the same site.

3.2.1. Installations at the origin of radioactive waste

All workshops, installations and activities at the origin of radioactive waste, even if it is occasionally, included in the perimeter of the considered BNI, have to be described in detail. In the scope of having a detailed inventory of the elementary, permanent or occasional fluxes producing the rough effluents intend for treatment. Each flux is characterized by its nature, its mode of production, its flow (or its quantity), the inventory of the different kinds of radionuclides with the corresponding activities, the physicochemical characteristics of importance (for example pH, temperature) and the physicochemical forms of the radionuclides, if necessary for the impact calculations (for example, for C14, the mineral or organic forms). This description refers to:

- Installations or workshops, the different functions and operations that are carried out there, the operating mode (operations continuous or in series…);

- The characteristics of the present material or implementations in each installation or workshop in order to identify as comprehensive as possible the sources of radioactivity in the perimeter of the BNI, including waste (solid or liquids) coming from installations other than the ones described in the license application, are to be reviewed. This inventory includes the radionuclides generated within the installations by the process (fission products or of activation products) or by radioactive by-products. Specific details are provided on the different forms of radionuclides present in the installation, their activities and their treatment and furthermore to explain the production of radioactive effluents, the physicochemical nature of the products needed for the process or stored in installations (for example, the type of fuel used in a nuclear reactor).

The radionuclide characteristics provided in the file are representative at the same time of the average operation over one year, of possible variations from one year to the other and design limits of the installations or operating limits required by the technical specifications for operation. When these characteristics vary in time or are unplanned but known, indications in terms of amplitude and frequency should be provided;

- The physicochemical changes implemented in each installation or workshop, in a simplified way in order to follow the flux of radioactivity throughout the whole process. This is in the scope to identify, the ratio of active flux to be found in the effluents, from a qualitative and quantitative point of view. Assessment of this ratio of active flux is based on assumptions possibly checked by control points, concerning the division of the radionuclides during different elementary stages of the process (treatments of the products, separations, phase changes, chemical changes,…) the assessment takes also into account the possible recycling operations, reclassification of the radio active flux as well as stages of long-term storage (by taking into account the radioactive decay). Occasional events (start-up operations, maintenance, cleaning…) are also taken into account in this assessment. The organization of the flux, the transfers and the outlet identifications" in the form of untreated effluents is shown, either entirely or partly in diagrams or tables.

Note:

1) The operator estimates, during the above assessment that diffused radionuclides releases may occur. For example the following phenomena are described such as resuspension of dust, gas releases etc., by specifying the points concerning, for example, stored packages, storage tanks, joints between buildings, the setting with the air of circuits, etc, and quantifies them (by a theoretical evaluation if necessary), in a way to justify the provisions taken to ensure safety in compliance with the interministerial decree of November 26, 1999.

2) If the file refers to several BNIs of the same site operated by the same operator, the above description must be carried out for each BNI individually, even if their effluents are afterwards treated and released together. In addition connections between installations, in terms of flux exchange, must be specified.

3.2.2. Reception of radioactive wastes coming from other installations

The application concerns all installations (for example, a liquid waste treatment station) receiving effluents coming from other installations, the file must provide a detailed description of the composure and the quantities (or flow) of the transported effluents, as well as the conditions of this transport.

3.2.3. Installations involving an exposure of the public by direct radiation

Independently of any production of radioactive effluents, the file describes the installations and activities (generally storing or storage areas of radioactive products) likely to involve an exposure of the public by direct irradiation. However, even if the release authorisation procedure does not refer to this type of exposure, the impact on the public should be assessed to apprehend the radiological impact of all the installations to value the acceptable character of the impact due to the radioactive releases. The file describes and classifies the installations or activities concerned, the maximum activities likely to be carried out in each installation and the associated consequences expressed in the form of dose rates according to the distance starting from the limits offsite. These indications will be used further to estimate the impact on the public.

3.2.4. Summary of the produced effluents

Further to a full description, it is recommended to provide a summary of the different categories of rough effluents (before any treatment), by distinguishing the liquid and gaseous effluents. In general, in addition to the radioactive component, this summary takes also into account the physical and chemical characteristics of the effluents. To establish this summary, it is useful to distinguish the different categories of effluents by specifying qualitative and quantitative aspects, for example:

- All effluents related to the process, classified according to their levels of activity;

- Permanently released gaseous effluents related to the ventilation of the different premises of the installation;

- Gas effluents resulting from the process, in general directed towards decay tanks before release;

- Liquid effluents resulting from “active” tanks, generally directed towards a station of radioactive liquid waste treatment;

- Liquid effluents resulting from “suspected” tanks, directed, after possible treatment, towards the general network of the so called “industrial” effluent collection, then released into the environment;

- All liquid effluents coming from the so called non radioactive “washroom facilities” (toilets, sinks, showers….) directed towards a biological treatment station;

- Rain water to be controlled…

3.3. Description of the conditions of collection, treatment and discharge of the different effluents

Descriptions concerning the following points are submitted in a separate way for liquid effluents and for gaseous effluents.

3.3.1. The collection of effluents

For the different categories of the previously identified rough effluents, the application file describes in detail all devices and conditions of collection, management and transport of the effluents towards the storage and treatment centres before being released into the environment. The conditions of effluent management will be justified, for example according to the quantity, to the physical-chemical characteristics or to the level of radio activity of the effluents. The application file will give a detailed description of the equipment and measures taken to ensure a safe collection of the effluents (Choice of materials, controls, routine inspections, regular maintenance……)

3.3.2. Effluent treatments

The application file gives a detailed description of the different means of processing effluents before discharge, by technical specifications of the equipment and processes being used for the treatment of effluents (nature, capacity, limits, efficiency…). When the treatment consists in storing the effluents for a certain amount of time in order to reduce the radio activity, the storage capacities and the time of storage are indicated for the different effluent categories concerned.

The file explains the accepted criteria concerning the choice of different effluent treatments based on the characteristics of the effluents and the efficiency of the equipment used for the different specific treatments. Note that any absence of treatment before discharge must be duly justified. Sometimes these accepted criteria are based on the best available technology for an economically acceptable cost. The process efficiency on the different effluents already treated is explained, not only in terms of the reduction of radio activity but also concerning the final composition of the effluents obtained after treatment. The final by-products resulting from a specific treatment process are specified. If necessary, a possible exposure of workers induced by the treatment process must be mentioned.

Lastly, the application file must give a full description of the provisions selected to check the performance and the efficiency of the treatment, based on the control of the radioactivity in the effluents.

If the effluents are treated in installations of a site depending on another operator, the file will mention the convention (or the draft of the convention) stipulated in article 9 of the modified decree n°95-540 of 4 May 1995, by specifying the main terms of this convention in particular regarding the transportation and monitoring conditions of the

effluents. The efficiency of the treatment processes of the different effluents on transport is specified.

3.3.3. Characteristics of the effluents after treatment

A summation is provided of the different effluent categories as treated by the installation concerned by the application or another installation on the same site, and ready to be released into the environment. The summation will notably reveal for each effluent category, the nature, the physical-chemical characteristics, the quantity, volume or flow-rate, a list of the radionuclides with their corresponding activity …

3.3.4. Release conditions for effluents

The file describes the release conditions for each effluent category, by specifying:

- The characteristics of the outlet: chimney (position, height, release speed, flow rate…); vent pipe; discharge system in a river, at sea, etc (a complete description of the receiving environment, the position of the discharge system and the possible provisions and devices facilitating the dispersion…);

- If needed, the use of effluent dilution before release (this process should not be considered as a treatment but as a measurement, applied only as an extra support for the required treatments, with the intention to facilitate dilution in the environment), by specifying the obtained results;

- Effluent release conditions (by an uninterrupted flow or by emptying a complete tank at once, flow rates, speed…) by indicating the parameters taken into account on the moment of the effluent discharge (such as weather conditions in terms of dissemination, speed or direction of the wind, conditions of the flow rate of a river's current, the quality (level of radioactivity) of the receiving aquatic environment, tides…). Assumptions retained for the choice of conditions and their corresponding parameters are clarified.

3.3.5. Analyzes and controls of the released effluents

The file describes the nature of control and analyzes practiced on the released effluents, by notably specifying the different types of measurements, their frequency, their sensitivity as well as their decision threshold (or if needed, the limit of detection) and the corresponding alarms. The coherence between these controls and analyzes and the characteristics of the releases concerned is demonstrated, in particular compared to the different levels of release requested.

