# NUCLEAR FACILITIES EMERGENCY PLANNING IN BELGIUM

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Abstract

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After a short review of the Belgian nuclear sector in electricity generation (more than 50% nuclear – about 5450 MW(e)), the fuel cycle industry and research centres, the paper presents the general framework of the response plans (laws and decrees). The paper also describes internal and external emergency plans and the present status of the alert procedure, the important role of the "Co-ordinating Committee", the main protective measures, decision criteria and emergency drills. The levels of responsibilities (local, provincial, national) are also explained.

## 1. THE BELGIAN NUCLEAR SECTOR

The origin of nuclear energy development in Belgium dates back to the 'fifties with the founding of the "Centre d'étude de l'énergie nucléaire" (CEN) at Mol.

Since then, the Belgian nuclear sector has evolved on four fronts in particular:

- electricity generation
- the fuel cycle industry
- engineering and equipment supply
- research and development

### 1.1. Nuclear power plants

Belgium is heavily dependent on imports for its energy; consequently, it has set up a major nuclear programme which accounted for more than 50% of total electricity generation in 1984 and foresees a 60% share in 1986. This programme puts Belgium in second place in the world rankings, after France.


*FIG. 1. Main nuclear sites in Belgium.*

The units are located on two sites (see Fig. 1):
Doel, comprising:

- Doel 1, 390 MW(e) PWR, in operation since 1974
- Doel 2, 390 MW(e) PWR, in operation since 1975
- Doel 3, 900 MW(e) PWR, in operation since 1982
- Doel 4, 1000 MW(e) PWR, in operation since 1985

Tihange, comprising:

- Tihange 1, 870 MW(e) PWR, in operation since 1975
- Tihange 2, 900 MW(e) PWR, in operation since 1983
- Tihange 3, 1000 MW(e) PWR, in operation since mid-1985.

### 1.2. The fuel cycle industry

The Belgian fuel cycle industry's facilities are located in the immediate vicinity of the CEN. They include:

- Belgonucléaire at Dessel: plutonium fuel assemblies

- Belgoprocess (formerly Eurochemic) at Mol: reprocessing of irradiated fuel and intermediate storage of high-level waste
- FBFC at Dessel: fuel assemblies.

### 1.3. Research centres

The CEN at Mol has three test reactors:

- BR-1 (physics, exposure)
- BR-2 (testing of materials)
- BR-3 (nuclear power plant training centre, exposure).

The Institute of Radioelements (IRE) at Fleurus has a cyclotron and 2 irradiators; it produces sealed sources and equipment and is active in the field of biomedical applications (radiopharmaceuticals and radioactive kits).

## 2. GENERAL FRAMEWORK OF THE RESPONSE PLANS

Response organization in the case of an accident in a nuclear installation is to be considered in the wider context of civil defence; this covers all the measures and means aimed at the protection of the population at large in all circumstances and in particular during calamitous events, catastrophes and disasters.

Under the Act of 31 December 1963 [1], the Minister of the Interior (Home Secretary) is responsible for issuing appropriate provisions to protect the civil population over the whole of the country. To this end, he has the help of specialized services, e.g. the Civil Defence Department of his Ministry.

When an accident occurs which is likely to require the simultaneous implementation of the response actions of government, provinces or municipalities as well as of private or public organizations, the operations are co-ordinated by the Governor of the province. So the primary responsibility for co-ordinating such joint actions lies with the provincial authorities. Only when the operations need to be extended to include two or more provinces will the Home Secretary be in charge of co-ordination.

The presence in some provinces of the nuclear installations described above has led the provincial authorities concerned to draw up special emergency plans for every one of these installations.

Basically, these plans are documents on how to organize external response in the case of an accident occurring in a nuclear installation. They distinguish between:

- different types of accidents (conventional, nuclear, etc.)
- specific emergency procedures for each type of accident
- agencies and institutions involved
- countermeasures to be taken.

