APPLICATION

OF ARTICLE 37

OF THE EURATOM TREATY

Survey of Activities

Experience Gained

1959 - 1972

ABSTRACT

Article 37 of the Euratom Treaty stipulates that each Member State shall submit to the Commission such general data concerning any plan for the disposal of radioactive waste as will enable the Commission to give its opinion whether or not the implementation of such a plan is likely to involve radiological consequences in another Member State.

In the 12 years during which this Article has been applied, the Commission has issued 57 opinions relating to 79 nuclear installations.

This report, which is intended particularly to give information to the new Member States, sets out the procedure followed in formulating such opinions, the main points under consideration when a plan for disposal is examined, the experience acquired and some of the prospects for the future.

* * *

Address for correspondence:

Commission of the European Communities,
Directorate-General for Social Affairs,
Directorate of Health Protection
29, rue Aldringen
LUXEMBOURG (Grand-Duchy of Luxembourg)

DOC. No. 2748/1/72 e

CONTENTS

I. INTRODUCTION

Chapter III ("Health Protection") of the Treaty instituting the European Atomic Energy Community (Euratom) imposes upon Member States the following obligations regarding the discharge of radioactive effluents from nuclear plants :

"Article 37

"Each Member State shall submit to the Commission such general data concerning any plan for the disposal of any kind of radioactive waste as will enable the Commission to determine whether the implementation of such plan is likely to involve radioactive contamination of the water, soil or airspace of another Member State."

"The Commission, after consulting the group of experts referred to in Article 31, shall give its opinion thereon within a period of six months."

Another article of the Treaty (Article 38) defines the measures to be taken by the Commission in order to preclude all possibility of the permissible level of radioactivity in the atmosphere, water or soil as specified in the Euratom Basic Safety Stardards for the protection of the health of the general public and workers against ionizing radiations being exceeded in Member States.

After more than twelve years' experience of the application of the Treaty, it seemed useful to present a review of the work that has been carried out under the terms of Article 37 and to appraise the lessons that can be drawn

from it. This report is also intended to provide background information for new Member States.

In accordance with the procedure followed in pursuance of Article 37 of the Treaty, between the notification of a project involving waste disposal and the issue by the Commission of its opinion regarding this project, an essential role is played by the consulting body created for this purpose, viz. the group of experts. It is this role that will be considered first.

II. THE GROUP OF EXPERTS

The group of experts mentioned in Article 37 and instituted by Article 31 is that which co-operated in the formulation of the above-mentioned Basic Safety Standards; in principle, therefore, a group of this kind should be composed of experts in the field of public health. However, in view of the specific nature of the technical problems that need to be taken into consideration in order to assess the health hazard associated with the release of radioactive wastes, it seemed advisable that the membership of the group should include a certain number of technical experts. At its meeting of 13 October 1959, therefore, the Scientific and Technical Committee (instituted by Article 134 of the Treaty), which designates the experts of which the group is composed, decided that, for the purposes of the work to be carried out in pursuance of Article 37, the group should be composed of 6 technical experts and 6 public health experts.

Since the experts were often detained by other commitments, it was frequently difficult to arrange for the presence of specialists in the various disciplines at the meetings of the group. It therefore seemed necessary to increase the number of specialists within the group still farther, and so, at the suggestion of its members, the Scientific and Technical Committee nominated 6 additional experts at its meeting of 4 December 1962.

In 1968 two further members joined the group, which consequently now numbers 20 experts. Since then, a sufficiently large number of experts have been available for the investigation of the problems of health protection and safety that need to be studied in pursuance of Article 37.

A list of the experts' names, as at 31 December 1972, is given in Appendix I.

As at the same date, the group of experts had been convened 37 times; occasionally a number of projects were examined.

The secretariat for the group of experts is provided by the Directorate of Health Protection.

III. RECOMMENDATION OF THE COMMISSION RELATING TO THE APPLICATION OF ARTICLE 37

At its first meetings in March and July 1960, the group of experts exchanged points of view regarding the content and objectives of Article 37, the procedure to be followed for its application, and the clarification of certain terms in the wording of the Treaty.

There is, for instance, no generally recognized definition of the level starting from which waste discharges are regarded as "radioactive"; the same is true of the concept of "radioactive contamination". Furthermore, it is not clear which aspects of a project involving waste discharge should be covered by the "general data" stipulated in the Treaty. It was therefore necessary to start by defining the type of projects that would be subject to the procedure required by the Treaty and indicating the kind of information on which the opinion of the Commission would be based.

These discussions led to the formulation of a recommendation concerning the application of Article 37 which was approved by the Commission on 16 November 1960 /1/. The essential points of this recommendation, which is addressed to all Member States, are summarized as follows.

It may be inferred from the Treaty that the health aspects play an essential role in the assessment of a waste discharge project. In this respect, the Euratom Basic Safety Standards /2/, which were drawn up in pursuance of Article 30 of the Treaty, constitue the authority to which reference should be made. This is why any explanations to define the wording of Article 37 more precisely must be made under the terms of these Basic Safety Standards. Thus, for instance,

in the sense of this article "disposal of radioactive waste" means "any definitive release into the air, water or soil of radioactive substances that can cause, for persons other than those who are occupationally exposed, a contamination involving a danger of exceeding the maximum permissible dose for the general population as fixed in the Basic Safety Standards in pursuance of Article 31 of the Treaty".

Thus, it is this health aspect alone, and not the type of plant (laboratory, power station, reprocessing plant, etc.) or its capacity or location, which determines whether a project is subject ot the terms of Article 37. Member States are, however, at liberty to submit to the Commission individual projects which do not come unter the definition given above but for which they would welcome the opinion of the group of experts.

The said recommendation also specifies :

- which activities are regarded as comprising releases of radioactive waste;
- that handling or temporary storage of radioactive wastes are not regarded as "disposal";
- what is meant by "general data" in the sense of Article 37;
- that this general data should be submitted at least six months before the date set for the disposal to be carried out.

Nuclear plants that were already in service in 1960 are listed, together with data specifying their effluent discharge under normal operating conditions, in a schedule of all the plants in the Community that discharge radioactive effluents.

This inventory therefore provides background information, for use in assessing new projects notified to the Commission, on the presence and influence of other sources of effluent discharge in the vicinity and on the existing environmental conditions.

In addition, at the request of the "Committee for Atomic Affairs", the Secretariat of the Council of the EAEC defined more precisely, in a note dated 12 January 1962 (see Appendix II), the obligations imposed upon Member States as implied by Article 37. It emphasized, in particular, that the Commission should also be notified of any substantial modifications made subsequently to projects that had previously been submitted to it, if they are relevant to the aspects covered by Article 37.

This document also emphasizes the fact that to grant official authorization in any circumstances for the implementation of any project without having first obtained the Commission's opinion would be inconsistent with the spirit of Article 37 and would rob the latter of all practical significance.

In this respect, it is worthwhile noting that two Member States, Belgium and Italy, have made explicit reference to Article 37 in their legislation. The Belgian Royal Decree of 28 February 1963 /3/ specifies that the opinion of the Commission must be sought before granting authorization for a certain category of nuclear plants, while Decree No. 185 (1964) of the President of the Republic of Italy /4/ stipulates that "general data" should be submitted to the Commission before authorizing a discharge project.

IV. PROJECTS SUBMITTED TO THE COMMISSION

As at 31 December 1972, the Commission had received 57 notifications of general data on projects involving radioactive effluent discharge relating to 79 plants and on which it had issued its opinion. Some of these notifications were particularly complex, as in the case of the research centres at Jülich and Karlsruhe and the Ispra Joint Research Centre, or of industrial plants such as Eurochemic, for which one single notification related to a whole series of laboratories, reactors, radioactive waste processing plants or other nuclear plants.

The distribution of these notifications by Member States was as follows :

Country	No. of notifications	No. of plants concerned
Germany	26	38
Belgium	13	22
France	9	10
Italy	6	6
Netherlands	3	3
	57	79

These notifications cover a wide range of projects, viz. :

- teaching and research reactors
- radiochemical and metallurgical laboratories

- power reactors of all different types
- fuel element manufacturing plants
- installations for the storage of irradiated fuel elements
- reprocessing plants for irradiated fuel elements
- the "OTTO HAHN" nuclear-powered vessel
- treatment and storage plants for liquid and solid radioactive wastes
- controlled submersion of radioactive wastes in the sea, etc.

In some cases, when substantial modifications have been made to the capacity or the design of the installations, several opinions have been issued with respect to a single installation.

The Belgian government made valuable use of the procedure specified in Article 37 by seeking the Commission's opinion at the preliminary design stage of a sewer project for the discharge of industrial wastewater into the Scheldt. Thus, the possible consequences, beyond national frontiers, of implementing a large-scale project that fell within the scope of regional planning, were examined in an international context at a very early stage even before investments had been authorized.

It can be seen that, for the period covered by this report, commercial and industrial applications of nuclear engineering tend to predominate. Whereas, in the early sixties, notifications of discharge projects related mainly

to research installations and to laboratories (research reactors and pilot plants), they now relate mainly to industrial installations, particularly nuclear power stations, and also plants for the manufacture and reprocessing of fuel elements. In the case of nuclear power stations, the trend, starting from the experimental stations at Mol (BR3) and Kahl (VAK) (11.5 and 15 MWe) and other experimental and prototype units, has been in the direction of increasingly powerful units. Power stations with capacities of more than 1100 MWe are in the course of construction. There is also a growing tendency to build several power stations on the same site, not only in order to satisfy the energy requirements of the region concerned but also in an attempt to achieve more efficient utilization of the auxiliary installations.

The various installations on which opinions have been issued are arranged by country in Appendix III.

Finally, it should be emphasized that all radioactive effluent discharge projects relating to the installations on which public interest is concentrated, namely, nuclear power stations, have been subjected to scrutiny under the terms of Article 37 of the Treaty.

