



# **INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)**

## **MISSION**

TO

## **FRANCE**

*PARIS, FRANCE*

*14 to 24 January 2018*

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY  
DEPARTMENT OF NUCLEAR ENERGY





**REPORT OF THE  
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FRANCE**

**Mission dates:** *14 to 24 January 2018*  
**Location:** *Paris, France*  
**Organized by:** *IAEA*

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IAEA - January 2018

**The number of recommendations, suggestions and good practices is in no way a measure of the status of the national infrastructure for nuclear and radiation safety. Comparisons of such numbers between ARTEMIS reports from different countries should not be attempted.**

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## EXECUTIVE SUMMARY

At the request of French authorities, specifically the *Ministre de la Transition écologique et solidaire* (the “Ministry”), the International Atomic Energy Agency organized an ARTEMIS review of the French Policy on Spent Fuel and Radioactive Waste Management. The objective of the ARTEMIS Peer Review Service is to provide independent expert opinion and advice on radioactive waste and spent nuclear fuel management, decommissioning and remediation, based upon the IAEA safety standards and technical guidance, as well as international good practice. France requested this review to fulfil its obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a *Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste* (“*Waste Directive*”). Representatives of the Bureau Politique Publique et Tutelle, Direction Générale de l’Energie et du Climat (DGEC), from the *Ministre de la Transition écologique et solidaire* provided the interface with the IAEA and coordinated the involvement of other relevant French organizations.

The review was performed by a team of ten senior international experts in the field of decommissioning and radioactive waste and spent fuel management, from multiple IAEA Member States, with IAEA staff providing coordination and administrative support. Subsequent to a preparatory meeting in May 2017, and the receipt and review of Advanced Reference Material fourth quarter of 2017, in January 2018 the ARTEMIS Peer Review team evaluated the overall French programme for the management of all types of radioactive waste and spent fuel, including aspects of decommissioning.

As guided by the expectation of the *Waste Directive*, the review addressed the following topics:

- The French national programme for the implementation of the Policy for Radioactive Waste and Spent Fuel Management, its scope, milestones, deadlines, and the progress indicators;
- The plans for the establishment of a detailed inventory of radioactive waste;
- The allocation of responsibilities between the different organizations involved in the various steps of the management of spent fuel and radioactive waste;
- The funding mechanisms for the management of spent fuel and radioactive waste;
- The French national arrangements for public information and participation; and
- The plans to ensure a high level of expertise, training and competence in the management of spent fuel and radioactive waste.

Overall, the Review Team was impressed with the nature and implementation of the French national programme. The team consensus is the French national programme is comprehensive and coherent in fostering safety across the spectrum of laws, regulations, and decrees, and their effective implementation by the pertinent waste management organizations. Consequently, there are no recommendations made by the team, though a number of suggestions and best practices are noted.

The national framework for the management of radioactive materials and waste is defined by the Environment Code and by the Programme Act 2006-739 of 28 June 2006, complementing and modifying the Act of 30 December 1991 on research into the management of radioactive waste, which define *inter alia*:

- the policies for the management of all radioactive waste in France;
- basic principles underlying policy, such as limiting burdens for future generations;
- the main responsibilities for the management of radioactive waste and spent fuel; and

- the National Plan (PNGMDR – Plan National de Gestion des Matières et des Déchets Radioactifs), including the National Inventory, as a policy implementation tool and a road map for future management steps.

The team took note that the combination of the Programme Act 2006-739, the Environment Code and the *National Plan* establishes the policies for the safe management of all France's radioactive waste, as well as the main strategic management directions, actions and responsibilities for their implementation. The *National Plan* is based upon a current and projected *National Inventory* of radioactive waste updated every three years. In addition, the efforts at capacity building for human resources and transparency with stakeholders was noted for its proactive approach.

The French radioactive waste and spent fuel management programme is one of the older and larger programmes in the world, with commensurate resources to ensure effectiveness in fostering safety and programme implementation. Regardless, all programmes should maintain a certain vigilance in assuring effective practices are maintained or enhanced, and remain open to opportunities for improvement.

In this regard, the Review Team has provided the following summarized suggestions:

1. Specify the implementation strategy at the national level of the policy requirement of decommissioning "in the shortest possible time", by translating this general policy requirement into obligations for operators or facility owners;
2. Evaluate the current LLW-SL management paths to identify potential optimizations in consideration of future waste arisings;
3. Finalise the current development of requirements related to storage and disposal of radioactive waste and ensure their issuance, per the 2017 IAEA's Integrated Regulatory Review Service (IRRS) follow-up item S18;
4. Formalize the role of ASN in the National Plan working group to enhance its high standards of independence;
5. Consider options for optimization of VLLW management, including the potential for different approaches in different regions, and include from the outset representatives from devolved State services in consultations;
6. Recognize the interdependencies between the realization of a next generation fleet of nuclear power reactors and the strategy for disposal of HLW, with the aim to identify inflection points whereby delay of the future facilities for reuse of spent fuel and nuclear materials affect the spent fuel management predisposal capabilities and capacities;
7. Consider creating a mechanism to permit small producers to transfer title and liability to Andra, or some other persistent entity, for waste disposal at an appropriate time after the acceptance for disposal;
8. Consider financial risks to the state arising from entities outside the nuclear legislative framework and whether there should be some additional obligations vs. relying solely on the fiduciary duties of the companies, and provide clarity on this financial risk in the *National Plan*; and
9. Consider a systematic view of financial prudence as it applies to decommissioning and radioactive waste management and apply an operator requirement to manage financial risk to the state and include a statement on this risk in the *National Plan*.

Good practices are so noted to encourage their continued use and improvements, to encourage a careful consideration of any changes to them, and to publicise practices that could be of value to other national programmes. In this regard, the Review Team noted the following good practices:

1. The systematic and structured manner of all the successive steps of management of radioactive materials and waste, taking account of all interdependencies and management factors and of all stakeholders;
2. The legally binding character of, and continuing government commitment to, the key actions identified in the *National Plan* for the management of spent fuel and radioactive waste to ensure progress in the objectives of the national policy;
3. The comprehensive *National Plan* includes all waste types and nuclear materials, as well as alternative future scenarios and management routes. Preparation, implementation and follow-up of the plan is well organized, main stakeholders are committed, and continuous improvement of the plan takes place efficiently;
4. The approach to compiling, maintaining, and publishing the *National Inventory*, providing the *National Plan* with a thorough record of all radioactive materials and waste types, is commendable, as is the proactive effort to identify legacy inventories and sources;
5. The development of preliminary safety cases or evaluations for facilities not only for the planned scenarios but also for scenarios resulting from a change in the national strategy fosters sound planning and decision making;
6. Requiring the creation of tangible assets to cover decommissioning and radioactive waste management liabilities and giving these assets legal protection; and
7. The efforts made by the major actors of the radioactive materials and waste management programme to establish, to develop and to maintain the necessary and required competence and skills of staff is robust and exemplary.

In summary, the Review Team considers that France has established a good basis for the safe and responsible management of radioactive waste and spent fuel upon which further improvements can be considered for future implementation.

The Review Team is of the collective opinion that France is in a good position to continue meeting high standards of safety for radioactive waste and spent fuel management in the country. The Review Team commends the French authorities and organizations involved in the design and implementation of the national programme for radioactive waste management and decommissioning, as demonstrated by the deliberate actions taken, the proactive attitude and professionalism displayed by all, and the commitment to safety in all its efforts.



## I. INTRODUCTION

On 1 August 2016, the *Ministre de la Transition écologique et solidaire* (the “Ministry”) requested the International Atomic Energy Agency (the “Agency”) to organize and carry out, in the second semester of 2017 a peer review of their national programme using the Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) of the French Policy on Spent Fuel and Radioactive Waste Management, in the framework of the obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a *Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste* (“the *Waste Directive*”). Through a subsequent letter dated 27 April 2017, the Ministry requested the Agency to reschedule the dates of the ARTEMIS Review to January 2018.

### TERMINOLOGY

In this document *National Plan* is used to mean the mechanism by which the requirements of section 28 of the *Waste Directive* are fulfilled and the document referred therein is the PNGDMR.

Throughout this document the French classification system for radioactive waste is used. This corresponds to the Agency classifications as shown in the following table.

	IAEA SAFETY SERIES GSG-1			
	Distribution %			
	VLLW	LLW	ILW	HLW
VLLW (Very Low Level Waste)	100	0	0	0
LLW/ILW SL (low-level waste and intermediate level waste, short-lived)	0	100	0	0
LLW-LL (Low-Level Waste – Long Lived)	0	0	100	0
ILW-LL (Intermediate-Level Waste – Long Lived)	0	0	100	0
HLW (High Level Waste)	0	0	0	100

Throughout this document BNI where appropriate is taken to include SBNI.

#### Disposal Facilities

France has operational disposal routes for VLLW and LLW. The sites are referred to within this document are:

- Cires (Industrial centre for collection, and disposal) for VLLW located at Morvilliers; and
- CSA (Aube waste disposal facility) for disposal of LLW/ILW SL at Soulaines-Dhuys.

In addition there are disposal facilities in the planning phase:

- Cigéo (Industrial centre for geological disposal) for HLW and ILW-LL at Bure; and
- New facility proposed for the disposal of LLW-LL.

There is also the CSM (Centre de Stockage de la Manche) facility in northern France, a LLW-SL disposal site currently in the post-closure monitoring phase.

## II. OBJECTIVE AND SCOPE

The ARTEMIS Review provides an independent international peer review of the French programme, in line with the obligations in the *Waste Directive*.

The ARTEMIS Review, organized by the Department of Nuclear Safety and Security and the Department of Nuclear Energy of the IAEA, was benchmarked against the relevant IAEA Safety Standards and good international practice and experiences from the combined expertise of the international peer review team selected by the IAEA.

The ARTEMIS Review assessed, in accordance with the *Waste Directive*, the overall programme for the management of all types of radioactive waste and spent fuel in France.

As indicated in the letter from the Ministry, dated 1 August 2016, the review covered the following topics:

- The French national programme for the implementation of the Policy for Radioactive Waste and Spent Fuel Management, its scope, milestones, deadlines, and the progress indicators;
- The plans for the establishment of a detailed inventory of radioactive waste;
- The allocation of responsibilities between the different organizations involved in the various steps of the management of spent fuel and radioactive waste;
- The funding mechanisms for the management of spent fuel and radioactive waste
- The French national arrangements for public information and participation; and
- The plans to ensure a high level of expertise, training and competence in the management of spent fuel and radioactive waste.

The requirement under Article 14(3) of the *Waste Directive* for a review of the competence of the regulator was not addressed as this is covered through IRRS.

### III. BASIS FOR THE REVIEW

#### A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Government of France, a preparatory meeting for the ARTEMIS Review mission, was conducted from 11 to 12 May 2017. The preparatory meeting was carried out by the appointed Team Leader Mr Magnus Vesterlind, the IAEA Team representatives, Mr Andrew Orrell, Mr Gerard Bruno, Ms Rebecca Robbins and the National Counterparts, Mr Stanislas Reizine, Mr Aurélien Louis, Ms Mathilde Maillard, Mr Thierry Granier and Ms Elodie Petry.

The ARTEMIS mission preparatory team had discussions regarding:

- the Terms of Reference for the ARTEMIS review of the French programme to fulfil obligations from article 14(3) of the *Waste Directive*; and
- the relevant detailed aspects for organization and conduct of the review.

Mr Stanislas Reizine gave an overview presentation of the French radioactive waste management programme including key legislation, the regulatory framework and the main organizations and their responsibilities.

IAEA staff presented the ARTEMIS principles, process and methodology. This was followed by a discussion on the work plan for the implementation of the ARTEMIS review in France in January 2018.

Mr Stanislas Reizine was appointed as the National Counterpart for the ARTEMIS mission and designated IAEA point of contact.

France provided IAEA with the Advance Reference Material (ARM) for the review at the beginning of October 2017, with additional material provided in response to initial questions in December 2017.

A preliminary meeting of the ARTEMIS team was held at IAEA headquarters in Vienna in October 2017. The purpose of the meeting was to familiarize the team members with the ARTEMIS guidelines, review of the ARM and assignment of review task to specific team members.

In December 2017 Mr Peter De Preter replaced Mr Magnus Vesterlind (who had to withdraw due to unforeseen circumstances) as the Team Leader, and Mr Kai Moeller assumed the role of Deputy Team Leader.

#### B) REFERENCES FOR THE REVIEW

The articles of the *Waste Directive*, the draft guidelines for the ARTEMIS review service and the responses to the self-assessment questionnaire were used as the basis for the review together with the ARM and materials presented during the mission and associated discussions. The complete list of IAEA publications used as the basis for this review is provided in Appendix D.

#### C) CONDUCT OF THE REVIEW

The initial Review Team meeting took place on Sunday, 14 January 2018 in Paris, directed by the ARTEMIS Team Leader Mr Peter De Preter and the ARTEMIS Team Coordinator Mr Andrew Orrell. The Deputy Team Leader, Mr Kai Moeller and the Deputy Team Coordinator, Ms Rebecca Robbins supported their respective leads.

The National Counterpart Mr Stanislas Reizine was present at the initial Review Team meeting, in accordance with the ARTEMIS guidelines, and presented logistical arrangements planned for the mission.

The ARTEMIS entrance meeting was held on Monday, 15 January 2018, with the participation of the General Directorate for Energy and Climate Change (Direction générale de l'énergie et du climat

(DGEC)), the Nuclear Safety Authority (Autorité de sûreté nucléaire (ASN)) and the French National Radioactive Waste Management Agency (Agence nationale pour la gestion des déchets radioactifs (Andra)) senior management and staff. Opening remarks were made by Mr Aurélien Louis, Head of Nuclear Industry Department (DGEC) and Mr Peter De Preter, ARTEMIS Team Leader. Mr Aurélien Louis (DGEC) and Ms Mathilde Maillard (ASN) gave an overview of the French context.

During the ARTEMIS mission, a review was conducted for all review topics within the agreed scope with the objective of providing French authorities with recommendations and suggestions for improvement and, where appropriate, identifying good practice.

The Review Team performed its review according to the mission programme given in Appendix B.

The ARTEMIS exit meeting was held on Wednesday, 24 January 2018, hosted by Mr Laurent Michel, Director General of Energy and Climate and Ms Lydie Evrard, Commissioner of ASN. Opening remarks were presented by the IAEA Deputy Director General Mr Juan Carlos Lentijo, Head of the IAEA Department of Nuclear Safety and Security, and were followed by the presentation of the results of the mission by the ARTEMIS Team Leader Mr Peter De Preter. Closing remarks were made by Mr Laurent Michel.

An IAEA press release was issued.

# 1. NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

## 1.1. NATIONAL POLICY

### France position

The national framework for the management of spent fuel and radioactive waste is defined by the Environment Code and by the Programme Act 2006-739 of 28 June 2006 concerning the sustainable management of radioactive materials. This act, complementing and modifying the Act of 30 December 1991 on research into the management of radioactive waste, defines *inter alia* :

- the policies for the management of all radioactive waste in France;
- basic principles underlying policy, such as limiting burdens for future generations;
- the main responsibilities for the management of radioactive waste and spent fuel;
- the Plan National de Gestion des Matières et des Déchets Radioactifs (PNGMDR) referred to as the *National Plan* – including the *National Inventory*, as a policy implementation tool and a road map for future management steps. This plan is updated every three years, as required by law.

The combination of the Programme Act 2006-739 and the *National Plan* establishes:

- the policies for the management of all radioactive waste that is produced or arising, including that from existing or under-construction nuclear facilities and from their decommissioning; and
- the main strategic management directions, actions and responsibilities for actions for all the implementation steps of the policies in the domain of radioactive waste and spent fuel management and decommissioning.

The *National Plan* is based on and linked with the *National Inventory* of radioactive waste and radioactive materials (see Section 3), which is also updated every three years.

The Act 2016-1015 of 25 July 2016 specifies the procedures for the creation of a deep geological disposal facility, Cigéo, that incorporates the concept of reversibility, for the high-level and intermediate-level long-lived radioactive waste (HLW and ILW-LL). The Act stipulates that the actual implementation of the principle of reversibility in a deep geological disposal facility is reviewed at least every five years.

The Review Team team was informed about the principle to further develop and refine the national policies with future Acts, as more knowledge becomes available, e.g. for the transition to the operational phase of the deep geological disposal facility after the conclusion a pilot phase, and for the commissioning of a subsurface disposal facility for LLW-LL.

The Act 2015-992 of 17 August 2015 concerning energy transition for green growth (known as the “TECV” Act) and the Decree of 28 June 2016 have introduced into the legislation the policy principle of decommissioning in the shortest possible time. The application of this policy principle to the large number of nuclear facilities to be decommissioned at the national level requires evaluation of the factors of major importance (on-site safety, long-term management of decommissioning waste through disposal routes, costs and financial coverage, management of skills and expertise, etc.) and is a matter of decisions by the competent authority. The application of this principle constitutes an important challenge, and is the subject of ongoing evaluations and discussions between the safety authority ASN and the facility owners.

The *National Inventory* does not cover the historical uranium mining sites with mine tailings or historical disposal sites in the vicinity of nuclear facilities for which there is an ongoing action to prepare a complete inventory . For all these sites an evaluation is ongoing or planned in order to prepare (policy) decisions on their future (long-term) management.

### **ARTEMIS observation**

On the basis of all the information provided, the Review Team concluded that France has established policies for the management of all its radioactive waste arisings from historical and existing nuclear facilities, including decommissioning activities, and from other facilities and activities, such as site remediation.

The Review Team identified three specific areas related to policy and policy implementation where observations were made, i.e. for implementing the policy requirement of decommissioning in the shortest possible time, for the policy principle of management of interdependencies, and for the application of optimization at the global national level for the management route of LLW-SL.