Apart from these 'external plans', licensees have developed 'internal plans'. These describe emergency procedures within the nuclear installation and lay down the means and measures that come under the responsibility of the licensee with a view to controlling the incident and the source and ensuring mainly the protection of workers.

These internal plans have been examined by the public authorities involved in the licensing procedure, which is primarily based on the Act of 28 March 1958 [2] on the protection of the population against the dangers of ionizing radiation. The main implementing Decree of this Act, the Royal Decree of 28 February 1963 [3], contains a number of provisions dealing with the licensing procedure and prescribes the general protection measures such as the basic standards related to doses, exposure and admissible contamination. It also lays down the actions to be taken in case an accident occurs and, broadly speaking, requires that close attention be given to the preparation and implementation of the measures to be taken should an accident occur or should the ambient radioactivity be abnormally high.

It should be noted that the licensee is required by law to give the public authorities any useful information on a possible decision to respond to an accident or to implement external response plans.

## 3. OUTLINES OF THE INTERNAL EMERGENCY RESPONSE PLANS

The internal intervention plan of nuclear power plants centres mainly on four aspects:

- management of the incident
- calculation of doses
- off-site measurement
- integration into the external emergency response plan.

### 3.1. Management of the incident

The on-call duty engineers of the damaged unit are recalled. They may be assisted by engineers from other units and by some outside qualified people (consulting engineers, manufacturers). Together with the unit manager, they assemble in the unit's operational centre in order to take all technical measures required to cope with the incident.

### 3.2. Calculation of doses

Based on the measures at stack and meteorological data, the supervision department calculates the doses which the site's surrounding areas will receive in the initial stages of the accident and throughout the accident. To this end, a mathematical model of the plume of gaseous effluents is used.

### 3.3. Off-site measurement

Subject to the calculation of doses, the power plant's intervention vehicle carries out a series of measurements at pre-selected points in the area judged to have been the most affected. The vehicle remains in contact by radio with the power plant.

### 3.4. Integration into the external emergency response plan

As indicated below (see Section 4.2), a 'Co-ordinating Committee' is convened; it meets at the crisis operational centre. The latter is located either at the power plant itself or outside.

The power plant is represented in this committee by:

- the site manager
- the site supervision head
- engineers of the undamaged units.

In addition to the supervision team and intervention vehicle already mentioned, the plant makes available its laboratories and the inspection and maintenance teams of undamaged units.

These means are integrated into the means made available by the CEN, IRE and other organizations involved.

## 4. OUTLINE OF THE EXTERNAL EMERGENCY RESPONSE PLANS

The elements of the current provincial response plans, which will be dealt with in some detail, are related to the alert of the authorities, the Co-ordinating Committee, the list of authorities and institutions capable of responding, the notification of the public, and evacuation of the population.

### 4.1. Alerting the authorities

Normally, the alert is given by the person responsible for the nuclear facility.

The form of the emergency message and the various authorities to be notified vary for each type of accident and are detailed in the plans.

They are:

- conventional accidents (such as a fire) originating within the facility but not of nuclear nature
- nuclear accidents without any immediate consequence for the population and the environment outside the nuclear site
- nuclear accidents having off-site consequences.

In every case, the emergency is notified to one or more public utilities which are on call around the clock (emergency telephone service 900, fire department, etc.). This notification is relayed to other bodies such as the gendarmerie, the police, the mayor(s), the provincial section of the Civil Defence Department and the Governor of the province concerned.

It should be noted that one of the emergency plans (that regarding Tihange) includes a possible pre-alert phase, corresponding to an event that could possibly contaminate the environment. This pre-alert does not trigger any immediate action, it aims at placing the service involved on alert and it is automatically cancelled if the alert is not given within a fixed period of time.

### 4.2. Co-ordinating Committee

Judging from the information he has gathered on the type of accident and on its gravity, the Governor decides whether or not the Co-ordinating Committee needs to be convened.

