

**ASN's Policy on Dismantling and
Decommissioning of Basic Nuclear Installations
in France**

Version 0.v3 – April 2009

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1. Context and purpose of the document

Like all industrial facilities, nuclear facilities, at the end of their operating period, are subject to dismantling operations prior to possible release of the site upon which they have been built, or re-use of the latter for another activity.

Within the framework established by the French Nuclear Transparency and Safety Act [1], the programme law relating to sustainable management of radioactive materials and waste [2] and the legislation resulting therefrom, the aim of this document is to specify ASN's policy and expectations with regard, more specifically, to:

- the various dismantling strategies that can be implemented by operators;
- the conditions in which the facility's period of operation should come to an end and in which the subsequent dismantling operations should take place;
- the final state of nuclear facilities after they have been dismantled and decommissioned;
- informing the public.

2. Dismantling and decommissioning strategies

2.1. The dismantling and decommissioning of nuclear facilities

The term 'dismantling', generally speaking, covers all of the activities – technical or administrative – carried out after a facility has ceased to operate, for the purposes of achieving a pre-defined final state. These activities, which can take place over several decades in the case of complex nuclear facilities (e.g. nuclear reactors or waste-processing plants) can, in particular, include operations such as the dismantling of equipment, remediation of the premises and soils and the demolition of civil engineering structures and structures for the treatment, conditioning, evacuation and elimination of waste (both radioactive and non-radioactive). In accordance with article 29-V of the Act [1], all of these operations must be carried out in such a way as to prevent or sufficiently limit the risks or disadvantages with regard to public health and safety and protection of the environment. Once it has been dismantled, and subject to certain conditions, a nuclear facility may be decommissioned. The facility is then no longer subject to the legal and administrative regime applying to nuclear facilities. Decommissioning allows some¹ or all of the regulatory controls to which a nuclear facility is subject, to be lifted.

2.2. The various dismantling strategies

The International Atomic Energy Agency (IAEA) has defined, in a document which gives recommendations for the decommissioning of facilities concerned with radioactive substances [4], three dismantling strategies for the dismantling of nuclear facilities once they have permanently ceased to operate:

- *deferred dismantling*: the parts of the facility containing radioactive substances are maintained in or put into a safe shutdown state for several decades before the dismantling operations begin (the "conventional" parts of the facility can be dismantled upon shutdown of the facility);

¹ Easements may be put in place (cf. § 4.2)

- *safe confinement*: the parts of the facility containing radioactive substances are placed in a reinforced confinement structure for a sufficiently long period that they attain a level of radiological activity sufficiently low to allow the site to be released (the “conventional” parts of the facility can be dismantled upon shutdown of the facility);
- *immediate dismantling*: in such a case, dismantling of the entire facility is embarked upon as soon as it ceases to operate, without a waiting period, although the dismantling operations themselves - due to their complexity - can take a long time.

The decision as to which dismantling strategy to implement is influenced by many factors: national regulations, socio-economic factors, financing of the operations, the availability of waste-elimination channels, dismantling techniques and qualified personnel; the exposure of personnel and the public to ionizing radiation caused by the dismantling operations, etc. Therefore, international practices vary from one country to another.

Currently, ASN recommends that the operators of French nuclear facilities use immediate dismantling strategies. The arguments supporting this stance are explained below. Any alternative choice must be supported with solid arguments by the operator.

It should also be noted that more and more countries have opted for an immediate dismantling strategy, such as the United States, Sweden, Germany and Spain. Some countries use a very similar strategy, dismantling which takes place after a short period, of around 5 to 10 years of safe confinement (e.g. Japan and South Korea). Other countries have different approaches depending on the facility, like Finland, which uses the immediate dismantling strategy for its European Pressurized Water Reactor (EPR), whereas it uses a safe confinement period of 30 years for its Boiling Water Reactor (BWR). This is also the case in the United Kingdom, where some facilities have been subject to immediate dismantling but, in the case of gas-cooled reactors, a safe confinement period of approximately 100 years has been selected. Furthermore, international organizations such as the IAEA [4] or the OECD’s Nuclear Energy Agency [6] present the immediate dismantling strategy as preferable, when the conditions for its implementation are satisfied.

2.3. The required conditions in France for immediate dismantling

One of the main arguments to recommend an immediate dismantling strategy is that such a strategy prevents or limits the burdens to be borne by future generations in terms of radioactive waste management, and, consequently, with regard to the dismantling of nuclear facilities. In addition to this consideration, other factors must be taken into consideration.

2.3.1. *Political and socio-economic factors*

French legislation on nuclear facilities has contained stipulations relating to dismantling since 1990². In 2006 and 2007, the act [1] and the order [3] clarified the statutory procedures governing the dismantling and decommissioning of basic nuclear installations. All stakeholders (operators, councils, the public, associations, etc.) therefore have a **clear and transparent statutory framework** in which nuclear facility dismantling operations may be authorized and carried out.

