Foreword: ITER in Cadarache

The implantation on the Cadarache site of the ITER project, aimed at proving the scientific feasibility of fusion energy, has been subject to detailed studies since the beginning of 2001. These studies permit to confirm today that Cadarache is suitable to receive the project in the best possible conditions.

In the heart of the Provence garrigue, Cadarache has more than 40 years experience in the nuclear energy field. Next to a complete scientific and technological platform on nuclear fission, Cadarache also houses research on plants, bacteria and renewable energies. More than 4000 people work on a site of 1600 hectares. Eighteen nuclear installations are present.

One finds in particular the French research centre on controlled fusion, housing Tore Supra, in operation since 1988, the first tokamak in the world using superconducting magnets. Three hundred researchers, engineers and technicians specialised in this field form an essential part of the capability to host the project.

The CEA is very keen to host ITER.

Cadarache is to bring the ITER project in very competitive conditions a logistic, technical and scientific support of the highest order. Finally, the quality of life in the Provence Alpes Côte d'Azur region and its capacity to welcome the project staff and their families guarantee a reception, remarkable in all respects.

The Director of CEA Cadarache

Hervé Bernard

The CEA – Commissariat à l'Energie Atomique - is a public institution involved in fundamental and technological research. Its current aims are to:

- improve current performance in the nuclear industry and develop nuclear energy for the future
- provide specific solutions for dealing with nuclear waste
- develop new technologies for alternative forms of energy
- make progress in the fields of information technology, biotechnology, microelectronics, nano-technology and new materials for industry
- gain deeper knowledge of the biological effects of radiation
- use nuclear technology to improve medical imagery techniques, the development of new medical treatments and the understanding of genetics, cells, viruses and prions
- conduct fundamental research in physics and chemistry in an international context to support technological developments

The CEA guarantees national independence by designing, manufacturing and maintaining nuclear weapons as a deterrent, guaranteeing their credibility and safety on the basis of its Simulation programme. It also helps to monitor international nuclear non-proliferation treaties.

16,000 people work for the CEA in 10 research centres in Ile-de-France (Saclay, Fontenay-aux-Roses, Bruyères-le-Châtel), the central region of France (Le Ripault), Aquitaine (Cesta), Burgundy (Valduc), the Rhône-Alpes region (Grenoble, Pierrelatte), Languedoc-Roussillon (Marcoule) and Provence-Alpes-Côtes d'Azur (Cadarache).

Introduction and summary

The objective of the ITER machine is to demonstrate the scientific feasibility of fusion. To do so the installation will produce 500 MW of fusion power during pulses of 400 seconds. The facility will also demonstrate key fusion technologies. The ITER Engineering Design Activities (EDA) were carried out between July 1992 and July 2001 under the framework of the ITER Agreement and Protocol signed by, originally, four main Parties: the European Atomic Energy Community, Japan, the Russian Federation and the United States of America [1] .

During the EDA phase, the ITER Team elaborated a reference design, called hereafter "generic design", including in particular a set of **needs** to be satisfied by any proposed site, some obligatory – the **site requirements**, some more liberally – the **design assumptions**.

A European ITER Site technical Study group (EISS group) has been established to examine sites in Europe. For the Cadarache site in France, the EISS group was asked:

- to establish compliance of the site with the ITER technical site needs
- to identify key elements for the licensing procedure;
- to examine site specific aspects of the ITER construction and operation costs;
- and to evaluate the social and infrastructure impacts of the project.

Cadarache fulfils all ITER site requirements and most of the design assumptions needed for ITER construction.

The Cadarache site appears to be remarkably suited to host ITER: the site has considerable experience in dealing with nuclear installations and hosts broad expertise on magnetic fusion research. The construction of ITER will benefit greatly from the technical, scientific and logistics environment already in existence on the Cadarache centre.

Cadarache fulfils all the requirements as defined for the generic site and has all the conditions necessary to host ITER.

Most of the ITER generic design assumptions are already perfectly fulfilled and where a difference exists, an evaluation of the additional work has been made. Certain aspects are more favourable in Cadarache. This allows certain modifications that could lead to economies. The modifications are minor both inside and outside the fence.

The socio-economic environment of Cadarache is particularly rich and attractive. Scientific and industrial resources are widely available, and the region provides also a large variety of schools, medical care and housing as well as leisure and cultural activities. The existing infrastructures fulfil all possible needs.