This description is made for each category of released effluents (processed gaseous or liquid effluents, used water, rain water…) by specifying and justifying, according to each case:

- The type of control or measurement (uninterrupted, remotely, periodically, on aliquot…);

- The frequency or the due (expiration) date of the samples and measurements;

- The measurement or sampling point;

- The type of measurements or analyzes carried out (α, β, γ, total measurement or spectrometric…) or the measured radionuclides, as well as the decision thresholds (or failing this, the detection limits) and, possibly, the corresponding alarms. The file also specifies the conditions selected (control point, threshold of decision, frequency of control) to check if certain radionuclides for which a release is not planned in the effluent considered, are not detected after all. The file also mentions the management operated in the event of exceeding a parameter or a selected limit value. Generally, the file justifies the choice of analysis and control conditions of the releases, in order to be able to check if the releases carried out are in compliance with the values indicated in the file, by taking into account the best technologies available for an economically acceptable cost.

In addition, the file explains the principles and the conditions of accounting, in particular for the very low activities, for the test results, as well as the operation carried out further to these results.

3.4. The application of the operator and a summary of the releases carried out in the environment

3.4.1. The authorization application for the release of radioactive effluents

The file clearly reveals the application concerning the release of radioactive effluents. The request mentions the types of effluents concerned (liquids, gas), the radionuclides in question, annual activities likely to be released, even other characteristics of the released effluents if necessary. The application is drawn up in such a way that it takes into account the categories of radionuclides defined in the above mentioned decree of November 26 1999 (tritium, radioactive iodines, rare radioactive gases, carbon-14, other beta and gamma transmitters, alpha transmitters…), by adapting them if possible to the characteristics of the installation. The different categories selected in the application are justified.

The classification of the radionuclides or categories of radionuclides is clarified according to the list of radionuclides selected in the preceding demonstrations, in order to be able to calculate the dosimetric impact for the groups of reference considered. The possible negligible character of certain releases will have to be demonstrated, if necessary by a rough calculation of the dosimetric impact.

The possibility of an application evaluating with time may be taken into consideration (for example, an application corresponding to an installation before a planned modification, and an application corresponding to the modified installation…). In this case, the study must deal with both phases (before and after modification). Furthermore, the application may also be adaptable with time according to specific operating modes distinguishing different release phases according to the nature and the quantity; for example, a test in an installation may produce a release of a particular composition for a relatively short time and being followed by long cleaning and restoration works (decontamination, dismantling) because of the nature and the different levels of activity of the effluents. In this last case, all the different operation phases must be clearly described.

The file also reveals the application concerning the transport of radioactive effluents towards other installations of the site. This application mentions the different types of effluents concerned (liquids, gaseous), the radionuclides in question, the annual

activities likely to be transported, and if necessary other characteristics of the transported effluents.

3.4.2. Best estimates and margins

Generally, data related to the released activities, submitted in the files, are best estimates and they have to be as close to the realistic situation as possible. The application for authorization is based on the expected levels of the release addressing the real needs for the installation and if possible matching reasonable margins. These margins are clarified, quantified and justified. They are never founded on incident or accident situations, the authorized limits are exclusively based on a situation of normal operation. These margins are taking into account the normal variations of operation of the installation, by including all the possible regular maintenance operations, the various uncertainties related to the assessment of the expected releases, uncertainties on the conditions of control and of total amount of radioactivity of the effluents (if needed, by relying on operating experience feedback), the planned modifications of the activity of the installation (change of equipment, use of other fuels, etc), the uncertainties concerning the activity of the installation (for example, uncertainties on experiments that will be carried out in the research laboratories in the future). These different factors are in fact not cumulative because they do not intervene simultaneously. Likewise, if the quantification of margins relies on the clarification of different operation scenarios, these scenarios will be best estimates and reasonably realistic and consistent between them.

The variations and uncertainties related to the composition of the released effluents are described in detail. The selected simplifications must be justified.

3.4.3. Example of studies related to several BNI

In the case of a radiological impact study file concerning several BNIs operated by the same operator on the same site, the effluent release of each BNI has to be considered preferably separately if possible (in general, the releases are authorized and regulated for each BNI individually and if possible in the same decree). However, common requirements are specified by the authorization for all the units of these BNIs and also for all the other Classified Installations for Environment Protection (CIEP) in the neighbourhood of these BNIs. For example, the release levels for all the installations together would have to be lower than the total of all the given release levels for each installation (except for a duly justified impossibility), because of the non cumulative character of the previously mentioned margins. In this respect, files concerning several installations should reveal the accepted margins and the optimization related to release management of all the installations concerned without systematically cumulating the given margins for each installation.

Note: taking into account the provisions (article 5) of the modified decree n°95-540 of May 4, 1995, an application for the authorization of drawing (pumping) water and the consequent releases only concerns Basic Nuclear Installations operated by the same operator in a given place. When there are other BNIs or other Classified Installations (CIEP) owned by a different operator nearby the installations concerned, it is compulsory for them to file their own application for an authorisation. However, it is very important for the concerned installations to take the presence of other neighbouring installations into consideration by the selection of release management of the BNIs,

subject to the application for authorisation (released activity, release conditions, long term, short term, periodic, uninterrupted etc).

3.4.4. A recapitulative description of the releases into the environment

A recapitulative description should be made, for example in the form of a table in order to have a global view of the radioactive releases into the environment. A global view is necessary to calculate the dosimetric impact and to specify the release limits in the authorization decree.

The description should in particular specify the nature of the different effluent releases, the activities annually released corresponding with the different radionuclide characteristics of each effluent, the maximum volumic activities, parameters corresponding with the releases (flow rate, speed, physicochemical parameters…) and the release conditions (outlets; activity flowrate). In addition the nature of the different effluents transported from one installation to another installation nearby and their corresponding activity annually released for the different radionuclide characteristics of each effluent transported should also be specified.

If the application concerns an existing installation, the file takes into account the operation experience feedback, in terms of production and management of the effluents. The file highlights the operating movements and fluctuations (evolutions) and all incidents that generated accidental releases not covered by a normal operation of the installation. The requested release values are taking into account the detecting limits of the assessment conditions like uncertainties related to measurement results. It is always difficult to say if the measurement results entirely match or are entirely representative.

3.5. Justification of the accepted effluent processes and management conditions in order to reduce releases

General technical specifications of the above mentioned decree,of 26 November 1999, applicable to the release authorisations of radioactive effluents by BNIs, are in particular drawn up to match the regulations applying to classified industrial sites for the protection of the environment (ICPE). In this respect, the decree forces to limit releases by using the best technologies available for an economically acceptable cost, by taking into account the specific environmental characteristics of the site. The application of this principle aims at limiting the releases to the real needs of the installations in question. In addition the decree specifies that the releases are maintained as little as reasonably possible. These regulations force (art. 8 and 15) the operator to minimize his releases thanks to careful effluent management in order to prevent or reduce the danger of pollution[4] and nuisance that the installation may present. The operator has to consider the following aspects: technical performances, processing costs, the safety of personnel and the population, guarantee the safety of the process. Within this framework, the dosimetric impact on the population constitutes one of the main aspects to consider.

4 In order to prevent that a process intended to reduce an effluent release leads to the production of other forms of pollution or leads to problems due to a more important risk

Indeed, the optimization of the exposure of the population is a provision of the European Directive on the basic standards 96/29. The article 6 stipulates that “*each member State takes care… that in the context of optimization, all the exposures are*

maintained at the lowest level reasonably possible, taking into account economic and social factors ". The so called "ALARA" (As Low As Reasonably Achievable) approach, concerning the optimisation of exposure by the BNI and ICPE installations "applies to:

- The level of activity in the liquid and gaseous releases;

- The preferential direction of the releases either into the atmosphere or into the aquatic environment (river or sea)

- The used technology for treatment and management of effluents, allowing to reduce or to avoid the release of undesired radionuclides because of their high dosimetric impact on the environment;

- Release conditions: for example, the right moment to release in order to optimize the capacity of dispersion and dilution of the radionuclides into the atmosphere and into the aquatic environment (river, sea);

- Direct external exposure, if necessary.

The file of the operator justifies the accepted technical options based on the overall policy of maximum release reduction. The file shows a comparison of the advantages and disadvantages in relation with the main solutions for:

- Effluent flow management (triage at the source, separation of flows…);

- The reduction of diffuse releases (not channelled);

- The reduction of radioactivity of all the channelled releases: storage tanks, efficiency of the means used for the treatment of liquid and gaseous effluents…

The operator should pay extra attention to the management and to the reduction of certain specific categories of radionuclides[5] because of their major contribution to the dosimetric impact of the liquid or gaseous releases. The operator justifies the list of the radionuclides accepted in the optimization study, based on the calculation of the dosimetric impact. The experience feedback of the operator is used to complete the safety demonstration.