These evaluation of these observations and the related suggestions and good practice are detailed below.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *France has established policies for the management of all radioactive materials and waste from the past and existing nuclear facilities. For decommissioning, the policy principle is to decommission nuclear facilities "in the shortest possible time". The decommissioning of the nuclear facilities constitutes a big challenge for France because of the large number of nuclear facilities (incl. the nuclear power plants) to be decommissioned in the following years and decades, in line with the goals set by the energy transition for green growth Act of August 2015, and because of the need to have the required disposal capacities available when decommissioning takes place, in order to manage the decommissioning waste streams in an optimal manner. The Review Team was informed about the ongoing interactions of ASN with individual actors to assess their decommissioning strategy. There seems to be a need for the Government to specify the implementation strategy of this policy requirement at the national level.*

(1)	<b>BASIS: GSR Part 1 Requirement 10 states that</b> <i>“The government shall make provision for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities, and the safe management of spent fuel.”</i>
(2)	<b>BASIS: GSR Part 5 Requirement 2 states that</b> <i>“To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors. The policy and strategy shall be compatible with the fundamental safety principles [2] and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste.”</i>
(3)	<b>BASIS: GSR Part 6 Requirement 4 states that</b> <i>“The government shall establish and maintain a governmental, legal and regulatory framework within which all aspects of decommissioning, including management of the resulting radioactive waste, can be planned and carried out safely. This framework shall include a clear allocation of responsibilities, provision of independent regulatory functions, and requirements in respect of financial assurance for decommissioning.”</i>
(4)	<b>BASIS: GSR Part 6 Requirement 8 states that</b> <i>“The licensee shall select a decommissioning strategy that will form the basis for the planning for decommissioning. The strategy shall be consistent with the national policy on the management of radioactive waste.”</i>
S1	<b>Suggestion: The Government should specify the implementation strategy at the national level of the policy requirement of decommissioning "in the shortest possible time", by translating this general policy requirement into obligations for operators or facility owners.</b>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *There are many elements in the French national radioactive waste and spent fuel management system that facilitate the management of all interdependencies between the successive management steps, from waste generation until disposal, such as:*

- *process and responsibilities for the National Plan and the recommendations of the National Plan;*
- *waste acceptance criteria and the system for disposal;*
- *COCIDRA;*
- *Andra's global industrial schemes for the disposal facilities in development;*
- *waste management strategies asked for by ASN from the main waste generators;*
- *inventory and forecasts (including a reference inventory and alternative inventories for alternative energy policy scenarios); and*
- *evaluation and follow-up of operational and future storage and disposal capacities.*

(1)	<b>BASIS: GSR Part 5 Requirement 6 states that</b> <i>“Interdependences among all steps in the predisposal management of radioactive waste, as well as the impact of the anticipated disposal option, shall be appropriately taken into account.”</i>
GP1	<b>Good Practice: The way in which France organizes in a very systematic and structured manner all the successive steps of management of radioactive materials and waste, taking account of all management factors and of all stakeholders.</b>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *France has a long management and industrial experience for the management routes for LLW-SL, from generation to surface disposal (CSM & CSA). Many actions by the various actors involved have been taken in the past and are being taken to evaluate, improve and optimize the various components of these management routes (waste conditioning, disposal facility operation, management of specific waste streams, disposal long-term safety). Recommendations in the National Plan directly deal with various aspects of optimization of this management route, which will be necessary for future waste arising and for a fraction of the large amounts of radioactive waste from future decommissioning.*

(1)	<b>BASIS: GSR Part 3 Requirement 11 states that</b> <i>“The government or the regulatory body shall establish and enforce requirements for the optimization of protection and safety, and registrants and licensees shall ensure that protection and safety is optimized.”</i>
(2)	<b>BASIS: GSR Part 5 Requirement 6 states that</b> <i>“Interdependences among all steps in the predisposal management of radioactive waste, as well as the impact of the anticipated disposal option, shall be appropriately taken into account.”</i>
S2	<b>Suggestion: It could be beneficial to perform in due time a comprehensive and systematic optimization evaluation of the operational LLW-SL management route, e.g. in the framework of the National Plan process, in order to identify in a systematic and documented process, with the implication of all parties involved, if, and what, further optimization steps are possible in view of future waste arisings. This documented process can also be an element of transparency through the National Plan.</b>



## 1.2. LEGAL, REGULATORY AND ORGANIZATIONAL FRAMEWORK

### France position

#### Arrangements for safe management of radioactive waste and spent fuel in France's legislation

The key legal framework for radioactive waste management is established primarily in the 1991 waste Act, the 2006 Planning Act “On the sustainable management of radioactive materials and wastes” and the 2016 deep geological disposal Act. Most of these acts are codified into the Environment Code. In addition to the general provisions in the French legal framework, Chapter II of title IV, book V, of the Environment Code contains specific provisions in relation to radioactive waste, primarily in section L542. This legal framework provides for the production of a *National Plan* and *National Inventory*. The *National Plan* defines and communicates how all management steps for radioactive waste are considered.

The established legal framework ensures that all radioactive wastes and spent fuel from all producers in France are covered under legal instruments so that no radioactive waste is out of scope. This is reflected in the National Programme where all radioactive wastes are dealt with from generation to disposal, including NORM (naturally occurring radioactive material), TENORM (technically enhanced naturally occurring radioactive material), disused sealed sources and legacy situations.

The primary international instruments integrated into national legislation that are relevant to this review are the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (*Joint Convention*); European Council Directives 2011/70 (the *Waste Directive*), 2013/59 and 2009/71 as amended (the *Basic Safety Directives*); and international transport regulations.

France's legislation provides a framework for the establishment and maintenance of the necessary competences and skills for discharging the responsibilities of waste management affected parties:

- Compliance with this aspect is described in the France's National Report implementing Article 8 (Experience and Skills) of the *Waste Directive* ;
- A framework on the subject is described in broad terms under Environment Code (L593-7 for operators of BNIs (basic nuclear installations) and L512-1 for operators of ICPE<sup>1</sup>s). For the case of activities under Public Health Code the person responsible must present the qualifications or capacities required as required in the Environment Code L1333-38;
- Necessary training and qualification for BNI is required by the Order of 7 February 2012 and for all sort of activities involving radiation protection under the Labour Code;
- For the case of ASN, article 6 “Capacités d'expertise” Arrête 3 Décembre 2010, regulates the skills and qualifications for technical staff and their maintenance;
- Environment Code L542-1-2 requires a research programme in line with the needs related to the implementation of the *National Plan*. Appendix D of the *National Plan* lists the R&D activities; and
- The Ministry for Higher Education, Research and Innovation and the Ministry de la Transition Ecologique et solidaire coordinate the French research efforts.

Financing arrangements are established through the requirements of Articles L594-1 and following of the Environment Code Decree 2007-243 of 23 February 2007 (modified by decree 2010-1673 of 29 December 2010), the order of 21 March 2007 together with section L542 of the Environment Code which makes specific provisions for radioactive waste.

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<sup>1</sup> ICPEs are installations classified on environmental protection grounds

Decree 2007-243 of 23 February 2007 Concerning the Secure Financing of Nuclear Costs develops in detail the subjects of, among others, the costs to be covered, the methodology to follow, structure of the actives, control and supervision ring ring-fencing for long-term costs etc.

In line with the Energy Transition for Green Growth Act different scenarios are covered in the National Programme, taking into consideration the financing analyses mentioned in the aforementioned Decree.

Research costs on radioactive waste storage and disposal at the Cigéo deep geological disposal are funded by the operators through the so called “research tax” (Environment Code L542-12-1), similarly for design of Cigéo (Environment Code L542-13) funded by the operators through the “special contribution”.

The *National Plan* provides information on how the various responsibilities within the national programme are distributed.

National policy is defined by the Parliament by means of the approval of different Acts and amendments, which in the context of radioactive waste, is mainly through the Environment Code. For the case of a deep geological disposal, the role of the Parliament is emphasized as it reserves the establishment of reversibility conditions and authorization of its closure. The authorization Decree for the creation of the deep geological disposal may only be issued if previously examined by the Parliament.

### **Assignment and documentation of the responsibilities**

According to Environment Code<sup>2</sup> the Government is in charge of the development and update of the *National Plan* and issuing Decrees, thus providing a strong legal basis as a binding obligation. This is done every three years, the responsibility for which rests with the Ministry and its General Directorates for Energy and Climate (DGEC) and Risk Prevention (DGPR). ASN also participates in the joint update of the *National Plan*. A working group with participation of all relevant stakeholders takes part in the consultations, follow-up and update. The *National Plan* contains a number of recommendations and indicators whose fulfilment serve as a performance indicator of the progress of the national policy implementation.

The *National Plan* is submitted to the Parliament and to Office for the Evaluation of Scientific and Technological Choices (OPECST). Radioactive management activities cannot deviate from the prescriptions of the National Programme without concurrence from the Ministry. It is the Decree 2017-231 of 23 February 2017 that effectively gives a legal basis to the prescriptions of the *National Plan*.

The above mentioned Decree clearly assigns responsibilities for the implementation of the *National Plan*. These responsibilities applies to all parties involved in the management of radioactive material & radioactive waste.

The *National Plan* mentions waste acceptance criteria as an element to assure the proper handling of interdependencies between different management steps (§1.2.3). In chapter 2 there is mention of the need to consider inter-dependence with regard the potential reutilization of materials (depleted uranium (DU) enriched reprocessed uranium (URE), reprocessed uranium (URT), thorium,) and inventory.

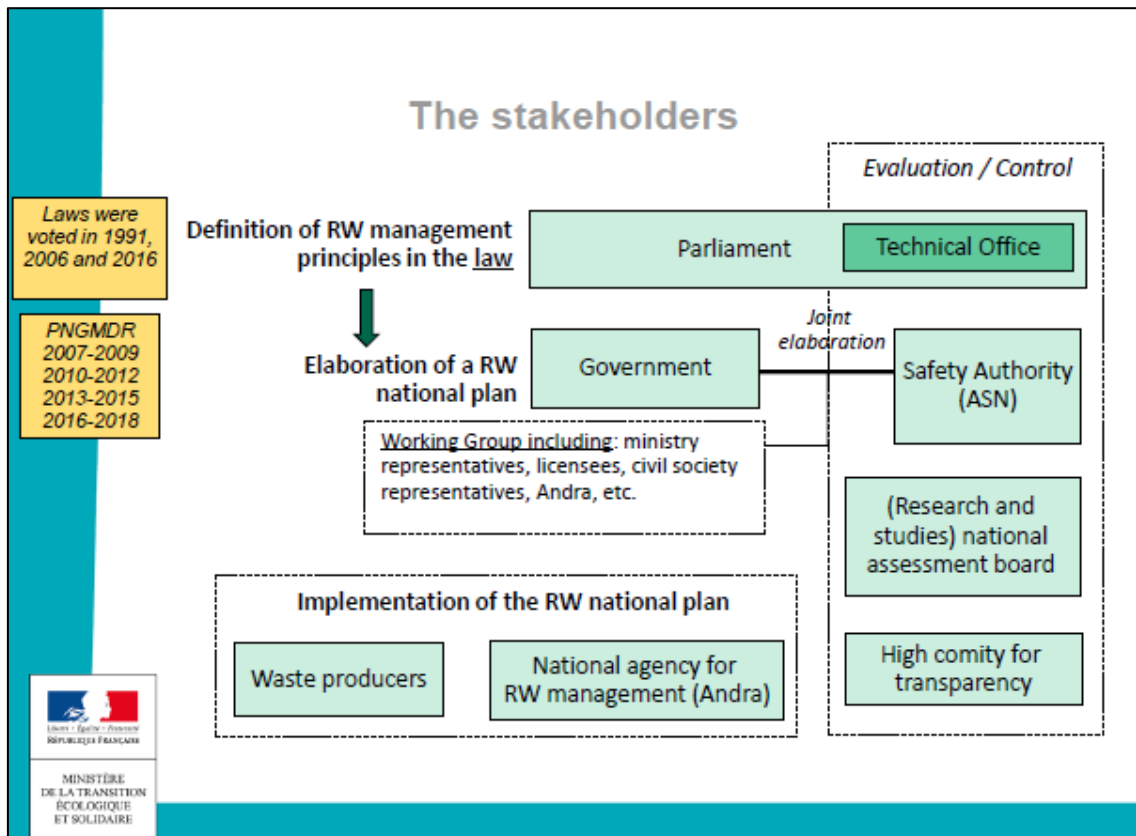
The French *Joint Convention* Report (2017) with regard article 4 of the *Joint Convention* mentions the need to verify the consistency within fuel cycle facilities and charges EDF, as main ordering customer, with the responsibility to identify and characterize the technical constraints of the fuel cycle in order to anticipate dependency between the various steps.

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<sup>2</sup> Environment Code L542-1-2

The French report implementing the 2011/70 Directive mentions the Committee for Industrial Coordination in Radioactive Waste Management (COCIDRA) (art. R.542-73 EC) that ensures that questions relating to interdependencies between different steps of spent fuel and radioactive waste are handled at operational level.

The *National Plan* §1.5.2, “The work of the PNGMDR working group”, describes in brief the involvement of the Working Group in the follow-up of the National Programme. The Working Group meets quarterly with the purpose to monitor actions defined by the National Programme and implementation Decree, to inform members of the Working Group about subjects relating to radioactive materials and waste management, and to provide input for the three yearly revision of the National Programme.



*National Plan elaboration, evaluation and control*

Generators of spent nuclear fuels and radioactive wastes are responsible for such substances without prejudice of the responsibilities of the owner/keeper of these substances, as the entity in charge of nuclear activities<sup>3</sup>. The French state can entrust the management of spent fuel and radioactive waste, and the remediation of contaminated sites to Andra in cases where the responsible party is not identified or defaults<sup>4</sup>. Where the responsible party is identified or if they become solvent, Andra may ask for reimbursement. Under this approach, Andra is not expected to default. This is only possible because Andra is backed by the State.

With regard to the reprocessing by France of spent fuel from third party countries, the legislation clearly covers the subject. France does not permit disposal of “foreign waste”<sup>5</sup> and the import into France of such spent fuel and radioactive wastes for treatment requires intergovernmental agreements<sup>6</sup>. Through

<sup>3</sup> Environment Code L542-1

<sup>4</sup> Environment Code L542-12

<sup>5</sup> Environment Code L542-2

<sup>6</sup> Environment Code L542-2-1

application of the “equivalence rule”, implemented by Decree of 29 August 2017, radioactive waste substitution of wastes disposed in France between foreign countries is made possible, while respecting the principle forbidding the disposal of foreign waste in France.

The legislative framework for the post-closure period is established in the Environment Code Book V, Title IX Chp III Section 4 “Definitive shutdown, dismantling and declassification”. For disposal facilities the shutdown, decommissioning (surface facilities), closure (disposal facility) and post-closure periods are subject to a Ministerial Decree as well as to ASN’s prescriptions<sup>7</sup>. These prescriptions are directed to the title holder and comprise radiological and geological monitoring of the site. Preservation of memory is another crucial element considered under the responsibility of the title holder.

The responsibilities of ASN during post-closure of a BNI are addressed under the Environment Code Chapter II. An updated monitoring and surveillance report is periodically provided to ASN. Other Institutional controls, basically in the form of easements on the site, and activities that could impair the preservation of the disposal site and monitoring locations are set out in the Environment Code<sup>8</sup> and are part of the closure Decree.

For the case of disposal facilities classified on the grounds of protection of the environment e.g.: Cires (non-basic nuclear installation) an undefined surveillance period is mentioned<sup>9</sup>.

Appendix A of the *National Plan* contains a detailed list of studies and research to be carried out, with assignment of responsibilities and specification of time frame for completion. As stated previously, the Decree implementing the prescriptions of the National Programme provides a legal status to these studies.

Appendix B of the *National Plan* describes in some detail the concepts and plans for the post-closure period for the case of an installation classified on the environmental protection grounds (ICPE) and for basic nuclear installations (BNI). An exhaustive list of regulations applicable to the post-closure period of nuclear facilities is included, as well as examples on measures applied to post-closure at the Manche disposal facility, the Aube waste disposal facility, and Cigéo.

Environment Code creates the National Research Board<sup>10</sup> (accounting directly to the Parliament through OPECST) in charge of the annual evaluation of the advance of research and studies relating to Radioactive Materials and Waste linked to the National Programme. This report also includes the international perspective on the subject and is passed to the Parliamentary Office and made public.

### **Roles of different actors**

Government, regulatory authorities, waste producers, waste management organizations and technical support organizations (TSOs) all have defined roles within the national programme.

Through its constitutional powers, the Government develops and sets the national policy which is established by the Parliament and Ministerial Decrees into a national programme summarised in the legally binding *National Plan*.

The role and functions of ASN are established in the Environment Code Book V, Title IX Chapter. II. ASN has a range of functions in the context of spent fuel and radioactive waste e.g. inspection, control, surveillance, evaluation, etc. ASN also participates in the writing of the *National Plan* and follow-up.

The Prefects are endowed with the licencing and supervision role for the case of ICPE facilities.

According to Environment Code<sup>11</sup> the Institute for Radiation Protection and Nuclear Safety (IRSN) is the TSO in support of ASN and Public institutions and has a specific role within the *National Plan*.

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<sup>7</sup> Environment Code L593.31

<sup>8</sup> Environment Code L593-5

<sup>9</sup> Environment Code R.512-39-1

<sup>10</sup> Environment Code L542-3

<sup>11</sup> Environment Code L592 45 to 49

The role of waste producers with regard to the *National Plan* is basically threefold: adhere to the basic principles (mainly optimize the processes for the corresponding management routes and consideration of interdependencies through waste acceptance criteria for next step of waste management); forecast waste production/inventory according to different scenarios, and; make financing provisions for waste management.

Waste producers in France also have responsibilities for the management strategy and in that sense are also waste management organizations. The Directive Report and *National Plan* identify the different organizations acting as managers of radioactive waste i.e.: AREVA, CEA, SOCODEI, EDF, Andra with different roles in: waste production, waste treatment, transport, interim storage and disposal (in this last case under the exclusive responsibility of Andra).

Andra, created as a national agency, is endowed by law<sup>12</sup> with the long term management of radioactive wastes, which includes designing, siting, constructing, operating and closing disposal facilities for radioactive waste including managing interim storage at disposal facilities. This means that all management steps prior to disposal are the responsibility of producers and processing companies acting on behalf of the producers.

A large number of organizations are involved with the National Programme including: the OPECST, the Commission Nationale d'Evaluation (CNE), and the High Committee for Transparency and Information on Nuclear Safety (HCTISN)<sup>13</sup>, and the Local Information Commissions together with National Association of Local Information Commissions<sup>14</sup>.