Local and governmental authorities, as well as local organisations and associations have shown a great interest for the construction of ITER at Cadarache, by their constant implication in the project. The local and regional authorities have proposed to provide help with all administrative and socio-cultural issues for ITER staff and their families.

The French regulations concerning operation and dismantling of similar installations are compatible with the ITER needs. CEA has started the licensing procedure in order to satisfy the ITER construction planning assumptions.

[1] The USA withdrew from the project in 1999.

Site Requirements

Each ITER Site Requirement has been analysed in great detail before the satisfaction of each requirement has been validated for the Cadarache site.

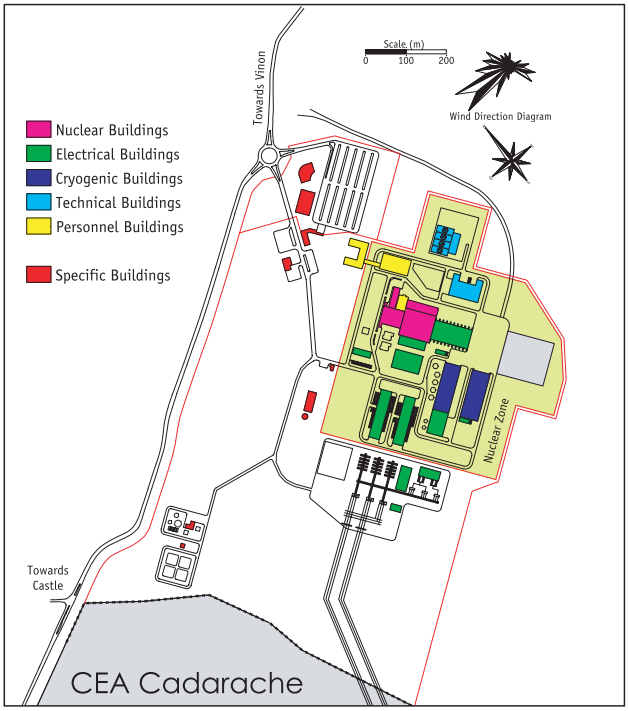
LAND

> **ITER site requirement:**
Land area: 40 hectares available for at least 30 years.
> **Requirement satisfied**

The site proposed for ITER is at the north east of the Cadarache centre. On the selected site 180 ha are available. The proposed implementation is shown here.

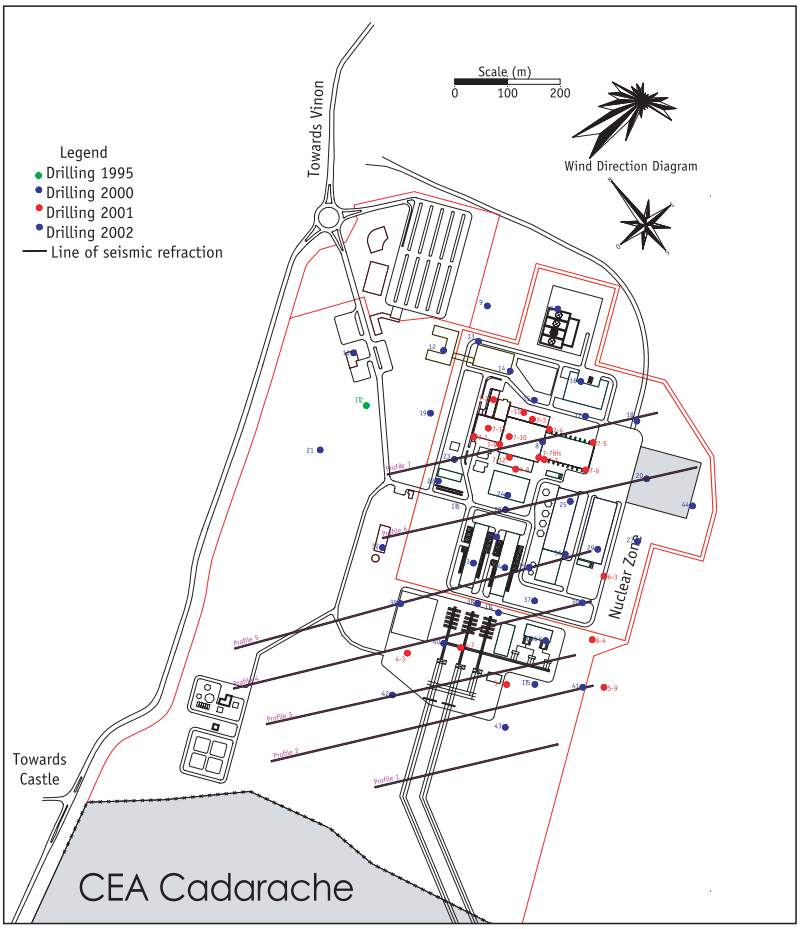
> **ITER site requirement:**
Geotechnical: soil bearing capacity of 25 t/m² for buildings, 65 t/m² to a depth of 25 m for tokamak building.
> **Requirement satisfied**

