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Vol. 1: Genesis, Design and Evolution

Chapter 8 - Managing the Design and Construction of ITER

Section 6 - Oversight of the Construction Regulatory Framework

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About the ITER Basis Engineering Handbook

This handbook consists of two volumes which describe the ITER design from its inception up to the design, construction and assembly in 2025.

The handbook is not designed to be read as a continuous sequence of chapters. Instead, it is composed of focused, self-contained sections that address specific topics. Each chapter can be read and understood independently, allowing readers to engage with the material most relevant to their needs without requiring familiarity with preceding chapters. As a result, the reader will find certain overlapping content in chapters.

It is to be noted that at the time of writing, the design for some systems is still on-going. Therefore, the reader should consider that whilst there is significant value of this important point-in-time study, an update would be required as the Project progresses.

A broad Project overview is given in the first volume, to provide the reader with background information necessary to understand the context in the subsequent more-detailed chapters of the second volume, dedicated to the individual systems composing ITER.

For the overall table of contents of the Handbook and to access each one of the chapters, please refer to <https://www.iter.org/scientists/iter-technical-reports>.

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Chapter 8

Managing the Design and Construction of ITER

8.6 Oversight of the Construction Regulatory Framework

The legal framework applicable to the IO, and more specifically, the applicable construction regulatory framework, is determined by the international treaties (constitutive agreements) which have established the ITER Organization (IO) as an intergovernmental organization and which provided for its legal status, i.e. the “Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project” hereinafter referred to as the “ITER Agreement”^[1] and the “Agreement on the privileges and immunities of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project” hereinafter referred to as the “ITER Agreement on P&I”^[2].

As any intergovernmental organization established by an international treaty, the IO is subject to its constitutive agreement only and not to the national legal framework applicable in the state hosting the organization.

However, by exception to this principle, considering the nature of the activities to be carried out by the IO, the parties to the ITER Agreement agreed, pursuant to its Article 14, that the IO “*shall observe applicable national laws and regulations of the Host State in the fields of public and*

occupational health and safety, nuclear safety, radiation protection, licensing, nuclear substances, environmental protection and protection from acts of malevolence”.

Furthermore, According to Article 22 of the ITER Agreement on P&I, the IO shall cooperate, at all times, with the Host State to ensure the observance of these laws and regulations according to the terms agreed with the Host State which are laid down in the Headquarters agreement (HQA) and related supplementary agreements, such as the additional protocol related to the role of the Labour Inspector on the ITER Site and concerning occupational health and safety[3].

Article 16 of the HQA provides also that the privileges and immunities conferred in accordance with the HQA shall not diminish or affect the duty of the IO, the DG or the Staff to comply with French laws and regulations in the field of public and occupational health and safety, nuclear safety, radiation protection, licensing, nuclear substances, environmental protection and protection from acts of malevolence.

The construction of the ITER facilities is impacted by all these fields of French laws and regulations to be observed by the IO. The below developments provide an overview of how the land was secured to enable the construction to begin and of the implementation of certain items of this construction regulatory framework and of the different national authorities involved.

8.6.1 Securing the Land

The first step before starting construction activities was to make the land available to the IO.

According to Article 1 of the Annex on Site Support to the ITER Agreement, the Host Party (i.e. EURATOM) had the obligation to make available to the IO the land needed for the construction of the ITER facilities. It did so through the French Atomic and Renewable Energy Commission (CEA) who made available the land to the IO through a particular notarial deed: an emphyteutic deed.

The land was prepared, under French laws and regulations, by the CEA with the support of Agence ITER France so that it would be ready for starting construction works as soon as it would be made available to the IO. In this process, due to environmental protection of protected wild species, the CEA had to purchase land elsewhere as an environmental compensation measure, due to the presence of a protected species on the land chosen to host the ITER Project, before proceeding with the clearing of the site.