V. EXPERIENCE ACQUIRED

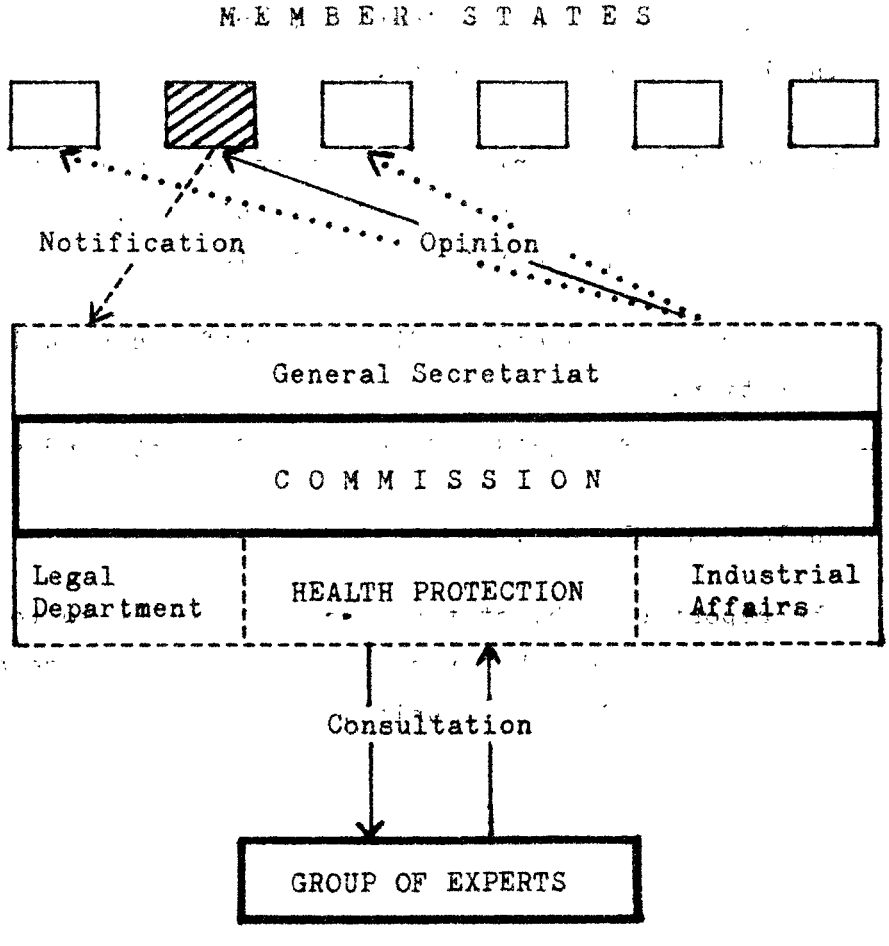
An account is given below of the experience acquired over the last 12 years or so in the application of Article 37, with particular emphasis on the following aspects:

1) procedure followed from the notification of a disposal plan up to the issue of an opinion;

2) main points covered in the examination of radioactive effluent discharge plans;

3) progress achieved towards reconciling different approaches to the assessment of health hazards.

1) Procedure followed for the issue of an opinion



The above diagram represents the processes comprising the procedure in pursuance of Article 37. This procedure is initiated by the notification of the "general data" by a Member State and ends with the issue of the Commission's opinion to this Member State and also, possibly, to other (neighbouring) countries concerned.

The chronological sequence of the various stages in the procedure is shown in Appendix IV.

The translation and reproduction of the documents submitted takes a long time (from 4 to 8 weeks depending upon their volume). Some governments (France, Belgium and Italy) have helped to reduce this delay considerably by sending enough copies of the general data for them to be passed on directly to the experts.

During this same period, in order to aid the compilation of the experts' report, the secretariat prepares, for the meeting of the group of experts, a report comprising a critical analysis of those elements of the project that are essential to its assessment in the sense of the Treaty.

In addition to a brief description of the installation and its associated monitoring and safety equipment, the report compiled by the experts contains an analysis of:

- discharges of gaseous radioactive effluents during normal operation;
- discharges of liquid radioactive effluents and solid radioactive wastes;
- unplanned releases.

The report ends by stating whether, and if so to what extent, the implementation of the project is likely to cause a contamination in another state of the Community.

When the experts' report has been completed, the Directorate of Health Protection prepares, in co-operation with the Directorate General III "Industrial, Technological and Scientific Affairs" *) and the Legal Department, a draft Opinion of the Commission which is submitted for the approval of the latter, usually in accordance with a written procedure.

The opinion obtained in this way is communicated to the government of the Member State that gave notification of the project and also to that of the neighbouring member country or countries concerned.

* * *

The progress of the procedure as outlined above, from initial notification of a project to the opinion to be issued in pursuance of the Treaty, obviously depends upon the quality of the general data that are provided by the government in question. It frequently happens that this information fails to satisfy completely the requirements of the recommendation discussed above in section III.

On the basis of the experience gained over what now amounts to some twelve years, the experts have drawn up a new list of the details that should be supplied as constituting the general data stipulated by Article 37 (see Appendix V). Copies of this list have been sent to the governments of Member States.

By doing this, it is hoped to reduce the number of cases in which incomplete or contradictory information has to be supplemented or elucidated. Steps of this kind, although essential, are a particular cause of much time being lost.

---

*) Re-named "Industrial and Technological Affairs" since 19 February 1973.

For the group of experts, as also the Commission, can be in a position to issue an assessment of a plan in the sense of Article 37 only inasmuch as they have adequate information at their disposal. This implies - and the wording of the Treaty is explicit on this point - that before any discussion of a project begins all necessary details "as will enable the Commission to determine whether the implementation of such plan is likely to involve radioactive contamination of the water, soil or air space of another Member State" should have been provided in the capacity of "general data".

By any logical reckoning, the period of 6 months which the Treaty allows the Commission for the issue of an opinion can only begin to date from the time when the information supplied to the Commission is considered to be adequate. At its meeting of 20-21 February 1963, the Euratom Commission passed a resolution to this effect.

In order to accelerate the progress of the procedure, it seemed advisable to invite to the meetings of the experts representatives of the competent authorities in the country that had sent notification of the project to be considered, so as to obtain an immediate and adequate answer to any questions that were raised, as well as any other useful explanations. In actual fact, considering the nature of the questions raised it has become customary for the representatives to bring with them engineers associated with the installation.

2. Main points covered in the examination of discharge projects

The summary given in the previous section of the content of the report submitted by the experts to the Commission on a plan for the disposal of radioactive effluents gives some indication, with the main points covered in an examination of this kind, of the various problems involved.

On the one hand, it is obvious that the scope of Article 37 does not include a complete analysis of the safety of a plant. On the other hand, the opinion that is to be issued in application of the Treaty is essentially dependent upon the consequences that may be expected in the event of accidental release. It can therefore be seen that it is, in practice, necessary to make use of the results of the safety studies and analyses that are usually required by the national competent authorities as part of the licensing procedure.

Normal discharges. Normal discharges include not only continuous discharges but also discharges of an episodic nature, sometimes called planned releases *). Observance of the Basic Safety Standards /5/ implies that the possibility of any hazard to the areas surrounding the site as a result of these releases is excluded. Also, it is hardly conceivable that an appreciable amount of activity can be propagated as far as into a neighbouring country (as a result, for instance, of capture by the clouds and subsequent rain-out).

However, there are specific cases in which, under the terms of Article 37 (although for other reasons), "normal" discharges must also be examined. This is so, for example, when liquid effluents are discharged into a river that waters the territory of another Member State. Apart from the problems presented by the exhaustion of the dilution capacity of the river, the problem may arise of an insidious and appreciable increase in its radioactivity (for instance, in the mud that forms the bed of the river or as a result of the use of its water for irrigation purposes); monitoring of the radioactivity of a river in such a case must then be organized under bilateral or multilateral agreement.

---

*) They are also sometimes called "planned exceptional releases" in order to distinguish them from normal (= planned) discharges; releases of this kind, the activity level of which is higher than that of the quasi-continuous releases, are associated with operating conditions and occur particularly in the case of reactors and reprocessing plants.

Under normal operating conditions, gaseous effluent discharges usually need to be considered only in the case of an installation near a frontier, when surveillance of the effects of its releases on the environment could be carried out only in collaboration with the competent authorities in the neighbouring country, or, again, in cases where the respective proximity of several installations means that superposition of the releases must be expected.

The smallest distance from a neighbouring country that has been recorded under the terms of Article 37 is approximately 3 kilometres (the Doel nuclear power station in Belgium and the "SENA" *) nuclear power station in the Ardennes sited near Chooz in France). In the near future, nuclear power stations are to come into service right on the banks of the Rhine, in the immediate vicinity of the Franco-German frontier. In cases such as these, superposition of the effects of discharges into the atmosphere originating from neighbouring sites on either side of the national boundaries has to be taken into consideration.

Unplanned releases. Whereas, in the majority of cases, normal and planned discharges present few problems under the terms of Article 37, unplanned releases are important from this point of view. It is only in the event of uncontrolled, i.e. accidental, releases that a considerable quantity of activity of varying seriousness could be liberated and cause significant contamination at fairly appreciable distances from the site.

---

*) In the case of the "SENA" power station, the governments of Belgium and France have settled the problems of radiological protection under the terms of an agreement /6/.

In the safety reports, a certain number of accidents of this kind are always analysed. Of these, the accident that has the most serious consequences for the environment *) is studied with particular attention by the group of experts referred to in Article 37. The consequences of this accident usually serve as the final criterion on which the opinion required by the Treaty is based. Starting from the hypotheses adopted for this accident, the experts assess the consequences of the release of activity upon the immediate vicinity of the site in question, frequently assessing it on the basis of their own calculations using cautious parameters, and then carry out an extrapolation in order to determine the possible consequences in a neighbouring Member State, particularly in the latter's frontier region.

