

METHODOLOGY FOR PREPARING THE OFFICIAL SHUTDOWN DOCUMENTATION FOR ALMARAZ NPP TO OBTAIN THE MINISTERIAL DCEX



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INTRODUCTION

According to Spanish Nuclear Safety Council (CSN) Instruction IS-45 [1], the decommissioning period of a nuclear facility is defined as the period starting from when the Ministerial Declaration of Permanent Cessation of Operation is issued that formally terminates the activity for which the facility was originally designed. This declaration sets out the conditions in the operating license governing the activities to be performed during the shutdown period.

The 2023–2030 National Integrated Energy and Climate Plan [2] outlines a phased and orderly shutdown scenario for the Spanish nuclear power plants from 2027 to 2035. Table I lists the current Operating Licence dates for the Spanish nuclear power plants presently in operation along with their scheduled dates for permanent shutdown.

The CSN has also recently issued a Technical Instruction regarding the submission of official documents and supporting documentation required for the MDPCO of Almaraz Nuclear

Power Plant Unit I, as per Article 28 of Royal Decree 1217/2024 approving the Regulation on Nuclear and Radioactive Facilities and other activities involving exposure to ionizing radiation (RNRF) [4]. This regulation establishes that the operating licence holder must notify the Ministry for Ecological Transition and the Demographic Challenge (MITECO), at least one year in advance, of its intention to cease the activity for which the facility was designed. Following a prior report from the CSN, the Ministry may formally declare the cessation of such activity.

This Technical Instruction requires the licensee to submit the following documentation to the CSN prior to the expiry date of the Operating Licence (or of the Declaration of Permanent Cessation of Operation), in accordance with Article 31 of the RNRF [4].

Two years before the scheduled shutdown date:

- List of regulations and licensing bases applicable to the decommissioning phase.

NPP	Current Operating Licence Date	Scheduled Permanent Shutdown Date
Almaraz I	7/2020	11/2027
Almaraz II	7/2020	10/2028
Ascó I	9/2021	10/2030
Cofrentes	3/2021	11/2030
Ascó II	9/2021	9/2032
Vandellós II	7/2020	2/2035
Trillo	11/2024	5/2035

Table 1. Current operating licence dates and scheduled permanent cessation of operation dates for Spanish nuclear power plants [3].

- Proposed revisions to the Official Operating Documents adapted to shutdown conditions and thereafter designated as official shutdown documents together with supporting documentation justifying the proposed changes:

- Defueled Safety Analysis Report
- Defueled Technical Specifications
- Shutdown On-Site Emergency Plan
- Shutdown Radiation Protection Manual
- Shutdown Quality Assurance Manual
- Shutdown Radioactive Waste and Spent Fuel Management Plan
- Shutdown Operating Regulation

One year before the scheduled shutdown date: The following complementary documents to the official shutdown documents, updated for shutdown conditions, must be submitted to the CSN for favourable assessment:

- DTS Bases
- Technical Requirements Manual
- Shutdown Off-Site Dose Calculation Manual
- PSA for other sources
- Shutdown In-Service Inspection Manual

In accordance with the dates presented in Table I and with the deadlines established in the CSN Technical Instruction regarding the required documentation, the various official shutdown documents and complementary documents were prepared as part of the activities in the Almaraz NPP Transition-to-Decommissioning Plan. In parallel, all engineering studies required as input data for the preparation of the official shutdown documents and complementary documents were completed, for the purpose of obtaining the Ministerial Declaration of Permanent Cessation of Operation for Almaraz Unit I.

This paper focuses on the methodology applied to the preparation of the official shutdown documents (i.e., the Defueled

Safety Analysis Report and Defueled Technical Specifications) and the complementary documents, namely the Bases for the Defueled Technical Specifications and the Technical Requirements Manual.