Coordination among different actors is ensured by the active participation of representatives from the Ministry in the different committees.

## **Regulatory provisions and implementation**

The role and responsibility of the safety regulatory body (ASN) is clearly established in the regulation covering licensing, review and assessment, inspection and enforcement. This subject was examined by the IRRS mission.

Regarding ASN's financial resources, its budget is incorporated in the State budget following a proposal from ASN to the Government. ASN has a human resources plan linked to its financial funds. Human and financial resources as an issue were subject of a recommendation (R4) in the IRRS mission, and later considered during the follow-up mission. In this respect ASN performed an optimization of its structure and activities using a graded approach. Nonetheless, the IRRS follow-up review team concludes the recommendation remains open.

The licensing process for facilities involving waste generation and management is described in the Environment Code and developing Decrees for the case of BNI and ICPE, while for medical facilities licensing is under the Health Code. This item was fully covered under the IRRS mission.

The licensing process for the deep geological disposal facility, Cigéo, is established in the Environment Code<sup>15</sup>. The reversibility principle is established in law, which ensures Parliamentary debate on a matter of such relevance affecting future generations. Citizens involvement is ensured through active participation, together with other stakeholders, in the update, every five years, of an operation working plan for which Andra is responsible. The creation authorization is subject to State Council Decree (the highest rank of regulations) and subject to a cohort of revisions by different Administrations and a public

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<sup>12</sup> Environment Code L542-12

<sup>13</sup> created through the Environment Code L125-34 to L125-40

<sup>14</sup> Environment Code L125-17 to L125-19

<sup>15</sup> Environment Code L542-10-1

enquiry. Equally relevant is the fact that final closure of the deep geological disposal facility requires a law.

There is an open policy of communication with regard to waste management. This ensures public access to waste inventories, as well as other information, and active public participation in reviewing and updating the *National Plan* at all stages. This public information and consultation policy is supported at Law level.

### **ARTEMIS observation**

The Review Team noted that France's legal and regulatory structure provides a national framework for the safe management of radioactive materials and radioactive waste.

The Review Team noted that the National Programme develops in detail, and in a comprehensive way, the strategy for the implementation of the objectives of the National Policy. National legislation and its practical implementation covers all types of radioactive waste and used fuel from producers in France as well as foreign waste being processed in France. The national legislation and regulatory framework ensures that the management of radioactive material and radioactive waste are covered from generation to disposal.

The Review Team noted that National legislation and its practical implementation ensures the establishment and maintenance of the necessary competence and skills needed by the different institutions and operators to discharge their functions. This competence and skills also extends to the academy. ASN representatives informed us that acquisition of specific expertise for the Cigéo assessment and inspection during construction is needed and is foreseen. To achieve this the Ministry for Higher Education, Research and Innovation (General Directorate for Research) and the Ministry for Transition Ecologique and Solidaire are coordinating the French research efforts. Andra is financed for research linked to Cigéo by the "research tax" that is obtained from the operators of nuclear installations.

The Review Team noted that National legislation and the regulatory framework provides for the assignment of responsibilities for the preparation, review, implementation and follow-up of the *National Plan*. The legal and institutional arrangements put in place to prepare and update the *National Plan* are adequate and solid.

The Review Team noted that the *National Plan* recommendations define the different steps to follow in order to comply with the strategy and thus the objectives. Of particular relevance is the commitment at Parliamentary and Government level to advance effectively the implementation of the National Policy. This is evidenced by the transposition into a Ministerial Decree of the *National Plan* recommendations as a means to ensure the implementation of the various activities in the strategy, and thus to fulfil the National Policy. This is considered a good practice.

The Review Team noted that in addition to the interdependencies associated with the waste acceptance criteria for successive management steps, the *National Plan* scenarios analyses implicitly cover the interdependencies between generation and capacity for processing, storage and disposal. Of particular note is the "waste management industrial programme", (PIGD) that ensures cooperation between Andra and the waste producers, and contains fundamental data for the design and scheduling of the Cigéo project: scheduling deliveries of wastes, types of transport packaging, transport and operating modes, packaging capacity hypothesis, etc.

The responsibility of the producer for the management of wastes it generates and their transfer for disposal are covered by regulation. The responsibility of the producer is unlimited in time. The liability as producer of the waste in order to finance the management costs of the waste is unlimited. The producer maintains the ownership over the wastes generated.

The Review Team noted that the role within the *National Plan* of the different actors and coordination of the relevant bodies: the Government, regulatory body (ASN), waste producers, waste management organization, TSO (IRSN), NGOs and others (OPECT, HCTISN) is adequately managed.

The Review Team noted that the institutional arrangements associated with waste management policy and strategy development and implementation are effective.

The Review Team noted that the legislative framework adequately encompasses the different elements of the regulatory pyramid.

The Review Team noted that the IRRS Mission (2014) observed that there were some topics missing from the French regulations, but was informed that these will be covered through completion of an ongoing project for new resolutions and guides. At that time, ASN was drafting new guidance about radioactive waste disposal facilities. The new WENRA reference levels for radioactive waste disposal facilities have been already integrated in this draft guidance and will address aspects related to the authorization for closure of a disposal facility. Many general regulations and guides for BNIs are also applicable to radioactive waste management facilities (RWMF), however ASN has been drafting some guidance specific to predisposal management of radioactive waste such as guidance on: waste storage facilities; packaging of radioactive waste; a study of waste management and a summary of waste produced. The IRRS Mission Report noted also that "... The available regulations and guides may cover basic safety aspects of RWMFs, however radioactive waste safety issues should be more appropriately addressed once the regulations under development will be published. Therefore, ASN decisions, which are currently being drafted, should be finalized without delay."

The IRRS Mission Report noted that "*more specifically, ASN should consider preparing safety guides on the standard format and content of a safety case, site criteria, etc., related to the upcoming proposal from Andra of a near- or sub-surface disposal facility for LLW-LL waste (e.g. radium bearing and graphite waste) in a timely manner (depending on the options to be proposed by Andra in 2015). ASN already published in 2008 a note about general safety orientations for site selection for the disposal of LLW-LL, but this general note has to be updated and completed with additional specific guides.*" At that time a Suggestion number 18 was issued by the IRRS Mission: "ASN should consider gaining specific expertise and developing specific safety guides (standard format and content of a safety case, site criteria, etc.) related to a near-/sub-surface disposal facility in a timely manner (depending on the options to be proposed by Andra in 2015)".

The IRRS Follow-up Mission (2017) noted that following the 2014 IRRS mission, ASN requested its technical support organization (IRSN) to review its existing near and sub-surface disposal guidelines. These guidelines are mainly concerned with the siting of a near or sub-surface disposal facility, and were published in 2008. Specifically, ASN requested advice on what aspects of the guidelines required to be updated and also what needed to be added. IRSN provided the results of its review in June 2017 in its Avis IRSN/2017-00216. The delays which have occurred in implementing this suggestion were due to competing national priorities to allow IRSN's assessment of the Cigéo deep geological repository project.

The IRRS Follow-up Mission (2017) also noted that ASN and IRSN have decided to form a working group which also includes Andra and some waste producers, to develop a new near or sub-surface disposal guide. It is expected that the terms of reference and the composition of the working group would be created before the end of 2017. With respect to gaining specific expertise as made in the suggestion, ASN has stated that it has appointed a project manager for the development of the guide since the 2014 IRRS mission, and has also recruited several positions in the waste management area.

The IRRS Follow-up Mission (2017) concluded that the Suggestion S18 remains open. Since the 2014 IRRS mission, no new or updated safety guide on near surface or sub-surface disposal facilities has been produced.

After discussions with the representatives of ASN, the Review Team concludes a suggestion which encourages ASN in a timely manner to close the suggestion S18 provided by the IRRS Mission.

In addition, the Review Team was informed that since the IRRS Mission (2014), ASN improved the requirements regarding waste management in BNI and processing of radioactive waste :

- In 2015, ASN issued the resolution 2015-DC-0508 of 21 April 2015 on the management of waste and on the annual report of the waste produced in a BNI. This resolution was completed in 2016 by Guide n°23 on drafting and modification of the waste zoning plan in BNI;
- In 2016, ASN also issued Guide No 24 on the management of soils polluted by BNI activities, Guide N°6 Final shutdown, decommissioning and delicensing of basic nuclear installations in France, Guide N°14 Remediation of structures in basic nuclear installations in France;
- In 2017, ASN issued the resolution 2017-DC-0587 of 23 March 2017 on packaging of radioactive waste and conditions for acceptance of radioactive waste packages in disposal facilities. It specifies the interactions between the waste management operator, the waste producers and ASN.

The Review Team noted that the regulatory bodies, Government and Prefects (for the case of ICPEs) have assumed different responsibilities in radioactive waste management. The licensing and oversight of ICPE by the Prefects may be considered an example of a graded approach. The Review Team noted that financing of the regulatory body was subject to IRRS scrutiny and the mission concluded in a recommendation (R4) that *“The Government and ASN should explore new ways to ensure that human and financial resources needed for effective regulation of nuclear and radiation safety are sustained into future as ASN’s workload increases”* based on GSR Part 1 Requirement 3 and Requirement 16. The Review Team endorses this recommendation.

The Review Team noted that the process for licensing, review, assessment, inspection and enforcement are adequately covered under legal instruments. This subject was fully covered by the IRRS mission. Of particular interest to the Review Team was the specific licensing process for the deep geological disposal characterised by the involvement of the Parliament (particularly in defining the reversibility principle as well as reserving the closure authorization), and different stakeholders through different working groups. As an outcome of this interaction with stakeholders, the definition of a pilot phase before the effective operation of the facility is commendable.

The Review Team noted that the public consultation phase organised on the National Strategy as described by the French counterparts is a weak element and an opportunity for improvement was identified by DGEC. The Review Team agrees and acknowledges the efforts by the Government to find a way to develop or improve better instruments to promote an effective public participation in the public consultation process.



## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *The National Programme recommendations serve to define the different steps to follow in order to comply with the strategy and thus the objectives of the National Policy. France’s National Programme recommendations are transposed into a Ministerial Decree as a means to ensure the implementation of the various activities in the strategy and thus to fulfil the National Policy.*

(1)	<b>BASIS: GSR Part 1 Requirement 1, para. 2.3 states that</b> <i>“National Policy and strategy for safety shall express a long term commitment to safety. The National Policy shall be promulgated as a statement of the Government’s intent. The strategy shall set out the mechanisms for implementing the National Policy...”</i>
GP2	<b>Good Practice: The legally binding character of, and continuing government commitment to, the key actions identified in the National Programme for the management of spent fuel and radioactive waste ensures the progress of the objectives of the National Policy.</b>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *The IAEA IRRS Mission (2014) noted that some regulation needs to be elaborated to complement the regulatory framework in force. The IRRS Follow up Mission (2017) noted that some documents were finished and others still had to be finished and issued by the ASN. According to ASN, the storage safety requirements and the disposal safety requirements, will be issued in 2018.*

(1)	<b>BASIS: GSR Part 1 Requirement 32,</b> <i>“The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based.”</i>
(2)	<b>BASIS: GSR Part 1 Requirement 33,</b> <i>“Regulations and guides shall be reviewed and revised as necessary to keep them up to date, with due consideration of relevant international safety standards and technical standards and of relevant experience gained.”</i>
(3)	<b>BASIS: GSR Part 5 Requirement 3,</b> <i>“The regulatory body shall establish the requirements for the development of radioactive waste management facilities and activities and shall set out procedures for meeting the requirements for the various stages of the licensing process....”</i>
S3	<b>Suggestion: ASN is encouraged to finalise in a timely manner the development and issuance of updates and revisions to requirements related to the storage and disposal of radioactive waste, as identified in the 2017 IRRS follow-up S18.</b>

## 2. NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

### 2.1. SCOPE

#### France position

#### Overview of management plans for all spent fuel and radioactive waste streams/types management steps

The general strategy for radioactive materials and waste management is to develop suitable predisposal, storage and disposal methods for each waste type taking graded approach into account. Reutilization is considered for all the radioactive materials. Materials are declared as waste only when no further use is envisaged. Estimates of future storage and disposal capacity are based on existing and future accumulation of materials and waste in the *National Inventory*, and on the expected technical development with a clear margin. The continuous improvement principle is applied to all stages of radioactive materials and waste management.

France is one of the few countries in the world with a closed fuel cycle with industrial reprocessing capacity and production of recycled fuel both from plutonium and uranium. France's strategy is to deploy fourth generation fast neutron reactors and with multiple recycling of fuel. At the moment France reprocesses uranium based fuel once and produces MOX from the plutonium. They also have technical capabilities for producing fuel from the recycled uranium but this process is not currently in use. While technical development takes place for the options of fast neutron reactors and multiple recycling, France will store its spent MOX fuels. These are declared as radioactive materials, not waste, since the aim is to use these as a source of fast neutron reactor fuel. As a contingency plan, France has also carried out R&D work for the disposal of spent fuel without reprocessing in case the multiple recycling of fuel is not realized in the future.

For the disposal of radioactive waste, France has operational predisposal and disposal facilities for VLLW and LLW/ILW-SL wastes. For both of these waste types the disposal solution is near surface disposal with different barrier design. One LLW/ILW-SL disposal facility is already closed and is now in monitoring phase.

For LLW-LL, storage and treatment processes are available but on both aspects several R&D projects are ongoing. The technical sub-surface disposal concept is under development and site studies have started. For LLW-LL disposal the present goal is to develop an overall industrial system for the management of all the LLW-LL radioactive waste by end of 2019. The storage capacity for this type of waste is sufficient for the schedule of the disposal facility development. As a contingency, the deep geological disposal facility concept includes in its safety case an alternative scenario for hosting LLW-LL disposal rooms.

The planned solution for ILW-LL and HLW is reversible disposal in deep geological clay formation. The R&D work for Cigéo has been ongoing for decades with underground laboratory in operation from 2003 at the potential disposal area. Andra submitted the safety option file for ASN review in 2016. The review was finalized in January 2018 with the main conclusion that the technical concept is satisfactory although complementary studies were required. A construction license is expected to be submitted in 2019 and the facility is expected to be in industrial operation around 2030. The existing and planned storage capacity for the waste to be disposed of in Cigéo is on the responsibility of the waste producers and has to be based on the time schedule of the Cigéo project with a margin.

There are still a few waste types without a proper management route defined. As a whole this category is less than 0.3 % of the whole inventory by volume. The *National Plan* sets a goal to find a final solution for these by 2030.

## **Developing and implementing national strategy**

The National strategy for radioactive waste and spent fuel management is given in the *National Plan* which covers the whole field of nuclear materials and waste management including collection, pre-treatment, packing, storage, transportation, reuse and disposal. The *National Plan* was introduced to the system in the 2006 Programme act on the sustainable management of radioactive materials and wastes which required the plan to be established and to be updated every three years.

The *National Plan* is drafted by a pluralistic working group chaired by the DGEC and ASN. Other parties in the working group are nuclear license holders, representatives from ministries and society, environmental organizations and local information commissions. The working group meets yearly 4-5 times to monitor the progress of the existing programme based on the status reports on the requirements and indicators defined in the plan. Another task of the Working Group is to plan and prepare the next version of the *National Plan*. In addition to the follow-up of the progress, national energy policy, *National Inventory*, ASN opinions, IRSN assessments, National Review Board annual report, OPECST review, HCTISN recommendations and consultations with the stakeholders are taken into account as input for the *National Plan*. The final version of the plan is made legally binding by publishing a ministerial order and decree including all the recommendations with responsibilities given in the plan.

The latest version of the plan was revised to give more focus on strategic planning. As a new initiative, with the latest version of the plan, a draft version was submitted to public consultation and to a strategic environmental assessment for transparency and to obtain a more integrated overview on the challenges. Results of these were integrated in the final plan.

## **ARTEMIS observation**

The scope of the *National Plan* is comprehensive for all waste types, alternative scenarios and management routes. Preparation, implementation and follow-up of the plan are well organized and main stakeholders are committed to the plan. Public participation is organized in an exemplary way on local and national level. Based on the consecutive plans, continuous improvement of the plan takes place efficiently. Making the *National Plan* legally binding by issuing an order and decree is a solid way to implement the plan and it also addresses the political commitment to radioactive waste management which is essential for success.

The 2006 Act “On sustainable management of radioactive materials and waste” and the *National Plan* together form a solid long term plan for the national radioactive materials and waste management. The three year interval of updating the *National Plan* seemed a challenging schedule, especially when considering radioactive waste management projects tend to be of very long duration. The Review Team learned that the frequent updating schedule of the *National Plan* was a result of the fact that during the last twelve years, radioactive waste management has developed rapidly in France. To keep up with the pace, it had originally been seen necessary to update the plan every third year.

During the discussions it was explained that France had already noticed that in the future the whole plan does not have to be updated with same frequency and they introduced an idea of dividing the *National Plan* in strategic and operational parts. The former would be updated at a six year interval and the latter with a three year interval. The suggested approach would give the *National Plan* a more strategic point of view and the Review Team supports the suggested idea.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *The Review Team observes that ASN has a central role in the development of the National Plan and having a position in the working group is standard practice. However, the Regulator’s role as co-chair of the working group is unusual. The Review Team has identified no concern with the level of independence exhibited by ASN. However, it would be helpful if a better definition of ASN’s role as co-chair of the working group were published. It is essential for ASN to remain visibly independent, in particular in its assessment of the work produced under the National Plan. In order for ASN to maintain the visibility of its high standards of independence to date and into the future, it is suggested that ASN’s role as co-chair be formalized.*

(1)	<b>BASIS: GSR Part 1 (Rev 1) Requirement 4 para 2.7 states that</b> <i>“An independent regulatory body will not be entirely separate from other governmental bodies. The government has the ultimate responsibility for involving those with legitimate and recognized interests in its decision making. However, the government shall ensure that the regulatory body is able to make decisions under its statutory obligation for the regulatory control of facilities and activities, and that it is able to perform its functions without undue pressure or constraint.”</i>
(2)	<b>BASIS: GSR Part 1 (Rev 1) Requirement 4 para 2.9 states that</b> <i>“No responsibilities shall be assigned to the regulatory body that might compromise or conflict with its discharging of its responsibility for regulating the safety of facilities and activities.”</i>
(3)	<b>BASIS: NW-G-1.1 section 7.1 states that</b> <i>“The committee should contain representatives of the regulatory body, the radioactive waste management organization, the radioactive waste generators and other organizations with responsibilities in the area of radioactive waste management.”</i>
S4	<b>Suggestion: It is suggested that the role of ASN in the National Plan working group be formalized to enhance its high standards of independence.</b>

Management principles defined in the *National Plan* follow the national policy and cover the principles given in IAEA safety standards. A graded approach is also taken into account when defining management routes. There are still open questions, for example on LLW/ILW-LL and sealed source disposal, but the plan aims to solve these by the end of 2030 when disposal option for all waste categories should be available. It also covers the storage capacity needed to cope with the expected time schedules and to some extent delays which might occur.