It is the preparation of this part of the experts' report that demands the particular co-operation of the technical experts in the group, not only in order to assess the stringency of the accident hypotheses, but also in order to judge whether the results of the calculations are reasonable. What is important is not so much to achieve absolutely indisputable calculations and precise numerical results regarding the exposure as to have, for each nuclear installation on the basis of current knowledge of the subject at the time of the

---

*) The following designations are used for this type of accident:

German : "grösster anzunehmender Unfall (G.a.U.)
English : "maximum credible accident" (m.c.a.);
"design basis accident" (d.b.a.);
"reference accident for emergency planning"
French : "accident maximal concevable";
"accident maximal hypothétique"
Italian : "massimo incidente credibile"
Dutch : "ergst denkbaar ongeluk".

assessment, an idea of the upper limits of the health hazard which, throughout the operational lifetime of the plant, will exist for the environment of the site and possibly for the frontier zone of a neighbouring state.

Assessment of the risk of contamination. When it comes to assessing the possibility of a contamination, that is, the risk of contamination of the area surrounding a nuclear site, the dilemma that has to be faced is the same as that encountered in assessing the safety of a nuclear installation: on the one hand, in spite of the hazards inherent in the installation, nuclear engineering has given proof of its safety, while on the other hand, it is still far from being possible to quantify this safety with an adequate degree of accuracy. What we in fact lack in such a case are probability factors, by which the accident consequences that have been evaluated need to be multiplied for it to be possible to draw conclusions regarding the actual risk itself.

In addition, it has to be kept clearly in mind that when it is a matter of deciding upon the site on which a nuclear power station is to be built, the surrounding population in question are hardly likely to be interested in the mathematical probability of their exposure to radioactive effluents; what they want to know is what "could happen to them", that is, these people feel the need to be informed of what the operation of a power station can imply for them on the health level. Thus, in this case too it is to some extent the upper limit of the health hazard involved that the population wish to know. To satisfy this need for information on the part of the public, the only logical approach is to make an evaluation of the doses that they are likely to receive. In the same way, in order to assess a risk of contamination under the terms of Article 37, it is necessary to evaluate the possible exposure of the general public.

Thus these doses, evaluated on the basis of cautious hypotheses, become the main criterion in the judgment that is passed on the project. They are also taken into account in the definition of the safety equipment and measures to be used in case of emergency.

For the evaluation of these doses, the group of experts has at its disposal a certain number of reference values. These values have been up-dated and supplemented to take account of the most recent experience.

A list of the reference values used at present can be found in Appendix VI.

* * *

The study of projects involving the discharge of radioactive effluents from the aspects mentioned above confirms the impression gained from experience acquired elsewhere, emphasizing the low health hazard that nuclear technology now presents for the environment. This experience will be summarized briefly below.

The planned routine discharge levels of the nuclear installations studied are usually so low that the evaluated radiation exposure of the population living in the vicinity of the site resulting from these discharges is far below the dose limits fixed in Articles 9 and 10 of the Basic Safety Standards *).

---

*) The same statement can also be made for discharges that have been effectively carried out.

It may, however, be observed with regard to the supplementary but more general restrictions resulting from the

- Recommendations of the ICRP *) which are aimed at avoiding any exposure that is not strictly necessary and at keeping all doses as low as is readily achievable /7/

and also those imposed by the

- Basic Safety Standards which are based on these recommendations and are themselves (Article 6, § 1) aimed at limiting exposure and the number of persons exposed as far as practicable /8/

that, in the field of discharge control, these principles too have always been observed by the competent authorities and plant operators within the Community. In the case of nuclear power stations, which are the major factor here, it can be specified in particular that the average exposure in the vicinity of the site amounts to only a few percent of the exposure due to the natural radiation background and generally falls within the range of fluctuations in the natural level of radiation. In Appendix VII, comparisons are given for a certain number of nuclear power stations of the discharge limits fixed by the competent authorities and the discharges that are actually carried out. A table is also given indicating the maximum doses, calculated on the basis of the effective discharge levels, that are likely to be received in the immediate vicinity of the site in each case /9/.

This satisfactory situation described above is due to developments in the technical field, viz.:

---

*) ICRP = International Commission on Radiological Protection

- better knowledge at present of the behaviour of the reactor itself during operation and of its auxiliary installations;

- information gained from tests and research programmes on nuclear safety;

- the favourable experience that has been gained of the operation of nuclear power stations; up to the present time no accident has occurred in the six Member States of the Community that has caused any harm to the surrounding areas.

This explains why the assessment of normal discharges and of releases to be expected in the event of technical breakdown can now be made much more precisely than in the early sixties.

Simultaneously the discharge limits imposed by the competent authorities are being fixed with much narrower margins. This tendency should increase in the future, the more so as efforts are made from now on, by reinforcing the legal provisions, to apply the principle aimed at keeping exposures at the lowest possible level more stringently, and consequently, authorization is granted only for nuclear power stations for which the discharge levels of radioactive effluents are reduced to the minimum *) /10/.

For the sake of completeness, it should be noted that, up to the present time, it has not been necessary to apply Article 38 of the Euratom Treaty, which was mentioned above in the introduction.

---

*) "release as low as practicable"

3. Progress achieved

The Commission believes that the procedure laid down under the terms of Article 37, in addition to making it possible to assess the health consequences of the waste discharges of the nuclear installation projects that are submitted to it, also offers the possibility of moving towards achieving agreement on approaches and methods in the field of radiological protection, partly owing to the opinions that are issued but mainly as a result of the exchanges of information and discussions that take place both between the experts, the plant operators and the Commission and between the experts themselves.

For it must be borne in mind that although the Basic Safety Standards have made it possible to bring into accord the legislation of the different Member States in this field, this is not the case as regards nuclear engineering, for which the possibility of a certain degree of standardization on aspects relevant to the protection of the public has only very recently appeared /11/. It must also be remembered that methods of evaluation and assessment criteria for the health consequences of radioactive discharges may develop differently from one member country to another. Thus, the suggestions and recommendations sometimes made in the opinions issued by the Commission are a move towards agreement between ideas on the subject. In addition, the meetings organized within the scope of the application of Article 37, as a result of the exchanges of information that they involve, have already begun to produce a certain unity of approach in the treatment of the problems presented by the evaluation of the radiological consequences of the releases of nuclear installations unter normal operating conditions and in the event of foreseeable accidents. This unity of approach is becoming increasingly apparent in the presentation of new projects that are submitted to the Commission.

The values of the reference levels that have been proposed for the evaluation of discharge projects, some of which have been collected together in Appendix VI, should also contribute towards reaching agreement on the criteria used for evaluating the exposure of the general public, particularly in the event of nuclear accidents.

Alongside its potential for promoting general agreement, Article 37 also constitutes an effective tool for smoothing out some of the difficulties of an administrative and political nature that arise because of the existence of frontiers between Member States. Thus, in suggesting the establishment of contacts between national competent authorities the intention of the Commission is to make these frontiers more permeable to a real exchange of information and hence, in the case of installations sited near frontiers, to promote co-ordination of the safety and emergency measures to be implemented in case of urgency.

Finally, the procedure laid down by Article 37 appears to constitute a practical channel for the general dissemination of new knowledge and trends *) on the subject of radioactive effluent discharges and the evaluation of the radiological consequences of these discharges. The departments of the Commission and the experts who take part in these studies are thus in a position to see how the Basic Safety Standards are applied and to assess the difficulties that are encountered in practice.

---

*) It may be recalled, for instance, that:

- tritium, as a ternary fission product, was not discovered until around 1960 /12/;
- lithium and boron, which are a source of production of tritiated effluents, are being used to an increasing extent as anti-corrosion additives to the cooling water of reactors or for flattening of the neutron flux /13/;
- the concepts of "critical pathway" and "critical group", which are used in the evaluation of radiological effects, were only developed several years ago /14/.

VI. CONCLUSIONS AND FUTURE PROBLEMS

From the experience gained in the course of the studies carried out over the last twelve years in pursuance of Article 37, it can be concluded that:

- up to the present time, discharges of gaseous radioactive effluents have not presented any problems for neighbouring countries;

- discharges of liquid radioactive effluents, even of low concentration, deserve special attention, particularly when it is a matter of discharge into rivers that extend beyond national frontiers, or into the sea; they should therefore always be the subject of agreements on an international level or, as in the case of Article 37, be submitted to a Community authority for its opinion;

- high-level contaminations capable of reaching a neighbouring country are conceivable only in the event of a serious accident occurring in nuclear installations of a specific category, namely:

  . nuclear power stations

  . plants for reprocessing irradiated fuel

  . plutonium processing plants.

This category of installations, to which there should possibly be added some type of site for the storage of high-activity radioactive waste, will need to continue to be the object of the closest attention under the terms of Article 37.

It can already be observed that new projects for installations are providing for much higher capacities than those of

the installations built during recent years. This trend will continue, particularly when breeder reactors will replace those of the present generation.

In addition to the increase in the capacity of the various types of installation, and particularly of nuclear power stations, an increasing tendency to concentrate several units on the same site is already apparent. This is doubtless a preliminary stage in the formation of what are called "nuclear parks" /15/, in which the manufacture of nuclear fuels, the production of energy and the reprocessing of irradiated fuel are to be concentrated together (mainly to reduce costs and the hazards inherent in transportation).

The present procedure, which consists in submitting each stage in the construction separately, seems ill suited to complexes of this kind, particularly in the case of sites near a frontier or on the banks of international rivers.

For projects of this kind, it is not merely desirable but essential for there to be contacts of a technical nature at an early stage between the competent authorities, bridging national frontiers, starting from the preparation of the plans and continuing until completion of the project. To an increasing extent, the construction of power stations is becoming a problem of regional planning to which the public are not indifferent. It is therefore advisable for the public to be kept informed and, if necessary, reassured by demonstrating to them that all measures necessary for their protection have been taken. In this respect note should be taken of the initiative shown by the Belgian government: for major projects such as nuclear power stations, etc., the relevant departments in neighbouring countries are kept regularly informed of the state of the work via a "Contact Committee", from the stage of preparing the plans up to that of operational

start-up, special attention being paid to problems relating to safety and the environment. A procedure of this kind, which has also been adopted in a similar fashion by the government of the Netherlands /16/, is, without any doubt whatsoever, more judicious and more satisfactory for the public than if contacts are established only after the completion of an installation, and then merely with the sole aim of arranging for co-operation in the event of accident.