The planning and implementation of dismantling programmes, which present the major characteristic of lasting relatively long periods of time compared with the operating period of the facilities themselves, requires the mobilization of significant sums of money. The law [2] sets out the methods by which the **sustainability of such funding, and its availability at the required time, can be guaranteed**. Nuclear operators must therefore, in particular, carefully assess the costs of dismantling their nuclear facilities and managing their used fuels and radioactive waste. Based on these cost assessments, operators must set aside funds to cover them, in the form of an asset portfolio dedicated to these costs. Operators meet these obligations with the help of regular communications with the public authorities, and, in particular, a three-yearly report describing the operator's situation with regard to the above-mentioned technical and financial obligations. A three-yearly report is also prepared for the purposes of informing the public. In this context, and in accordance with the missions entrusted to it, ASN checks, when examining the three-yearly reports, that the strategy for the dismantling operations and management of the used fuels and nuclear waste is in line with nuclear safety. It must, in particular, in accordance with the law [2], return an opinion on the three-yearly reports to the administrative body responsible for checking that the above-mentioned stipulations have been met (the Department of Energy and Climate Change).

The issue of dismantling nuclear facilities is closely linked with that of managing radioactive waste. In fact, the dismantling of a nuclear facility requires the availability of channels to manage total elimination of the waste generated by the dismantling operations, or, at the very least, temporary storage thereof. The dismantling of the equipment and possible demolition of the buildings making up nuclear facilities produce, for the most part, large amounts of very low activity (VLA) waste. Smaller quantities of low and intermediate level short-lived (<31 years) waste may also be generated. These two categories of waste, produced mainly during dismantling operations, have elimination channels in operation in France. Some low-level long-lived waste, produced by the dismantling of first generation power reactors, does not currently have elimination channels. The same is true of high-level long-lived waste³. As far as these two waste categories are concerned, the order provides for the availability of outlet channels. **In 2008, French nuclear operators therefore had outlet channels which allowed them to manage most of the waste resulting from the dismantling of nuclear facilities, and should, in the future, have elimination channels allowing management of all such waste.**

² Order no. 90-78 of 19 January 1990 amending Order no. 63-1228 of 11 December 1963.

³ Whilst awaiting an outlet, this waste is stored in nuclear facilities.

2.3.2. *Technical and operational factors*

The dismantling of nuclear facilities presents a certain number of technical challenges, due to the characteristics of these facilities: risks to the environment and to health, due to the presence of radioactive substances, the “unique” size or nature of certain equipment or facilities, risks induced by insufficient knowledge of the history of old facilities, etc.

Since the 1980s, the dismantling operations carried out have allowed operators to acquire a wealth of experience in dismantling and management techniques for this type of project. Dismantling operations which have taken place since the year 2000 illustrate the **technical feasibility** of the dismantling operation. ASN works to ensure that the skills in existence today remain available in the future. The dismantling operations currently underway involve all types of facility: power or research reactors, laboratories, waste-treatment facilities, fuel-reprocessing plants, etc.

2.4. The risks and disadvantages of deferred dismantling

2.4.1. *Political and socio-economic factors*

With regard to political and socio-economic factors, when a deferred dismantling strategy is implemented, the question arises as to whether the necessary funding is available at the required time, even though current laws guarantee the availability of such funds in principle. The question also arises as to the availability of outlet channels for the waste (the current availability of which does not guarantee availability in a hundred years' time, for example).

2.4.2. *Technical and operational factors*

In the case of a deferred dismantling strategy being implemented, technical and operational factors also present considerable risks.

It is a known fact that uncertainties increase with time: the loss of information on the construction/operating conditions of certain facilities and the disappearance of skills, accentuated by the departure of personnel familiar with the facility. Current dismantling operations, involving facilities which have been in operation for forty years or so, are, in many cases, already suffering from uncertainties due to a loss of records on the facility concerned.

Deferred dismantling also raises the question of surveillance and maintaining the facilities in a secure condition. There can also be technical problems: management of ageing civil engineering structures, obsolescence of the equipment, in particular the surveillance equipment, etc.

Finally, the possibility of a dosimetric gain, due to the radioactive decay of certain radionuclides (⁶⁰Co in particular) – the argument most often put forward in support of deferred dismantling strategies – does not apply to all situations and depends on the type of contamination or residual activation⁴. All things considered, this would not appear to be a very discriminatory factor in the choice of a dismantling strategy.

⁴ In the case of UNGG reactors, a waiting period of between 80 and 120 years would appear to be necessary in order for manual dismantling to be carried out. (Source: NEA report [6])

3. Preparing for final shutdown and the dismantling operation

As the dismantling phase of a nuclear facility is a major industrial project, ASN recommends that operators anticipate, as far as possible, the administrative and technical actions that will be required for its smooth performance. The dismantling plan, which, in accordance with the order [3], is drawn upon the creation of a nuclear facility, must be designed with this objective.