According to the emphyteutic deed, which was signed on 10th July 2010, the CEA remains the owner of the land while the IO has all the necessary rights to carry out all needed activities on the ITER Site for the purposes of implementing the ITER Agreement. The duration of the deed is aligned with the duration of the ITER Agreement. The land and all construction (including the nuclear installation) will be transferred back to the CEA at the end of the project as the Host State oversees the dismantling phase.

Certain parts of the ITER Site have been made available by the IO or special access have been provided by the IO to other legal entities to enable them to carry out their activities in the framework of the ITER Project. For example, certain access rights or servitudes have been granted to the supplier of raw water to the site. Another example is related to the electrical grid that has been built specifically for the ITER facilities for which a part of the ITER Site has been sublet to the legal entity in charge of electricity transport.

Despite the ownership of the land remaining with the CEA, the ITER Site is subject to the legal status of the IO, meaning that the IO premises are inviolable, pursuant to the privileges and immunities of the IO. National Authorities of the Host State may only intervene on the ITER Site with the prior approval of the Director-General and according to the HQA and its related supplementary agreements.

8.6.2 Environmental Protection

8.6.2.1 ICPEs: INB and non-INB perimeters

Legal framework

The IO operates both nuclear and non-nuclear installations that fall under the French legal framework of *Installations Classées pour la Protection de l'Environnement (ICPE)*, as defined in the French Environmental Code (Book V, Title I), already at the time of construction.

The ICPE system ensures that facilities presenting risks for health, safety, or the environment are declared, registered or authorised and remain under competent authority oversight.

Two categories apply:

- **INB-related ICPEs:** Located inside the INB perimeter, under ASN supervision, as their operation can impact INB operation and environmental compliance.
- **Non-INB ICPEs:** Located outside the INB perimeter (e.g. workshops, storage areas, construction installations, landfill), supervised by environmental authorities (DREAL), under standard ICPE requirements.

Regulatory Oversight

- **ASN:** Conducts inspections of ICPEs inside the INB perimeter, verifies consistency of environmental requirements with nuclear safety prescriptions, and issues technical prescriptions aligned with INB licensing.
- **DREAL:** Supervises ICPEs outside the INB perimeter, with inspections covering air, water, waste, and hazardous substances. Under ASN's coordination, DREAL may participate in joint inspections when environmental and nuclear regulatory requirements intersect.

Inspection framework programmes

Because the IO is an international organization with privileges and immunities, inspections are conducted according to the principle of the HQA and detailed in specific inspection framework programmes:

- ASNR Framework Programme (2014): Defines inspection modalities inside the INB perimeter.
- DREAL Framework Programme (2017): Defines inspection modalities outside the INB perimeter.

These programmes provide a structured mechanism for compliance with French law and regulations while respecting the IO's legal status.

8.6.2.2 *Water Law (Loi sur l'Eau)*

Legal Framework

The *Loi sur l'Eau* included in the French environmental Code (Articles L.214-1 et seq.) regulates activities that may affect water resources, aquatic environments, and runoff, so-called activities qualified as IOTA (Installations, Ouvrages, Travaux et Activités impacting the water resource) require declaration, registration or authorisation depending on their environmental impact.

Application

For the activities on the ITER Site, the IOTA regime applies to:

- Stormwater management systems (basins, reservoirs, diversion works).
- Drainage networks during construction and operation.
- Water intakes and discharges not directly linked to nuclear effluents.
- Protection of aquatic ecosystems in the Durance River basin.

The main objectives are the prevention of pollution, control of erosion and runoff, and protection of downstream ecosystems. Supervision follows the general division of competences: ASNR for INB-related installations, DREAL for non-INB works.

8.6.2.3 *Release Authorisation*

Legal Framework

Under the *French environmental code* (Articles L.593-7, R.593-48, L.214-1 et seq.), nuclear installations require explicit authorisation for liquid effluent releases. These authorisations:

- Define categories of effluents (industrial, cooling, sanitary).
- Establish limit values (VLEs) for chemical, thermal, and radiological parameters.
- Impose monitoring, reporting, and incident declaration obligations.