This Committee plays a key role in the response plans. It is chaired by the Governor and consists of delegates of:

(a) the Civil Defence Department
(b) the local authorities and response services (mayor(s), fire department, police, etc.)
(c) the authorities of the arrondissement and of the province
(d) other bodies such as the gendarmerie, the Department of Defence and the Public Health Inspectorate
(e) specialized institutions such as the Institute of Hygiene and Epidemiology, CEN, IRE
(f) the nuclear installation where the accident occurred.

In addition, the Governor may invite any other competent person to participate in the meetings.

The Committee gathers all the information with a view to identifying the threatened areas and the hazards. These data (in particular the dose evaluation by area) are given especially by delegates of the facility where the incident occurred and by mobile squads performing local measurements (nuclear power plant, fire divisions, civil defence services, specialized institutions and bodies, etc.).

The Committee's main tasks are to propose integrated protective measures, to see that they are carried out and to advise the Governor on every proposed protective action.

Section 5 of this paper examines the main protective measures and discusses by which criteria they are decided upon.

### 4.3. Organizations involved and their duties

A substantial part of the response plans is devoted to the detailed listing (addresses, telephone numbers, etc.) of the authorities and bodies called upon

to participate in the organization of the response, and their specific duties. One can distinguish various disciplines: rescue, emergency medical and health care, police, logistics, broadcasting, information, detection and monitoring, etc.

Here, the various provincial plans differ slightly with respect to presentation. The plan of the nuclear power plant at Tihange, for example, describes the duties to be performed by each service; the plan drawn up for Doel considers three main disciplines:

- "maintenance of order and traffic", which comes under the responsibility of the district commander of the gendarmerie
- "medical assistance and health care", under the responsibility of the local health inspector
- "material assistance and operations", which rests with the chief of the local fire department.

It is obvious that these parts of the plans need constant revision and updating.

### 4.4. Warning of the public

In the case of an accident with off-site consequences, the population living in the vicinity may be warned of danger by sirens installed to this end within a 10 kilometre area. In addition, the alarm may also be given from vehicles of the response forces equipped with loudspeakers.

The public has been notified of this procedure, and particularly of the type of modulation of the sound-signal, by an information booklet distributed to the citizens living in the area [4].

These sirens may be sounded only on the advice of the Co-ordinating Committee.

### 4.5. Plan to evacuate the population

In the improbable event that it should be decided to evacuate the population, a specific evacuation plan has been established for municipalities situated within a radius of 10 km from the installation; this plan is a part of the external response plan.

The population of these communities has been split up into groups of about 600 inhabitants each. Each group has been assigned shelters capable of receiving them in an emergency. These shelters are located at a distance of 20–40 kilometres from the facility.

The evacuation order would be issued by the mayors in close liaison with the Co-ordinating Committee and would be broadcast in the area concerned.

The evacuation plan also specifies the composition and tasks of the reception committeees within the sheltering centres.

TABLE I. EMERGENCY REFERENCE LEVELS OF DOSE (in mSv)

| Countermeasure | Lower limit | | | Upper limit | | |
|---|---|---|---|---|---|---|
| | Whole body | Thyroid, lung or other individual organ | Skin | Whole body | Thyroid, lung or other individual organ | Skin |
| Evacuation | 100 | 300 | 1000 | 500 | 1500 | 3000 |
| Stable-iodine tablets | – | 50 | – | – | 250 | – |
| Sheltering | 5 | 50 | 50 | 25 | 250 | 250 |

Source: Ref. [5].

## 5. MAIN PROTECTIVE MEASURES AND DECISION CRITERIA

The protection of the population and of the environment against hazards caused by nuclear installations depends in the first place, both under normal operating conditions and in the case of an accident, on the safety characteristics of the nuclear facility itself: multiple active and passive barriers to the release of radioactivity, safety devices, competent operating personnel, etc.

However, in spite of technical improvements and despite ever more elaborate analyses of accident scenarios, it is really impossible to foresee every accidental event and all its consequences.