After a survey of the surface geology ground level and earlier geotechnical studies around the centre, a site for the tokamak building was selected. Extensive geological studies, including drillings to depth of 60 m and refraction measurements, have been performed on the tokamak building area. Initial investigations on the rest of the site have also been performed. Further detailed investigations are planned for all buildings and the results will be taken into account into the design of the foundations. All nuclear buildings will have their foundations in limestone. An overview of the geotechnical studies is shown.



The investigations included:

- Geological measurements using seismic refraction;
- Drillings, destructive drillings and core samples;
- Geotechnical tests, dilatometry and cross-hole tests.



> **ITER site requirement:**
Water supply: 0.2 m³/minute average, 3m³/minute peak, daily average 200 m³.
> **Requirement satisfied**

Water supply will be assured through one of several options.

> **ITER site requirement:**
Sanitary waste 1000 people, industrial waste 200 m³/day.
> **Requirement satisfied**

The sanitary waste and industrial waste requirements are within the existing authorisations for the centre. Extra waste treatment installations and intermediate storage basins will be constructed.

HEAT SINK

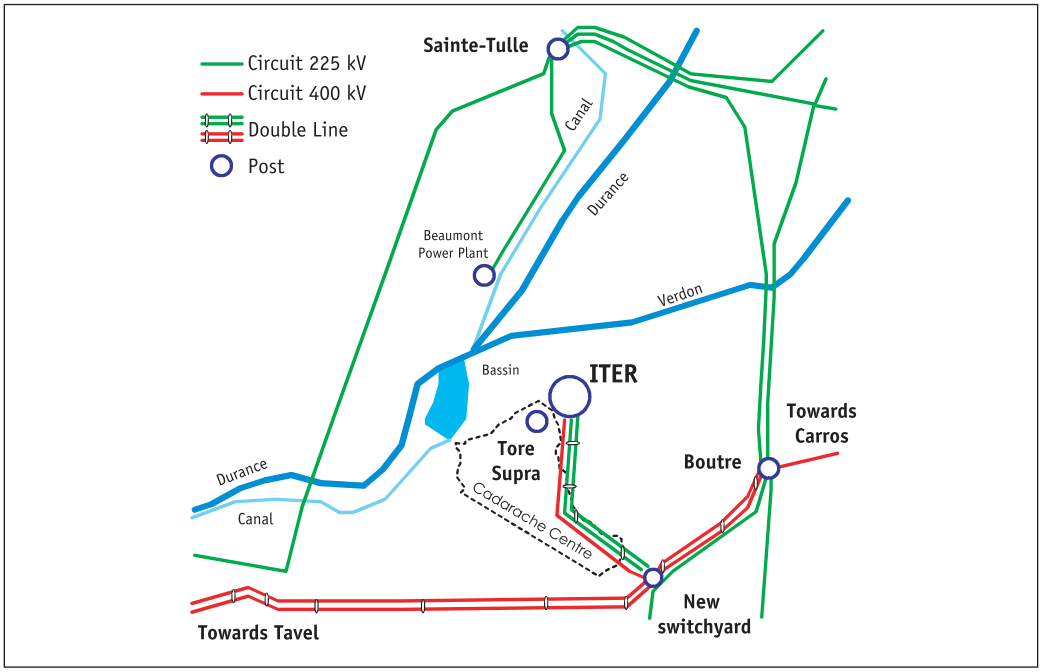
> **ITER site requirement:**
Average 450 MW (thermal) energy to environment
> **Requirement satisfied**

Three large irrigation/hydro-power canals are located close to the Cadarache centre and each one can provide the necessary cooling water. The solution retained for ITER will depend on investment and consumption costs in synergy with other new installations on the centre. About two thirds of the water evaporates in the cooling towers. The rest will most likely be discharged into the Durance, after the necessary controls, making use of the current discharge outlet of Cadarache.