Application

For the IO, obtaining a release authorisation demonstrated several challenges typical of new nuclear projects:

- **Evolution of commissioning assumptions:** The initial DAC licensing basis primarily addressed operational discharges while some commissioning related effluents (e.g. flushing, hydrotests, coil cleaning), were later characterized in greater detail as design and commissioning methods matured. This highlighted the need to align early licensing assumption with the full range of construction and commissioning activities
- **Interim measures:** Effluents were temporarily transferred to a neighbouring operator's system. This solution was accepted under a *Porté à connaissance*, but ASNR clarified it could not replace the IO's own authorisation on the long term.
- **INB perimeter requirement:** Authorities required that effluent treatment and monitoring installations be legally integrated into the INB perimeter before granting a release authorisation, to ensure prescriptions were coherent with nuclear safety oversight.
- **Phased strategy:** Because the full scope could not be authorised in one step, the IO pursued a phased approach: first for pre-operational activities (pre-PFPO), then for PFPO/DT.
- **Changing effluent volumes:** Forecasts evolved significantly compared to the DAC, due to design changes, commissioning methods, and refined hydraulic modelling. Authorities accepted revised figures, but the process showed the importance of flexibility and conservative bounding in early files.

Supervision follows the general division of competences: **ASNR** is the authority for INB effluent releases; **DREAL** covers only runoff outside the INB.

8.6.2.4 Greenhouse Gases (GHG)

Legal framework

The IO is subject to French GHG reporting requirements under:

- French environmental code, Articles L.229-25 and R.229-47.
- BEGES methodology (v5), aligned with the GHG Protocol.

Obligations include:

- Submission of a GHG Emissions Report (BEGES) to ADEME every three years.
- Coverage of Scope 1 (direct), Scope 2 (purchased energy), and Scope 3 (significant indirect) emissions.
- Inclusion of a transition plan with emission reduction measures.
- Use of the operational control approach: if IO directs or manages the activity, related emissions are reportable.

Application

Typical sources include:

- Scope 1: On-site emissions (fuel, generators, refrigerant and SF₆ leaks).
- Scope 2: Electricity purchased from the French grid.

- Scope 3: Indirect emissions (procured components, freight, staff travel, commuting, waste, IT/cloud services).

Supervision follows the general division of competences: ASNR for refrigerant and SF₆ oversight, and the Ministry of Ecological Transition / ADEME for national reporting.

8.6.2.5 *Other Environmental Regulations*

In addition to ICPE, Water Law, Release Authorisation, and GHG, the IO shall observe other environmental regulatory requirements:

- **Chemical Product Storage (Seveso)**
Governed by Directive 2012/18/EU (Seveso III) transposed into French ICPE law. The IO inventories remain below upper-tier thresholds but require monitoring, containment, fire protection, and spill response measures.
- **Waste Management**
Regulated under the French environmental code (L.541-1 et seq.) and the INB Order of 7 February 2012. The IO applies strict segregation (INB vs. non-INB), uses licensed contractors, and ensures traceability and minimisation.
- **Dust**
Controlled under ICPE prescriptions and prefectural orders. Measures include water spraying, enclosures for dusty activities, and continuous boundary monitoring.
- **Noise**
Subject to thresholds in the French Public Health Code and ICPE prescriptions (≈70 dB(A) daytime, ≈60 dB(A) nighttime at property limits). The IO uses acoustic barriers, noise mapping, and scheduling of heavy works to maintain compliance.
- **Light Pollution**
Governed by the Order of 27 December 2018. The IO limits night lighting to operational needs and uses downward-facing fixtures to reduce impacts on biodiversity and skyglow.

Experience feedback

These regulatory requirements show that even when thresholds are not exceeded, proactive measures (inventory control, waste segregation, dust suppression, noise and light minimisation) are essential to maintain compliance and stakeholder confidence.