In order to limit as much as possible the possible negative consequences of such accidents it is imperative to organize and plan response actions well in advance. Such planning is not related to pre-established accident scenarios but aims to respond adequately to any eventuality.

The main measures to protect the public are:

(a) sheltering
(b) administration of stable-iodine tablets
(c) evacuation.

Of course, this list is far from exhaustive; other measures may be taken as and when they are required, such as the banning of some foodstuffs or water, etc.

The decision to implement a countermeasure may be taken only when the circumstances have been duly evaluated and on the basis of a number of criteria associated with various factors:

- type of accident and its actual and foreseeable consequences
- weather conditions (e.g. wind)
- degree of emergency
- efficiency and relative risk of the countermeasure
- exposure dose (cumulative)
- time-related dose rate.

The two last factors are crucial. When an accident occurs involving off-site radiological consequences, the dose is estimated by both the licensee and the authorities in accordance with a jointly agreed calculation procedure; the results of the evaluation are transmitted to the Co-ordinating Committee, which, as indicated above, is charged with proposing countermeasures.

The present Belgian legislation does not impose an automatic coupling between numerical values of the evaluated doses and any countermeasure; however, in its assessment, the Co-ordinating Committee makes use of certain reference levels. In this respect, the guide drawn up in 1982 by a group of international experts at the request of the Commission of the European Communities [5] proposes emergency reference levels, as summarized in Table I.

Nevertheless, it is the Co-ordinating Committee's duty to select the most appropriate countermeasures in order to minimize the population's exposure, with due consideration to all factors involved.

The main innovation of this guide is that it lays down a double dose limitation for each of the three most important countermeasures: a lower limit at which the implementation of the countermeasure must be envisaged and an upper limit where the countermeasure is expected to have been implemented, except in exceptional circumstances (e.g. unusual weather conditions).

Finally, it is worth while mentioning that supplies of potassium iodide tablets are stored in appropriate locations (pharmacies, hospitals) around the nuclear facilities.

## 6. EMERGENCY DRILLS

Each year an emergency drill is held to try out the external response plans.

A serious-accident scenario is imagined, most often involving radiological consequences outside the nuclear installation; the alarm procedure is started – note that the time when the emergency signal is given is intentionally modified from exercise to exercise (day, evening, weekend) to test preparedness and response. The Co-ordinating Committee is convened and simulates the taking of countermeasures.

Up till now, these simulation drills have been restricted to the organizations and bodies directly involved with the response plans; the population does not participate in them.

A lot may be learnt from this experience. It allows the elimination of shortcomings in the initial planning procedure, verification whether certain hypotheses are realistic and improvement of the training of the persons in charge.

## REFERENCES

[1] Loi du 31 décembre 1963 sur la Protection Civile, Moniteur Belge (1964) 422.

[2] Loi du 29 mars 1958 sur la protection de la population contre les dangers résultant des radiations ionisantes, modifiée par les lois du 29 mai 1963, 3 décembre 1969, 14 juillet 1983, Moniteur Belge (1958) 3286, (1963) 6608, (1970) 90, (1983) 10 019.

[3] Arrêté royal du 28 février 1963 portant règlement général de la protection de la population et des travailleurs contre le danger des radiations ionisantes, modifié par les arrêtés royaux du 17 mai 1966, 22 mai 1967, 23 décembre 1970, 23 mai 1972, 24 mai 1977, 12 mars 1984, Moniteur Belge (1963) 5206, (1966) 5956, (1967) 9272, (1970) 1962, (1972) 7581, (1977) 8845, (1984) 5037.

[4] MINISTERE DE L'INTERIEUR, "En cas d'accident aux installations nucléaire de ...", Bruxelles (1981).

[5] COMMISSION OF THE EUROPEAN COMMUNITIES, "Radiological Protection Criteria for Controlling Doses to the Public in the Event of Accidental Releases of Radioactive Material", Luxemburg (1982).