Within the enlarged Community, the North Sea, which has become a kind of "internal sea", will require increased attention. In addition to the nuclear power stations already built on its shores, there are proposals for building nuclear power stations on artificial or "floating" islands. The choice of such sites, the operational safety of these installations and also the discharge of their radioactive effluents will require co-ordination on the part of the countries bordering the sea. However, since

- the North Sea is also used as "dump" for all kinds of industrial wastes, and
- in addition, the drilling being carried out there threatens to be a considerable source of pollution, it

it would seem that to confine monitoring and control activities to the radiological sector alone is not sufficient to safeguard the ecological status of this sea.

An analogous situation was encountered with the Rhine which has become a drainage channel for all kinds of radioactive and non-radioactive *) waste-products to be discharged finally in

---

*) Strictly speaking, the term "non-radioactive" can not be applied without qualification. It is, for instance, only some ten years since it was realized that the level of radioactivity of the effluents of certain non-nuclear industries, notably plants handling phosphates /17/, could be not inconsiderable, owing to the natural radioactivity of the ores used.

the North Sea. In the case of this river, the international Commission of the Rhine, which represents all countries concerned with the Rhine basin, is endeavouring to compile an overall picture of the tolerable pollution level for this river: radioactive and non-radioacitve pollution as well as the thermal pollution that is foreseeable as a result of the construction of power stations.

The setting up of similar organizations might be contemplated mutatis mutandis to study and control the future use of the North Sea in order to anticipate and limit any additional risks which might be incurred by the adjoining countries when new projects are completed.

It has been emphasized on many occasions at international congresses and in European Parliament debates that compulsory Community consultation, arranged on the basis of Article 37, has achieved satisfactory results where the prevention and control of radioactive contamination risks on an international scale are concerned.

It has also been suggested that the experience acquired in the course of the application of Article 37 could serve as an example for the control of other contamination risks and possibly be integrated into a general policy for the reduction of pollution and health hazards likely to affect the environment.

REFERENCES

/1/ "Recommandation de la Commission concernant l'application de l'article 37 du Traité"
J.O. *) 3e année, N° 81, 1893-1896, 1960

/2/ The Basic Safety Standards for the Protection of the Health of the General Public and Workers against Ionizing Radiations are laid down in the following Directives by the Council of Ministers of the EAEC:

- "Directives fixant les normes de base relatives à la protection sanitaire de la population et des travailleurs contre les dangers résultant des radiations ionisantes."
J.O. 2e année, N° 11, 221-239, 1959

- "Directive portant révision des annexes 1 et 3 des directives fixant les normes de base en matière de protection sanitaire."
J.O. 5e année, N° 57, 1633-1649, 1962

- "Directive du Conseil du 27 octobre 1966, portant modification des directives fixant les normes de base relatives à la protection sanitaire de la population et des travailleurs contre les dangers résultant des radiations ionisantes."
J.O. 9e année, N° 216, 3693-3703, 1966

An English version of the coordinated text of the Basic Safety Standards in accordance with these three Directives has been published by the Commission in December 1968.

---

*) J.O. : Journal Officiel des Communautés Européennes

/3/ "28 FEVRIER 1963 - Arrêté royal portant règlement général de la protection de la population et des travailleurs contre le danger des radiations ionisantes."

Moniteur Belge, 133e année, N° 98, 5206-5266, 1963;
cf. especially Art. 6.5 and 7.4.

/4/ Decreto del Presidente della Repubblica Italiana
13 febbraio 1964, n. 185
"Sicurezza degli impianti e protezione sanitaria dei lavoratori e delle popolazioni contro i pericoli delle radiazioni ionizzanti derivanti dall'impiego pacifico dell'energia nucleare"

Gazzetta Ufficiale n. 95 del 16 aprile 1964, Supplemento ordinario, 1-30, 1964;
cf. especially Art. 42, par. 2.

/5/ Cf. /2/ (Basic Safety Standards), especially Art. 6, 9, 10 and 12 § 5.

/6/ "Convention entre la Belgique et la France sur la protection radiologique concernant les installations de la Centrale nucléaire des Ardennes, et annexes, signée à Paris, le 23 septembre 1966"

Moniteur Belge, 137e année, N° 45, 2276-2280, 1967.

/7/ "Recommendations of the International Commission on Radiological Protection"

ICRP Publication 2, page XXI, § 45
(Pergamon Press Ltd., 1959)

"Recommendations of the International Commission on Radiological Protection (Adopted September 17, 1965)"

ICRP Publication 9, § 52
(Pergamon Press Ltd., 1966)

/8/ Cf. /2/ (Basic Safety Standards), Article 6, § 1.

/9/ Extract from the report "Radioactive Effluents from Nuclear Power Stations in the Community - Discharge Data / Radiological Aspects", November 1972
Commission of the European Communities (Doc. 380/73 e).

/10/ USAEC (10 CFR Part 50)
"Licensing of Production and Utilization Facilities / Light-Water-Cooled Nuclear Power Reactors"
Fed. Reg. Vol. 36, No. 111, 11113-11117, 1971.

/11/ Cf. the programme of standardization drawn up by the "American National Standards Institute" and the "American Nuclear Society":
"ANS sets up Plant Standardization Group"
Nucleonics Week, Vol. 13, No. 29, 1, 1972

"Huge Nuclear Standards-Writing Project Set in Motion"
Nucleonics Week, dito, p. 5

O. KNECHT & R. NEIDER, "Kerntechnische Normung und Genehmigungsverfahren für Kernenergieanlagen in den USA"
Atomwirtschaft, XVII, Nr. 11, 555-557, 1972.

/12/ ALBENESIUS, E.L., "Tritium as a Product of Fission"
Physical Review Letters, 3, 274, 1959

ALBENESIUS, E.L. & ONDREJCIN, R.S., "Nuclear Fission produces Tritium"
Nucleonics, Vol. 18, No. 9, 100, 1960.

/13/ BLOMEKE, J.O. & HARRINGTON, F.E., "Waste Management at Nuclear Power Stations"

Nuclear Safety, Vol. 9, No. 3, 239-248, 1968.

/14/ "Principles of Environmental Monitoring related to the Handling of Radioactive Materials"

ICRP Publication 7
(Pergamon Press Ltd., 1966).

/15/ MUYSKEN, M., "Het nucleaire park-concept"

Atoomenergie en haar toepassingen, 11e jaargang, nr. 4, 103-107, 1969.

WEINBERG, A.M. & HAMMOND, R.Ph., "Global Effects of increased Use of Energy"

Fourth United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, 6-16 Sept. 1971 (A/CONF.49/P/033).

/16/ "Nota inzake het kernenergiebeleid", ingediend door de Nederlandse regering bij de Tweede Kamer der Staten-Generaal

Atoomenergie en haar toepassingen, 14e jaargang, nr. 5, 113-123 and 133, 1972.

/17/ Cf. for instance:

BOUQUIAUX, J. "Redissolution du radium insoluble d'origine résiduaire dans un fleuve"

Tribune du CEBEDEAU n° 291, 1-10, 1967.

APPENDIX I

MEMBERSHIP OF THE GROUP OF EXPERTS

Article 37 of the Euratom Treaty

(31 December 1972)

	Speciality
GERMANY	
- Prof. Dr. Ing. Hermann BORCHERT Leiter des Instituts für Tieflagerung der Gesellschaft für Strahlen- und Umweltforschung mbH 3392 CLAUSTHAL-ZELLERFELD Bornhardtstrasse 22	Geology
- Prof. Dr. Hans Joachim BORN Technische Universität Institut für Radiochemie 8046 GARCHING b/München	Radiochemistry
- Ministerialrat Dr. Wolfgang POHL Bayer. Staatsministerium für Landesentwicklung und Umweltfragen 8000 MÜNCHEN 81 Rosenkavalierplatz 2	Environmental protection
- Dr. Karl ZUEHLKE Gesellschaft für Kernforschung mbH 7500 KARLSRUHE Postfach 947	Nuclear engineering
BELGIUM	
- M. H. DOPCHIE Directeur Association Vinçotte 1640 RHODE-SAINT-GENESE	Nuclear engineering
- Prof. Dr. S. HALTER Secrétaire Général Ministère de la Santé Publique et de la Famille Cité Administrative 20, rue Montagne-de-l'Oratoire 1000 BRUSSELS	Public health
- Dr. A. LAFONTAINE Directeur de l'Institut d'Hygiène et d'Epidémiologie 14, rue Juliette Wytsman 1050 BRUSSELS	Public health

FRANCE

- M. J. JACQUET — Hydrology, Meteorology
  Chef de la Division "Echanges atmosphériques"
  Service Générateurs de Chaleur Thermiques et Nucléaires
  Electricité de France
  6, Quai Watier
  Boîte postale no. 24
  78400 CHATOU

- Dr. H. JAMMET — Health protection
  Chef du Département de la Protection Sanitaire
  Centre d'Etudes Nucléaires
  Boîte postale no. 6
  92260 FONTENAY-AUX-ROSES

- M. G. LACOURLY — Ecology
  Chef de la Section Protection de l'Environnement
  Département de la Protection Sanitaire
  Centre d'Etudes Nucléaires
  Boîte postale no. 6
  92260 FONTENAY-AUX-ROSES

- M. G. LAMBERT — Measurement techniques
  Service d'Electronique Physique C.E.A.
  Centre d'Etudes Nucléaires de Saclay
  91190 GIF-SUR-YVETTE

ITALY

- Dott. Pietro CAGNETTI — Meteorology
  Capo Gruppo di Meteorologia Applicata
  Laboratorio per lo Studio della Radioattività Ambientale
  Centro Studi Nucleari della Casaccia del C.N.E.N.
  S.P. Anguilarese
  Casella Postale N. 2400
  00100 ROME