8.6.3 **Protection of Workers (Occupational Health & Safety)**

During the construction of the plant, The ITER Organization faced several significant challenges. One of the primary difficulties was related to the operational concepts of the various buildings and production areas, particularly regarding occupancy and way maintenance was supposed to be achieved. It was essential to carefully plan how many people would be present during the day and at night, and to understand how this would impact workflows, safety measures, and overall

operational efficiency. This information was not available at the beginning of the ITER Project and have been progressively consolidated.

Another challenge involved the interaction between the control rooms (including the security control room) and the buildings where systems were operated. Clear procedures, including action lists and response protocols, had to be developed to ensure smooth and safe operations in the event of safety incidents or deviations.

Additionally, the international and multi-contract nature of the project required particular attention to ensuring a shared understanding of French regulatory expectations, including preventions plans and PPSPS (Safety and Health Protection Plans). The OHS service therefore played an important coordination and support role, helping contract managers, schedulers, and programme teams apply these requirements consistently and maintain the organization's alignment with French regulation.

In general, the development of a strong safety culture among both staff and subcontractors was a gradual process, requiring the alignment of different cultural approaches, behaviours, and attitudes towards safety. This process was not primarily related to familiarity with French regulations, but rather to establishing a consistent and proactive safety mindset across the organization. Initially, the organization introduced 12 Golden Rules, which were later followed by 9 Life-Saving Rules. As part of the continued evolution of our safety approach, we have since aligned with industry-standard Life-Saving Rules, with a particular emphasis on visible leadership commitment and active leadership engagement in their implementation and rollout.

To meet French regulatory requirements, the ITER Organization engaged a CSPS (Coordinator for Health and Safety during the Design and Construction phases), whose involvement had a significant influence on the way the buildings were designed and constructed from an occupational health and safety perspective. Separately, and in accordance with French regulatory requirements, the IO organized the site into distinct zones with controlled access and appropriate safety measures for both construction and operational activities. These two measures addressed different regulatory and organizational requirements and were implemented as separate elements of the overall health and safety framework.

The IO safety team was initially established to monitor construction activities and subsequently expanded its role to define safety requirements for the buildings. One key challenge was determining the role of the safety department—whether it should act primarily as a support service for project teams or as an authoritative body responsible for verifying that all procedures and regulations were properly followed. This challenge was particularly evident regarding fire safety and the applicability of the NF S61-933 standard when determining departmental responsibilities, as well as compliance requirements for stairs and ladders, regular inspections for some equipment.

The scale and complexity of the project, together with the number of separated teams involved and with independent responsibilities for example in fire detection coverage, which were then addressed through improved coordination and consolidation. The identification of confined spaces through the construction phase also required sustained attention. Electrical safety procedures—such as Lockout/Tagout (LOTO) and first energization protocols—were progressively developed as the roles and responsibilities of the various stakeholders became clearly defined. This topic required close coordination between construction teams, commissioning engineers, and safety representatives to ensure that each party understood its duties and that all activities were performed under controlled and safe conditions.

Crisis management and on-call systems were gradually developed over a period exceeding 10 years following the start of construction. These systems evolved in parallel with the identification of new risks and the allocation of available resources, initially structured around facilities and safety on-call duties.

Numerous risk response plans were developed to address a wide range of scenarios, including both internal and external fire events. From the earliest stages of the project, exchanges were initiated with local, regional, and national authorities to ensure a shared understanding of risk management and to integrate the Organization into the broader French emergency and risk management framework.

The signing of formal agreements between the Organization and the relevant ministries—particularly the Ministries of the Interior and of Labour—was a key milestone. These agreements were essential to clarifying the Organization’s specific status within the French regulatory system and ensuring consistent interpretation of its obligations and responsibilities in terms of safety and emergency preparedness.