3.1. Preparing for final shutdown

The specific features of the dismantling phase, particularly in terms of the nuclear safety and radioprotection risks, require that it takes place within a specific safety framework, once an authorization, ruled by order, has been obtained. The statutory procedure for obtaining this authorization requires consultation between the relevant parties: the public, the public authorities concerned (national or European) and the local information commission (cf. §6).

Consequently, no dismantling operation must be embarked upon before the order authorizing the final shutdown and dismantling operation has been obtained.

Operations carried out between shutdown of the facility and the obtaining of the authorization for the final shutdown and dismantling operation (the "preparation for final shutdown" phase) must comply with the order authorizing creation of the facility and with its operational safety guidelines.

The 'preparation for final shutdown' phase must allow the facility to be prepared, as far as possible, for its dismantling operations, taking optimum advantage of the presence of the operating staff, who have detailed knowledge of the facility: its operating history, details of any incidents, knowledge of the premises and the various items of equipment, etc. ASN believes that the final shutdown preparation phase should be limited to carrying out the following operations: putting the facility in order, preparation of the dismantling operations (training of teams, carrying out radiological inventories, etc.), evacuating as many as possible of the dangerous substances present in the facility, including waste resulting from operation of the facility, and evacuating part or all of the source term⁵.

3.2. Dismantling

Dismantling projects are often complex and involve a great number of modifications to the facility, the importance of which, in terms of safety and/or radioprotection, can be very variable. In this context, operations with the highest stakes in terms of safety or radioprotection must be authorized by ASN. For the others, ASN recommends the implementation of internal authorization systems controlled by it, as provided for by article 27 of the order [3].

The risks present during operation of the facility gradually increase during the dismantling operation. While certain risks can disappear rapidly, such as the criticality risk, others, like those linked with radioprotection (progressive withdrawal of the confinement barrier) or conventional safety (co-activity, pressure-drops, working at heights, etc.) gradually increase. The same is true

⁵ Core unloading and fuel removal for a nuclear reactor, or draining and rinsing process systems for a laboratory or plant, for example. Déchargement du cœur et évacuation du combustible dans le cas d'un réacteur ou vidanges et rinçage des circuits procédés dans le cas d'un laboratoire ou d'une usine par exemple

of fire or explosion risks (technique of dissecting the structures according to their "hot-spots"), and, for example, risks linked with human and organizational factors (such as changes in organization compared with the operational phase or the frequent use of service-provider companies). ASN is committed to checking, during its inspections of facilities in the process of being dismantled, that operators have properly taken into consideration the specific risks of this phase in the life of a nuclear facility.

In accordance with the provisions of the law [1], the safety of a facility, including when it is in the process of being dismantled, is re-examined periodically. The frequency of these re-examinations is usually every 10 years. A different frequency can, however, be specified in the order authorizing the final shutdown and dismantling operation. In the case of safety re-examinations carried out during the dismantling phase, ASN's objective is to ensure that:

- the facility's safety level must remain acceptable until it is decommissioned, and, if applicable, compensatory provisions in proportion to the risks must be implemented;
- the safety arrangements made in connection with implementing the dismantling operations must comply with industry standards and with legislation on the subject.

The re-examination activity must be conducted in the light of an overall analysis of the dismantling project, the aim of which, ultimately, is to decommission the nuclear facility after a limited period of time.

4. The final state of facilities and decommissioning

4.1. The objective of the dismantling operation and the final state of facilities

The final state achieved upon completion of the dismantling operation must be capable of preventing or sufficiently limiting the risks or disadvantages which could be presented by the dismantled facility and its site in terms of public health and safety or protection of the environment, taking into consideration, in particular, the anticipated re-use of the site or buildings. This objective must be fixed and based on the scientific and technical knowledge available at the time.

In this context, **ASN recommends implementing remediation and dismantling practices which aim to achieve a final state in which all dangerous substances, including non-radioactive ones, have been evacuated from the nuclear facility.** For this reason, all of the waste generated must be evacuated from the facility once it has been dismantled.

Situations in which an operator cannot carry out a complete remediation of their facility must be firmly justified in the dismantling plan. Furthermore, by application of article 20 of the law [2], the operator must make financial arrangements to cover management of the waste resulting from the dismantling operations, even if elimination thereof is deferred to a later date. It should be noted that this particular case, which involves deferring the complete remediation of a nuclear facility or of a site to a later date, does not correspond with the immediate dismantling strategy recommended by ASN.

In terms of the dosimetric impact of the facility and of its site after dismantling, operators' objectives are justified in relation to national and international best practices, in particular the guide developed by the IAEA on this subject [5].