A closed fuel cycle and its implications on the waste management strategy were discussed during the review mission. Implementing waste management strategy with closed fuel cycle includes uncertainties related both to technical development and energy policy development. To address these uncertainties France has demonstrated on conceptual level the feasibility of disposal of spent fuel to Cigéo without reprocessing and the latest version of the *National Plan* includes still several requirements on the future R&D for the disposal option for spent fuel. It also addresses to the storage capacity needs which might be needed because of the uncertainties. Preparing for both the reference and variant scenarios is a solid approach to cope with the uncertainties related to the closed fuel cycle.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *The National Plan is updated at three year intervals by a pluralistic working group consisting of nuclear safety regulators, nuclear license holders, representatives from ministries and society, environmental organizations and local information commissions. The working group meets yearly 4-5 times to follow the progress of the program and also to prepare the next version of the plan. In addition to the follow-up of progress, national energy policy, National Inventory, ASN opinions, IRSN assessments, National Review Board annual report, OPECST review, HCTISN recommendations and consultations with the stakeholders are accounted for in the National Plan. The last report was also under public consultation and strategic environmental assessment. The implementation of the plan is made legally binding by publishing an Order and a Decree.*

(1)	<p><b>BASIS: GSR Part 1 (Rev 1) Requirement 10 states that</b> “<i>Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel</i>”</p> <p><i>The government shall make provision for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities, and the safe management of spent fuel.”</i></p>
(2)	<p><b>BASIS: GSR Part 5 Requirement 2 states that</b> “<i>National policy and strategy on radioactive waste management</i>”</p> <p><i>To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors. The policy and strategy shall be compatible with the fundamental safety principles [2] and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste. (See Ref. [5].)</i></p>
GP3	<p><b>Good Practice: The French approach to developing and implementing the National Plan: the scope of the National Plan is comprehensive including all radioactive materials and waste types, alternative scenarios and management routes; preparation, implementation and follow-up of the plan is well organized and main stakeholders are committed to the plan. Based on the consecutive plans, continuous improvement of the plan takes place efficiently.</b></p>

## 2.2. MILESTONES AND TIMEFRAMES

### France position

Milestones and timeframes for the strategy are set on in the act on the sustainable management of radioactive materials and waste, 2006. It gives timeframe for the R&D work on separation and transmutation, reversible disposal in deep geological formation and storage and also set goals for developing a disposal solution for graphite and radium bearing wastes, developing the storage solution for tritium-containing waste, finding a disposal solution for spent sealed sources, appraisal of management solutions for NORM waste and uranium mining based waste. The milestones and timeframes have been evaluated and updated if needed within the revision of the *National Plan*.

### **ARTEMIS observation**

The milestones and timeframes for the waste management programme appear to be well-defined, followed up regularly and updated based on the latest technical knowledge and energy policy which may have a big effect on the existing plans.

The latest *National Plan* sets 83 different milestones for the future. All of these aim for finding solutions for safe management of the nuclear material and waste inventory of France including future scenarios in the technical and policy fields.

Monitoring the progress is the responsibility of the working group which prepares the *National Plan*. To act on this, the working group meets 4-5 times per year and follows all the ongoing projects set in the plan. On the parliamentary level the OPECST reviews the draft *National Plan* and ensures that it complies with the national policies (energy and radioactive materials and waste management) and legal requirements.

## **2.3. PROGRESS INDICATORS**

### **France position**

Although many indicators are used, progress indicators for the *National Plan* as a whole are not given but the progress of the strategy is monitored by the pluralistic working group which meets regularly several times a year, by the CNE in its annual reviews on the research done, and by the OPECST on parliamentary level during the update of the *National Plan*.

### **ARTEMIS observation**

Even though there are not specific progress indicators defined for the *National Plan*, the Review Team is satisfied with the monitoring performed.

### 3. INVENTORY OF SPENT FUEL AND RADIOACTIVE WASTE

#### France position

The *National Inventory* is based on five guiding principles: Availability of information, Comprehensiveness, Neutrality, Transparency and Responsibility.

The waste classification system of France is divided in various categories based upon Activity levels and half life of radioactive waste.

There are four categories radioactive waste: very low-level, low-level, intermediate-level and high-level (VLLW, LLW, ILW, HLW) with a distinction between short-lived (SL) and long-lived (LL).

VLLW come from operations, maintenance and dismantling of nuclear power plants, fuel cycle facilities and research centres. A part of Natural Occurring Radioactive Materials are in this category.

LLW-LL typically consists of radium bearing waste, graphite waste and spent sealed sources. Some Natural Occurring Radioactive Materials are also in this category.

LLW-SL comes mainly from maintenance and operations of nuclear power plants, fuel cycle facilities and research centres.

ILW-LL comes mainly from spent fuel reprocessing, maintenance and operations of reprocessing plants for example, compacted waste from fuel assemblies, technological waste and sludges.

HLW is from nuclear power plants and research centres and to lesser extent from defence activities and predominantly comprises vitrified waste from the reprocessing of spent fuel.

		Very short-lived waste (i.e. containing radionuclides with a half-life < 100 days)	Short-lived waste in which the radioactivity comes mainly from radionuclides with a half-life ≤ 31 years	Long-lived waste containing a significant quantity of radionuclides with a half-life > 31 years
hundreds Bq/g	Very low level (VLL)	Management by radioactive decay	Recycling or dedicated surface disposal (CIRES – the industrial grouping, storage and disposal centre in the Aube département)	
Millions Bq/g	Low level (LL)		Surface disposal (Aube disposal centre, CSA)	Solutions being studied under Art. 4 of the Waste Act
	Intermediate level (IL)			Solution planned under Art. 3 of the Waste Act
Billions Bq/g	High level (HL)	Not applicable <sup>5</sup>	(Planned CIGÉO disposal centre)	

TABLE 4: RADIOACTIVE WASTE CLASSIFICATION PRINCIPLES

*Waste Classification System of France*

Andra is the organization in France which is assigned the task of surveying radioactive materials and waste and compiling this in a *National Inventory* of Radioactive Materials and Waste. Andra is empowered to do the *National Inventory* and survey tasks by the Environment Code (L542-12). The *National Inventory* uses a methodology with data verification and has the aim to list all the waste and materials present in France including waste and materials from abroad. Andra has performed this survey since 1992 and in the beginning submissions were based on voluntary declarations by the waste producers. Since 2006, it has been mandatory to provide an overview of present and future waste



volumes, based on projected scenarios with snapshots of stocks on the key dates, defined in a Ministerial Order of 9 October 2008 (last modified 16 March 2017). The aim is to help the authorities prepare the *National Plan* for the management of radioactive materials and waste by providing them with a realistic inventory that reflects the waste producers' position at the time of their declarations.

The producers of radioactive materials and waste are the nuclear industry (EDF, AREVA, CEA) who manage the nuclear sites, and the non-nuclear power industries like hospitals, universities research etc. Each site appoints 'officers' who are well acquainted with the state of stocks and who complete the declaration forms (the declarant). For the major waste producers only, the declarations are then checked and validated by a responsible person from each organization (producer validator). The reliability of declarations relies on the producer's internal monitoring systems: verification and validation systems and re-reading for consistency.

Andra gathers this information and correlates it to various other sources to which it has access. Andra examines also the proposed waste management solution. This information is presented in three documents: *The Synthesis Report* provides a detailed description of all current and future radioactive materials and radioactive waste found in France. The *Geographical Inventory* presents the sites producing, treating, conditioning, storing and disposing of radioactive waste. The *Catalogue of families* presents the waste survey data grouped into families made up of waste incorporating similar characteristics. A last document "The Essentials" provides an overview of the main figures. Before publishing the reports a steering committee of the *National Inventory* (COFIL) validates the presentation and consistency of the data. The reports are made public on the Andra Inventory website ([www.inventaire.andra.fr](http://www.inventaire.andra.fr)).

### **ARTEMIS observation**

The Review Team noted that in accordance with the Environmental Code (L542-12) the Government assigned Andra the task of establishing, updating every three years and publishing the *National Inventory* of radioactive materials and radioactive waste found in France, including its location. Since the Waste Act of 1991, Andra publishes reports ("*observatories*") and since 2006, the *National Inventory* contains information of all radioactive materials and existing radioactive waste in France on the basis of the availability of information by the waste producers. The inventory helps the authorities to prepare the *National Plan* for the management of radioactive materials and waste.

The Review Team noted that the comprehensiveness of past and existing radioactive waste, transcription of collected data, by web based declaration and the transparency about the origin and the responsibility of producers for their declaration ensures a reliable Inventory. Andra does a periodic consistency check and examines if the waste management solution proposed by the producer is suitable for disposal. In addition cross checking the data for radionuclides and radioactivity may be considered. Finally a steering committee validates the conclusions.

The Review Team noted that:

- there are around 1,200 sites within the *National Inventory* which declare their waste to Andra;
- disused spent sources are not declared in the *National Inventory as disposed* in m<sup>3</sup> due to the variability of possible management routes and conditioning assumptions;
- NORM from extraction of rare earth elements is included in the *National Inventory*;
- waste and spent fuel imported from other countries is included in the *National Inventory* and this waste has to be returned to the customer in his country of origin, after which the *National Inventory* is up-dated;
- mining waste that has been disposed of permanently or disposed of near the former mining site is in the *National Inventory*;



- future arisings of waste are estimated in the *National Inventory* with different planning scenarios (a scenario with forecast of radioactive waste and materials evaluated at the end of 2030, at the end of 2040, or at the end of facility life (for radioactive waste only), scenarios with forecast of radioactive waste at the end of facility life among which scenarios of renewal and a scenario of non-renewal of nuclear power production after 40 years of service life);
- the *National Inventory* is published on a very informative website with an interactive geographical map designating all known location of radioactive waste. The open data records show location and name of the facility which are in possession of waste belonging to a family with their radioactivity and principal radionuclides. Management of disused spent sources is explained in an e-book.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *In accordance with the Environment Code<sup>16</sup> the Government assigns Andra the task of establishing, updating every three years and publishing the National Inventory of radioactive materials and waste found in France, as well as its location. Since the Waste Act of 1991 Andra publishes reports (observatories) and since 2006 the National Inventories containing information of all radioactive materials and existing radioactive waste in France on the basis of availability of information by the waste producers. The Inventory helps the authorities to prepare the National Plan for the management of radioactive materials and waste. The comprehensiveness of past and existing radioactive waste, transcription of collected data, by electronic declaration and the transparency about the origin and the responsibility of producers for their declaration ensures a reliable Inventory. Andra does a periodic consistency check and examines if the radioactive waste management solution proposed by the producer is suitable for disposal. In addition cross checking the data for radionuclides and radioactivity may be considered. Finally a steering committee validates the conclusions after which the National Inventory is published on the website [www.inventaire.andra.fr](http://www.inventaire.andra.fr).*

(1)	<b>BASIS: GSR Part 1 req. 35, para. 4 states that</b> <i>“the regulatory body shall make provision for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities.”</i>
(2)	<b>BASIS: GSR Part 1 req. 36, para. 4 states that</b> <i>“the regulatory body shall promote the establishment of appropriate means of informing and consulting the public about possible radiation risks associated with facilities and activities.”</i>
(3)	<b>BASIS: GSR Part 5 req. 4, para. 3 states that</b> <i>“Responsibilities of operators in maintenance of records and reporting as required by the regulatory body, including those records and reports necessary to guarantee the accountability for and traceability of radioactive waste throughout the different processes of radioactive waste management.”</i>
GP4	<b>Good Practice: The French approach to compiling, maintaining, and publishing the National Inventory, providing the National Plan a thorough record of all radioactive materials and waste types, and the proactive effort to identify legacy inventories and sources.</b>

<sup>16</sup> Environment Code L542-12

## 4. CONCEPTS, PLANS AND TECHNICAL SOLUTIONS FOR SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

### Solutions, operational and/or planned, for the management of all types of spent fuel and radioactive waste

#### France position

The review for this topic commenced with the French *National Plan* for the management of Radioactive Materials and Waste as the foundation document, supplemented by several other documents shared with the review team in advance, including:

- list and description of laws and decrees regarding radioactive waste management;
- Sixth National Report on Compliance With the Obligations of the Joint Convention on the Safety of the Management of Spent Fuel and on the Safety of the Management of Radioactive Waste;
- The results of peer review reports, in particular Integrated Regulatory Review Service (IRRS) and review on the safety option dossier for Cigéo;
- *National Inventory* of Radioactive Materials and Waste.

Presentations containing more detailed information on various aspects of this topic were delivered by knowledgeable experts from the Government Ministry (DGEC and DGPR), the regulatory body (ASN), the radioactive waste management agency (Andra) and operators (EDF, CEA, AREVA). The experts responded to questions for additional clarification from the review team, as well as questions intended to test the degree of thoroughness in the approach that has been implemented.

#### ARTEMIS observation

The *National Plan* is a comprehensive document providing up to date details of the plans and current status for management of all types of spent fuel, radioactive waste, and nuclear materials some of which could become waste. The comprehensive nature of this document that thoroughly describes the basis for the entire nuclear waste and nuclear materials program in France is fully described under topic 2, “National Strategy for Radioactive Waste and Spent Fuel Management”, and indeed this has been highlighted as a Good Practice.

Overall, the evidence presented provides a compelling case that:

- The plan is based on a robust *National Inventory* (as described under review topic 3);
- Routes for disposal exist and are in operation for >90% of the volume of radioactive waste in France;
- The routes that are in operation are executed confidently and safely according to the rules in France consistent with the *National Plan*;
- Solutions are tailored to the waste types and characterization, with consideration of optimization; and
- Research & Development priorities focus primarily on routes not yet in service, with a legally binding commitment to have routes established for all wastes by 2030.

The plan and the materials presented lend to being discussed according to broad categories of radioactive wastes and nuclear materials.

### *Very short-lived waste*

#### **France position**

Very short-lived waste is defined as that containing radionuclides with < 100 days half-life. These wastes are primarily produced from nuclear medicine and laboratories, and are either stored until no longer radioactive, or processed more quickly due to other hazardous properties (e.g. biohazard). As such, these wastes do not require disposal as radioactive waste.

#### **ARTEMIS observation**

The plan and evidence presented indicate that the management arrangements for this waste are adequate, with no priority issues requiring attention. The review team concluded that no deeper questioning for this waste category was warranted.

### *Legacy waste sites*

#### **France position**

This category pertains to “*those places (except for mining processing residues and waste rock repositories) where radioactive waste not under Andra responsibility is placed and for which the producers or those in possession did not, at the time of placing it there, envisage management in existing or planned external routes dedicated to the management of radioactive waste.*” Many of the sites are associated with historical burials at or near sites of nuclear facilities. The current three year cycle of the *National Plan* requests completion of investigations into these possible sites and a substantiated presentation of disposal management strategies identified.

#### **ARTEMIS observation**

The review team applauds the identification of this category, the efforts and commitment expended to identify and study sites of potential concern, inclusion of such wastes in the *National Inventory* of radioactive wastes and the performing of studies into appropriate remediation strategies. The review team concluded that management strategies are appropriate and effective.

### *Waste from mining processing residues and waste rock*

#### **France position**

Uranium mines were worked in France from 1948 until 2001. Wastes from the mining and processing of ores were stored near the location of mining and processing. These residues contain concentrations of radium and uranium.

The currently adopted management method is *in-situ* management with ongoing evaluation of long-term performance of both the embankment structural stability, and mobility of contaminants in waters. These studies will continue for at least next two *National Plan* cycles with the goal of confirming the long-term management strategy.

#### **ARTEMIS observation**

The review team concluded that management strategies are appropriate and effective and no deeper questioning for this waste category was warranted.

## *Waste containing high levels of NORM*

### **France position**

Some industrial activities have resulted in wastes with higher concentrations of natural radioactive substances. Such wastes include foundry sand, zirconium-based refractory materials from glass making industry, processing of monazite, manufacture of zirconium sponges or decommissioning of certain industrial facilities.

The typical management strategies include in-situ management, reutilization where practical, or disposal in conventional facilities, depending on concentrations of NORM. Higher concentration wastes will be disposed at Cires, the national facility for VLLW disposal managed by Andra. Wastes containing concentrations above the acceptance criteria at Cires will continue to be stored pending repository for LLW-LL wastes.

Four facilities for conventional wastes have been authorized to receive some of the wastes in this category. Studies have been undertaken to demonstrate that this method of management is acceptable from both a radiation protection and environmental protection standpoint, and it may be possible to further extend this practice. Controls around management of these wastes will be modified as per Council Directive 2013/59/Euratom of 5 December 2013 (health protection against exposure to ionizing radiation). Changes will be presented in the *National Plan*.

### **ARTEMIS observation**

The Review Team concluded that management strategies are appropriate and effective and no deeper questioning for this waste category was warranted. The review team also noted that the developments in authorizing four conventional waste disposal facilities to receive some of these wastes may be relevant when investigating options for optimizing VLLW disposal strategies. This will be discussed further under the VLLW section below.