To strengthen our capacity for incident response, an internal fire brigade was established under a dedicated contract. This service was designed to provide a rapid and effective response in the event of a fire or similar emergency. Over time, this team expanded to include a Hot Work Team, responsible for supervising and authorizing hot work permits, further enhancing fire prevention and on-site safety oversight.

Overall, the ITER project demanded meticulous coordination between operational planning, safety compliance, construction management, and cultural integration to ensure functionality, regulatory adherence, and the progressive development of a strong safety culture.

8.6.4 Urban Planning

8.6.4.1 *Regulatory Framework*

Urban planning for nuclear installations in France is governed by a combination of national laws, environmental codes, and local urban planning documents. Key regulatory instruments include:

- **Environmental Code** (Articles L.591-1 to L.597-46)
- **Act No. 2006-686** on Transparency and Security in the Nuclear Field (TSN Act)
- **Energy Code** and **Public Health Code**

Local planning documents such as the **Plan Local d'Urbanisme (PLU)** and **Schéma de Cohérence Territoriale (SCoT)** define land use compatibility and zoning regulations.

Throughout the design and construction of ITER, the local planning documents applicable to the ITER site have changed several times. In 2006, at the time of signature of the ITER Agreement, Saint-Paul-Lez-Durance had a so-called Plan d'Occupation des Sols (POS). In 2018, following a national reform, this plan was replaced by the Plan Local d'Urbanisme (PLU). With the creation of the Métropole Aix-Marseille-Provence, the PLU's of the various municipalities were replaced in 2023 by a common Plan Local d'Urbanisme Intercommunal (PLUI). With each change, the ITER Organization has been consulted by the authorities, and comments raised have been addressed.

8.6.4.2 *Buildings within the INB Perimeter*

According to the Plan d'Occupation des Sols (POS) valid in 2006, the ITER site was located in a natural area, where construction was not allowed. Moreover, the area was classified as "Espace Boisé Classé" (Classified Wooded Area), which prohibits construction of any kind. Therefore, a procedure was initiated in 2016 to change the status of the ITER site from an ND zone (natural area) to a dedicated NAN zone (nuclear urbanization area) and the downgrading of the Classified Wooded Area in the same zone. The planning rules that were defined for the NAN zone were very similar to those of the CEA site, with very few restrictions.

After approval of the revised urban planning rules end-2006, the CEA obtained permission from the ministry of agriculture and fishing to clear the ITER site of trees, accompanied by compensatory measures in favour of the protection of species. In parallel, CEA requested a so-called "Autorisation d'Installation(s) et Travaux Divers (ITD)", an authorization to perform the site preparation works, awaiting the formal building permit for the buildings. This permit covered site levelling, the site boundary fence, the heavy haul road and the spoil disposal area.

When ITER Organization was established in 2007, a building permit request was prepared for the construction of all buildings within the INB perimeter, including the Tokamak complex and the Hot Cell Complex, and submitted to the authorities in September 2008. The application was based on

the building design at that stage of the project, with an architectural concept of the buildings. The building permit was issued by the Prefect on 7 April 2008.

After the appointment of the Architect-Engineer by Fusion for Energy, in charge of the design and the construction of the ITER buildings, the design of the buildings was further developed, including a completely new concept of the facades. Considering the significant changes to the original building permit design in the number, size and appearance of the buildings, the urban planning authorities were approached. After analysis, they concluded that those changes required a revised building permit ("permis modificatif"). This revised building permit was obtained on 18 March 2013.

It is anticipated that further revised building permit applications will be necessary to formalize the building modifications that occur throughout the design and construction phases.