The stakes are important; therefore systematic research is carried out to find alternatives for flow management, adopted processes or equipment. Possible solutions are submitted. The comparison between the different technologies available will determine with precision the chosen direction, based on the following criteria:

Technical feasibility, safety of the process, costs, annual effective doses for the reference groups, collective doses received by the population, exposure of the workers due to the effluent treatment, the category and the quantity of the produced waste. The choices are justified by a study proving that the adopted solutions are the best ones among the different solutions considered. It is possible to base the safety demonstration on the example of other similar installations in France or abroad. This study must also show that the selected processes are in compliance with the protection of the environment set at a national or local level (Regulatory texts, charts for environmental protection, large scale planning to avoid pollution SDAGE, WISE, analysis of the quality of the air on a local level). Possible by-products due to the processing (mud, cinders, ashes…) is mentioned in the file.

When an installations is compelled to emit radiation leading directly to exposure of the public off- Site (cf. § 3.2.3), the operator must explain the reason why and must justify the doses received by the reverence groups , compared to the means he has at his disposal to reduce or remove this type of exposure (screens, safety limits, etc.).

5 Because of the physicochemical similarity in behaviour that makes them inseparable from each other.

4. DESCRIPTION OF THE ENVIRONMENT

4.1. The description covers an extensive field.

The environment description is extremely variable depending on the examined aspect (terrestrial environment, aquatic environment, economic and agricultural activities, demography, etc). Therefore it is necessary to have a detailed description in order to identify all the reference groups and to assess their risks of exposure. Accordingly, for one given aspect of the environment, the number of details in the description may vary according to a progressive zoning starting from the installation.

For the release of gaseous effluents, the reference groups are in general located within a radius of a few miles. This zone is under constant radiological environmental monitoring and must be described in detail. The description of geographical areas at a large distance from the installation considered is normally less detailed, even if the impact of the gaseous effluent release is noticeable. In general, one may consider that at a distance of about 10 to 30 kilometres, the impact of a gaseous effluent release under normal circumstances is negligible.

For the liquid effluent releases in fresh water, the situations may vary. A joint assessment of the major hydraulic characteristics (dams, junctions, interactions with the groundwater, zones easily flooded,…) and of the different utilizations of the water in question is necessary to establish the geographical area of interest. However, the description will not only give a detailed description of the environment before the releases but also after the releases, in order to get a clear view of the possible changes in the natural environment due to the releases.

In general, a rather broad zone (possibly till the sea) of the aquatic environment of fresh water should be covered, although the description will gradually be less detailed moving away from the installation. Indeed, the spreading process is fast immediately downstream from the outlet, but afterwards the volumic activity varies relatively little till the sea due to the relatively-closed character of the aquatic environment. That is why the continental aquatic environment contaminated by liquid releases is defined at distances more important than those considered for the gaseous releases.

For the liquid effluent releases at sea, the situations vary a lot. A joint assessment of hydraulic characteristics (topography of seabed and coast line, presence of islands inhabited or not), of ecological characteristics (presence and abundance of the biotope, development of specific ecosystems), current characteristics (tides, wind streams, airstreams, surface waves), sediment characteristics and the way the environment is used by Man (fishing zones, zones of nautical leisure, pisciculture and shellfish farming) will establish the geographical area of interest.

More indications on the different aspects of the description concerning the environment of the installation will be provided here-after.

4.2. Description of the natural environment

The objective of the description of the natural environment in this context is primarily to support the assessment of the radiological impact. All components of the natural environment likely to influence the result of the calculation of the impact (selected conditions, values of the parameters) are addressed.

4.2.1. Climatology

The dispersion of gaseous effluent releases is strongly influenced by weather conditions. Therefore it is very important to have a precise knowledge of the meteorological processes occurring during the dispersion.

To quantify (by modeling) the dispersion of the gas releases, the turbulent diffusion must be taken into account. In practice, different dissemination categories are specified depending on the used model, for example normal dissemination and weak dissemination, or a stable, unstable or neutral atmosphere.

How the deposit of the aerosols on the ground and on the vegetation takes place depends on the weather condition, if it rains or not. It is advisable to determine with precision

The pluviometry should be carefully determined (duration of the rain period, moment of the year, average quantity of rainfall). If necessary, snowfall will also be examined.

The file must also provide detailed wind roses. In practice, it means that the wind frequency divided over a sector of 20° and the clas sification of the wind speed should be provided (the number of different wind speed categories will be defined according to the local climatology, but in general this number should be lower than 3). Assumptions for the presentation of calm winds are specified.

The file gives a description of the combined frequencies of wind conditions (per sector and wind speed category), the conditions of dispersion and the conditions with or without rainfall (snowfall).

These data are representative for an “average” year and are based on a compilation of several years.

These data must be representative for the conditions close to the release points of the gas discharge. Horizontally, the data come from the site it self or a point a little bit further away and representative of the conditions on site. Vertically, the data are collected at chimney level (or at a point close to chimney level) and if necessary a little bit higher than chimney level because of the extra height of the plume (due to “steam”jet and thermal effect).

For the assessment of dispersion on an average and long distance, it is important to know the statistics of appearance and the height of the temperature change.

The relevant statistics of the main parameters for climatology are also submitted for example: air temperatures (in particular the extremes ones), the humidity of the air (and in particular fog), exceptional events (storms, thunder storms,..).

4.2.2. Geography - Topography

A general description of the geography of the area and a more detailed description of the local geography are submitted. Topography is specified, particularly the variations of relief near the installations, in order to specify the modeling conditions of the gaseous effluent dispersion (spreading)s. This description is accompanied by maps on relevant scales.

4.2.3. Geology

A general description of the geology of the area and a more detailed description of the local geology are submitted. This description is accompanied by maps on relevant scales. Relevant data concerning the substratum of the studied zone (the nature and the presence of rocky formations at seabed level) are specified, in connection with the geological description

4.2.4. Pedology

A classification table of the local soil and ground is submitted. The different ground and soil categories are submitted, and in particular their agricultural interest and the different types of natural vegetation growing on this soil. By soil used for agricultural activities (cultivation, breeding) all information on the grading, the level of organic matter, their pH, the capacity of cation exchange, the levels of easily assimilated phosphorus and potassium, has to be taken into account by the calculation of the radiological impact on the population .

4.2.5. Hydrogeology

A description of all groundwater and their main characteristics (location, water conduit, communication between groundwater and surface water, etc) is submitted. This description is accompanied by maps on relevant scales. Quantified data are provided (the average groundwater level and the variability of the upper level of the groundwater, flow rate, transfer capacity) as well as data on the physical properties (for example the resistivity, the hardness, the Ph and the temperature of the groundwater) and the chemical properties (for example bicarbonates, chlorides, nitrates, sulphates, sodium, potassium, calcium, magnesium).

The vulnerability of the resource is examined, in connection with existing or future use of the groundwater.

If necessary, the file mentions all information related to the perimeters of protection of drinking-water supply stations located in places likely to be influenced by the radio active liquid or gaseous effluent releases. (see also paragraph 4.3.4).

4.2.6. Continental hydrology (releases into a river)

A description of the discharge system(s) of the liquid releases is submitted, from the source till the sea. This description is accompanied by a map on relevant scales. The file gives a detailed description of the profile and the mode (particularly the tides, high and low water levels) of the rivers, the drained surface, all the different installations like dykes, pipelines, dams and possible flooding. All possible exchanges with ground water are indicated.

The nature of the basic sediments of the rivers (grading and mineralogical characteristics) and the dynamic of their deposits are specified.

The detailed description concerns especially the environment close to the installation, but may also concern more remote situations, for example other human activities in connection with the release of radionuclides upstream or downstream from the installation, or other activities using the aquatic environment like irrigation by farmers, using the river for the drinking water supply and for leisure purposes like swimming etc..

4.2.7. Hydrography, courantology (for example release at sea)

A general description of the oceanic area is submitted: topography of seabed and coastline, general description of dynamic movements of the currents, general circulation, a general description of the temperature and salinity gradient, the main features of the sediments, and if necessary the main influences generated by Man like landscaping (creation of artificial beaches) constructions, pollution due to all the different releases and eutrophication of water.

A more detailed local description is submitted giving a detailed topography, a description of the beaches, the local movement of the currents (instantaneous and residual tide, sea heaves, the variability and currents of the wind) , the spatiotemporal temperature and salinity changes, a detailed description of the different sediments and their quantity and the presence of local pollution.

These descriptions are accompanied by maps on relevant scales.

The examination of local dispersion (mathematical model, mock -ups, field studies with tracers or buoys) is fully detailed.

4.2.8. Biotope (natural flora and fauna) and ecosystem

Fauna and the flora are described at a regional level in detail in particular on local level.

A detailed description of the terrestrial flora (arborescent flora, shrubby flora, herbaceous flora, mushrooms, moss, ferns…) and the aquatic flora (brown algae, red and green, moss, mushrooms, ferns, plants with seeds…) is submitted.

A detailed description of the terrestrial fauna with a skeleton (batrachians, reptiles, birds, also the migratory birds, mammals…) and without a skeleton (molluscs, insects, moth, etc) as well as the aquatic fauna (fish, mammals, batrachians, plankton, molluscs, shellfish, …) is submitted.