PLANT CONFIGURATION DURING PERMANENT SHUTDOWN

The permanent shutdown condition corresponds to the decommissioning stage in which all nuclear fuel has been removed from the reactor and is stored either in the Spent Fuel Pool or in the Interim Spent Fuel Storage Installation (ISFSI). Consequently, reactor control, protection, safeguards, and auxiliary systems associated with the reactor and containment are no longer required, nor are any systems associated with the steam-water cycle, the turbine, or their auxiliary systems.

As a result, the potential for off-site radiological releases during permanent shutdown is significantly reduced compared with normal power operation, and the spectrum of postulated accidents is correspondingly limited to ones associated with shutdown and decommissioning activities.

Under permanent shutdown conditions, the safety functions entail maintaining safe storage of spent fuel in the spent fuel pool and the Interim Spent Fuel Storage Installations. These safety functions are:

- Spent fuel subcriticality
- Spent fuel cooling
- Confinement and shielding of radioactive material
- Fuel integrity during heavy-load handling operations

In addition, support systems that provide electrical power and instrumentation and control for the above safety functions also perform safety-related functions.

Considering the decommissioning schedule for Units I and II of Almaraz NPP shown in Table I, the following operational phases were defined for permanent shutdown conditions:

- **FTA-2 Period:** Unit I is in permanent shutdown and subject to the limits and conditions established in the

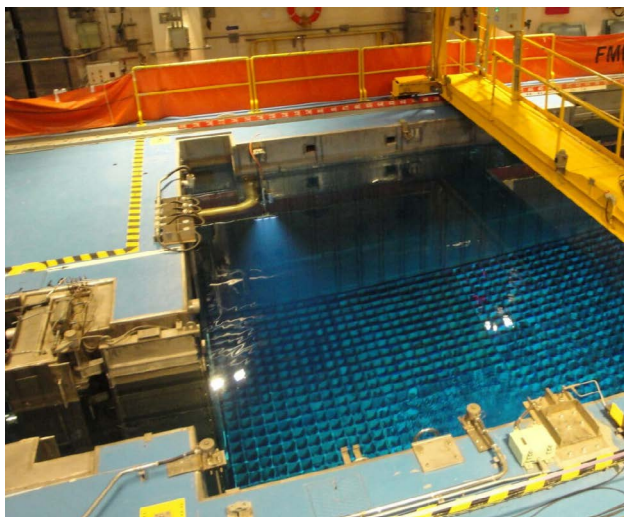


Figure 1. Spent fuel pool CNA Unit I.

Ministerial Order declaring permanent cessation of operation, while Unit II remains subject to the limits and conditions of the current Operating Licence.

- **FTA-3 Period:** Both units are in permanent shutdown and subject to the limits and conditions established in the corresponding Ministerial Orders declaring permanent cessation of operation.

METHODOLOGY FOR PREPARATING THE OSD AND OSDCD TO OBTAIN THE MINISTERIAL DECLARATION OF PERMANENT CESSATION OF OPERATION

The CSN provided the licensee of Almaraz NPP with the criteria applicable to the preparation of the official shutdown documents and their complementary documents.

Along with the methodology used as the basis for preparing the OSDs and OSDCDs, these criteria are described in document GTDCEx/GT1/01, "Methodology for the Development of Supporting Documentation for the Application for the Declaration of Permanent Cessation of Operation" [5]. This document was developed by Working Group No. 1 of the Ad Hoc Group (CSN, ENRESA, Industry) established to define the licensing strategy and planning processes prior to transfer of ownership. It should be noted that the guidance provided in this document is intended to apply generically to all nuclear power plants currently operating in Spain.