Buildings outside the INB Perimeter

Apart from the building permit for the INB area, various other building permits have been obtained at various stages of the project:

- By Agence ITER France:
 - o Office buildings 81(2008) and 82 (2009)
 - o Building 07 (2008), Electrical substations 91/92 (2008), Sewage Treatment Plant (2009)
 - o Headquarters buildings 03, 06 and 72 (2010)
- By the ITER Organization:
 - o Buildings 55 – PF Coil Building (2010)
 - o Buildings 36 and 38 (2012)
 - o Building 56 – Cryostat Sub-Assembly Building (2013)
 - o Building 89- Logistics Platform (2014)
 - o Building 22 – Tokamak Assembly Preparation Building (2019)
 - o Building 62 – Hot water boilers building (2019)
 - o Building 70 – Emergency Response Building (2023)

Some of these buildings were subject to ICPE regulations (refer to Section 8.4.3.3.1), and ICPE files have been prepared and submitted in parallel to the building permit applications.

8.6.4.3 *Temporary Buildings*

According to Article R421-5 of the French urban planning code, temporary constructions directly necessary for the conduct of the works are exempt from building permit formalities. For this reason, no building permit applications have been submitted for all construction site facilities, such as temporary offices, contractor welfare facilities, workshops, and warehouses.

8.6.5 Abbreviations & Glossary

ADEME	Agence de la Transition Écologique, the French agency responsible for ecological transition and GHG reporting.
AE	Autorité Environnementale (Environmental Authority).
AIF	Agence ITER France.
ASN	Autorité de Sûreté Nucléaire (former French Nuclear Safety Authority).
ASNR	Autorité de Sûreté Nucléaire et de Radioprotection, the French authority responsible for nuclear safety and radiation protection, including oversight of INB-related activities.
BEGES	Bilan des Émissions de Gaz à Effet de Serre (Greenhouse Gas Emissions Report methodology).
CEA	Commissariat à l'Énergie Atomique et aux Énergies Alternatives (French Alternative Energies and Atomic Energy Commission).
CSPS	Coordinator for Health and Safety during the Design and Construction Phases.
DAC	Décret d'Autorisation de Création (Construction Authorization Decree for a French nuclear installation). Mentioned as the original licensing basis for estimated effluent releases.
DG	Director-General of the ITER Organization.
DREAL	Direction Régionale de l'Environnement, de l'Aménagement et du Logement. (Regional Directorate for Environment, Planning and Housing)
EURATOM	European Atomic Energy Community, acting as the Host Party under the ITER Agreement.
GHG	Greenhouse Gas.
HQA	Headquarters Agreement between the ITER Organization and the Host State.
ICPE	Installation Classée pour la Protection de l'Environnement (Classified Installation for Environmental Protection).
INB	Installation Nucléaire de Base (Basic Nuclear Installation).
IO	ITER Organization.
IOTA	Installations, Ouvrages, Travaux et Activités impacting water resources and regulated under French Water Law.
ITD	Autorisation d'Installation(s) et Travaux Divers, authorization for preliminary site development works.
LOTO	Lockout/Tagout, an electrical safety procedure used to isolate hazardous energy sources.
NF S61-933	French standard relating to fire safety systems and associated responsibilities.
OHS	Occupational Health and Safety.
PF Coil	Poloidal Field Coil, a major magnet component of the ITER machine.
PFPO	First Plasma and Power Operation related phase referenced in the staged release authorization strategy.
PLU	Plan Local d'Urbanisme (Local Urban Development Plan).
PLUI	Plan Local d'Urbanisme Intercommunal (Inter-municipal Urban Development Plan).
POS	Plan d'Occupation des Sols (Land Occupancy Plan).
PPSPS	Plan Particulier de Sécurité et de Protection de la Santé (Site-Specific Safety and Health Protection Plan).
SCoT	Schéma de Cohérence Territoriale (Territorial Coherence Scheme).
SF ₆	Sulfur Hexafluoride, a greenhouse gas used in electrical systems and subject to



	monitoring requirements.
TSN Act	French Transparency and Security in the Nuclear Field Act (Act No. 2006-686).
VLE	Valeur Limite d'Émission (Emission Limit Value) applicable to effluent releases.

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[1] ITER Organization, “Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (ITER Agreement),” 2006. [Online]. Available: <https://www.iter.org/sites/default/files/ITERAgreement.pdf>

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