All fragile species sensitive to pollution or endangered species are quoted.

A brief description of the different ecosystems is submitted, in particular if the releases are likely to reach ecosystems that are considered to be sensitive.

4.2.9. Parks, natural reserves, ZNIEFF

The existence of natural reserves, natural reserves, natural areas of ecological interest fauna and flora ZNIEFF) in the zone under the influence of liquid and gaseous effluent releases has to be indicated. In addition the main characteristics and the main perimeters of these areas are specified.

Please find below a short explanation of the French acronym ZNIEFF!

The acronym stands for: Natural Area of Ecological Interest, Fauna and Flora.

A ZNIEFF is part of the territory particularly interesting from the ecological to the maintenance of large balances or constituting the natural living environment of animals and rare plant, characteristics of natural regions.

There are two types of ZNIEFFs:

ZNIEFF (type I), is in general a limited area, defined by the presence of endangered species and associations of species or environments with rare or outstanding natural features of great biological and ecological interest on national or regional level.

ZNIEFF (the type II) are in general large natural rich areas slightly modified by Man, however they are still providing an important biological potential. The areas of type II may include one or more areas of type I

Together these two types of zones (type I and II combined) cover 46 % of the regional surface. This is the highest proportion among the regions of France. This wide variety of environments is linked to the diversity of climatic influences Mediterranean, Atlantic and Continental as well as reliefs and regional geological features.

The inventory of ZNIEFF identifies, locates and describes the heritage of sites of interest for species and habitats. It streamlines the collection and management of data on the natural environment, fauna and flora. Prepared for the Ministry of the Environment, it is the main tool of scientific knowledge of natural heritage and is the basis for the definition of political nature. It has no direct legal value but allows a better consideration of the rich heritage in the development of projects likely to have an impact on the natural environment. Therefore, the failure to take into account a ZNIEFF at the development phase of a project like for example a Basic Nuclear Installation would be a manifest error of assessment an may be subject to appeal. The ZNIEFF constitute a basis for the development of a nature policy, especially for the most sensitive wetlands, moorlands etc ...

4.3. Description of the economic and agricultural environment

The objective of the economic and agricultural environment description in this scope is primarily the support of the assessment of impact. Only components of economic and agricultural environment likely to influence the result of the calculation of impact are mentioned. All elements with no influence on the impact are simply avoided.

4.3.1. Economic activities

A general presentation of the regional and local economy is made. Especially industrial activities are described (the nature of the activities, the importance of subcontracting, numbers of workers, planned evolutions,…). The description might reveal very different situations. The environment should be assessed under several economic angles in a suitable geographical area. Therefore the following points are described in detail:

- All activities (industry, hospital, etc) contributing with their radioactive releases to the risk of exposure of the population must be mentioned because it will imply restraining the quantity of the to be authorised releases of the installation considered;

- In addition, all economic activities potentially affected by the releases of the installation (in particular the ones using the same environment that will receive the effluents) should be described. For example tourist activities are described, in particular by indicating a possible seasonal increase of the population people in the close

surroundings of the installations concerned (camp-sites, beaches for example) likely to be exposed to the releases of the installations.

4.3.2. Agriculture - Breeding – Agri-food industry

Agricultural activities, activities of breeding and economic activities in relation to the agri-food industry are described at a regional level and they have to be extremely detailed in the geographical area close to the installation, in order to provide relevant data for the dosimetric impact calculations for the reference groups. Please note that for gaseous effluent releases the described zone generally corresponds to larger area around the installation. In order to carry out dosimetric impact calculations for the reference groups and to provide useful data to assess the consequences of a possible dysfunction of the gaseous effluent releases.

A full description is given of farming areas that are irrigated and or easily flooded by rivers receiving liquid effluent releases. The closer to the concerned installation the more detailed the description has to be.

For liquid effluent releases at sea, a full description is given of all areas where collection of algae or any other product used as a fertiliser for agricultural soil takes place.

A detailed description should also be given of the whole farming industry (dairy farming, factory farming, intensive farming, single crop farming etc……)

The nature and importance of the industry, livestock, and occupation of the soil, the transformations and the distribution of the industry are specified. The practices used are mentioned (for example it should be clearly specified whether the agricultural production is in an open field or in greenhouses, the different types of irrigation and sprinkling systems …). Whether the food production is continuous or variable from one year to another must also be mentioned. The presence, the location and the number of kitchen gardens and private orchards are specified, as well as the main plants, trees and vegetables cultivated there.

4.3.3. Fishing – aquaculture (fish farming) - shellfish farming

Activities of fishing, activities of aquaculture and shellfish farming and economic activities related to the agri-food industry are described on a regional level and even more detailed on a local level close to the concerned installation.

The nature and importance of the aquaculture and the shellfish farming and oyster farming industry and of the fishing industry (the captured species and their quantity), the location of producing and the fishing areas at sea, the fishing harbours, the transformations and the distribution of the products are specified. All aquaculture, shellfish farming and fishing practices used are mentioned (in particular concerning seasonal workers).

4.3.4. The use of water

Only the use of water likely to be affected by the liquid releases (if necessary in case of the gas releases after cleaning the soil) is concerned. For all installations releasing into the river, the use of water is described in general downstream from the installation. For

the installations releasing at sea, only the area under the influence of the liquid releases is concerned.

In case of releases into the river the description should cover a large area downstream from the outlet, because of the variable conditions of the river's situation that will have a direct influence on the dilution and concentration of the radionuclides of the discharge (river junctions, exchanges of water with the ground water and retention of radionuclides by sediments). Therefore description must be given of how and for what purpose the water is used even far away from the outlet. However a more detailed description must be provided for the use of water located at close distance from the installation.

The use of water for domestic reasons is described as followed: the use of surface or groundwater, distribution networks, purification stations for the drinking water supply, the corresponding quantities of water and if necessary the quality of untreated water. This description is in general rather detailed because the use of domestic water is the most direct way to expose and contaminate the population, which has to be avoided at all times

The use of water for industrial reasons is described as followed: the use of surface or ground water, the different water treatments with their corresponding quantities of water and the quality of untreated water is required.

The use of water for agricultural reasons is described as followed: the use of surface or ground water with the corresponding quantities of water, how the water is used sprinkling, irrigation with a pipeline system etc.., seasonal aspects, location and the kind of agricultural industry concerned. Generally this description is rather detailed because the transfer of radionuclides into agricultural products may result in an accumulation of the radionuclides.

4.3.5. Other uses of water

The possible use of water for fishing, leisure or tourism are described as followed: swimming, water sports, hunting and fishing sports, food and flower picking… The description covers the following locations: fields, riverbanks, beaches.

4.4. Description of the demographic environment

The objective of the description of the demographic environment in this context is

primarily to support the impact assessment, in particular concerning the identification and characterization of the reference groups. The level of necessary details varies considerably according to the fact whether the populations are likely to be reference groups or not. For areas that are less affected by the releases, from all the reference groups only the most concerned are described, like a first assessment element for the collective exposure due to the releases.

4.4.1. Demography

Demographic data are provided, for the gaseous and liquid effluent releases in a circular zone around the installation. In addition, all zones affected by liquid releases must be specified especially in relation with the use of water for other purposes. The data relate initially to the area close to the installation. Demographic data in this area are very detailed because they are used for the determination of the reference groups.

The data are based on all scales from village to town or if possible even on a finer scale (hamlets, isolated farms, etc). These data concern not only the habitat but also the population of workers (industrial parks, factories, workshops, administrative buildings), and any other population (schools, tourists, etc). These data describe the structure of the population in function of age, by detailing in particular the young population (infants, young children, teenagers). The data are extremely precise in a radius of 10 miles from the concerned installation covering all villages and towns in this area.

Other data of demography are submitted on a broader scale (typical for gaseous effluent releases is a radius of 50 km around the installation concerned). Only data related with large groups of the population are indicated (for example, cities of more than 10.000 inhabitants).

4.4.2. Habitat, activities and practices

In combination with the demographic data, data are provided related to the identified population groups.

For the gas releases, these data concern the habitat (crowded or dispersed) and if needed the work locations. These data also concern the parameters in relation with the activities of this population that will have an influence on their risk of exposure to the radioactive releases (for example work in the fields, professional fishing at sea, nautical and leisure activities, etc….).

These data concern finally all practices likely to modify the risk of exposure of the whole population (for example, mushroom collecting, oysters, shellfish etc).

Data in connection with budget-time are associated with those concerning the habitat, the activities and practices. It is a question of specifying the annual time spend by the population concerned in areas likely to receive deposits of aerosols or sediments containing radionuclides. These data are detailed according to the age groups of the subcategories of the identified population.

These data are extremely detailed for the identified population groups (the residents or the population groups whose activities are exerted in the zone) in the area close to the releases, and only mentioned in a more general way in the other areas.