- Dott. Osvaldo ILARI — Health protection
  Capo del Servizio Impianti Nucleari
  Divisione Protezione Sanitaria e Controlli
  C.N.E.N.
  Viale Regina Margherita, 125
  Casella Postale N. 2358
  00198 ROME

- Dott. Carlo POLVANI — Health protection
  Direttore della Divisione di Protezione Sanitaria e Controlli
  C.N.E.N.
  Viale Regina Margherita, 125
  00198 ROME

- Ing. Arnaldo TURRICCHIA — Nuclear engineering
  E.N.E.L.
  Direzione delle Costruzioni Termiche e Nucleari
  Via G.B. Martini, 3
  Casella Postale 386
  00100 ROME

LUXEMBOURG

- Dr. Paul KAYSER — Public health
  Direction de la Santé Publique
  37, rue Glesener
  LUXEMBOURG

- M. Henri WAGENER — Nuclear engineering
  Chef du Département Nucléaire
  de la Société ARBED S.A.
  Arbed-Recherches
  Rue de Luxembourg
  ESCH-SUR-ALZETTE

NETHERLANDS

- Dr. H. HUIZENGA — Public health
  Adviseur van de Gezondheidsraad
  Ministerie van Volksgezondheid en Milieuhygiëne
  Dr. Kuyperstraat 8
  THE HAGUE

- Prof. Dr. P. KORRINGA — Marine ecology
  Directeur van het Rijksinstituut voor Visserijonderzoek
  Haringkade 1
  Postbus 68
  IJMUIDEN

- Ir. C.J. VAN DAATSELAAR — Nuclear engineering
  Adviseur bij het Directoraat-Generaal van de Arbeid
  Ministerie van Sociale Zaken
  THE HAGUE

APPENDIX II

EUROPEAN ATOMIC
ENERGY COMMUNITY

Brussels, 12 January 1962
32/62 (ATO 4)

Council

N O T E

Re : Application of Article 37 of the Euratom Treaty

Article 37 is worded as follows:

"Each Member State shall submit to the Commission such general data concerning any plan for the disposal of any kind of radioactive waste as will enable the Commission to determine whether the implementation of such plans is likely to involve radioactive contamination of the water, soil or airspace of another Member State.

The Commission, after consulting the group of experts referred to in Article 31, shall give its opinion thereon within a period of six months."

At the request of the Committee on Atomic Affairs, the Secretariat has formulated some considerations regarding the application of this article.

1) It will be noted that this article imposes no obligations on companies themselves. It is only Member States that are required to provide the Commission with information. Consequently, it is the Member States alone that are held responsible for the accuracy, validity and completeness of this information for the purposes of the formulation of the Commission's opinion. The Commission has addressed a recommendation to Member States in this connection (Official Journal, 21 December 1960).

Every Member State must take all necessary steps to ensure, by internal arrangements (legislative if needed), that it has the necessary means of fulfilling this obligation. It must therefore, where applicable, require private companies to provide it with information and, possibly, monitoring data.

2) Article 37 does not require Member States to send to the Commission complete details of projects involving the discharge of radioactive effluents, but only general data on these projects insofar as is necessary to enable the Commission to determine whether the implementation of these projects is likely to cause radioactive contamination of the water, soil or airspace of another Member State.

Consequently, the Commission should be notified of any modification made subsequently to a project that has already been submitted to it, if the modification is relevant to these general data. On the other hand, a Member State can not be accused of failing to satisfy the requirements of Article 37 in any way for not notifying the Commission of modifications of details that do not come under the definition of this article.

3) In Member States the implementation of a project involving the discharge of radioactive effluents is usually subject to governmental authorization. It is precisely for the guidance of the national authority that possesses these powers of authorization that Article 37 makes provision for an opinion on the part of the Commission, issued after consultation of the group of experts referred to in Article 31. (This group is composed of individuals designated by the Scientific and Technical Committee from among the scientific experts of Member States, and particularly from among experts in the field of public health.)

It may be asked whether the national authority that possesses powers of authorization should

- examine projects before submitting them to the Commission, in fact, decide upon its own attitude in the matter before the Commission is requested to issue its opinion,

or, on the contrary,

- wait for the opinion of the Commission before granting its own authorization, in fact, before examining a project at all.

Article 37 does not require Member States to suspend all authorization before the opinion of the Commission is issued. However, to authorize a project without having first taken into consideration the opinion of the Commission would in practice mean robbing Article 37 of all significance. It therefore seems certain that no authorization should be granted until the Commission has first had time to issue its opinion.

In any case, there is nothing to prevent the national authority, upon receipt of an application for authorization, from carrying out a preliminary examination of the project before submitting it to the Commission. A preliminary examination of this kind could even be necessary in order to check the accuracy and validity of the data provided.

The question could then arise of exactly how far an examination of this kind could be taken before submitting the project to the Commission. In this connection, it does not seem permissible for the national authority to go so far as to formulate its official attitude to the project as a whole. For the adoption of an official attitude in this way would be taking place in the absence of an opinion from the Commission, which is explicitly intended for the guidance of the national authority in making its assessment.

It will, however, be noted that the opinion on the part of the Commission that is provided for in Article 37 relates only to one aspect of the project, namely, the risk that it may involve of causing contamination in other Member States. Thus, before granting its authorization the national authority should also examine all those other aspects of the project that are not taken into consideration in the Commission's opinion. Consequently, the question may arise of whether the national authority should examine the other aspects of the project before, at the same time as, or after it is submitted to the Commission.

It will be noted in this connection that preliminary examination of these other aspects would have the fortunate effect of avoiding unnecessary examination on the part of the Commission of projects that could not in any case be implemented because of factors outside the scope of its opinion. On the other hand, any delay in submitting the project to the Commission caused by a preliminary examination of this kind would prolong the total period of authorization. Finally, the significance of the Commission's opinion will depend in particular upon the site on which the project is to be built (near to frontiers or international rivers, for instance).

It seems, therefore, that the question raised here is a matter of expediency rather than law. It could be settled individually case by case. It could also be subjected to general criteria agreed upon between Member States.

APPENDIX III

PLANS FOR THE DISPOSAL OF RADIOACTIVE WASTE NOTIFIED TO THE COMMISSION UNDER THE TERMS OF ARTICLE 37 OF THE EURATOM TREATY

(as at 31 December 1972)

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
BELGIUM		
- BR2 reactor (Mol)	50 MW_{th}	27/07/61
- BR3 nuclear power station (Mol)	10.5 MW_e nett	20/12/61
- Plant for processing radio-active wastes from CEN (Mol), operated by the Société Belchim	-	09/05/62
- Plutonium laboratories for the "Belgonucléaire-CEN (Mol)" research programme	-	09/05/62
- EUROCHEMIC installations (Mol):	-	18/09/64
. Research laboratory	-	"
. Building for the delivery and storage of U-235 enriched fuel elements ($\leq$1.6 %)	-	"
. Pipelines for carrying liquid effluents to the CEN reprocessing plants	-	"
- BR3/VULCAIN nuclear power station	10.5 MW_e nett	09/03/65
- Sewer for the discharge of spent industrial liquid wastes into the Scheldt	-	15/07/65
- Building for the delivery and storage of U-235 enriched fuel elements (> 1.6 %)	-	23/07/65

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
- EUROCHEMIC installations (Mol):	-	30/09/66
. Building for reprocessing fuels		"
. Analysis laboratory	-	"
. Buildings for storage of reprocessed products	-	"
. Processing plant for liquid effluents	-	"
. Building for the storage of high-activity liquid waste	-	"
. Building for the storage of medium-activity liquid waste	-	"
. Building for the storage of solid active waste	-	"
. Ventilation plant and stack	-	"
- Plutonium laboratories for the Belgonucléaire-CEN (Mol) research programme New laboratories	-	18/07/69
- Belgonucléaire "Atelier Plutonium" plant at Dessel for the manufacture of plutonium fuel elements	-	04/06/70
- Central Bureau for Nuclear Measurements (CBNM) at Geel	-	22/12/70
- Doel nuclear power station	2 x 392.5 MW_e nett	April 1973

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
FEDERAL REPUBLIC OF GERMANY		
- FR2 reactor (Karlsruhe)	12 MW_{th}	17/03/61
- BER research reactor (Berlin)	50 kW_{th}	17/03/61
- FRM research reactor (Munich)	1 MW_{th}	17/03/61
- ARGONAUT research reactor (Munich)	1 kW_{th}	17/03/61
- PR 10 reactor (Grosswelzheim)	100 W_{th}	17/03/61
- Nuclear Physics Institute, Goethe-Universität (Frankfurt/M.)	50 kW_{th}	20/07/62
- Installations for the Nuklear-Chemie und -Metallurgie (NUKEM) company	-	20/07/62
- Kahl/Main experimental nuclear power station	15 MW_e nett	12/10/62
- FRJ-1-MERLIN reactor for the Jülich Nuclear Research Centre	5 MW_{th}	11/07/63
- Jülich Nuclear Research Centre:	-	25/02/65
. FRJ-2-DIDO reactor	10 MW_{th}	"
. Processing plant for liquid and solid radioactive effluents	-	"
- AVR experimental nuclear power station (Jülich)	13.6 MW_e nett	18/05/66
- Karlsruhe Nuclear Research Centre:	-	28/06/67
. FR2 reactor (modified)	44 MW_{th}	"
. MZFR reactor	60 MW_e nett	"

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
. SNEAK reactor	-	28/06/67
. STARK reactor	10 W_{th}	"
. Hot cells	-	"
. Hot Chemistry Institute	-	"
. Prototype laboratory	-	"
. Alpha-Chemie und -Metallurgie (ALKEM)	-	"
. European Institute for Transuranium Elements	-	"
. Central decontamination building	-	"
. Solid wastes depot	-	"
- Gundremmingen nuclear power station (KRB)	237 MW_e nett	11/04/67
- Lingen nuclear power station (KWL)	240 MW_e nett	24/09/68
- Obrigheim nuclear power station (KWO)	282.7 MW_e nett	10/03/69
- Jülich Nuclear Research Centre:	-	22/04/69
. Hot-cell laboratory	-	"
. Nuclear fuel analysis laboratory (BZ III)	-	"
- KNK reactor, Karlsruhe Nuclear Centre	19.1 MW_e nett	22/04/69
- Decontamination building for the Karlsruhe Nuclear Research Centre (to replace central decontamination building: opinion dated 28/09/67)	-	22/04/69
- AVR experimental nuclear power station (Jülich): modifications	13.6 MW_e nett	10/12/69
- "OTTO HAHN" experimental nuclear vessel	38 MW_{th} (11,000 SHP)	21/01/70