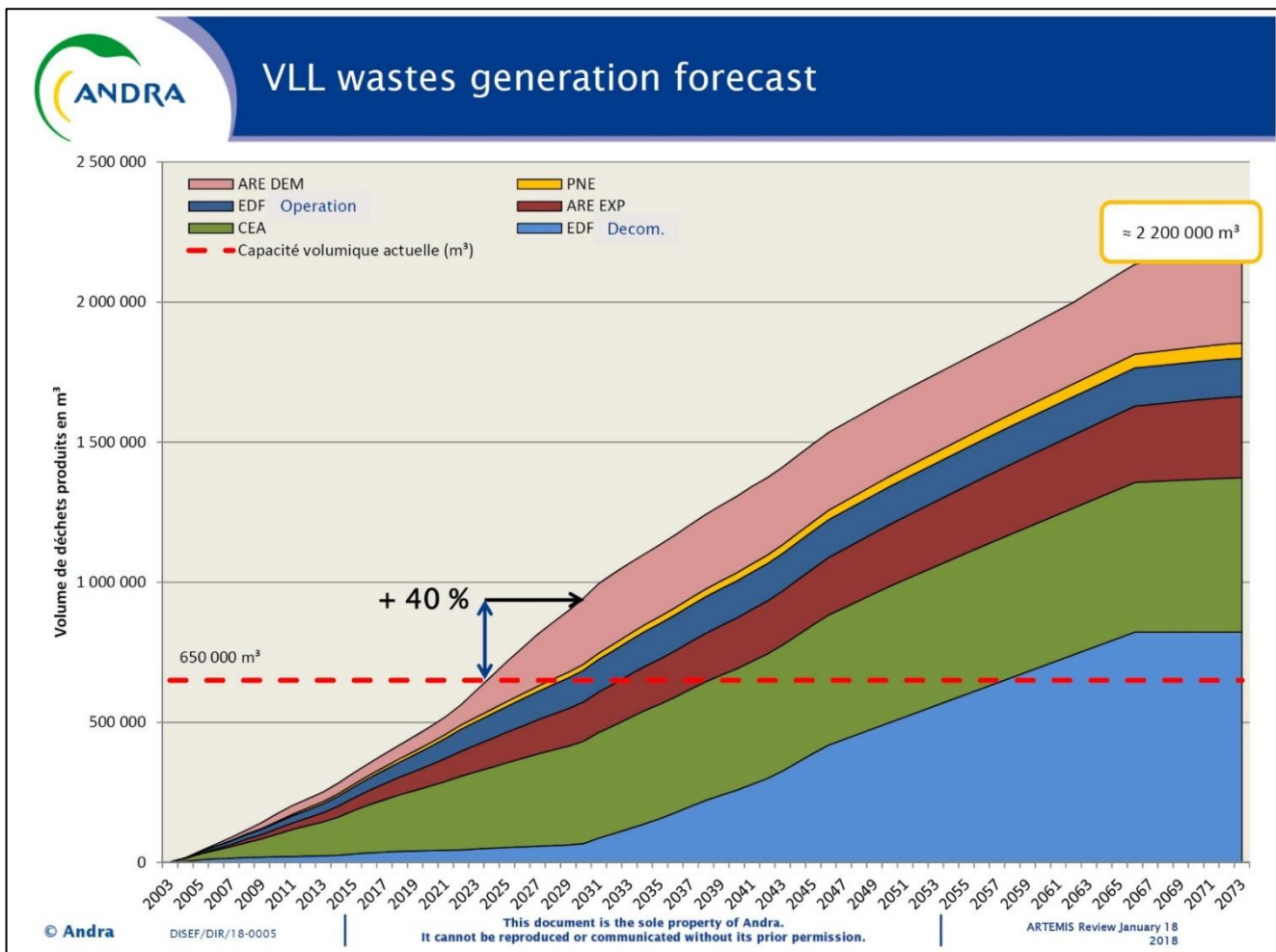
## *Very low level waste (VLLW)*

### **France position**

Clearance levels have not been implemented in France in favour of a more cautious approach of zoning, whereby all wastes generated in a zone determined to have the potential for radioactive contamination is segregated and managed as radioactive waste. The larger volumes of VLLW are primarily generated as a result of decommissioning of nuclear facilities. Andra has developed a VLLW disposal facility Cires with capacity for 650,000 m<sup>3</sup>.

Andra has been accepting VLLW for disposal since 2003 and Cires is currently filled to 43% authorized capacity. With more NPP approaching end of operational life, inventory projections forecast that the current capacity of Cires could be exhausted by 2025, with total projections for the disposal capacity required > 2,000,000 m<sup>3</sup>. Andra recognize there is an impending challenge and has started considering options to optimize the use of Cires capacity. Options being considered include:

- Expanding capacity of existing disposal site (Cires) by the modification of disposal cell design;
- Pursuit of new dedicated disposal beyond Cires;
- Potential for disposal more local to point of generation;
- Reutilization of materials within the nuclear industry;
- Further reduction in generation of VLLW through refinement of the zoning policy to optimize volumes that can be managed as conventional non-radioactive waste.



*Forecast of VLL Waste Generation (used with permission of Andra)*

### ARTEMIS observation

The Review Team acknowledges and supports the recognition that there are options to optimize management of this waste category. The review team respects the choice in France to not implement clearance levels. Based on the collective experience with this waste category within the review team, this category attracted much discussion, in particular relating to the wide range of options that could be considered.

While the Review Team acknowledged that the investigations of options are at the earliest stage, through questioning the team observed that consultation could be more broad in order to identify the widest possible range of solutions, including those that have been shown to be effective in other countries. The law in particular introduces another actor, the Prefect, as the assigned regulator for disposal of these low hazard materials. Some of the Prefects have gained experience in regulating disposal of related radioactive materials, including the four conventional waste facilities that are now authorized to accept some NORM wastes. This additionally shows that there is tolerance for different solutions in different regions as not all Prefects have this practice currently authorized or not all operators of such facilities accept this kind of wastes.

The Review Team suggests that consideration be given to building on the experience gained from authorizing certain types of NORM wastes for disposal in conventional facilities with the aim of identifying other potential options for disposal of some VLLW. In particular, the review team observes that the alternative options, such as the disposal in conventional waste facilities or dedicated facilities under the regulatory oversight of the Prefect, does not contradict France's no clearance policy as this

would still be disposal of VLLW under authorization permitted by the assigned regulator for VLLW, i.e. it is not leaving regulatory control. Some additional potential options to consider include:

- Disposal of some VLLW in conventional facilities already authorized for NORM within the same activity threshold and volume limits as authorised for NORM wastes;
- Further evolution of the zoning concept providing more credit to wastes where there is robust demonstration that no activity is present;
- Consideration that some of the lowest level VLLW may be easier to divert to a different route (e.g. that which does not have measurable radioactivity, but is still VLLW as a consequence of zoning);
- In-situ management of VLLW where the materials and location make it suitable;
- Disposal of some VLLW with other NORM bearing wastes, including where suitable VLLW materials could be used in reinforcing structures of existing NORM burials or of existing mining and processing residues burials.

Early involvement of the local stakeholders, including waste producers and their local regulatory representatives could help further identify options of particular interest and applicability to their specific circumstances. The review team suggest that, in the same way that the approach taken toward some NORM wastes that has resulted in different options in different regions, consideration be given to providing flexibility for different choices in different regions in the national decision. This could be evaluated through broad engagement including the local actors in the consultation leading up to a national decision.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *It is observed that the current disposal approach for VLLW at a central facility managed by Andra at Cires is being questioned with respect to whether it is optimum when considering the full environmental cost of this approach as compared to the level of hazard this waste presents. This becomes more evident when evaluation of the consequences of transporting very low hazard material very long distances for disposal. It is recognized that the re-evaluation of the current strategy and exploration of potential alternatives are at the very earliest stages of development, and that this issue has primarily been identified in light of the capacity challenges for Cires as a consequence of decommissioning plans for nuclear facilities. The Review Team supports the further exploration of this issue and acknowledges that further experience has been gained in other countries that could benefit the investigation of options in France. The team observes that experience has been gained by the devolved State services that regulates disposal of VLLW for similar hazard level wastes in some areas. The review team would like to draw to the attention of the government that earlier involvement of the local regulator for disposal of this material could result in a more broad consideration of options for disposal of these wastes in addition to the potential for development of new regional facilities under the management of Andra (that is already being explored). For example, utilization of existing infrastructure already under regulatory oversight of the Prefect as potentially viable options for disposal of VLLW may otherwise evade consideration (e.g. existing facilities for disposal of conventional or hazardous wastes, or NORM wastes). There is a potential opportunity to stimulate more broad discussions including the possibility for differences in approach between regions that are more customized to the needs of the local wastes producers, local regulatory authority and communities. It is recognized that such approach would not threaten the policy of no clearance as alternate options of disposal for VLLW would remain under regulatory control.*

(1)	<p><b>BASIS: GSR Part 5 Requirement 3, para. 3.8 states that</b> <i>“To facilitate compliance with regulatory requirements, the regulatory body has to do the following:</i></p> <ul style="list-style-type: none"> <li>- <i>Encourage dialogue between and participate in dialogues with the operator and other interested parties;</i></li> <li>- <i>Enter into agreement, where appropriate, with other governmental bodies responsible for regulation in related fields to delineate areas of responsibility or of cooperation;</i></li> </ul>
S5	<p><b>Suggestion: The Government should consider a broad range of options in a national decision for optimization of VLLW management, including the potential for different approaches in different regions. Broad consultation leading up to a national decision should include local representatives of the assigned regulatory body for VLLW disposal from the various regions at the earliest possible time.</b></p>

*Low and intermediate level, short lived waste (LLW/ILW SL)*

### France position

France has a long management and industrial experience over several decades in the disposal of this category of wastes, both at CSM and now at CSA. The disposal facility at CSM is filled and now capped and under monitoring. Further activities are underway to assure long-term structural stability. Post closure monitoring is being undertaken to further inform the design of the final cap and demonstrate post closure safety. As this is the first disposal facility to be closed in France, establishing what the details of post closure phase will really look like is evolving in real time. This is further complicated by the fact that the post closure safety was not assessed in advance at the time of the authorization to construct and put into service at the facility in the beginning. Experience gained with closing this facility will also further benefit the closure phase of CSA in future.

A current disposal facility is in operation at Aube (CSA). Presently filled to ~30% authorized capacity. The projected life of facility has been extended due to optimization activities including treatment for volume reduction such as melting and incineration at Centraco, segregation of VLLW to be sent to Cires and other waste avoidance implemented by the waste producers. It is clear that optimization undertaken by the waste generators has been effective, as have optimization efforts for CSA operations. Consideration of evaluation as to whether further optimization at a global level is possible is suggested under topic 1.1, National Policy.

### **ARTEMIS observation**

The Review Team concludes that the processes to characterize and package these wastes for disposal are mature, and waste generator processes to reduce wastes at source are well established. Pre-disposal processing such as incineration and metal melting are being utilized for volume reduction. The forecasted inventory shows that saturation of the facility capacity is not an issue in the near to medium term as optimization activities have been effective.

#### *Low level long-lived waste (LLW-LL)*

### **France position**

This category does not yet have a fully developed disposal concept. According to Andra, it is more straightforward to more fully define a near surface disposal facility for low and intermediate short-lived waste, and a geological disposal facility for high level waste. An intermediate-depth facility is much more complicated to specify and the review team recognizes the challenges being faced.

Wastes in this category involve graphite sleeves from gas-cooled reactors, radium bearing wastes from processing of rare earths, and bitumen immobilized sludges. Each have quite different properties as well as different ranges of hazard. Investigations thus far suggest only some of these wastes could be accommodated by a sub-surface facility, and as a result a portion is being assessed as possibly being included in the inventory for Cigéo.

Siting investigations continue for a sub-surface disposal facility. Investigations and R&D continue regarding increased characterization, packaging and processing options for these wastes. The review team was interested whether the committed date in the *National Plan* of 2030 for confirming the waste route for the graphite sleeves would constrain dismantling “as soon as possible” the oldest gas cooled reactor facilities. EDF responded that dismantling of the equipment and structures not associated with the reactor core have already advanced, and that the reactor core would be approached first by one facility as a test case in order to provide learning for the rest. The result is the 2030 date will be fine with respect to integration with their decommissioning schedule.

### **ARTEMIS observation**

The Review Team is satisfied with the approaches being pursued and the actions and priorities in the plan for this waste category.



*High level and intermediate level, long-lived waste and radioactive materials*

**France position**

Although these are two separate categories in the *National Plan*, they are totally interrelated according to the strategy. Disposal of these categories of waste, including HLW from reprocessing, will be deep in a clay layer in a repository called Cigéo. The 2016 Act requires “reversibility” of concept through its entire operational lifetime. The 2013 public debate resulted in inclusion of a pilot industrial phase prior to start-up of the installation. The licensing application for Cigéo is planned for the near term.

The reference plan is all spent fuel will be reprocessed, and nuclear materials recycled as fuel for new reactors. At the moment, not all reactors can use MOX fuel, uranium based fuel is reprocessed once, and MOX fuel is not routinely reprocessed. The reference plan has facilities being realized to reprocess all spent fuel, and a new fleet of reactors that can reuse the recovered materials, including fast neutron reactors.

Spent fuels continue to be stored wet, with reprocessing and recovery of nuclear materials for fuel production being carried out as demand arises, to avoid excess supply of separated nuclear materials. Additional storage is required as existing storage capacities approach saturation. As reprocessing policy is impacted by the choices regarding next generation nuclear power plants, the *National Plan* requires that scenarios involving disposal of spent fuel be evaluated if future demand for the harvested uranium and plutonium from reprocessing does not materialize. Scenarios include renewal of the existing fleet of nuclear power plants (with or without fast neutron reactors) and non-renewal of the fleet. Consideration of disposal of spent fuel without reprocessing in Cigéo has been evaluated.

**RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES**

**Observation:** *The reference national strategy for spent fuel management and nuclear materials management is based upon the assumption that all spent nuclear fuel will be reprocessed and nuclear materials recycled for use in manufacture of fuel for future nuclear power generation. It is recognized that this strategy depends upon the realization of a new nuclear fleet, including fast neutron reactors, for the reuse of the recovered nuclear materials, and that this new fleet does not yet exist. The Review Team observes that the current plans for realizing Cigéo, the studies that have been done regarding impacts of alternate scenarios, and near term actions for extending the capacity for spent fuel storage are adequate to manage safety of spent fuel management in the near term and provide margin in case the assumptions regarding a new nuclear fleet are not fully realized as currently assumed. It is further observed that at least until disposal for HLW becomes operational, the margin being pursued for storage of spent nuclear fuel is optimum. The review team observes that there will be times in the future if the facilities necessary for reuse of nuclear materials are not realized that continued pursuit of additional storage margin will diverge from optimum. An example where this situation may manifest is Cigéo becoming available for receipt of HLW for disposal.*

**(1)** **BASIS: GSR Part 1 Requirement 2, para. 2.30 states that** “Radioactive waste generated in facilities and activities shall be managed in an integrated, systematic manner up to its disposal. The interdependencies of the steps in the entire management process for radioactive waste, and likewise for spent fuel, shall be recognized.”

**S6** **Suggestion: The Government should aim to identify the points in time whereby continued delay in realization of the facilities for reuse of spent fuel and nuclear materials will create the need for decisions relating to predisposal capabilities and capacities for the management of spent fuel and nuclear materials. When faced with these decisions a review of the reference strategy and whether it remains optimized may be appropriate.**

## *Waste requiring specific work*

### **France position**

The vast majority of radioactive wastes produced in France have an identified waste management and disposal route, even if the final disposal facility has not yet been constructed. A very small amount of radioactive waste (<0.3% of all radioactive waste being produced) does not yet have an identified disposal route. Wastes of this category have properties making them problematic for the main final disposal facilities already identified in the plan. The *National Plan* commits to having a defined disposal route for all wastes by 2030.

Examples include:

- For waste containing free asbestos, the plan is to pursue obtaining authorization to dispose in Cires and CSA;
- For waste containing mercury, the plan is to pursue a possible mercury stabilization process that would result in wastes acceptable for disposal in Cires and CSA;
- For organic oils and liquids, the plan is to evaluate stabilization using polymers;
- For wastes containing tritium, the high mobility of tritium makes these unsuitable for disposal in Cires or CSA. The plan is to pursue treatment options and/or decay storage such that the waste would be suitable for an existing disposal route;
- For used sealed sources, the plan is to pursue expanding the waste acceptance criteria for CSA for the population of used sources where it can be shown it would be safe to dispose in CSA;
- For radioactive waste from small producers outside the nuclear power generating sector, Andra is creating services located at Cires;
- For management of waste resulting from a nuclear accident, the plan is to review lessons learned from the Fukushima accident and incorporate, as applicable, into the post-nuclear accident management doctrine that was first published in 2012.

### **ARTEMIS observation**

The additional work being undertaken for this category primarily represents evaluating approaches that would render the wastes suitable for one of the already identified disposal routes. This philosophy was confirmed through discussions with the experts. The Review Team further questioned whether the 2030 commitment date to have resolved all of the waste routes poses any undue constraint on other parts of the program, in particular the expectation for decommissioning to commence dismantling “as soon as possible”. The response from the operators confirming integration of the plan commitments and that this does not pose undue constraint on their decommissioning activities was convincing.

The Review Team supports the continued evaluation of lessons learned for management of waste resulting from a nuclear accident.

The Review Team concluded that management strategies for this category are appropriate and effective.

## 5. SAFETY CASE AND SAFETY ASSESSMENT OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT ACTIVITIES AND FACILITIES

### France position

The legal framework<sup>17</sup> specifies the content of the file accompanying the license application for a nuclear facility. It has to contain among other things a preliminary safety case (article 10).

The safety case is prepared by the operator and assessed by ASN as regulator. In case of VLLW the local Prefect has the role as regulator.

The preliminary safety case comprises an inventory of all the risks of whatever origin arising from the planned installation, as well as an analysis of the steps taken to prevent these risks, and a description of the measures designed to minimize the probability of accidents and their effects. Its content must be commensurate with the scale of the hazards from the installation and, in the event of an incident or accident, their foreseeable effects on the protection of personal health, safety, and the environment. It has to be updated for commissioning and then during the lifetime of a facility at each periodic safety review (at least every 10 years).