4.4.3. Dietary patterns and respiratory flow rates

All data concerning the dietary patterns of the identified population groups are provided, primarily for the area nearby the releases. These data are required to establish all food categories likely to be contaminated. These data reflect as much as possible the local food practices. These data are detailed according to the different age groups of the identified subcategories of the population.

It may be useful if these data comprise several statistical elements (average consumers, large-scale consumers).The origin of the consumed foodstuff is specified as detailed as possible, especially the local origin of the products. In the same way, the origin of drink water is specified. Any manipulation of the food products carried out by the agri-food industry before consumption has to be specified.

Any publication reference concerning the results of respiratory flow rates from any individual is mentioned. Because their use for the assessment of the relevant respiratory flow rates of the individual reference groups is justified by the characteristics

of these groups (age groups, distribution men/women, activities, workers and seasonal workers composition, etc…).

5. THE ASSESSMENT OF THE RADIOLOGICAL IMPACT OF THE RELEASES

5.1. Radiological reference state

The objective is to have a reference state covering all possible releases of radioactivity in the environment. This reference state allows on fore hand to plan and organize future monitoring of the environment in the environment and facilitates the follow-up of the contamination induced by the installations concerned, by measuring the radioactivity in the environment. Therefore it is very important to know the actual situation of the installation considered in the licence application for effluent releases. It has to be specified whether:

- The installation is isolated;

- The installation is close to the releases of other installations. ;

- The installation is in development (a future installation)

- The installation already exists;

- The installation modifies significantly the release before discharge (for example the released radionuclides are modified before discharge).

5.1.1. General principles

It is important to determine the different areas of the environment that are likely to be modified by the planned releases. What area to examine is a result of the impact study of the planned releases (in particular the transfer path ways in the environment) and of the description of natural, agricultural and demographic environment and if needed the economic situation of the site.

(See above).

The environment is divided over 3 areas of interest:

- The representative dispersion areas of the effluents (mainly water, air);

-The biological indicators representative of the biological accumulation process of radionuclides;

- Areas important for the food chain.

The reference state includes all the elements necessary for each type of area.

Samples should preferably be chosen among the most representative composition of the area (for example for the biological samples) or among the products that are used for consumption, especially if they are locally consumed in one of the environment categories. The selected areas must be monitored and checked year after year. The sampling must be justified.

Sampling is carried out in zones defined according to a double logic:

- Zones affected by the releases (downstream of a river, zone under the wind) in order to specify the variations of the radioactivity in the areas due to the releases. One has to be sure that these zones are or will be actually affected by the releases (pollution of the aquatic zone by a liquid effluent release or pollution of the atmosphere due to a plume);

- Zones little or not affected by releases (upstream of a river, a distant zone in an area without dominant winds) in order to define a reference point of reference likely to be monitored later in order to be able to give even more details concerning the activity source in the areas.

The sampling zones are justified according to this double logic. In this context, special attention is paid to crowded zones.

The number of samples and measurements, carried out in the environment representing the statistically reliable radiological state of the area, must be specified.

The period of sampling must also be adapted to the nature of the monitored environment: for example, samples of cultivated plants are taken at the time of harvest.

The major sampling points are:

- At the river: samples are taken from the water of the river, (untreated water, filtered water), sediments, water plants, fish, molluscs and biological indicators (algae, moss, molluscs);

- At sea: samples are taken from the water (untreated water, filtered water), sediments, water plants, fish, molluscs, shellfish and biological indicators (algae, molluscs);

- In the terrestrial field: samples are taken from aerosols, rainwater, groundwater, grass of permanent meadows, fodder, cultivated and not cultivated ground (soil), all products used for consumption by Man (cereals, vegetable-leaves, vegetable-fruits, vegetable-roots, beef and veal and all aggri-food industry products like poultry and/or porcine, eggs,… and processed products like wine) and biological indicators (moss, lichens, mushrooms, thyme, all dairy products like milk and by-products, in particular cheese).

Please note that the natural ambient dose rate is also measured.

The analysis carried out on the samples allows characterizing in detail their physicochemical and radioactive state.

The following analyzes are to be carried out:

- Physical analyzes (pH, particle-size distribution of soils and sediments);

- Chemical analyzes of the characteristic components of water and sediments, the level of potassium and calcium in terrestrial plants and fish;

- Biometric analyzes for fish;

- Spectrometry α;

- Spectrometry γ;

- Measurements of ^{3}H, ^{14}C and ^{90}Sr and if needed of other transmitters pure beta according to the future releases.

The quality of the radioactivity measurements must correspond to the required monitoring objectives, by using the best measurement technology against an economically acceptable cost.

Total measurements α and β may be carried out in order to have references for operational monitoring of the installations, although they are not very useful for the dosimetric impact calculations.

The description of the environmental radioactivity reference state is completed by a description of the dosimetric reference state of the site. The measured dose rates in the atmosphere must be specified on a map. These dose rates come from cosmic and terrestrial radiation, and sometimes from prior releases and deposits due to a nuclear accident. Irradiation due to cosmic radiation depends on the altitude of the location. Irradiation due to terrestrial radiation depends on the nature of ground and soil. It is therefore important to specify and demonstrate the situation of the direct environment of the site by a number of appropriated measurements

5.1.2. Example of a future installation in a place with no nuclear power activities: concept of "point zero"

The environmental radioactivity reference state of the environment without any influence of a nuclear installation located nearby must be specified; a so called "point zero" situation before the future installation;

All activities of artificial radionuclides spread in the atmosphere by nuclear weapon trials and nuclear accidents (134Cs, 137Cs, 90Sr, 14C, 3H, 238Pu, 239Pu, 240Pu,…) are specified.

All activities of artificial radionuclides in the aquatic environment due to nuclear weapon trials, nuclear accidents but also due to any other installation that may affect the environment of the future installation are to be mentioned. Note that, the activity of radionuclides is measured in the different areas of the aquatic environment, notably the sediments.

5.1.3. Example of a future installation in an existing nuclear site

The environmental radioactivity reference state is partly described by the analysis of the monitoring results of existing installations located close to the future installation.

However routine measurements are not always sufficient to describe with precision the reference state. The detection thresholds of measurements may be insufficient. The monitored areas of the environment around a site cover only a reduced part of all areas necessary to get a clear description of the reference state.

Certain monitoring measurements (total of α and β) are not directly useful for the dosimetric impact calculation. For example around certain large sites , the reference groups determined for the releases of all the existing installations may differ from the reference groups determined for the releases of the future installation. In addition samplings carried out around a badly located site may not result in a relevant radiology state reference for a future installation. Further analyses to complete the monitoring results of the site are to be required. All releases from the future installation likely to

contain one or more specific radionuclides that are not already released before by the existing installations on site should be specified.

5.1.4. Example of an existing installation or an existing nuclear site

A radioecological assessment of the environment around an installation or around a site already affected by prior releases must be carried out, in order to assess the radiological impact on the environment by former releases. The radiological impact has to be specified as accurately as possible before validating of the models of radionuclide transfer into the environment. It is important to note a possible accumulation of radionuclides, in particular in the ground and in aquatic sediments. Dosimetric impact studies of the releases considered must hold account of the accumulation if existence of an accumulation has been proved.

The impact of any event taking place offsite, modifying the radioecological state of the environment since the initial determination of point zero, must be specified, for example the impact of the Chernobyl accident.

Lastly, note that, the results coming from normal monitoring procedures of the environment are often insufficient to characterize the radiological reference state and extra sampling and analyses are to be carried out.

5.2. Suitable time scales

This question is particularly important for the correct treatment of the long- term accumulation phenomenon.

The licence application for release exclusively relates to effluents releases that will take place only after the delivery date of the authorization. In principle the authorisation is granted for an unlimited time. The time period to be considered in the assessment of the radiological impact of the releases has to correspond to a period during which no major evolution of the releases is planned (even with a higher or lower level of release). In general, the duration to take into account is the residual operation duration of the installation proposed by the operator.

Some exceptions call for a specific duration of the period. If for example significant modifications of the releases are considered, shorter periods of authorization than the lifespan of the installation may be considered. A new application might be necessary after the implantation of release modifications.

Concerning installations (or a group of installations) for which dismantling operations are considered, generally generators of releases different from those produced in normal operation, it has to be specified if these operations and their duration are still in compliance with the requested authorization.

5.3. Choice and description of the impact calculation methods

The calculation methods include not only an inventory of all the nuclide transfer pathways in the environment and of all the contamination pathways of the population but also an identification of the reference groups and the modelling of the exposure starting from valid computer codes.

The values of the parameters used in the models are always justified, notably on the basis of an environment description (values specific to the site) or on relevant scientific literature (values nonspecific to the site).