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
- Karlsruhe reprocessing plant (WAK)	-	01/07/71
- Grosswelzheim superheated-steam (HDR) reactor	25 MW_e gross	14/12/71
- Würgassen nuclear power station (KKW)	640 MW_e nett	17/04/72
- FERAB and bituminization plants for the Karlsruhe Nuclear Research Centre	-	24/04/72
- Stade nuclear power station (KKS)	630 MW_e nett	30/10/72
- Niederaichbach nuclear power station (KKN)	100.4 MW_e nett	May 1973
FRANCE		
- Submersion of radioactive wastes in the Mediterranean	-	26/07/60
- Chinon nuclear power station 1st stage - EDF 1	68 MW_e nett	30/04/64
- Chinon nuclear power station:	-	13/07/65
. 2nd stage - EDF 2	210 MW_e nett	"
. Irradiated materials plant (AMI)	-	"
- SENA nuclear power station in the Ardennes (Chooz)	266 MW_e nett	12/12/67
- Chinon nuclear power station 3rd stage - EDF 3	480 MW_e nett	"
- St. Laurent-des-Eaux power station, 1st stage - SL 1	487 MW_e nett	20/09/71
- Monts d'Arrée power station EL 4 stage	70 MW_e nett	09/12/71

	Power level specified at the time of issue of the Commission's opinion	Date of issue of the Commission's opinion
- St. Laurent-des-Eaux power station, 2nd stage - SL 2	516 MW_e nett	19/09/72
- Bugey nuclear power station 1st stage	526 MW_e nett	19/09/72
ITALY		
- Garigliano nuclear power station (SENN)	150 MW_e nett	15/10/64
- Latina nuclear power station (SIMEA)	200 MW_e nett	25/06/65
- Enrico Fermi nuclear power station at Trino Vercellese	257 MW_e nett	16/08/66
- CNEN-EUREX reprocessing plant for irradiated fuels at Saluggia	-	10/06/69
- Installations for the Ispra Joint Research Centre (JRC)	-	19/09/72
- Plant for the manufacture of fuel elements for nuclear power stations at Bosco Marengo	-	April 1973
NETHERLANDS		
- Discharge into the sea of liquid wastes from the RCN at Petten	-	20/07/62
- Submersion of solid radio-active waste in the Atlantic	-	18/11/66
- Dodewaard nuclear power station (GKN)	51.5 MW_e nett	15/01/69

PROCEDURE FOLLOWED FOR THE ISSUE OF AN OPINION BY THE COMMISSION

(Article 37 of the Euratom Treaty)

	Time scale in months *)
NOTIFICATION OF "GENERAL DATA" TO THE COMMISSION BY THE MEMBER STATE	0
SECRETARIAT - Translation/reproduction of documents - Forwarding of documents to the experts - Preparation of experts' meeting - Verification that general data are complete - Collection of missing information - Establishment of contact with the competent departments of the Commission - Preparation of a study - Examination of experts' comments	1 2
GROUPE OF EXPERTS - Meeting to examine the general data received - Compilation of report to the Commission	3 4
COMMISSION - Compilation of a draft opinion - Approval of the draft opinion by the Commission	5
ISSUE OF THE COMMISSION'S OPINION BY THE GENERAL SECRETARIAT TO THE MEMBER STATES CONCERNED	6

*) This time scale is given indicatively to illustrate the progress of the procedure. Since the experts are convened on average only about three times a year and it is therefore necessary to examine various different projects at the same time, there are sometimes differences in the timing; but the period of six months allowed by the Treaty is imperative.

APPENDIX V

"GENERAL DATA"

WITHIN THE MEANING OF ARTICLE 37 OF THE EURATOM TREATY

(20 March 1973) *)

1. The site and its surroundings

1.1. Geographical and topographical features of the area with

- map showing the location of the site;
- distance of the site from frontiers of adjacent Member States.

1.2. Main geological, morphological and seismological features

1.3. Hydrology

- features of nearby watercourse (average yearly waterflow, average low waterflow over 30 days and maximum flow stating frequency and period of occurrence);
- maritime features of coastal sites (tides, marine currents);
- dangers of flooding and protection of the site;
- ground-water level and direction of flow.

1.4. Meteorology and climatology

- frequency distribution of wind directions and speeds;
- frequency distribution of precipitation intensity and duration;
- frequency distribution of the different categories of atmospheric dispersion conditions (e.g., Pasquill stability categories) in each wind sector; frequency distribution of duration of temperature inversions.

---

*) Revised version of the list of general data; such a list was first published as appendix to the Recommendation concerning the application of Article 37 of the Treaty, adopted by the Euratom-Commission on 16 November 1960 (cf. Official Journal of the European Communities, Nr. 81, 1893-1896, 1960).

1.5. Data on natural resources of the region

- pedological and ecological features of the region;
- water utilization in the region (for drinking, irrigation, etc.);
- main food supplies (crops, stock breeding, fishing, hunting);
- foodstuffs distribution system and particularly the export of agricultural products, fish or game from the regions concerned to other Community countries.

1.6. Industrial or other activities on the site or its surroundings which might affect the safety of the plant.

1.7. Population characteristics

- distribution and constitution of the population in any area of other Member States which could be affected by the release of radioactive effluents from the planned installation;
- main features of living conditions and eating habits of the population groups in these areas.

2. Description of the plant

2.1. Main features of the plant

For nuclear power plants, research or test reactors:

- main features of the reactor, the reactor building, auxiliary installations and safety provisions.

For reprocessing plants, laboratories and similar installations:

- brief description of processes and techniques used;
- amounts of radioactive and fissile materials treated;
- brief description of work areas and stores for radioactive material;
- methods of protection against fire, explosion and criticality.

2.2. Ventilation systems

- brief description indicating their function in normal operating conditions and in case of an accident; air flows, relative pressures in the buildings and heights of release;
- data on filters, their efficiency, methods and frequency of testing (laboratory and in-situ tests);

2.3. Containments

- brief description giving function, design pressure, leakage rates (design values and test results if already available), means of blocking off penetrations, closing times, methods and frequency of testing containments for leaktightness.

2.4. Time scale

- test period and probable date of regular operation of the plant;
- present stage of licensing procedure.

3. Release of gaseous (gases and aerosols) radioactive effluents

3.1. Sources of gaseous radioactive effluents in normal operating conditions; nature, composition and physico-chemical forms of radionuclides which are significant from the health viewpoint.

3.2. Treatment of these effluents, methods and routes of disposal.

3.3. Evaluation of the maximum annual activity to be released under normal operating conditions, with indication of the radionuclides concerned and assumptions made.

3.4. Meteorological model and parameters used in calculating atmospheric dispersion of the effluents; dilution factors for each distance considered, averaged for the various release periods under consideration.

3.5. Maximum activity release authorized by the licensing authorities.

3.6. On the basis of the maximum authorized activity release, evaluation for the most exposed area surrounding the installation and for affected areas in other Member States, indicating assumptions made and calculating methods used:

- in case of continuous release, average annual concentrations of activity in the atmosphere near ground-level; in case of intermittent release and planned special release, time-integrated concentrations in the atmosphere near ground-level;
- ground contamination under the same circumstances;
- annual doses received by critical groups of the population through inhalation, immersion and ingestion.

3.7. Coordinated waste disposal plan in cases where there are plants in the vicinity which also emit radioactive effluents into the atmosphere.

3.8. Monitoring of gaseous activity before release; main features of detectors; alarm levels; measures and means of intervention (manual and automatic) when setpoints are exceeded.

4. Release of liquid radioactive effluents

4.1. Sources of liquid radioactive waste in normal operating conditions; nature, composition and physicochemical forms of radionuclides which are significant from the health viewpoint.

4.2. Treatment of this waste; temporary on-site storage facilities; disposal methods and routes.

4.3. Maximum activity release authorized by the licensing authorities.

4.4. On the basis of this maximum authorized activity release, evaluation of the annual doses which would be received by critical groups of the population near the plant and on the territories of other Member States affected, indicating assumptions made and calculating methods used.

4.5. Coordinated waste disposal plan where there are other plants also discharging radioactive waste into the same body of water.

4.6. Monitoring of liquid radioactivity before discharge; main features of detectors; alarm levels; measures and means of intervention (manual and automatic) when these setpoints are exceeded.

5. Disposal of solid radioactive waste

5.1. Nature of solid radioactive waste and estimated annual production.

5.2. On-site processing and packaging.

5.3. Provisional storage; radiological risks to the environment and precautions taken.

5.4. Final disposal.

6. Unplanned releases of radioactive effluents

6.1. Review of possible accidents which could result in unplanned releases of radioactive substances.

6.2. Types of reference accidents taken into consideration by the national authorities for evaluating possible health effects on the population in case of an accident in the plant.

6.3. Evaluation of the radiological consequences of reference accidents:

A. Entailing releases into the atmosphere

- assumptions made;
- disposal routes; change of release with time;
- nature, amounts and physicochemical forms of radionuclides released which are significant from the health viewpoint;

- meteorological model and parameters used in calculating atmospheric dispersion of the effluents; dilution factors for each distance considered, averaged for the various release periods under consideration;

- maximum time-integrated concentration of radioactivity in the atmosphere near ground level and maximum ground deposition (in dry and wet weather) in the vicinity of the plant and at the most exposed area in the other Member States affected;

- doses by immersion, inhalation and ingestion received by the critical groups of the population near the plant and on the territory of the other Member States affected.