According to GTDCEx/GT1/01 [5], the starting point for preparing the OSDs and OSDCDs consisted of the existing official operating documents and complementary documents and the applicable licensing conditions. Accordingly, the Shutdown Documents were developed through an evolutionary approach, adapting the existing documentation to the conditions applicable during decommissioning. Prior to document preparation, the following steps were completed:

1. Identification of the regulatory requirements applicable to the permanent shutdown phase.
2. Performance of a safety analysis based on the new shutdown conditions, including a deterministic analysis consistent with permanent shutdown plant conditions. To this end, the events applicable under current operating



Figure 2. Interim Spent Fuel Storage CNA (ATI-20).

conditions and previously analysed within the framework of compliance with CSN Instruction IS-37 concerning design basis accident analysis for nuclear power plants [6] were reviewed and adapted to shutdown conditions. Because the main source of risk changes during decommissioning (e.g. the spent fuel pool becomes the dominant risk contributor), certain events previously analysed during commercial operation become design basis accidents under shutdown and decommissioning.

3. Identification of which Licensing Basis events remain applicable during permanent shutdown, followed by their corresponding revision to reflect shutdown conditions.
4. Identification of both required and additional activities performed during decommissioning, including spent fuel storage and cooling, conventional operational situations involving potential risks, management of operational radioactive waste, and preparatory decommissioning activities.

Following completion of the above activities, the OSDs and OSDCDs were developed through review of the existing official operating documents and complementary documents. Requirements and information no longer applicable under permanent shutdown conditions were removed whereas the characteristics defining this phase, the applicable accidents and postulated events, the relevant regulatory framework, and the preparatory decommissioning activities to be carried out during shutdown conditions were all taken into account.

In parallel with the preparation of the OSDs and OSDCDs, reports were written documenting the criteria for the scope and methodology described in this paper, thereby justifying both the scope and content of the resulting documents.

Defueled Safety Analysis Report

According to Article 24 of Royal Decree 1400/2018 approving the Nuclear Safety Regulation for Nuclear Facilities (RSN) [7], the Final Safety Analysis Report (FSAR) for a nuclear facility must contain:

- A description of the site and surrounding area, including supplementary data obtained during construction concerning site characteristics.
- A description of the facility as built and of the processes to be carried out therein. This includes descriptions of nuclear and non-nuclear instrumentation, control and pro-

tection systems, safety systems, containment buildings and structures, auxiliary systems, radioactive waste collection and disposal systems, and any other systems or components important to safety.

- An analysis of foreseeable accidents arising from malfunction of structures, systems and components, operator errors, or external hazards, together with their consequences.

The Defueled Safety Analysis Report (DSAR) contains an analysis of the facility from the standpoint of nuclear safety and radiological protection during the permanent shutdown period, together with an assessment of the risks associated with facility operation during that period.

Its preparation considered both SSC safety functions and postulated accidents and events, in order to determine which systems are required to fulfill the safety functions under all operating conditions during permanent shutdown.

The structure and content of the Defueled Safety Analysis Report were developed taking into account the guidance established in Section 8.2 of Regulatory Guide 1.184 [8], consistent with the DSAR previously developed for the Spanish nuclear power plants Santa María de Garoña and José Cabrera, both currently undergoing decommissioning.

Defueled Technical Specifications

The Technical Specifications for Operation constitute the set of minimum requirements necessary to ensure safe operation of a nuclear power plant. According to Article 24 of the RNS [7], Technical Specifications shall establish safety-related limiting values, automatic protection system setpoints, minimum operating conditions, periodic inspection, calibration and surveillance requirements, and operational controls.

Accordingly, the Defueled Technical Specifications (DTS) define the limits and conditions applicable to the plant Structures, Systems and Components (SSCs), ensuring fulfillment of the functions established in the Defueled Safety Analysis Report under existing operating conditions and under the postulated transients and accidents identified in Chapter 5 of the Defueled Safety Analysis Report for permanent shutdown and decommissioning.

In preparing the DTS and determining the systems within its scope, CSN Instruction IS-32 [9] was considered applicable as it sets out the general criteria governing the definition and revision of Technical Specifications for an operating nuclear power plant. Although IS-32 does not explicitly address permanent shutdown conditions, Section 4.2 states that the scope of the Technical Specifications must include all structures, systems, components, and plant-specific aspects related to safety and/or significant to risk, according to one or more of the four criteria summarized in **Table 2**.