5.3.1. Census of transfer pathways in the environment and of contamination pathways of the population

All the possible pathways of radionuclides transfer are explored, starting from the effluent discharge till the population, by covering not only the permanent pathways but also the irregular or rare pathways. The whole population concerned is studied no matter what age group. All forms of released radionuclides are studied. Especially the two main kinds of release are considered namely the gaseous and liquid effluent releases.

All the contamination pathways (external exposure, internal exposure by ingestion and by inhalation) are explored. The synthesis of all these combinations (the whole population, all transfer pathways, all contamination pathways) lead to a list of significant pathways, although many different ways to recombine are generally possible (by liquid and gas releases, categories of radionuclides, by different categories of the population, by the main types of contamination pathways).

Minor transfer and contamination pathways, minor radionuclides may only be neglected after a justification by global estimates.

5.3.2. Census of the reference group

A reference group is a group of individuals of the population for whom exposures coming from a given source are relatively homogeneous and representative for individuals receiving the highest dose coming from this source. Theoretically, it is possible to define, for a given release source, one or several reference groups for each pathway of transfer, each nuclide, each part of the population and each contamination pathway. In practice, because of the recombining mentioned above the number of possible reference groups is generally restricted to a few groups. At this stage, no group of individuals that may form a reference group must be ignored, especially before a dose calculation (even roughly).

Different criteria are considered to identify the reference groups. One can quote for example the geographical criterion of proximity (inhabitants of a village near the installation), socio-professional criteria (families of fishermen at sea), habits or behaviour (summer visitors on a beach affected by radionuclides releases), age criteria (infants, adults, the elderly….) or a combination of these criteria. A thorough analysis of the environment is generally a source of invaluable information for the identification and the inventory of the reference groups.

Note: it should be noted that individuals, generally workers, who remain daily at a nuclear site, even if they are not “ exposed workers” according to the regulations for radiation protection , are usually not taken into account in the definition of the reference groups, within the framework of the license application for effluent releases of a BNI.

It is important to recall that the dose determines the relevant reference groups because they must be representative of the most exposed individuals. At this stage of the study it is important to have a thorough inventory based on the indications provided by a study of the natural, economic, agricultural and demographic environment as already mentioned above(before complete and detailed calculations of the dose).

Apart from exceptions, this inventory does not stop with only one declared group, without a preliminary demonstration, of the“obvious” reference group (for example a

village under dominant winds for the gas releases), for at least two reasons:

1. The identification of the most exposed reference groups sometimes proves to be insufficient; knowledge of other less exposed but larger reference groups like young people, more sustainable, etc is useful, in particular to identify the territory or the populations under the influence of the releases. The information will help to define a relevant framework for the monitoring of environment or simply to inform the public;

2. Taking into account of only one parameter to estimate the impact (for example frequency of the wind directions for the example of dominant winds) is incorrect because other parameters play also a prevailing part (frequency of the wind speeds, stability conditions of the atmosphere, precipitations, etc) and may lead to higher impacts for reference groups who were not really considered.

Only an impact calculation will permit to identify the most exposed reference groups. However a global impact calculation might be sufficient to exclude groups who will be less exposed than other groups.

The size of the reference groups is often subject for discussion because there are no general rules to apply. In fact a group consisting of only some individuals or on the contrary a much larger group of individuals is both possible. It is the level of exposure (which must be sufficiently homogeneous within the group) that determines the size of the group. Please note that, the higher the dose the smaller the groups of the population to examine in order to be able to identify the individuals. Notably if the inhabitants are spread over a large area and are living rather isolated, it is strongly recommended to identify the different groups of the population, a group may even consist of only a few individuals, living close to the highest concentration peaks of pollution in the atmosphere due to gaseous effluents.

In addition, by the existence of a significant agglomeration close to an installation (for example in a radius of 30 km), it is useful to present a calculation of the dosimetric impact for the individuals of this agglomeration.

5.3.3. Dispersion of gas releases in the atmosphere

A model of gaseous effluent dispersion is selected and described. Justifications of the selection are provided.

The simplified assumptions of this model, the known limits (for example for zones close to the discharge outlet), the experiments for model validation are shown in detail (any possible publication reference duly referred and accessible to all may be given; in this case, a summary of this information appears in the file). The physicochemical form of the radionuclides taken into account is also mentioned.

Possible adaptations of the model to address the industrial site concerned are described in detail.

The influence of the topography of the ground of the site or the presence of high buildings is also discussed.

However it is possible to neglect the depletion of the plume.

5.3.4. Dispersion of liquid releases in rivers

A model of liquid effluent dispersion in rivers is selected and described.

Justifications of this selection are provided, in particular in relation with the environment (fishing, water sports, fish farming and shellfish farming…)

The simplified assumptions of this model, the known limits (for example for the flow rate of the river), experiments for model validation are shown in detail (any possible publication reference duly referred and accessible to all may be given; in this case, a summary of this information appears in the file). That the physicochemical shape of the radionuclides is taken into account is also mentioned.

Interactions of the radionuclides with aerosols and sediments of the riverbed are modelled if needed. The models and why they are selected are clarified. The possible aspects of the kinetics of these interactions are mentioned.

5.3.5. Dispersion of liquid releases at sea

A model of dispersion at sea of the liquid effluents is chosen and described. Justifications concerning the selection are provided, notably in relation to the environment (fishing, shellfish farming, nautical leisure,…).

The simplified assumptions of this model, the known limits (for example for certain tide margins or specific weather conditions),), the experiments for model validation are shown in detail (any possible publication reference duly referred and accessible to all may be given; in this case, a summary of this information appears in the file). That the physicochemical shape of the radionuclides is taken into account is also mentioned.

Interactions of the radionuclides with aerosols and sediments of the sea bed are modelled if needed. The models and why they are selected are clarified. The possible aspects of the kinetics of these interactions are mentioned.

5.3.6. Transfers into the different areas of the terrestrial environment

Models of transfer in the different areas of the terrestrial environment are selected and described in detail (deposits on the ground, accumulation and transfers in the ground, transfers to plants used for consumption by the livestock, transfers to plants and animals used for consumption by Man). Justifications of the selection are provided, regarding the rejected radionuclides, the type of ground, the agricultural and local industry etc.

The simplified assumptions of this model, the known limits (for example for the classification of the different vegetables in main categories like root- vegetables, fruit, leave vegetables like spinach and salads; the absence of differentiation between beef, pork, sheep or horse meat; the assumption of a non existence of radionuclides) and all experiments for model validation are shown in detail (any possible publication reference duly referred and accessible to all may be given; in this case, a summary of this information appears in the file). The physicochemical form of the radionuclides taken into account is also mentioned.

Models concerning specific radionuclides are fully detailed, in particular models of transfer into the environment of radioactive hydrogen and carbon isotopes which are components of life. The contamination level due to former activities of the installation (a release history and a summary of former incidents) is taken into account in the assessment of the activity levels in the different areas of the whole terrestrial environment.

5.3.7. Transfers into the different areas of the aquatic environment (River or sea)

Models of transfer in the different areas of the aquatic environment are selected and

described in detail (radionuclide tranfers into aerosols, on beaches and sea bed and coastal sediments, contamination of fish, oysters, shellfish, mollusc and algae; possible transfers into drinking water sea salt or salted sea water). Justifications of the selection are provided, in relation with the grading of sand, beaches and sediments, the species of fish, molluscs, shellfish and algae concerned, etc.

The simplified assumptions of this model, the known limits (for example for the classification of the different species in main categories like fish and seafood; the absence of differentiation between fine and coarse sediments; the assumption of a non settlement of radionuclides on aerosols) and the experience in model validation are shown in detail (any possible publication reference duly referred and accessible to all may be given; in this case, a summary of this information appears in the file). The physicochemical forms of the radionuclides taken into account are also mentioned.

Models concerning specific radionuclides are fully detailed, in particular models of transfer into the environment of radioactive hydrogen and carbon isotopes which are components of life.

The contamination level due to former activities of the installation (a release history and a summary of former incidents) is taken into account in the assessment of the activity levels in the different areas of the whole aquatic environment.

5.3.8. Assessment of activity intake and the corresponding dose rates

An estimate of the intake of activities by individuals of the reference groups is made in general over a whole year, in order to apply the regulation because the main limits are annual. The selection of the year considered is justified, notably compared to the possible phenomena of accumulation which could lead to different results according to the selected year.

An estimate of the specific and volumic activities in food eaten by Man is made by taking into account the modifications due to the transformations carried out in the agri-food industry and by the modes of culinary preparation of the dishes.

The activity intake through ingestion of the various radionuclides is calculated for each individual of the reference groups by taking into account their dietary patterns.

The activity intake through inhalation of the various radionuclides is calculated for each individual of the reference groups by using the respiratory flow rate and the time spent in the contaminated atmosphere.