B. Entailing releases into water

- assumptions made;

- disposal routes; change of release with time;

- nature, amounts and physicochemical forms of radionuclides released which are significant from the health viewpoint;

- hydrological and ecological dispersion of the various radionuclides released;

- doses which would be received by critical groups of the population near the plant and on the territories of other Member States affected by the contaminated body of water.

6.4. Emergency planning in case of an accident and, where applicable, agreements with other Member States.

7. Environmental radioactivity monitoring

7.1. Environmental monitoring programme and organization.

7.2. Apparatus for monitoring environmental radioactivity in normal and abnormal circumstances.

APPENDIX VI

ARTICLE 37

OF THE EURATOM TREATY

REFERENCE LEVELS

USED IN THE EXAMINATION OF RADIOACTIVE WASTE DISPOSAL PLANS

28 January 1972

INTRODUCTORY NOTE

This working document contains the principal reference levels (dose limits, reference doses, derived values), for a number of radionuclides (I-131, rare fission gases, Pu-231, Pu-240, Pu-241, Pu-242). These levels are used by the Secretariat in evaluating plans for the disposal of radioactive waste submitted by Member States under article 37.

These levels of reference were calculated for the most exposed population group which, in the case of iodine-131 and the plutonium isotopes is made up of young children (calculations made for a child of 6 months) and, in the case of the noble gases, of man in general, as the dose absorbed is the same for everyone.

In compiling this document we have based ourselves as far as possible on the latest literature which seemed most reliable. These values, however, may well change again in the years to come, and the Secretariat therefore proposes to keep this list up to date.

It is also intended to extend this work to cover other radionuclides and parameters frequently encountered in the study of radioactive waste disposal.

I O D I N E - 131

			Reference
REFERENCE LEVELS FOR A YOUNG CHILD			
A. Routine releases			
- Dose limit	1.5 to the thyroid	rems/y.	/1/
Corresponding concentrations :			
1. in inhaled air :	$5 \cdot 10^{-11}$	Ci/m^3	/2/
2. in milk :	400	pCi/l	/3/
- corresponding concentration on pasture :	$2 \cdot 10^{-3}$	$\mu Ci/m^2$	/4/
- corresponding concentration in air :	$3 \cdot 10^{-13}$	Ci/m^3	/5/
B. Accidental releases			
- Reference dose	25 to the thyroid	rems	/3/
To this dose corresponds :			
1. a cloud dosage of :			
- I-131 only :	0.031	$Ci \cdot s/m^3$	/3/
- I-131 with its other isotopes and Te-132 (steady state in a reactor) :	0.015	$Ci \cdot s/m^3$	/3/
- I-131 with its other isotopes, in case of a criticality accident :	0.0031	$Ci \cdot s/m^3$	/3/

			Reference
2. a peak concentration in milk of :	0.25	µCi/l	/3/
- corresponding contamination of pasture :	1.5	$\mu Ci/m^2$	/3/
- corresponding cloud dosage :	$1.5 \cdot 10^{-4}$	$Ci \cdot s/m^3$	/6/

RADIOACTIVE NOBLE GASES

REFERENCE LEVELS FOR CHILDREN AND ADULTS

		Reference
A. Routine releases		
- Dose limit	0.5 rems/y. to the whole body (submersion)	/1/
- Corresponding concentration in air :	0.1 • MPC (workers 168 hrs/wk)	/1/
B. Accidental releases		
- Reference dose :	15 rems to the whole body (submersion)	/11/
- Corresponding cloud dosage :		
Kr-85m	100 Ci•s/m^3	/7/
Kr-85	280 "	/7/
Kr-87	19 "	/7/
Xe-131m	380 "	/7/
Xe-133	280 "	/7/
Xe-135	100 "	/7/

PLUTONIUM

REFERENCE LEVELS FOR YOUNG CHILDREN

				Reference
1. SOLUBLE PLUTONIUM				
A. Routine releases				
- Maximum dose		3 to bone	rems/y.	/1/
- Corresponding concentration in inhaled air :				
	Pu-239	$2 \cdot 10^{-14}$	Ci/m^3	/9/
	Pu-240	$2 \cdot 10^{-14}$	"	/9/
	Pu-241	$1 \cdot 10^{-12}$	"	/9/
	Pu-242	$2 \cdot 10^{-14}$	"	/9/
B. Accidental releases				
- Reference dose		1.5 to bone	rems/y.	/11/
- Corresponding cloud dosage :				
	Pu-239	$1 \cdot 10^{-5}$	$Ci \cdot s/m^3$	/10/
	Pu-240	$1 \cdot 10^{-5}$	"	/10/
	Pu-241	$2 \cdot 10^{-4}$	"	/10/
	Pu-242	$1.1 \cdot 10^{-5}$	"	/10/
2. INSOLUBLE PLUTONIUM				
A. Routine releases				
- Dose limit		1.5 to the lungs	rems/y.	/1/
- Corresponding concentration in inhaled air :				
	Pu-239	$4 \cdot 10^{-13}$	Ci/m^3	/10/
	Pu-240	$4 \cdot 10^{-13}$	"	/10/
	Pu-241	$4 \cdot 10^{-10}$	"	/10/
	Pu-242	$4 \cdot 10^{-13}$	"	/10/

Reference

B. Accidental releases

- Reference dose	15 rems to the lungs		/11/
- Corresponding cloud dosage :			
Pu-239	$6.6 \cdot 10^{-5}$	$Ci \cdot s/m^3$	/10/
Pu-240	$6.6 \cdot 10^{-5}$	"	/10/
Pu-241	$6.6 \cdot 10^{-2}$	"	/10/
Pu-242	$7.2 \cdot 10^{-5}$	"	/10/

REFERENCES

/1/ Euratom
Basic Safety Standards for Protection against ionizing-radiation, 1966

/2/ According to ICRP, publication 2, 1959,
the MPC (workers 168 hrs/wk.) of iodine-131 in inhaled air is $3 \cdot 10^{-9}$ Ci/m^3 for an annual permissible dose of 30 rems.

Hence, the MPC for individuals of the population (1.5 rems/y.) will be : $1.5 \cdot 10^{-10}$ Ci/m^3.

For a child of 6 months, this value must be multiplied by $\frac{m_e}{m_a} \cdot \frac{A_a}{A_e} = 0.295$ where

$m_e = 1.8$ g /3/ (weight of child's thyroid)
$m_a = 20$ g (ICRP publ.2) (weight of the thyroid of the standard man)
$A_e = 70$ cm^3/s /3/ (breathing rate of a child)
$A_a = 230$ cm^3/s /3/ (breathing rate of the adult)

Hence, the MPC for children will be :

$$1.5 \cdot 10^{-10} \cdot 0.295 = 4.43 \cdot 10^{-11} \simeq 5 \cdot 10^{-11} \text{ Ci/m}^3$$

/3/ F. MORLEY and P.M. BRYANT,
"Basic and derived radiological Protection Standards for the Evaluation of environmental Contamination"
I.A.E.A.-SM-117/27, Vienna 1969

/4/ The following data /3/ were used in calculating the relationship between iodine-131 contamination A (μCi/m^2) on pasture and contamination C (μCi/l) in milk :

- area grazed daily by a cow : 160 m^2/day
- fraction of deposited activity retained on the edible portion of the herbage : 0.25
- fraction of daily ingested iodine by the cow transferred to milk : 0.0055 $\frac{\mu\text{Ci/l}}{\mu\text{Ci/day}}$

Between A and C the following relationship exists :

$$A \cdot 160 \cdot 0.25 \cdot 0.0055 = C$$

When C = $4 \cdot 10^{-4}$ μCi/l one finds :

$$A = 1.82 \cdot 10^{-3} \mu\text{Ci/m}^2 \simeq 2 \cdot 10^{-3} \mu\text{Ci/m}^2$$

/5/ An annual mean concentration of iodine-131 χ (Ci/m^3) in air at ground level results in a soil contamination of :

$$A = \int_0^\infty \chi \cdot 10^6 \cdot e^{-\lambda t} \cdot v_g \cdot dt$$

when v_g : deposition velocity (m/s)

λ : effective decay constant of iodine-131 in herbage (s^{-1}) = $\frac{0.693}{T}$

T : effective half-life of iodine-131 on the herbage (days)

hence

$$A = \frac{10^6 \cdot \chi \cdot v_g}{\lambda} \quad \text{and} \quad \chi = \frac{10^{-6} \lambda \cdot A}{v_g}$$

When : $A = 1.82 \cdot 10^{-3}$ /uCi/m^2 /4/

$v_g = 10^{-2}$ m/s

T : 5 d /3/

we find : $\chi = 2.9 \cdot 10^{-13}$ Ci/m^3 $\simeq 3 \cdot 10^{-13}$ Ci/m^3.

/6/ A cloud dosage χ (Ci·s/m^3) in air at ground level results in a soil contamination A (/uCi/m^2) :

$$A = 10^6 \cdot \chi \cdot v_g$$

When A = 1.5 /uCi/m^2 and $v_g = 10^{-2}$ m/s :

$$\chi = 1.5 \cdot 10^{-4} \text{ Ci/m}^3$$

/7/ The MPC of Kr-85m (10^{-6} Ci/m^3) /1/ corresponds to a whole body dose of 5 rems/y. or $1.58 \cdot 10^{-7}$ rems/s.

Hence 10^{-6} Ci·s/m^3 corresponds to $1.58 \cdot 10^{-7}$ rems

and $\frac{10^{-6} \cdot 15}{1.58 \cdot 10^{-7}} = 0.95 \cdot 10^2$ Ci· s/m^3 to 15 rems

or 100 Ci·s/m^3 $\simeq$ 15 rems.