4.2. Decommissioning of a dismantled nuclear facility

The decision to decommission a nuclear facility can only be made if its final state, as intended by the operator, has been achieved, and complies with the objectives outlined in §3.1.

In all cases, ASN believes that arrangements must be made to retain records of the presence of a former nuclear on the parcels of land concerned (to inform successive owners).

Depending on the final state achieved, public easements may be established, according to the anticipated subsequent use of the site and/or buildings. In accordance with article 50 of the order [3], these easements are established in order to:

- prevent or reduce the effects of an emergency radiological situation;
- prevent the effects of radioactive or chemical pollution of the soil.

Depending on the possible residual risks presented by the dismantled facility or its site, the public easement may contain a certain number of restrictions regarding use (limitation to industrial use, for example) or precautionary measures (radiological measures in the case of erosion for example, or a surveillance programme)

Easements of this type must be put in place so that they become effective before a nuclear facility is decommissioned.

5. The dismantling plan

In accordance with the order [3], any operator of a nuclear facility must draw up a dismantling plan relating to that facility, at the time of its creation. This plan must be updated throughout the life of the facility. ASN believes that operators should create a reference document in order to prepare for and anticipate, to the best of their ability, the dismantling of a nuclear facility.

The dismantling plan should set out the methods planned for the dismantling of the nuclear facility in question, as well as for remediation and surveillance of the site upon which it was built. It should mention and justify the **dismantling strategy** selected by the operator for the facility concerned, in the light of the strategy selected for all of that same operator's nuclear facilities. The dismantling plan should specify, in particular, the timescale anticipated between the final operational shutdown and the start of the dismantling operations. It should present a cost assessment for the dismantling of the nuclear facility and also justify, when this has been defined, the final state envisaged for the facility after it has been dismantled.

6. Informing the public and workers

6.1. Before the dismantling operation

In accordance with the order [3], final shutdown and dismantling authorization requests are subject to a public enquiry, under the usual terms and conditions outlined by the Environment Code. ASN believes that, in the public enquiry files, in addition to the technical aspects, the operator must, in particular, clearly explain:

- the dismantling strategy selected and the justification for this choice;
- the stages of the dismantling project, its schedule and the duration of all of the operations;
- the final state intended and future use envisaged for the facility and/or its site.

Furthermore, the authorization procedure also requires consultation with the local information commission. In order to facilitate the mission of local information commissions, and, in particular, to enable them to return their opinions on the file under proper conditions, ASN recommends that operators form an active partnership with them during the final shutdown and dismantling authorization application procedure. Therefore, it would appear essential to allow them, as far as possible, access to the files as early as possible before the public enquiry.

Finally, ASN recommends that the facility's Health, Safety and Working Conditions Committee be involved, as early as possible before the final shutdown and dismantling authorization application procedure.

6.2. During the dismantling operations

Throughout the dismantling operations, particularly when the operations are taking place over a long period of time, the operator must make the appropriate arrangements to inform the public of the progress of the dismantling operations, in particular via the local information commission. For this reason, the annual report drawn up by the operator in accordance with article 21 of the act [1] is of primary importance, and must inform the public of⁶:

- the overall progress of the dismantling project in relation to the forecast schedules (any project delays must be mentioned therein and explained);
- dismantling activities carried out during the year and any noteworthy facts (the completion or start of a dismantling phase for example);
- any technical or organizational developments in the dismantling project.

Furthermore, this report must be presented to the Health, Safety and Working Conditions Committee, which gives an opinion on its content.

6.3. Application for decommissioning

The application file for the decommissioning of a nuclear facility is subject to consultation with the prefecture and town halls concerned with the project, as well as with the local information commission. In this file, the operator must, in particular, present the final state achieved upon completion of the dismantling operations, and the future use envisaged for the buildings and land.

⁶ In addition to the requirements of article 21 of the law [1]

The procedure for implementing public easements, when these must be put in place (cf. 4.2), requires a public enquiry to be held. The public is therefore informed of the terms and conditions governing implementation of these easements: the intended scope of the easements, any restrictive and/or surveillance measures put in place, studies carried out on the subject of soil pollution, etc.

7. References

- [1] Law no. 2006-686 of 13 June 2006 on Nuclear Transparency and Safety
- [2] Programme law no. 2006-739 of 28 June 2006 on the Sustainable Management of Radioactive Materials and Waste.
- [3] Order no. 2007-1557 of 2 November 2007 on nuclear facilities and controls regarding the nuclear safety of transporting radioactive substances.
- [4] IAEA recommendations n° WS-R-5 “The decommissioning of facilities handling radioactive substances”
- [5] IAEA safety guide no. WS-G-5.1 “Releasing sites from statutory control after their period of operation”
- [6] OECD/NEA report no. 6038 “Selecting Strategies for the Decommissioning of Nuclear Facilities”