The doses received through inhalation and ingestion is calculated starting from the activity intake and the dose coefficients. The selected margins for the received doses are clarified, notably according to the physicochemical form of the radionuclides concerned and the age category of the population. Calculation conditions and factors as well as the effective dose values involved per intake unit for each radionuclide, through ingestion or inhalation must be used in compliance with the regulation pursuant to the R.43-5 article of the Public Health Code, must be used. If the calculation of the required doses requires margins, which are not set by any regulation, these margins are selected in a suitable and justified way.

5.3.9. Dose assessment by external exposure received by individuals of the reference groups

Doses received through external exposure coming from plumes (in the air or in the water), deposits on the ground or in the sea or river sediments are assessed for

eachradionuclide and each reference group starting from the specific or volumic activities added in the relevant areas, the time spent in the contaminated area of the individuals and of the dose coefficients. The dose coefficients are clarified. Generally, they come from scientific publications, which are mentioned in the file.

The estimate of activity intake is also clarified and also based on scientific publications, mentioned in the file the assessment of external doses is carried out in general over a year. The selection of the year is also justified and clarified.

If necessary, an assessment of the external exposure coming from the direct radiation from the installation is carried out specifically for individuals of the reference groups concerned.

5.3.10. Cumulative doses

The cumulative dose, concerning individuals of each reference group, which is the sum of all the doses received due to gaseous and liquid effluent releases, is given for all radionuclides and all contamination pathways. If necessary this is added to the received doses through direct exposure because of the installation.

In the case of a study related to several installations (respectively in the case of one installation part of several installations), this addition is carried out for each installation (respectively for the installation considered) and afterwards on all the installations together.

5.4. Presentation of the results

5.4.1. Results in terms of contamination in the different areas of the environment

All intermediate results related to contamination of the different areas of the terrestrial and aquatic environment are provided, for all radionuclides.

This exhaustive presentation has two objectives:

- To allow a double check independent of calculations;

- To have a clear view of the order of magnitude of the expected maximum contaminations, in order to check whether other regulations applicable to certain products for human consumption are respected and to prepare the monitoring of environment.

5.4.2. Comparison of the amounts in extreme cases lawful

The decree n°2002-460 of 4 April 2002 concerning th e general protection of the people against the dangers of ionizing radiation defines the dose limits to be respected for all individuals of the public. This decree imposes that the sum of the effective doses concerned received in one year by an individual of the public likely to be exposed due to Human activities should remain less than 1 mSv. The file compares, for each reference group the annual doses received due to the releases if necessary the file will also compare the exposure coming directly from an installation, limited to 1mSv by taking into account the doses possibly received by individuals of the reference groups due to other activities (notably from other installations close to the installation concerned).

5.5. Sensitivity and uncertainty - calculation of the impact of the releases expected

5.5.1. Sensitivity and uncertainty

In general, a certain number of simplified assumptions are adopted in the composition of the released effluents, in the modelling of the transfers into the environment and in the habits and the dietary patterns of the population. Certain parameters intervening in calculations are slightly unknown. Moreover, it is frequent to adopt an approach of importance by the selection the simplified assumptions. Consequently the dose calculation will always remain close but uncertain.

Although an analysis of complete uncertainty is not required in the file, it is preferable that a sensitivity study concerning parameters with a direct impact on the dose and a study of the most uncertain parameters is provided, notably for the maximum dose estimate likely to be received by the population considering the uncertainties. Such an analysis is to be carried according to the dosimetry stakes corresponding with the releases, for example the margins of a radio ecologic transfer.

5.5.2. Doses due to the expected realistic releases

The release limits are generally defined by margins. Expected realistic releases for which the margins were not taken into account are generally significantly lower than the limits. For a better understanding of the information by the public, the file specifies the dosimetric impact estimate of the releases without the margins. In practice, for existing installations discharging without significant modifications of the effluent releases and subject to the application of the ALARA approach(see§ 3.5), it is accepted to calculate the doses based on the data of effluent releases of a recent year.

6. DEFINITION OF THE MONITORING SYSTEM OF THE ENVIRONMENT

The modified decree n°95-540 of 4 May 1995 stipulat es that the license application for effluent releases indicates the technical an human means of monitoring envisaged. In addition, the decree of 26 November 1999 imposes the implementation, by the operator, of a monitoring program for the radioactivity in the environment. The nature, the frequency and location of the samples and the measurements are defined in the authorization decree. The file accompanying the authorization application must thus propose a monitoring system which will be taken into account in the definition of the regulations accompanying the authorization.

Generally, the measurements in the environment permit:

- To detect dysfunctions in the release operations (vigilance);

- To make sure that the concentrations of radionuclides remain lower than the estimated values in the modelling of the radiological impact of the releases that have been carried out.

- To highlight the evolution of radioactivity in the different areas of the environment in the course of time.

A normal monitoring procedure of the environment includes:

- Continuous or regular monitoring primarily for control and alarm purposes; which is the reason why it is carried out permanently;

- Periodic inspection visits making it possible to establish assessments of the environment contamination in order to follow the variations of the indicators of the contamination on the long-term; meticulous measurements make it possible to monitor undetectable radionuclides within the framework of regular monitoring.

Note: there are other types of measurements of the radioactivity in the environment, apart from the normal monitoring procedures. These measurements are mainly used after an accidental or incidental release and therefore not described in this guide. However they improve the knowledge on the phenomena of transfer into the environment and on dosimetric assessment.

The monitoring system suggested in the licence application relates to the following:

- The magnitude to be measured;

- The selection of the samples;

- Location of the measurement points;

- Frequency of the measurements;

- Presentation of the results.

6.1. Selection of the analyzes to be realized

The analyzes to be carried out include instantaneous measurements (dose rate, specific activity in a crop product,…), measurements integrated in time (measured dose on a dosimetric film, daily sampling of rainwater,…) or average measurements over a given period (volume activity of the air,…).

It is important to note that the monitoring of the radioactivity in the environment does not only comprise total measurements (α total, β total) but must comprise the measured activity of the radionuclides which are rejected by the installation concerned.

The radionuclides to be measured are to be defined according to the composition of the releases; for example, gamma transmitters radionuclides of ^{14}C, ^{90}Sr, the I' ^{129}I, I' ^{131}I, ^{3}H linked and free, ^{238}Pu, ^{239}Pu + ^{240}Pu, ^{241}Am, ^{244}Cm, and other radionuclides specific for certain installations like ^{65}Zn, ^{85}Kr and ^{133}Xe .

A certain number of physicochemical characteristics influence the capacity of the different environments to settle the radioactivity. It is therefore necessary that these characteristics are specified using complementary analyzes adapted to the studied areas in order to be able to compare (in time or in space) the activity of identical samples:

- For water, the pH, conductivity, the dissolved oxygen content, the majority of cations and of anions;

- For plants, the water content;

- For the ground and the sediments, the grain size, the capacity of cation exchange.

6.2. Selection of the samples

The samples are selected according to the nature of the relevant transfer pathways, which have already been identified.

6.2.1. Terrestrial environment

The following areas of the terrestrial environment are to be monitored:

- Air (gas and aerosols), grass, ground, rain and snowfall;

- According to the local agri-food industry, the leave- vegetable (salads, spinach,…), fruit-vegetables (tomatoes, beans, …), root- vegetables (potatoes,…), cereals (corn, corn, rice) and fruit.

Note: The selection is guided not only by food products intend to be sold for human consumption but also by food products coming from the vegetable gardens;

- According to the local livestock products, milk (of cow and goat), beef, sheep, poultry meat, eggs, honey;

- If necessary, all processed products (flour, wine, cider,…).

6.2.2. Aquatic environment

The normal monitoring procedure on inland water is focused on the water of the river, fish, molluscs and sediments, when the liquid releases take place in rivers. The sampling is the same for all releases at sea with an additional sampling of shellfish and gastropod molluscs.

The species to be selected for sampling are representative for the environment and the transfer pathways to Man. The abundance and the mobility of the species are obviously a criterion of selection, the economic value of the products is also to be considered (lobsters,…). Not to forget that, algae are largely used in the cosmetic industry and the food industry. They also have the characteristic to accumulate the radionuclides with the course of time. Therefore, their activity is periodically measured.

Measurements and sampling of the water are related at the same time to the dissolved forms and the specific forms of radionuclides.

6.3. Location of the measurement points

In the scope of a normal monitoring procedure, the measurement and sampling points are located as close as possible to the identified reference groups or to the places where they exert their activities (fields, vegetable gardens, meadows,…). It is also strongly recommended to plan sampling at atmospheric concentration points and points with a maximum deposit.

- ***Ambient gamma radiation***

The continuous recording of ambient the gamma radiation is normally done from four measuring sites established close to the site, one is placed under the dominant winds compared to the installation in order to monitor the zone likely to be more affected by the gaseous effluent releases of the installation. This type of measurement does not specify the released radionuclides and must considered as a provider of useful information for a possible alarm.