/8/ (In this version Ref. /8/ has not been taken up)

/9/ Belgonucléaire BN 6912-03

"Projet de construction d'un établissement pour la fabrication d'éléments combustibles au plutonium à Dessel"

(Construction project of an establishment for the manufacture of plutonium fuel elements at Dessel)

General data required by article 37 of the Euratom Treaty ; December 1969

/10/ F. Breuer, C. Brofferio, A. Nardi

"Considerazioni sui parametri da utilizzare nel calcolo dei 'Livelli di Riferimento derivati' per emergenze nucleari"

(Considerations on the parameters to be used in calculating the 'Derived Levels of Reference' for nuclear emergencies)

XVth National Congress of the Italian Health Physics and Radiation Protection Association, Cagliari 1969

/11/ X. de Maere

"Evaluation de 'Niveaux-Guides' applicables à des rejets de routine, concertés ou accidentels, dans l'atmosphère"

(Evaluation of 'Guide Levels' applicable to the routine, deliberate or accidental release of waste into the atmosphere)

CEN. Working document, March 1967.

APPENDIX VII-a

ANNUAL GASEOUS RADIOACTIVE WASTE DISCHARGES (NOBLE GASES) AS A PERCENTAGE OF DISCHARGE LIMITS /9/

Country	Facility	Discharge limits [Ci/year]	Discharge as a % of limits 1969	1970	1971
GERMANY					
	KRB	1.9×10^6	0.6	0.4	0.3
	KWL	3.1×10^6	6.5	4.3	
	KWO	8×10^4	7.0	9.6	1.8
	VAK	8.8×10^4	2.0	3.8	2.8
FRANCE					
	CHINON	4×10^5 (a)	3.1	2	1.1
	St-LAURENT-DES-EAUX	4×10^5 (a)	0.5	0.08	0.9
	SENA	2.5×10^6 (a)	0	0	0.2
	EL 4	4×10^5 (a)	0.01	0.02	13.5
ITALY					
	LATINA	5×10^5 (b)	0.3	0.5	0.5
	GARIGLIANO	3×10^6 (b)	4.7	9.2	21.3
	TRINO VERC.	5×10^4	0	0.04	1.2
NETHERLANDS	DODEWAARD	3×10^5		1	1

(a) At this discharge rate, assuming an atmospheric dilution factor of 1.5×10^{-5} sec/m^3 and a 20% probability of the wind being in one direction, the maximum concentration in the air at ground level is equal to the MPCP in air.

(b) The actual discharge limits for the Latina and Garigliano stations are based on the MPCP in air at ground level. These limits are being at present replaced by discharge formulae based on analyses of the critical groups of the population and on actual waste discharge needs of the power stations.

ANNUAL DISCHARGES OF RADIOACTIVE AEROSOLS AND IODINE-131 AS A PERCENTAGE OF DISCHARGE LIMITS /9/

Country	Facility	Discharge limits /Ci/year/		Activity discharged as a percentage of discharge limits					
				1969		1970		1971	
		aerosols	iodine-131	aerosols	iodine-131	aerosols	iodine-131	aerosols	iodine-131
GERMANY	KRB	2 850	22	2.7×10^{-4}	1.6	2.6×10^{-3}	0.9	1.8×10^{-3}	1.5
	KWL	15 800	16	$1,6\times10^{-3}$		4.3×10^{-3}	1.6		
	KWO		15 (a)		0.42		0.32		
	VAK	88	0.61	0.1	1.1	0.15	110	0.08	0.48
FRANCE	CHINON	1×10^{3}(b)		$<10^{-3}$		$<10^{-3}$		1.8×10^{-3}	
	St-LAURENT-DES-EAUX	1×10^{3}(b)		<0.1		$<10^{-3}$		4.7×10^{-3}	
	SENA	1×10^{3}(b)		0		0		0	
	EL 4	1×10^{3}(b)		$<2\times10^{-4}$				7.3×10^{-3}	
ITALY	LATINA	5×10^{2}(c)	3×10^{3}(c)	0	0	0	0	0	0
	GARIGLIANO	3×10^{3}(c)	1×10^{4}(c)	2.2×10^{-3}	0	2.2×10^{-3}	6×10^{-4}	2.2×10^{-3}	1.3×10^{-3}
	TRINO VERCELL.	0.2 (d)	5×10^{-2}(d)	0	0	<0.06	1.2	0.07	2
NETHERLANDS	DODEWAARD								

(a) Limit calculated from the hourly limit of 1.7×10^{-3} Ci/h. However, during the grazing period the limit is reduced to 1.4×10^{-5} Ci/h.

(b) At this rate, assuming an atmospheric dilution factor of 1.5×10^{-5} sec/m^3 and a 20% probability that the wind is in one direction, the concentration at ground level is equal to the MPCP in air (10^{-9} Ci/m^3).

(c) For Latina and Garigliano the actual limits correspond to the MPCP in air at ground level. These limits are being at present replaced by discharge formulae based on analyses of the critical groups of the population and on actual waste discharge needs of the power stations.

(d) In 1969 the limits were still 15 Ci/year of aerosols and 300 Ci/year of iodine-131.

APPENDIX VII-c

ANNUAL LIQUID RADIOACTIVE WASTE DISCHARGES AS A PERCENTAGE OF DISCHARGE LIMITS /9/

(exclusive of tritium)

Country	Facility	Discharge limits /Ci/year/	Activity discharged as a percentage of discharge limits 1969	1970	1971
GERMANY	KRB	14.4	11.5	10.6	13
	KWL	5.4	11.8	11	5.6
	KWO	18	59	17	25
	VAK	0.6	1	10.7	10
FRANCE		(a)			
	CHINON	900	0.82	0.25	0.22
	St-LAURENT-DES-EAUX	800	0.34	0.1	0.28
	SENA	100	3.8	6.4	34
	EL 4	4	0.67	0.15	2.5
ITALY					
	LATINA	1.6×10^3 (b)	1.8	0.6	0.1
	GARIGLIANO	5×10^3 (b)	0.2	0.2	0.4
	TRINO VERCELLESE	21 (c)	0.06 (c)	14	90
NETHERLANDS					
	DODEWAARD	2.6	19	90	62

(a) Limits derived from the MPCP in drinking water of 10^{-7} Ci/m^3 (any mixture of alpha, beta, gamma emitters, from which Ra-226 and Ra-228 can be excluded and from the volume of water carried annually by the river. A waste discharge formula is applied at SENA.

(b) The actual discharge limits for the Latina and Garigliano power stations correspond respectively to 1/3 and to the MPCP in drinking water measured in the cooling water discharge canals. These limits are actually being replaced by discharge formulae based on analyses of the critical groups of the population and on the actual waste discharge needs of the power stations

(c) In 1969 the limit was still 5×10^3 Ci/year.

APPENDIX VII-d

ANNUAL LIQUID TRITIUM DISCHARGES /9/

Country	Facility	Activity discharged /Ci/year/ 1969	1970	1971	Discharge limit /Ci/year/	
GERMANY	KRB	17.8			432	(a)
	KWL	26	31.7			
	KWO	328				
	VAK				480	(a)
FRANCE	CHINON					
	St-LAURENT-DES-EAUX					
	SENA		340	706	7×10^6	(d)
	EL 4					
ITALY	LATINA	25.2	16.7	13	2.5×10^5	(b)
	GARIGLIANO	7	5	5	5×10^5	(b)
	TRINO VERCELLESE	0	135	1 117	5×10^3	(c)
NETHERLANDS	DODEWAARD		2.37			

(a) Figure derived from monthly limit.

(b) The actual discharge limits for the Latina and Garigliano power stations correspond respectively to 1/3 and to the MPCP in drinking water, measured in the cooling water discharge canals. These limits are actually being replaced by discharge formulae based on analyses of the critical groups of the population and on the actual waste discharge needs of the power stations.

(c) In 1969 the limit was still 5×10^5 Ci/year.

(d) Discharge limit derived from the MPC in drinking water.

MAXIMUM EXPOSURE FROM NOBLE GAS DISCHARGES AT 0.5 KM AND AT 5 KM FROM THE POWER STATIONS /9/

Country	Facility	Discharge height [m]	Atmospheric dilution factor [sec/m³] at 0.5 km	Atmospheric dilution factor [sec/m³] at 5 km	Dose at 0.5 km [mrem] 1969	Dose at 0.5 km [mrem] 1970	Dose at 0.5 km [mrem] 1971	Dose at 5 km [mrem] 1969	Dose at 5 km [mrem] 1970	Dose at 5 km [mrem] 1971
GERMANY	KRB	109	2×10^{-7}	5×10^{-8}	0.12	0.08	0.07	0.05	0.02	0.02
	KWL	150	9.5×10^{-8}	2.6×10^{-8}	1.1	0.6		0.3	0.18	
	KWO	60	7×10^{-7}	1.3×10^{-7}	0.2	0.3	0.05	0.04	0.05	0.01
	VAK	50	1×10^{-6}	2×10^{-7}	0.1	0.18	0.13	0.02	0.04	0.03
FRANCE	CHINON	50 (a)	1×10^{-6}	2×10^{-7}	5	3.3	1.6	0.15	0.65	0.35
	St-LAURENT-DES-EAUX	78 (b)	4×10^{-7}	9×10^{-8}	0.31	0.05	0.6	0.07	0.01	0.13
	SENA	18	6×10^{-6}	4×10^{-7}	0	0	1.5	0	0	0.09
	EL 4	70	5×10^{-7}	1×10^{-7}	0	0	11	0	0	2.2
ITALY	LATINA	52	1×10^{-6}	2×10^{-7}	0.61	1	1	0.12	0.20	0.20
	GARIGLIANO	92	3×10^{-7}	7×10^{-8}	2.3	4.5	10.2	0.53	1	2.5
	TRINO VERCELLESE	100	2.3×10^{-7}	6×10^{-8}	0	0	0.008	0	0	0.002
NETHERLANDS	DODEWAARD	100	2.3×10^{-7}	6×10^{-8}	0	0.04	0.04	0	0.01	0.01

(a) The three Chinon power stations have different discharge heights (49, 67.5, 52 m). Calculation of exposure was based on the conservative hypothesis of a single discharge point at a height of 50 m.

(b) Calculation of exposure was based on the conservative hypothesis of a single discharge point for the two power stations.