Application of IS-32 criteria [9] to the new permanent shutdown and the final content of Chapter 5 of the Defueled Safety Analysis Report results in having the Defueled Technical Specifications include systems that had previously been beyond the scope of the Technical Specifications for Operation applicable to the reactor in service or otherwise included under different considerations.

Additional references used in development of the Defueled Safety Analysis Report included NUREG-1625 [10], together with the Defueled Technical Specifications drawn up for Santa María de Garoña NPP and José Cabrera NPP in Spain as well as those Indian Point NPP in the USA.

In contrast, specifications regarding SSCs that no longer meet the criteria for inclusion in the Defueled Technical Specifications but are still needed during the shutdown period either to comply with a Licensing Basis requirement or because their availability is considered necessary for operational or ALARA reasons were relocated to the Technical Requirements Manual.

The format of the Defueled Technical Specifications and their Bases, the numbering of Limiting Conditions for Operation, and the treatment of surveillance requirement uncertainties were kept consistent with the existing Technical Specifications for Operation.

Technical Requirements Manual

The Operating Requirements Manual (ORM) contains requirements applicable to SSCs that do not satisfy any of the criteria set out in IS-32 [9], nor are required to comply with applicable regulations, but which must remain functional for

Criterion	Description
Criterion 1	Instrumentation required to detect any abnormal and significant degradation of the reactor coolant pressure boundary and indicate it in the control room.
Criterion 2	A process variable, design feature, or operating restriction constituting an initial condition in the analysis of design basis accidents or transients challenging the integrity of barriers against the release of fission products.
Criterion 3	A system, structure or component forming part of the principal success path and functioning to mitigate a design basis accident or a transient challenging the integrity of barriers against the release of fission products.
Criterion 4	A system, structure or component that the plant Probabilistic Safety Assessment or operating experience has been shown to be important to safety.

Table 2. Criteria for inclusion of SSCs in the Technical Specifications.

operational reasons or because their control minimizes radiological releases in the event of postulated accidents or events.

The Technical Requirements Manual (TRM) retains any ORM requirements applicable to systems necessary for compliance with a Licensing Basis requirement or whose continued availability is considered necessary by CNAT during the shutdown period for operational or ALARA reasons. As previously noted, it also includes the requirements associated with systems relocated from the Technical Specifications for Operation.

Additional references used preparing the Technical Requirements Manual included the SRM for Santa María de Garoña NPP and the corresponding document for Indian Point Nuclear Power Plant.

The format of the TRM and the numbering of shutdown requirements were maintained consistent with the existing ORM. New requirements arising from permanent shutdown conditions and not previously included in the ORM were consecutively numbered to be consistent with the existing numbering system.

CONSIDERATIONS RELATED TO THE PHASES OF PERMANENT SHUTDOWN

As noted in Section 2 above, during the FTA-2 period Unit I will be subject to the Shutdown Documents, whereas Unit II will remain subject to the Operating Documents. Once both units are in permanent shutdown (FTA-3), each unit will be governed by its corresponding Shutdown Documents.

These differences between shutdown phases were taken into account during preparation of the official shutdown documents. Applicability conditions specific to the FTA-2 period were identified for any Limiting Conditions for Operation in the Unit I DTS and Technical Requirements in the TRM whose content differs between the FTA-2 and FTA-3 periods due to continued operation of Unit II. Similarly, within the Defueled Safety Analysis Report, observations were incorporated in sections whose content is not applicable while Unit II remains in operation, identifying instead the content applicable during the FTA-2 period.

CONCLUSIONS

Safe operation of nuclear power plants must be ensured throughout all phases of the facility's lifetime, demonstrating compliance at each stage with both applicable safety requirements and licensing conditions.