Major documents submitted for a creation authorization include details of licensee and site, the environmental impact assessment, preliminary safety case, risk control study, decommissioning plan, technical capabilities of the organization, technical resources available, financial capabilities, etc. For a radioactive waste disposal installation, the decommissioning plan is replaced by a document presenting the envisaged procedures for final closure and subsequent post-closure monitoring. During the commissioning authorization stage, the licensee submits a safety case comprising the updated preliminary safety case, general operating rules the operator intends to implement, a study of the installation's waste management, an on-site emergency plan and an update of the environmental impact assessment.

The operator of a radioactive waste disposal installation wishing to proceed with final closure of its installation and to make the transition to the closure phase and then the institutional control phase, submits an authorization application to the ministry responsible for nuclear safety.

The application is accompanied by a file containing among other items a safety case concerning the final closure operations and the institutional control phase.

The submission requirements for various authorization stages of all BNIs are the same; however, the level of detail varies for various types of installations.

The legal and regulatory framework<sup>18</sup> define safety requirements that apply to all basic nuclear installations, including disposal facilities. There are no binding safety requirements that specifically apply to disposal facilities, e.g. for post-closure safety of a disposal facility.

ASN has established specific non-binding basic safety rules for both deep geological and near surface disposals of radioactive wastes; these basic safety rules define the protection criteria that are used to evaluate the operational and post-closure safety of each type of disposal facility.

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<sup>17</sup> Decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the supervision of the transport of radioactive materials with respect to nuclear safety

<sup>18</sup> The Order of 7 February 2012 relating to general rules applying to nuclear installations and the ASN Resolution on safety reports (17/11/2015)

## ARTEMIS Observation

The regulatory processes for developing and assessing a safety case are well developed. There is a clear allocation of responsibilities. The relevant regulations are very clear, though the long term protection criteria and targets for disposal are laid down in non-legally binding ASN Guidelines. The safety case for all facilities is required for all phases and guidelines for the safety assessment are published by ASN. In the process of developing the *National Plan*, France developed various detailed future scenarios and considered the effect on available predisposal and disposal management options for various waste streams and developed resulting inventories. Though the full safety case for the Cigéo was carried out for the inventory for the reference scenario the operator had to demonstrate that he would be able to adjust his project for the other inventories. This includes radioactive materials like spent fuel as well as ILW-LL. Due to this approach France ensured that a change in its national policy would not lead to waste streams without an envisaged endpoint.

### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *In the process of developing the National Plan France developed various detailed future scenarios regarding the available predisposal and disposal management options for various waste streams and developed resulting inventories. Though the full safety case for the Cigéo was carried out for the most likely scenario the operator had to demonstrate that he would be able to adjust his project for the other scenarios. By taking this approach France is minimizing the chance that a change in strategy would not lead to waste streams without an envisaged endpoint.*

(1)

**BASIS: SSR 5 Requirement states that** “Responsibilities of the regulatory body The regulatory body shall establish regulatory requirements for the development of different types of disposal facility for radioactive waste and shall set out the procedures for meeting the requirements for the various stages of the licensing process. It shall also set conditions for the development, operation and closure of each individual disposal facility and shall carry out such activities as are necessary to ensure that the conditions are met.”

GP5

**Good Practice: Developing preliminary safety cases or evaluations for facilities not only for the planned scenarios but also for scenarios resulting from a change in the national strategy fosters sound planning and decision making.**

## 6. COST ESTIMATES AND FINANCING OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

### France position

The principles of “Polluter Pays” and “inter-generational equity” are clearly and explicitly recognised within the costing and financing arrangements both within accounting law<sup>19</sup> and Environmental law<sup>20</sup>. Owners of facilities and producers of wastes are required to estimate and provision for their future liabilities. In addition to the requirements falling upon operators under company law to prudently provision for their future liabilities, there are additional obligations on licensees for BNIs and ICPEs dealing with radioactive waste. In the former case there is a requirement for segregated assets and, as a matter of law, these assets are not accessible to creditors of the companies and may only be liquidated against the liabilities for which they have been set aside. In the case of ICPEs dealing with radioactive waste there is no requirement for segregated assets, but operators are obliged to have financial guarantees, of a required value and of a required quality. This protects against insolvency of the operator. Third party liabilities are covered through the *Paris Convention on Third Party Liability in the Field of Nuclear Energy* and its subsequent protocols (“Paris-Brussels Convention”) with operators insuring against liabilities at the first tier. There is no mechanism for transfer of liability from a waste producer to a third party and this would be seen as counter to the “full and infinite responsibility” principle that underpins the arrangements.

There are no legal or administrative requirements as to how costs estimates for decommissioning and radioactive waste management are to be prepared, except for the cost, schedule and inventory assumptions for Cigéo, and control of this relies upon the general obligations of companies to estimate their costs prudently. Presentations were received on cost estimating from AREVA, EDF and CEA and it is clear, however, that the large waste producers, and Andra, are also major project and operational companies which have, for their own business purposes, comprehensive and effective project and operations cost and schedule estimating tools including consideration of contingency.

The segregated fund must be established from the point the facility is commissioned and, at all times, be sufficient to meet the obligations of the operator, as far as radioactive waste management and decommissioning, is concerned *as those obligations fall due*. This means that fund growth during the operational period and during decommissioning is a part of the arrangements.

Operational costs during the period of operations are excluded from the requirement for segregated funds, however only costs that can be linked to existing capabilities and contracts can be considered as operational. In cases where policy uncertainties exist, or where capabilities are not in place, for example on future re-use of spent MOX, scenarios are developed and the highest cost scenarios are reflecting in the prudent provisioning, for example in EDF’s provision for spent MOX fuel which is based on an estimate of the costs of disposal in Cigéo.

Investment strategies for dedicated assets for BNIs are constrained by law, based upon the requirements for the European insurance industry, for example to limit excessive investment in any one asset, high risks equities, or self investment. Fund growth assumptions (discount rates) are determined by the companies subject to a ceiling established by DGEC. The only exception to this is the arrangements for pre-2010 liabilities for CEA which are covered by a governmental undertaking and therefore fall short of this standard.

The adequacy of the dedicated assets, both as far as the estimate of costs is concerned and the assumptions about asset growth, is the responsibility of the Boards of the companies. Assurance is primarily delivered through the auditors of the companies who audit the company’s accounts in

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<sup>19</sup> L123-20 of the Trade code

<sup>20</sup> Environment Code L110-1 II

accordance with all legal requirements which include the requirements in relation to financing of liabilities associated with radioactive waste and decommissioning.

DGEC and a Ministerial Administrative Authority have oversight of the adequacy of the provisioning both as regards the cost estimating and the segregated assets. Operators are required to submit a detailed report every three years describing both their cost estimating and their investment strategy and update this at least annually, or as circumstances require. The Administrative Authority's powers include directing additional audits, which are paid for by the operators, requiring additional information, requirements for improvements to address non-compliances and financial penalties. The Administrative Authorities oversight, which calls upon other parts of the state with particular competencies including the safety and financial regulators, includes periodic deep-dive audits of the arrangements for particular facilities, for example EDF's NPP decommissioning provisioning. ASN has a particular role in assuring the compliance of the operators' plans and estimates with the overall strategy and the *National Plan*. External auditors and consultants are used where necessary to augment capability in, for example, cost estimating and contingency calculation.

The 2016 *National Plan* (§1.4.3) provides details of the position for the main three operators giving rise to a total undiscounted liability of €110.5Bn, €55.9Bn discounted, of which €44.3Bn is to be covered by segregated assets. In aggregate this is a 100% coverage ratio although it should be noted that both EDF and AREVA are reported as having a coverage ratio below 100%. It was reported that EDF and AREVA have since the 2016 *National Plan* reached 100% coverage ratio. All three main operators have discount rates of around 4.1% which is consistent with the asset portfolio performance but is higher than would usually be regarded as acceptable for other long term investments, for example pension funds.

For companies handling radioactive wastes or materials that are not BNIs or ICPEs handling radioactive waste, there are no requirements in regard to estimating or provisioning arising over and above the general obligations of limited liability companies (*Société à Responsabilité Limitée*). However, these latter requirements also include the requirement to provision prudently and be able to meet obligations as they fall due and all the requirements in relation to polluter pays, persistence of liability etc that are part of the general legal framework.

The principles for the funding of Cigéo are clear and laid out in legislation<sup>21</sup> which establishes three funds – the first for research, the second for design and the third for construction. The first two funds are generated by a tax upon the primary waste producers (CEA, EDF and AREVA) in a specified proportion. The detailed arrangements for the construction fund, which will be created when the project is licensed, have yet to be established but are anticipated to comprise contracts between Andra and the waste producers. In addition there is a tax that provides for the local support system for the underground laboratory which applies to all operators of BNIs<sup>22</sup>. These taxes are taken from the segregated funds of the waste producers.

## **ARTEMIS observation**

In general terms, the French system for ensuring appropriate financing for decommissioning and radioactive waste management is comprehensive, consistent, well-structured and systematic and, through the *National Plan* and other mechanisms, transparent. The intent to ensure that liabilities are identified, costed prudently and prudently provisioned for in a way that ensure the resources necessary to deal with the obligations that fall upon nuclear operators are available when required, thereby protecting both present and future generations, has been broadly met to a very high standard. The specific arrangements for the funding of decommissioning and radioactive waste management costs also sit within a very mature and systematic general French legal system for the protection of people and the

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<sup>21</sup> Environment Code L542-12-1,2,3

<sup>22</sup> Environment Code L542-5 to L542-11

environment and the control of economic activities. In addition, there are clear and explicit set of accountabilities for establishing policy on nuclear matters generally.

Appropriate long term financing arrangements for nuclear activities are made harder by the interaction of a number of factors: policy and technology uncertainties, for example energy mix, spent fuel management, and future technologies and societal expectations in relation to safety and the protection of the environment; difficulties in predicting the performance of financial assets over the very long timescales involved in decommissioning and radioactive waste management; and difficulties in estimating the costs of decommissioning, particularly for legacy facilities. These factors are clearly recognised within the French system and the risks arising from them mitigated by conservative decision making and explicit planning assumptions. The natural tensions in a system involving segregated funds whereby overly conservative decision making in relation to decommissioning costs results in excessive funds being set aside to the detriment of the companies' business, while insufficiently conservative decision making results in the funds being insufficient, are clearly present in the French system. However, not only are control mechanisms in place to require the system to respond to changing circumstances, but it was also clear, from the presentations given, that DGEC was very aware of these issues and that there was continual alertness to the risks and a willingness to make changes to the arrangements if it became apparent these would be beneficial.

Within this very strong system, three areas may merit further consideration:

The first is that the machinery established through the 2006 Act to ensure the proper provisioning for nuclear liabilities applies only to BNIs and ICPEs handling radioactive materials. For other users of radioactive materials reliance is placed entirely upon the general fiduciary duties of the companies responsible. The review team was unable to form a comprehensive view of the number and type of companies handling radioactive materials outwith these arrangements and so were unable to form a view of the extent to which there is a significant exposure to the French state from the failure of these companies to discharge their duties. Since the *National Inventory* is very comprehensive in respect of entities holding radioactive materials, it should be possible to take a view as to this level of exposure and consider whether the current arrangements are sufficient or whether there should be some additional control. In any event, the extent to which the possibly of this, admittedly small and unlikely, liability falling to the state should be recognised in the *National Plan*. There are a number of observations that can be made in regard to the IAEA safety standards and the arrangements in the French system that arise from the lack of explicit specific arrangements in these cases. However, the French state has significant capabilities in the management of radioactive materials, the main players have significant resources and are backed by the French State, and France has mature and comprehensive general controls covering both protection of people and the environment and control of economic activities and there is no reason to believe that any difficulties could not promptly and easily be dealt with.

The second is the persistence of the "polluter pays" principle and the retention of title and financial liability by the waste producer. In the case of the large waste producers (e.g. CEA, AREVA, EDF), all of whom have the assumption of continuing in existence indefinitely, and for whom the management of radioactive materials is intrinsic to their core business, this mechanism is appropriate. In the case of small producers consigning small amounts of radioactive waste there may be merit in considering whether such entities can carry out a complete transfer of their title and liabilities to Andra, as part of the payment for waste disposal, rather than retaining a contingent liability that is peripheral to their core business activities. In the case of entities that have completed their purpose, for example an entity running a research reactor, and who wish to close their accounts, again it may be beneficial to allow a full and final transfer of title and liability to Andra for wastes disposed to ensure clarity on the location of the liability and allow the entity to close its company cleanly. In both cases, the likely additional liability to Andra is small. It may be that the persistence of a diversity of ownership will require all consignors of wastes to maintain insurance provision against third party claims since, in the event of damage, in principle, every consignor may be exposed to claims. Transfer of title and associated liability to Andra would limit this exposure and result in Andra, together with the large producers, being the only

entities exposed to such claims. Such a system would require a definition of “small producer” but it may be possible to use existing classifications (for example whether an entity is an operator of a BNI or ICPE handling radioactive waste) to avoid further complexity.

The third is in relation to the confidence associated with the provisions for decommissioning and waste management. The arrangements seek to balance on one hand the desire to limit the exposure to the French state arising from the funds being insufficient with, on the other, the desire to not unnecessarily damage the ability of nationally important companies to operate effectively with their Boards controlling how their assets are used. With the exception of the control over the maximum allowed discount rate DGEC does not establish a systematic view of prudence as it applies to decommissioning and radioactive waste management. Rather, the Boards of the companies and their auditors determine what represents prudent estimating and provisioning and DGEC audits this on a case by case basis. It is possible that the companies’ assessment of a prudent provision provides less confidence that liabilities will not fall to the state than would be expected by stakeholders who generally take a very conservative position in matters relating to the radioactive materials. DGEC should consider whether it would be helpful to establish its own, systematic, view of prudence as it applies to decommissioning and radioactive waste management and establish this as a requirement, where necessary, on operators to establish an appropriate level of risk to the tax payer. Case by case audits can then be done with this view of prudence in mind. In the interests of transparency DGEC should consider including a statement on their opinion of prudence, against this standard, in the *National Plan*.

A quick review of the published accounts of Areva and EDF indicates that the published accounts of large producers do not typically clearly reflect the nature of the segregated funds and the fact that these funds are not generally available to the company and a reader could be left with the impression that the arrangements for estimating assets and liabilities and appropriately provisioning are solely those that apply under the French accounting standards (which are of course consistent with the International Accounting Standards). Although not a matter directly related to safety, DGEC may wish to consider whether the public accounting transparency requirements for limited companies should, for those companies covered by the segregated fund arrangements, include requirements to explain how they meet these requirements and the extent to which their assets are constrained by the obligations.

#### *Specific Consideration against Relevant IAEA Safety Standards*

The explicit recognition of intergenerational equity is consistent with the requirements of SF1:Principle 7: Protection of present and future generations, §3.29.

The arrangements for estimating liabilities, their publication in the *National Plan* and the arrangements for the segregation of funds is consistent with the requirements of GSR 1 rev 1:Requirement 1 §2.3 that the national policy and strategy for safety “[...] shall take into account the need to provision for human and financial resources”. These arrangements are also generally consistent with Requirement 10, noting that in the case of entities that are not licensees of BNIs these requirements, particularly §2.33, are met through the general fiduciary duties of the companies responsible for such materials with no additional, specific control machinery. This comment also applies to the Requirement 17 of GSR Part 3 §3.60.

It is not clear where in the French Environment Code the requirements of GSR Part 3 Requirement 49 §5.10 for responsibilities of funding decommissioning and waste management in the event of a nuclear or radiological emergency are met.

The French arrangements are consistent with the requirements of GSR Part 3 Requirement 49 §5.10(a) for the identification of persons responsible for financing a remediation programme and for determining an alternative source of funding if persons are unable to meet their liabilities, except in the case of entities that are not licensees of BNIs or ICPEs handling radioactive materials where the arrangements are not explicit.

The French arrangements reflect the requirements of GSR Part 5 Requirement 1 §3.4 which requires governments to consider setting clearly defined financial responsibilities for organizations involved in



pre-disposal waste management except in the case of entities that are not licensees of BNIs or ICPEs handling radioactive materials where the arrangements are not explicit except the general fiduciary duties of limited companies and the principles in accounting law (L123-20) and Environmental law (L110- 1 II).

The French arrangements clearly reflect the requirements of GSR Part 5 Requirement 4 in respect of the responsibilities of the operator in particular §3.17 which requires the operator to provide the financial securities and Requirement 20 on the Shutdown and decommissioning of facilities which requires that “[...] assurance shall be provided that sufficient funds will be available to carry out shutdown and decommissioning”.

The French arrangements clearly reflect the requirements of GSR Part 6 Requirement 9 in Financing of Decommissioning that “responsibilities in respect of financial provisions shall be set out in national legislation” and §6.2 that “the cost estimate for decommissioning shall be updated periodically”. Whereas ASN is clearly involved in all aspects of ensuring the adequacy of the French arrangements, it is not clear whether the requirement of GSR Part 6 Requirement 9 §6.3 that “Approval by the regulator shall include provisions for financial assurance” is met through this being a specific part of the French permitting process. It is further unclear how this requirement is met in the case of operations or facilities that are not regulated by ASN.