The level of sensitivity of the system is adapted to local conditions, in particular with possible fluctuations of the activity levels natural radionuclides like radon.

In addition to the installation of a station under the dominant winds, it is also recommended to plan stations closer to the most significant deposits (the most significant deposits are very often located in areas not under the influence of dominant winds but under winds bringing regular rainfall, this will consequently wash down the plume.

Moreover, uninterrupted recording of ambient gamma radiation at a certain distance from the site should be carried out in points to be specified according to local conditions of urbanization, industrial zones and agricultural zones. In the case of a dispersed habitat, the points are selected based on the weather condition (direction of the winds).

- ***Atmospheric aerosols***

In order to identify the radionuclides present in the environment and, if necessary, to help with the interpretation of measurements of gamma radiation, sampling equipment for atmospheric aerosols allowing a permanent collection of the radionuclides present in the air in order to carry out a thorough analysis in a laboratory is installed at the same stations already mentioned above. For gas iodine, specific filters (cartridges of activated carbon) are added downstream from the air stream of the filter system of the sampling equipment for aerosols. this will provide important information concerning the activity of the air inhaled by Man, the air intake of the sampling systems are installed at least 1 or 1,5 meters of the ground, at a sufficiently remote distance from any obstacle that might disturb the airflow.

- ***Water coming from rain or snowfall***

The collection of rain water is carried out at the same stations as the collection of atmospheric aerosols. The measurement of volumes of the rainfall makes it possible to show the results in volumic activity and knowing the surface of collection of the pluviometer permits to determine the surface deposits. Determination of gamma emitting radionuclides is carried out, after filtration of water, by a direct measurement or by a measurement after concentration by evaporation if necessary. Aliquot of the sampling is used to determine the tritium level by direct measurement by liquid scintillation.

- ***Deposits of radionuclides on the ground***

The sampling locations are selected according to the wind roses by dry weather and by rainy weather; the distance from the releasing installation must correspond to a maximum deposit.

Two types of ground are selected for sampling: the ground of a meadow, which is in general only slightly altered and cultivated ground regularly ploughed. Cultivated ground is ground with a vegetable culture such as the market-gardening grounds, vines, orchards or cereals.

The ground selected for sampling should if possible be those where the plants grow and where agricultural products are taken within the framework of a normal monitoring procedure (see below). All samples should preferably be taken at the same time.

- ***Plants and milk***

To follow the transfer pathways of the food chains due to releases of a nuclear installation, sampling of plants (grass, moss, etc) is carried out in stations placed under the dominant winds of the installation, preferably in the meadows being used to feed the animals whose milk is also subject of sampling.

In addition, samples are taken from ground and grass of meadows that not only feed the animals but are also used for forage.

Milk is directly collected from producers whose extensive livestock are grazing or fed for at least two months with fodder coming from the same meadows from where the other samples have been taken.

- ***Agricultural products (except milk)***

The selection of samples is guided by the most significant local products in terms of produced quantities and their capacity to accumulate radionuclides. In the scope of a follow-up of releases into the atmosphere, the samples of vegetable-leaves or fruit are the most appropriate. They are carried out on cultivations in the open field and not in a greenhouse, preferably on vegetables or fruit fully grown.

- ***Volumic activities in the mixing of the liquid effluents***

Measurements of volumic activity are carried out in a fixed place representative for the mixing zone of the effluents, starting from samples of a semi-release or an uninterrupted release into the receiving environment. The results are therefore specific values (samples of semi-release) representative of the volumic activity reached in the receiving environment or of the values integrated over the duration of the rejection (regular sampling).

The use of automatic sampling equipment is to be recommended. The volume of water taken for sampling is specified according to the analysis to be carried out. Concerning a river, the sampling station is located at a zone were with an excellent mixture of the released effluent takes place. The definition of such a zone must be carefully studied by taking into account the river flow and the distance from the outlet of installation concerned because it will vary the mixture. Initially, this distance is assessed for the characteristic flow rate values (rising, low water level and medium flow). To determine the specific impact on the installation considered, it is useful to have another station upstream close to the outlet.

In the marine aquatic field, the sampling stations are defined starting from dipersion studies of the effluents. Sampling points of sea water permitting to determine the levels of volumic activity related to the releases are generally located at 500 meters of the releasing installation. The precise location of the sampling points is always decided after a radioecologic study and after modelling. A fixed point systematically affected by the effluents and easily accessible (generally at the coast) is defined; another sampling point considered as a point of maximum volumic activity at a distance selected (not located in the axis of the plume) is also defined; the hour of sampling compared to the tide is specified.

- ***Aquatic sediments, fauna and flora in the receiving environment***

The interministerial decree of November 26, 1999 stipulates the monitoring, by regular inspection visits, of radioactivity in aquatic sediments, fauna and flora in the receiving

environment. The sediments initially play a significant part in the integration of radionuclides present in the water, in particular those in the form of a particle. Monitoring of the sediments permits to follow the accumulation of the radionuclides. It is therefore important to monitor the zones of accumulation of fine sediments likely to concentrate the radionuclides. The choice of the location of the sampling points is based on the knowledge of sedimentary deposits which are indexed.

When a sampling site comprises sediments of various granulometry (for example beaches), combined samples are carried out; resulting in an homogeneous mixture, in identical proportions, of representative samples or fractions of samples in order to approach the average value of the volumic activities for one radionuclide or overall value for the site sampling.

The monitoring of the radioactivity in fauna and flora must preferably relate to all biological species accumulating the radionuclides (biological indicators) or to all species used for human consumption. To monitor if the installations operate normally research on species that are bio-indicators or of the type sentinel are required (because of their capacity to accumulate the radionuclides quickly). For the flora, they are hydrophytes fixed or floating, primarily of watery moss and algae. For the fauna, samples are taken from the molluscs filterers, like various species of mussels. When a site or a zone is deprived of such species due to the direct impact of the releases, re-establishment of the species might be carried out.

In order exclude the effect of variable accumulation of the radionuclides (variations according to species, according to individuals) due to the composition of the samples and to establish chronological series easy to interpret, a sample consists of several individuals of the same species and the same size, therefore roughly of the same age.

To monitor species used for human consumption, generally fish, the same precautions are taken as for the samples mentioned above.

For the releases at sea, a specific species of alga and mollusc always present on the beach are taken on both sides of the outlet in at least two sampling stations, as well as sediments of beaches close to the foreshore.

- ***Ground water and surface water other than those of the receiving environment***

The monitoring of ground water and surface water other than those of the receiving environment is meant as a preventive mesure, because normally they should not contain any form of radionuclides coming from the installation concerned. In addition by the presence of radionuclides in a water resource intended for human consumption, the monitoring has also a dosimetric vocation.

Water samples are taken from the groundwater directly by drillings or in pedometers by using pumps. Anyway it is advisable to privilege existing drillings so that the sampling begins only after the draining of the operating system; To be sure that the characteristics of the water collected (pH, temperature, conductivity) are definitely those of the groundwater.

Concerning irrigation water coming from drillings of the ground water or coming from a river or channel, the sampling is directly carried out in the distribution system at the site where the water is taken for irrigation. There again, a draining of the system of

distribution is carried out preliminary, so that the characteristics of the water collected are stable and representative.

This monitoring is supplemented by regular measurements (for example monthly) of the radio activity of drinking water, in points where this water comes from like groundwater or river water affected by liquid effluent releases or even affected by deposits on the ground of radionuclides coming from gaseous effluents (case of tritium).

6.4. Frequency of sampling and measurements

Normal measurements procedures, when they are not carried out uninterrupted, have to be carried out with a frequency corresponding with the periodicity of the releases.

Therefore, all sampling equipment for atmospheric aerosols present near the installation are continuously in operation to allow at least a daily analysis of the filters in a laboratory in order to determine the volumic activity of gamma transmitting radionuclides , like the isotopes of cesium and cobalt, and possibly of iodine if they are in the form of aerosols. Moreover, these daily filters, collected over one week or a month, can be gathered to take weekly or monthly samples because the results of the analysis may lead to lowering the limits of detection for the gamma transmitters or to carry out analyzes by alpha spectrometry to determine the volumic activities of the alpha transmitters (in particular plutonium and americium). In addition, periodical sampling of aerosols at longer distance from the installation should take place weekly.

The monitoring of radionuclide deposits on the ground is at least annual. The sampling date of the surface layer of the ground is given according to the local meteorological cycle: Sampling is carried out at the end of the wettest season.

Sampling on grass and milk is at least monthly.

The frequency of sampling for the monitoring of all agricultural products is normally annual; the sampling carried out during the season of cultivating: vegetables and fruits in springtime (salads, strawberries, cherries), in the summer (tomatoes, zucchinis, fishing) and in the autumn (grapes, apples, cabbages).