As per Article 35 of the RNS [7], prior to permanent shutdown and decommissioning, the licensee must perform a safety and risk assessment of the facility consistent with shutdown conditions, including the corresponding accident analyses. These accident analyses must establish the operating limits and conditions applicable to systems, structures and components important to safety, together with the surveillance requirements and actions applicable under shutdown conditions.

These analyses and the corresponding operating limits and conditions for permanent shutdown are documented in the Defueled Safety Analysis Report, the Defueled Tech-

nical Specifications, and the Technical Requirements Manual. These documents were prepared accordingly within the framework of the Almaraz Nuclear Power Plant Transition-to-Decommissioning Plan for the purpose of obtaining the Ministerial Declaration of Permanent Cessation of Operation for Unit I.

ABBREVIATIONS

CSN: Nuclear Safety Council

CTI: Complementary Technical Instruction

DTS: Defueled Technical Specifications

DSAR: Defueled Safety Analysis Report

FSAR: Final Safety Analysis Report

IS: Nuclear Safety Council Instruction

ISFSI: Interim Spent Fuel Storage Installation

MDPCO: Ministerial Declaration of Permanent Cessation of Operation

MITECO: Ministry for Ecological Transition and Demographic Challenge

NPP: Nuclear Power Plant

OL: Operating Licence

ORM: Operating Requirements Manual

OSD: Official Shutdown Documents

OSDCD: OSD Complementary Documents

RG: Regulatory Guide

RNRF: Regulation on Nuclear and Radioactive Facilities and Other Activities Involving Exposure to Ionising Radiation (RD 1217/2024)

RNS: Regulation on Nuclear Safety for Nuclear Facilities (RD 1400/2018)

SSC: Structures, Systems and Components

TRM: Technical Requirements Manual

REFERENCES

[1] IS-45 del CSN, de 17 de noviembre de 2021, sobre los requisitos de seguridad durante las fases de diseño, construcción y explotación de las instalaciones nucleares y radiactivas del ciclo del combustible nuclear, para prevenir su desmantelamiento y, en su caso, su desmantelamiento y cierre.

[2] Plan Nacional Integrado de Energía y Clima (PNIEC 2023-2030).

[3] «<https://www.foronuclear.org/recursos/infografias/fecha-de-autorizacion-y-cese-de-explotacion-de-las-centrales-nucleares-espanolas/>» Fecha de autorización y cese de explotación de las centrales nucleares españolas. página web (accedido 5 de septiembre de 2025).

[4] Real Decreto 1217/2024, de 3 de diciembre, por el que se aprueba el Reglamento sobre Instalaciones Nucleares y Radiactivas, y otras actividades relacionadas con la exposición a las radiaciones ionizantes.

- [5] GTDCEX/GT1/01, Metodología de desarrollo de la documentación soporte para la solicitud de obtención de la declaración de cese de explotación.
- [6] IS-37 del CSN, de 21 de enero de 2015, sobre análisis de accidentes base de diseño en centrales nucleares.
- [7] Real Decreto 1400/2018, de 23 de noviembre, por el que se aprueba el Reglamento sobre seguridad nuclear en instalaciones nucleares.
- [8] RG 1.184, Rev. 1: *Decommissioning Nuclear Power Reactors*, U. S. Nuclear Regulatory Commission.
- [9] IS-32 del CSN, de 16 de noviembre de 2011, sobre Especificaciones Técnicas de Funcionamiento de centrales nucleares.
- [10] NUREG-1625 ("draft"), *Proposed Standard Technical Specifications for Permanently Defueled Westinghouse Plants*, U. S. Nuclear Regulatory Commission.
- [11] «https://www.csn.es/ca/noticias-csn/2025/-/asset_publisher/9iAov9mrc931/content/el-csn-informa-favorablemente-la-itc-sobre-la-presentacion-de-los-documentos-oficiales-de-parada-de-la-unidad-i-de-almazar», El CSN informa favorablemente la ITC sobre la presentación de los documentos oficiales de parada de la unidad I de Almaraz, 2025. página web (accedido 11 de septiembre de 2025). ■