The French arrangements are consistent with the requirements of SSR5 Requirement 1 on Government Responsibilities that the government put in place arrangements for the “securing of financial and other responsibilities”

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *Operators of BNIs are obliged to set aside sufficient assets to meet prudent estimates of their obligations and French Law prevents these assets being accessed by any entity, including the state, for any purpose other than the liquidation of the decommissioning and radioactive waste management liabilities for which they were set aside. Operators of ICPEs handling radioactive waste are obliged to guarantee against the risk of insolvency.*

(1)	<b>BASIS: SF-1 Principle 7, para. 3.29 states that</b> “Radioactive Waste must be managed in a such a way as to avoid imposing an undue burden on future generations”
(2)	<b>BASIS: GSR part rev 1 Requirement 1 para. 2.3(d) states that</b> “In the National policy and strategy account shall be taken of [...] the need and provision for financial resources”
(3)	<b>BASIS: GRS part 1 rev 1 Requirement 10 para. 2.33 states that</b> “Appropriate financial provision shall be made for: (a) Decommissioning of facilities; (b) Management of radioactive waste, including its storage and disposal; (c) Management of disused radioactive sources and radiation generators; (d) Management of spent fuel.”
<b>GP6</b>	<b>Good Practice: Requiring the creation of tangible assets to cover decommissioning and radioactive waste management liabilities and furthermore giving these assets legal protection, rather than holding them as general assets of the operator.</b>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *No mechanism exists, under the polluter pays principle, for waste producers to fully transfer their liabilities to Andra, or any other entity, for disposed waste. For large waste producers, for whom radioactive waste management is intrinsic to their business, this is appropriate. For small companies, or organizations that have completed their purpose, this prevents orderly closure of these organizations, increases the number of entities with potential responsibilities for radioactive waste, proliferates the number of organizations that may face third party liability claims, and reduces transparency on exactly what organizations are part of the national waste management system.*

(1)	<b>BASIS: GSR Part 5 Requirement 1 states that</b> “The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities...”
<b>S7</b>	<b>Suggestion: Consideration should be given to creating a mechanism to permit small producers to transfer title and liability to Andra, or some other persistent entity, for waste disposal at an appropriate time after acceptance for disposal.</b>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *The legislative framework which provides for the estimating and provisioning for decommissioning and radioactive waste management arrangement arrangements excludes entities that are not licensees of BNIs or operators of ICPEs handling radioactive waste.*

(1)	<p><b>BASIS:</b> GRS part 1 rev 1 Requirement 10 para. 2.33 states that “<i>Appropriate financial provision shall be made for:</i></p> <p style="padding-left: 40px;"><i>(a) Decommissioning of facilities; (b) Management of radioactive waste, including its storage and disposal; (c) Management of disused radioactive sources and radiation generators; (d) Management of spent fuel.</i>”</p>
S8	<p><b>Suggestion:</b> The Government should consider the level of financial risk to the state that arises from entities outside the requirements for segregated assets and guarantees and, in the light of this, consider whether relying solely on the fiduciary duties of the companies is sufficient or whether there should be some additional obligations. In any event, consideration should be given to providing clarity on this potential exposure to the state in the <i>National Plan</i> in the interest of transparency and completeness.</p>

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *DGEC audit and evaluation considers the veracity of the estimating and provisioning process, including taking a case by case view on the prudence of the provisions. However, DGEC, has not established its own, systematic, view off what prudence should mean in the case of provisioning for decommissioning and radioactive waste management. Neither does it communicate its overall view on the adequacy of the national provisioning for decommissioning and radioactive waste management liabilities. It is possible that the companies’ assessment of a prudent provision provides less confidence that liabilities will not fall to the state than would be expected by stakeholders who generally take a very conservative position in matters relating to the radioactive materials.*

(1)	<p><b>GRS part 5 Requirement 1 para. 3.4 states that</b> “<i>Matters that have to be considered by the government include: Setting clearly defined [...] financial responsibilities for organizations involved in predisposal radioactive waste management activities</i>”</p>
S9	<p><b>Suggestion:</b> DGEC should consider whether it would be helpful to establish its own, systematic, view of prudence as it applies to decommissioning and radioactive waste management and establish this as a requirement, where necessary, on operators to establish an appropriate level of risk to the state. A statement on this level of risk should be presented, in general terms, in the <i>National Plan</i>.</p>

## **7. CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS**

### **France position**

#### **What are the requirements on the regulatory authority to ensure that arrangements for education and training are adequate?**

ASN has had the status of an independent administrative authority (namely, a State structure that is independent from the Government) as a matter of law since 2006 and ASN is free to decide its own internal organization. The structure of its national departments and regional offices is regularly reassessed. Art. 3 and 6 of the resolution n°2010-DC-0195 dated 19 October 2010 (ASN internal regulations) establishes “The Director General shall ensure by the recruitment policy and by a training plan, that ASN staff have the necessary skills and qualifications to carry out ASN's tasks and that it continues to develop these skills and qualifications.” Furthermore, ASN inspectors are designated and accredited by the ASN Chairman<sup>23</sup> if they have acquired the required level of legal and technical competence through their professional experience, tutoring or training.

The Review Team noted that for developing internal competency, ASN has, for several years, implemented an important training program of its staff. In addition, the Review Team was informed that ASN has organized a management system that contributes to the transmission of knowledge and professional practices. Emphasis is given on Competence, one of the four capital values of ASN, with Independence, Transparency and Rigour. About 40% of inspectors work in ASN department and 60% in ASN regional divisions. As part of its continuous improvement policy, ASN encourages the exchange and integration of good practices used by other inspection organizations. Internal guides have been developed and are regularly updated, to give adequate information to the inspectors and harmonize the conduct of inspections. The Review Team was informed that the future strategic plan of ASN will include a revision of the inspectors' training programme.

The Office of Administration (Secrétariat général) of ASN has developed a specification and has already launched a public call for tender for which the main goal is to acquire management assistance to set up a Human Resources information system. The Team also noted from the information provided that ASN recently recruited a new Deputy to the head of the Office of Administration, in charge of Human Resources Management, especially focusing on Career Management as well as related support of staff. In addition, ASN has at its disposal several types of external experts: the expertise provided by IRSN, by the advisory committees ASN has set up, and finally by other public or private bodies to which ASN can appeal as needed. Internal regulations approved by an order of 3 December 2010 require ASN to self-assess regularly (at least every 10 years), be subject to an international peer review and maintain a high level of expert capacities, by implementing an approach of projected management of its personnel's skills and qualifications.

#### **What are the requirements on a holder of radioactive material or radioactive waste or a license holder to ensure that arrangements for education and training are adequate?**

The French counterpart explained that according to the Environment code<sup>24</sup>: “*The licensee of a basic nuclear installation ... has technical, financial and human resources, which it describes in a manual and it implements the means necessary to exercise that responsibility. ... This guarantee must extend to the installation decommissioning and clean-up phase.*” As of the licence application stage, it is therefore advised to check that the operator will indeed have the human, technical and financial capacity to successfully operate its installation.

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<sup>23</sup> in accordance with the conditions defined by decree 2007-831 of 11 May 2007

<sup>24</sup> Environment Code L593-6 and L593-6-1

The BNI order<sup>25</sup> states that activities important for protection, their technical control, the verifications and assessments are carried out by persons with the necessary skills and qualifications. To this end, the licensee takes the necessary training measures to maintain these skills and qualifications among its personnel and to develop them as necessary, and ensures that the outside contractors do likewise for their personnel accomplishing the abovementioned operations.

In compliance with the requirement of the Minister of Energy of January 2012, nuclear operators have adopted social specifications applicable to the provision of services and work conducted on a BNI in France. These specifications form a basis common to all nuclear operators and will be included in their calls for tender. They include an article devoted to the development of the skills and professionalism of contractors. This states that the contractor must undertake to maintain and develop the knowledge and skills of its staff, notably to increase the appropriation of a culture of nuclear safety, radiation protection and prevention of occupational hazards. The company promotes the continuation and introduction of the necessary training, etc. The licensee is required to monitoring of the same matters when they are performed by outside contractors<sup>26</sup>. The licensee should ensure that these outside contractors have appropriate technical capabilities for the performance of contracted activities. It may not delegate this monitoring to a contractor.

The Review Team noted from the information provided that the licensing application file contains, among others, a description of the licensee's technical abilities, defining the technical resources it has, its organization and the experience and feed-back gained by the operation of other nuclear installations (2 November 2007 Nuclear Decree, Title III, Chapter II, article 8). These documents are assessed by ASN and its technical support organisation.

The French counterpart in its Self-Assessment Report explained that the Order of 7 February 2012 setting the general rules relative to basic nuclear installations, requires the licensee (Order of 7 February 2012, Art. 2.2.1 to 2.2.4) to perform the surveillance of activities performed by outside contractors. The licensee shall take the necessary training measures to maintain the skills and qualifications among its personnel and to develop them as necessary, and ensures that the outside contractors do likewise for their personnel accomplishing the activities important for protection, their technical control, the verifications and assessments<sup>27</sup>. These training measures have to be applied for instance for packaging of waste which is defined as an activity important for protection by an ASN resolution<sup>28</sup>.

## **ARTEMIS observation**

Detailed presentations were provided on the capacity building performed by the main actors in the radioactive waste management programme. The Review Team noticed that managing staff skills is based notably on a formalised curriculum of technical training courses for each employee in accordance with a detailed and regularly updated training reference system. For instance, an inspector must follow a series of predefined training sessions involving technical, legal and communication techniques, before being certified to carry out inspections. The Team noted from provided information that in 2016, ASN agents spent about 4 000 days in technical training spread over 212 sessions within 131 different courses. The financial cost of those training sessions provided the other organizations than ASN amounted €520k in 2016. The percentage of training costs with respect to the payroll also includes the payroll costs of the 4,219.5 "trainee days" (national and local training plans), the 184 internal instructor days and the payroll for the personnel responsible for training. In 2016 training costs totalled €2.2M, 7.4% of the ASN payroll.

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<sup>25</sup> of 7 February 2012

<sup>26</sup> Environment Code L593-1

<sup>27</sup> Order of 7 February 2012, Art. 2.5.5

<sup>28</sup> no 2017-DC-0587 of 23 March 2017.

The Review Team noted from the information provided that ASN verifies that the licensee has sufficient internal technical capacities to take, with knowledge of the facts and in appropriate time, any decision and implement any conservative measure that comes under its responsibility and that the licensee has, either internally or through third party agreements, adequate technical capacities to master the activities. The Review Team noted from the information provided that ASN verifies that the licensee describes in a notice the technical skills and the capacities at its disposal, distinguishing those available internally, and those available within its subsidiaries or companies under its control.

The Review Team noted from the information provided that since 1997, ASN has been involved in developing an inspector-qualification system relying on the recognition of their technical skills. A certification Committee was created in 1997 to advise the Director-General on an overall qualification mechanism. The Committee reviews notably suitable training curricula and qualification reference systems for each ASN service and holds hearings with inspectors as part of the confirmation process. Half the Certification Committee includes confirmed senior ASN inspectors, while the other half is composed of competent persons in the fields of nuclear-safety control, know-how and education, as well as ICPE control, its jurisdiction will be extended to radiation protection. The Committee met twice in 2016 and proposed to qualify three nuclear safety inspectors and three radiation protection inspectors as “confirmed inspectors”. On 31 December 2016, 56 ASN nuclear-safety inspectors were confirmed inspectors and represent approximately 20% of all nuclear-safety inspectors.

The Review Team was informed that, at the beginning of 2017, Andra’s staff amounted to approximately 650 staff, 69% of which were engineers and managers. Some 120 employees were assigned to general management or transverse support functions, such as human resources, purchasing, management, accounting, finances, legal services, information systems, and communication. About 140 people contribute directly to the operational industrial activities (particularly operation or monitoring of near surface disposal facilities) and providing services, particularly with the aim of optimizing the management of radioactive waste in France. They include staff in charge of checking that delivered packages comply with the facility’s safety rules. In that regard, the Agency intends to develop and to maintain a strong safety culture through training and daily operating procedures (notably in line with its quality and environmental-protection approach).

AREVA’s unit managers have the responsibility to decide the allocation of competent staff members for the execution of the required tasks and, consequently, to assess their skills. To achieve that goal, that responsibility refers to the initial training and experience; it also identifies the need for additional training, qualification or certification for specific tasks. It benefits from the support of the competent services of the Human Resources Division and of its functional extensions in the establishments themselves where they are responsible for providing and recording training sessions. Training, competence assessment and information measures are taken at all hierarchical levels. Each year, improvements in the various areas of safety and waste management are identified for each installation and action plans are established.

EDF’s staff training volumes have also risen greatly in the last 10 years, with more than a two-fold increase between 2007 and 2012 (from 1.2 million to 2.7 million hours) and reaching 3 million hours in 2015. Consequently, the initial training curricula have been extended and adapted to this context, with the evolution of “Nuclear joint know-how academies”, along with programmes that have been revised for each specific professional sector. Reactive training programmes are also deployed on the sites, based on experience feedback from other international licensees.

Regarding the safe management of radioactive waste and the safe management of spent fuel, the IRSN’s international relations revolve mainly around, among others, safety-training actions for waste management actions (decommissioning, waste treatment facilities, disposal) for the representatives of the civil society, experts or foreign safety authorities, through programmes managed by ENSTTI (training and tutorials modules).

In addition, the Review Team observed that the IRRS Mission in 2014 noted "...a very robust training programme is going on at all times in ASN. Every newcomer needs a full year of training. The IRSN supports the continuity in management of knowledge. ASN is an attractive workplace among Civil Servants. According to ASN experiences the system is basically good, but the duration that the civil servants spend in ASN is too short and should be extended to six to seven years..." The Review Team support this evaluation.

The Review Team noted that in fulfilling one of the IRRS Recommendations (November 2014), France under the Act on energy transition for green growth (TECV Act) and the associated ordinance of the 10 February 2016, implemented the provisions of the Euratom Directive on Nuclear Safety. In particular, articles of the ordinance taken together with existing legislation, set out the requirements for competence and experience of the licence holders for nuclear installations. There are also similar requirements for sub-contractors. These requirements on the operators are monitored by ASN. For other users of radioactive sources in the industrial, research and medical fields, there are general provisions concerning education and training in nuclear and radiation safety set out in the Labour and Public Health Codes, as well as various specific provisions in underpinning resolutions and ordinances. Separately, ASN has set out binding requirements for the competence of its staff in its internal resolution of October 2010. There is a project ongoing to update this resolution. Similarly, a decree published in March 2016 set out the competence required of its staff.

The Review Team noted that the major organizations involved in the radioactive waste management programme have implemented a human resources plan that states the number of staff necessary and the essential knowledge, skills and abilities for them to perform all the necessary functions. These human resources plan cover recruitment and, where relevant, rotation of staff in order to obtain staff with appropriate competence and skills, and include a strategy to compensate for the departure of qualified staff. Processes are established to develop and maintain the necessary competence and skills of staff of these organizations, as an element of knowledge management. This process includes the development of a specific training programme on the basis of an analysis of the necessary competence and skills

The Review Team was informed that arrangements are in place for carrying out analysis and to identify lessons to be learned from operating experience and regulatory experience, including experience in other States, and for the dissemination of these lessons learned as part of the training programmes.

The Review Team noted that senior management make arrangements to ensure that the organization has in-house, or maintains access to, the full range of competences and the resources necessary to conduct its activities and to discharge its responsibilities for ensuring safety at each stage in the lifetime of the facility or activity. Also, senior management ensure that competence requirements for individuals at all levels are specified and ensure that training is conducted, or other actions are taken, to achieve and to sustain the required levels of competence. A periodic evaluation is conducted of the training needs and the effectiveness of the training and of the actions taken as well as periodic retraining as required to ensure the necessary level of competence. It was noted also that the operating organization are maintaining the capability in terms of staffing, skills, experience and knowledge to undertake competently all activities throughout the lifetime of the facility, from its siting to decommissioning. Where the resources and skills necessary to fulfil any part of these undertakings are provided by an external organization, the operating organization nevertheless retains within its organization the capability to assess the adequacy of the external organization's capabilities for ensuring safety. Records of the training provided to staff or to contractors are maintained updated.

The Review Team noted that still some work needs to be done to ensure that all individuals in the organizations shall be trained in the relevant requirements of the integrated management system. Such training will ensure that individuals are knowledgeable of the relevance and the importance of their activities and of how their activities contribute to ensuring safety in the achievement of the organization's goals. Some efforts may need to be devoted also to evaluate in the safety assessment whether personnel competences, the associated training programmes and the specified minimum staffing levels for maintaining safety are adequate as well as that the results of the safety assessment are

being used to specify the necessary competences for the staff involved in the facility or activity, which are used to inform their training, control and supervision. The Review Team was informed that regarding training requirements ASN reviews and approves proposals made by the licensees on safety aspects, and also organizes additional activities such as inspecting central services, reviewing on a periodic basis the safety management organization of the licensees and also their Integrated Management System.

## RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

**Observation:** *A robust training programme is going on in the major actors of the radioactive materials and waste management programme. The relevant principal parties and other parties having specified responsibilities in relation to protection and safety in the radioactive materials and waste management programme ensure that all personnel engaged in activities relevant to their functions as well as protection and safety have appropriate education, training and qualification so that they understand their responsibilities and can perform their duties competently, with appropriate judgement and in accordance with procedures. The Review Team noted that strong knowledge management programmes are in place in the main organizations involved in the radioactive materials and waste management programme. These knowledge management programmes and training activities are implemented either internally or through third party agreements, with adequate technical capacities to master the activities.*

(1)	<b>BASIS: GSR Part 1 Requirement 18, para. 4.13 states that</b> <i>“A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills...”</i>
(2)	<b>BASIS: GSR Part 2 Requirement 9, para. 4.23 states that</b> <i>“Senior management shall ensure that competence requirements for individuals at all levels are specified and shall ensure that training is conducted, or other actions are taken, to achieve and to sustain the required levels of competence. An evaluation shall be conducted of the effectiveness of the training and of the actions taken.”</i>
(3)	<b>BASIS: GSR Part 3 Requirement 4, para. 2.44 states that</b> <i>“The relevant principal parties and other parties having specified responsibilities in relation to protection and safety shall ensure that all personnel engaged in activities relevant to protection and safety have appropriate education, training and qualification so that they understand their responsibilities and can perform their duties competently, with appropriate judgement and in accordance with procedures.”</i>
(4)	<b>BASIS: GSR Part 5 Requirement 4, para. 3.11 states that</b> <i>“Depending on the complexity of the operations and the magnitude of the hazards associated with the facility or the activities concerned, the operator has to ensure an adequate level of protection and safety by various means, including: ... Ensuring that staff are trained, qualified and competent, and, where applicable, licensed by the regulatory body;...”</i>
GP7	<b>Good Practice: The efforts made by the major actors of the radioactive materials and waste management programme in France to establish, to develop and to maintain the necessary and required competence and skills of staff is robust and exemplary.</b>



## **APPENDIX A: TERMS OF REFERENCE**

# **ARTEMIS Review of the French Policy on Spent Fuel and Radioactive Waste Management**

## **Terms of Reference**

### **1. Introduction**

On 1st of August 2016, the Ministry for the Ecological and Inclusive Transition (the “Ministry”) responsible for International Climate Relations requested the International Atomic Energy Agency (the “Agency”) to organize and carry out, in the second semester of 2017, an ARTEMIS Review (the “ARTEMIS Review”) of the French Policy on Spent Fuel and Radioactive Waste Management, in the framework of the obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste (the “EU Waste Directive”). Through subsequent letter dated 27 April 2017, the Ministry requested the Agency to reschedule the dates of the ARTEMIS Review to January 2018.

### **2. Objective**

The ARTEMIS Review will provide an independent international evaluation of the French Radioactive Waste and Spent Fuel Management Programme, in line with the obligations in the EU Waste Directive.

The ARTEMIS Review, organized by the Department of Nuclear Safety and Security and the Department of Nuclear Energy of the IAEA will be performed against the relevant IAEA Safety Standards and proven international practice and experiences with the combined expertise of the international peer review team selected by the IAEA.

According to preliminary discussions, the responsible counterpart for the ARTEMIS Review for the Government of France is the Bureau Politique Publique et Tutelle, Direction Générale de l’Energie et du Climat from the Ministry for the Ecological and Inclusive Transition.

### **3. Scope**

The ARTEMIS Review will assess, as requested by the EU Waste Directive, the overall programme for the management of all types of radioactive waste and spent fuel in France.

As indicated in the letter of the Ministry dated 1st August 2016, the review will notably cover the following topics:

- The French national programme for the implementation of the Policy for Radioactive Waste and Spent Fuel Management, its scope, milestones, deadlines, and the progress indicators;
- The plans for the establishment of a detailed inventory of radioactive waste;
- The allocation of responsibilities between the different organisms involved in the various steps of the management of spent fuel and radioactive waste;
- The funding mechanisms for the management of spent fuel and radioactive waste
- The French national arrangements for public information and participation;

- The plans to ensure a high level of expertise, training and competence in the management of spent fuel and radioactive waste.

#### **4. Basis for the ARTEMIS Review**

The ARTEMIS Review will be carried out, following the draft guidelines of the ARTEMIS Review service, against the relevant IAEA safety standards and proven international practice and experience.

#### **5. Reference material**

The basis for the ARTEMIS Review will encompass all documentation submitted by France according to the provisions in the EU Waste Directive, the draft guidelines for the ARTEMIS Review service and the responses to the self-assessment questionnaire.

All documents for the purpose of the ARTEMIS Review will have to be submitted in English.

#### **6. Language**

The working language of the ARTEMIS Review will be English.

#### **7. Timeline**

The proposed timeline for the ARTEMIS Review is the following:

- Guidelines for ARTEMIS review service: available to France as of 2017
- Self-assessment: available to France as of 2017
- Preparatory Meeting: 11 - 12 May 2017 (2 days)
- Reception of English documents for the purpose of the review: at the latest 2 months before the ARTEMIS Review mission (including self-assessment responses)
- Peer review mission: 14 to 25 January 2018 - 11 Days (precise dates will be confirmed during the preparatory meeting)
  - Arrival for Sunday meeting,
  - Monday to Friday: interviews/exchange/discussion with Counterpart(s) on the basis of preliminary analysis and drafting of recommendations and suggestions
  - Saturday-Sunday: drafting of the report

- Monday: Delivery of draft report/recommendations – fact checking by counterpart(s) and discussions
- Tuesday: discussions – finalization of draft report
- Wednesday: report delivery - closure

## **8. International peer review team**

The IAEA will convene a team of international experts to perform the ARTEMIS Review according to the agreed Terms of Reference. The team will be comprised of ten (10) qualified and recognized international experts from regulatory bodies and technical support organizations, operating and waste management organizations with experience in the safe management of radioactive waste and spent fuel and three (3) IAEA staff members (two (2) in the professional category and one (1) in the General Service category) from the Department of Nuclear Safety And Security and the Department of Nuclear Energy to coordinate the ARTEMIS Review. The peer review team will be led by a Team Leader assisted by a Deputy Team Leader from the international expert team as defined in the ARTEMIS draft guidelines. The IAEA will formally inform France regarding the composition of the proposed review team prior to conducting the ARTEMIS Review mission.

The review mission may include presence of observers, if approved by France.

## **9. Reporting**

The findings of the Artemis Review will be documented in a final report that will contain the proceedings, and the recommendations and suggestions. The report will reflect the collective views of the team members and not necessarily those of their respective organization or of Member States or of the IAEA.

According to preliminary discussions, France indicated its intention to publish the final report of the peer review.

## **10. Funding of the ARTEMIS Review**

The ARTEMIS Review will be funded by France. The costs for the services will be limited to the travel costs and per diem of the peer review team (external experts and IAEA staff members) and external expert fees in line with IAEA Financial Regulations and Rules, as per attached cost breakdown.

The costs of official publication of the final report of the peer review will also be covered by France.

By agreeing to the Terms of Reference it is understood that France accepts to cover the full cost of the mission, currently estimated at Euro 82,000, as per the attached breakdown, upon submission of an invoice for services rendered. France is aware that the currently estimated costs of the mission include a 7% programme support costs.

Done in Paris, **19 JAN. 2018**

the Ministry for the Ecological and Inclusive Transition  
the General Director for energy and climate



**Laurent MICHEL**

the International Atomic Energy  
Agency

Section Head, Waste and  
Environmental safety section,  
Division of Radiation,  
Transport and Waste safety  
Department of Nuclear  
safety and security



**Andrew ORRELL**

## APPENDIX B: MISSION PROGRAMME

### ARTEMIS MISSION TO FRANCE 14 – 24 JANUARY 2018

Sunday, 14 January 2018		
<i>Meeting room in Hotel Renaissance Paris La Defense</i>		
<i>16:00 – 18:00</i>	Team meeting	<i>Artemis Team and Mr Stanislas REIZINE (DGEC, Head of public policy and supervision unit)</i>
Monday, 15 January 2018		
<i>Meeting room 32A, Direction Générale de l’Energie et du Climat, Tour Sequoia</i>		
<i>09:30 – 12:00</i>	Opening	<i>Mr Andrew ORRELL IAEA Team Coordinator  Mr Peter DE PRETER Artemis Team Leader  Introduction of Artemis team members  Introduction of French Counterparts</i>
	General presentation	<i>Presentation by Mr Aurélien LOUIS (DGEC, Head of nuclear industry department) and Ms Mathilde MAILLARD (ASN, Head of radioactive waste management unit)</i>
<i>12:00 – 13:00</i>	<b>LUNCH BREAK</b>	
<i>13:00 – 17:00</i>	National Policy and framework	<i>Presentation by Ms Mathilde MAILLARD (ASN, Head of radioactive waste management unit) and Mr Stanislas REIZINE (DGEC, Head of public policy and supervision unit)</i>

		<i>Discussions (experts and counterparts)</i>
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**Meeting room in Hotel Renaissance Paris La Defense**

<i>17:00– 19:00</i>	Team meeting	<i>Artemis Team</i>
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**Tuesday, 16 January 2018**

**Meeting room 32A, Direction Générale de l’Energie et du Climat, Tour Sequoia**

<i>09:00 – 12:00</i>	National Strategy	<p><i>Presentation by</i>  <i>Mr Stanislas REIZINE (DGEC, Head of public policy and supervision unit) and</i></p> <p><i>Mr Benoît BETTINELLI (DGPR, Head of The nuclear safety and radiation protection mission)</i></p> <p><i>Discussions (experts and counterparts)</i></p>
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***LUNCH BREAK***

<i>13:00 – 17:00</i>	Safety Case and Safety Assessment	<p><i>Presentation by</i>  <i>Ms Mathilde MAILLARD (ASN, Head of radioactive waste management unit),</i></p> <p><i>Mr Benoît BETTINELLI (DGPR, Head of the nuclear safety and radiation protection mission) and</i></p> <p><i>Ms Elisabeth SALAT (IRSN, Deputy Head of department in charge of radioactive waste, Health and environment division)</i></p> <p><i>Discussions (experts and counterparts)</i></p>
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**Meeting room in Hotel Renaissance Paris La Defense**

<i>17:00– 19:00</i>	Team meeting	<i>Artemis Team</i>
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## Wednesday, 17 January 2018

*Meeting room 32A, Direction Générale de l'Energie et du Climat, Tour Sequoia*

<i>09:00 – 12:00</i>	Concepts and Plans	<i>Presentation by Ms Soraya THABET (Andra, , Safety, Environment and Waste Management Strategy Division Director) and  Mr Frédéric LAUNEAU (Andra, Cigeo Project Director) Discussions (experts and counterparts)</i>
<i>12:00 – 13:00</i>	<b><i>LUNCH BREAK</i></b>	
<i>13:00 – 17:00</i>	Inventory	<i>Presentation by Ms Elodie PETRY (Andra, National Inventory of Radioactive Materials and Waste Manager)  Discussions (experts and counterparts)</i>
<i>Meeting room in Hotel Renaissance Paris La Defense</i>		
<i>17:00– 19:00</i>	Team meeting	<i>Artemis Team</i>

## Thursday, 18 January 2018

*Meeting room 32A, Direction Générale de l'Energie et du Climat, Tour Sequoia*

<i>09:00 – 12:00</i>	Cost estimates and financing Capacity building	<i>Presentation by Mr Olivier GIRAUD (EDF, Head of High Level Waste (HLW/ILW) Industrial Projects, EDF decommissioning and waste management division) and  Mr Jean-Marc LEFEUVRE (EDF, Head of ALM division, Finance Department),  Discussions (experts and counterparts)</i>
<i>12:00 – 13:00</i>	<b><i>LUNCH BREAK</i></b>	

<p>13:00 – 17:00</p>	<p>Cost estimates and financing and Capacity building (AREVA)</p> <p>Capacity building (ANDRA)</p>	<p><i>Presentation by</i>  <i>Mr Yves CHANZY (New AREVA, Technical Director, Nuclear liabilities Management Department, Finance and Legal Department),</i></p> <p><i>Mr Philippe GUAY (New AREVA, Senior Vice president, nuclear liabilities, management department, Finance and legal department)</i></p> <p><i>Mr Philippe DERYCKE (New AREVA, VP dismantling, Dismantling and Waste, Management division)</i></p> <p><i>Mr Aurélien LOUIS (DGEC, Head of nuclear industry department),</i></p> <p><i>Mr Vincent GORGUES (CEA, Senior advisor to CEA's general administrator, Head of D&amp;D projects)</i></p> <p><i>Mr Vincent MAUGIS (ANDRA, Knowledge Management Officer, Development, Innovation and International Division)</i></p> <p><i>Discussions (experts and counterparts)</i></p>
<p><b>Meeting room in Hotel Renaissance Paris La Defense</b></p>		
<p>17:00– 19:00</p>	<p>Team meeting</p>	<p>Artemis Team</p>



## Friday, 19 January 2018

### *Meeting room 32A, Direction Générale de l'Énergie et du Climat, Tour Sequoia*

<i>09:00 – 10:00</i>	Team discussions on draft Recommendations, Suggestions and Good Practices	<i>Artemis Team</i>
<i>10:00 – 12:00</i>	Presentation of draft Recommendations, Suggestions and Good Practices to the French Counterparts	<i>All participants</i>
<i>12:00 – 13:00</i>	<b>LUNCH BREAK</b>	
<i>13:00 – 17:00</i>	Discussion with the Counterparts on draft Recommendations, Suggestions and Good Practices	<i>All participants</i>

### *Meeting room in Hotel Renaissance Paris La Defense*

<i>17:00 – 19:00</i>	Finalization of Recommendations, Suggestions and Good Practices	<i>Artemis Team</i>
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## Saturday, 20 January 2018

### *Meeting room in Hotel Renaissance Paris La Defense*

	Drafting of the report	<i>Artemis Team</i>
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## Sunday, 21 January 2018

### *Meeting room in Hotel Renaissance Paris La Defense*

	Draft report finalization	<i>Artemis Team</i>
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## Monday, 22 January 2018

### *Meeting room 32A, Direction Générale de l'Énergie et du Climat, Tour Sequoia*

<i>09:00</i>	Submission of the draft report to the French Counterparts	
<i>09:00 – 14:00</i>	Review of the draft report by French Counterparts	<i>French Counterparts</i>
<i>14:00 – 15:00</i>	Discussions on the draft report's comments	<i>Artemis Team</i>
<i>15:00 – 17:00</i>	Discussions on the draft report	<i>All participants</i>

## Tuesday, 23 January 2018

### *Meeting room in Hotel Renaissance Paris La Defense*

<i>09:00 – 17:00</i>	Finalization of the draft report	<i>Artemis Team</i>
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Wednesday, 24 January 2018

*Meeting room 32A, Direction Générale de l’Energie et du Climat, Tour Sequoia*

<p>09:30 – 11:30</p>	<p>Closure meeting</p>	<p><i>Mr Laurent MICHEL (Director General of Energy and Climate) and</i></p> <p><i>Ms Lydie EVRARD, (Commissioner of ASN)</i></p> <p><i>Mr Juan Carlos LENTIJO (Deputy Director General – Nuclear Security, IAEA)</i></p> <p><i>Presentation by Mr Peter DE PRETER Artemis Team Leader</i></p> <p><i>All Participants</i></p>
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**APPENDIX C: RECOMMENDATIONS AND SUGGESTIONS**

Area	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
<b>1. NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT</b>	S1	The Government should specify the implementation strategy at the national level of the policy requirement of decommissioning "in the shortest possible time", by translating this general policy requirement into obligations for operators or facility owners.
	GP1	The way in which France organizes in a very systematic and structured manner all the successive steps of management of radioactive materials and waste, taking account of all management factors and of all stakeholders.
	S2	It could be beneficial to perform in due time a comprehensive and systematic optimization evaluation of the operational LLW-SL management route, e.g. in the framework of the <i>National Plan</i> process, in order to identify in a systematic and documented process, with the implication of all parties involved, if, and what, further optimization steps are possible in view of future waste arisings. This documented process can also be an element of transparency through the <i>National Plan</i> .
	GP2	The legally binding character of, and continuing government commitment to, the key actions identified in the National Programme for the management of spent fuel and radioactive waste ensures the progress of the objectives of the National Policy.

Area		R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		S3	ASN is encouraged to finalise in a timely manner the development and issuance of updates and revisions to requirements related to the storage and disposal of radioactive waste, as identified in the 2017 IRRS follow-up S18.
2.	<b>NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT</b>	S4	It is suggested that the role of ASN in the National Plan working group be formalized to enhance its high standards of independence.
		GP3	The French approach to developing and implementing the <i>National Plan</i> : the scope of the <i>National Plan</i> is comprehensive including all radioactive materials and waste types, alternative scenarios and management routes; preparation, implementation and follow-up of the plan is well organized and main stakeholders are committed to the plan. Based on the consecutive plans, continuous improvement of the plan takes place efficiently.
3.	<b>INVENTORY OF SPENT FUEL AND RADIOACTIVE WASTE</b>	GP4	The French approach to compiling, maintaining, and publishing the <i>National Inventory</i> , providing the <i>National Plan</i> a thorough record of all radioactive materials and waste types, and the proactive effort to identify legacy inventories and sources.
4.	<b>CONCEPTS, PLANS AND TECHNICAL SOLUTIONS FOR SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT</b>	S5	The Government should consider a broad range of options in a national decision for optimization of VLLW management, including the potential for different approaches in different regions. Broad consultation leading up to a national decision should include local representatives of the assigned regulatory body for VLLW disposal from the various regions at the earliest possible time.
		S6	The Government should aim to identify the points in time whereby continued delay in realization of the facilities for reuse of spent fuel and nuclear materials will create the need for decisions relating to predisposal capabilities and capacities for the management of spent fuel and nuclear materials. When faced

Area		R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
			with these decisions a review of the reference strategy and whether it remains optimized may be appropriate.
5.	<b>SAFETY CASE AND SAFETY ASSESSMENT OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT ACTIVITIES AND FACILITIES</b>	GP5	Developing preliminary safety cases or evaluations for facilities not only for the planned scenarios but also for scenarios resulting from a change in the national strategy fosters sound planning and decision making.
6.	<b>COST ESTIMATES AND FINANCING OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT</b>	GP6	Requiring the creation of tangible assets to cover decommissioning and radioactive waste management liabilities and furthermore giving these assets legal protection, rather than holding them as general assets of the operator.
		S7	Consideration should be given to creating a mechanism to permit small producers to transfer title and liability to Andra, or some other persistent entity, for waste disposal at an appropriate time after acceptance for disposal.
		S8	The Government should consider the level of financial risk to the state that arises from entities outside the requirements for segregated assets and guarantees and, in the light of this, consider whether relying solely on the fiduciary duties of the companies is sufficient or whether there should be some additional obligations. In any event, consideration should be given to providing clarity on this potential exposure to the state in the <i>National Plan</i> in the interest of transparency and completeness.
		S9	DGEC should consider whether it would be helpful to establish its own, systematic, view of prudence as it applies to decommissioning and radioactive waste management and establish this as a requirement, where necessary, on

Area		R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
			operators to establish an appropriate level of risk to the state. A statement on this level of risk should be presented, in general terms, in the <i>National Plan</i> .
7.	<b>CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS</b>	GP7	The efforts made by the major actors of the radioactive materials and waste management programme in France to establish, to develop and to maintain the necessary and required competence and skills of staff is robust and exemplary.

## **APPENDIX D: IAEA REFERENCE MATERIAL USED FOR THE REVIEW**

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Fundamental Safety Principles, Safety Fundamentals No. SF-1, Vienna (2006).
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements No. GSR Part 1 (Rev. 1), Vienna (2016).
- [3] INTERNATIONAL ATOMIC ENERGY AGENCY, Leadership and Management for Safety, General Safety Requirements No. GSR Part 2, IAEA, Vienna (2016).
- [4] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).
- [5] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4, IAEA, Vienna (2009).
- [6] INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of Radioactive Waste, IAEA Safety Standards Series No. GSR Part 5, IAEA, Vienna (2009).
- [7] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).
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- [9] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR 5, IAEA, Vienna (2011).
- [10] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. NS-R-5 Rev. 1, IAEA, Vienna (2014).
- [11] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Energy Basic Principles, Nuclear Energy Series, NE-BP, Vienna (2008).
- [12] INTERNATIONAL ATOMIC ENERGY AGENCY, Radioactive Waste Management and Decommissioning Objectives, Nuclear Energy Series, NW-O, Vienna (2011).
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