ENERGY & ELECTRICAL POWER

> **ITER site requirement:**
120 MW continuous electrical power, 2 connections to be provided to site, no interruptions due to maintenance
> **Requirement satisfied**

One 400 kV line and a double 225 kV line will be used to provide, respectively, the pulsed and steady state electrical power needed for ITER. A 400 kV line already provides Tore Supra at the moment. A new switchyard will be created on the Tavel-Boutre High Voltage line. The proposed supply scheme is shown.

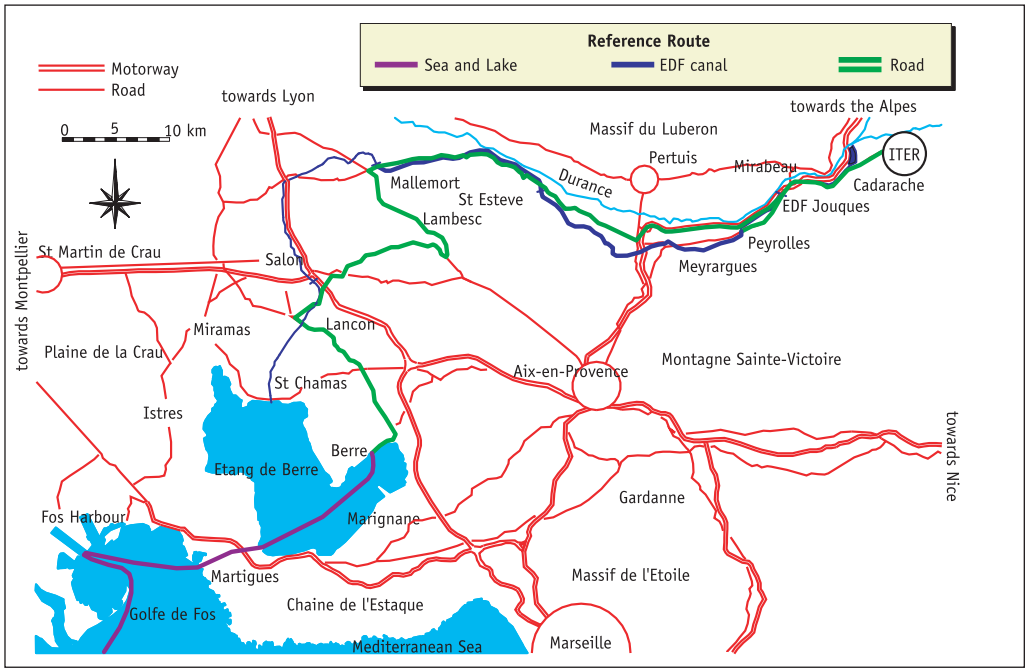


All modifications to the electrical network take place on terrain that is CEA property and have been studied by RTE, the French electric network company.

TRANSPORT & SHIPPING

> **ITER site requirement:**
Maximum size of components: width 9 m, height 8 m, length 15 m.
Maximum weight: 12 packages of maximum 600 t, 100 packages over 100 t.
> **Requirement satisfied**

Cadarache is located 70 km from the seaside. A solution for the transport of heavy and large components has been established. Two possible routes have been identified and further optimisation studies are undertaken by the governmental services responsible for exceptional transports in the region. All necessary modifications of roads, bridges, roundabouts etc., are being studied by state administrative services together with the local authorities.



REGULATORY & DECOMMISSIONING

> **ITER site requirement:**
Depending on host country, practicable licensing frame work has to exist to permit ITER to be build and operated, off-site matters: tritium transport, storage activated material.

> **Requirement satisfied**

The licensing process to obtain authorisation to construct and operate a nuclear installation is formalised in France by two decisions at government level. All steps to arrive at these decisions are clearly defined and are based on a continuous technical dialogue between the installation owner and the Safety Authority, assisted by technical experts. The licensing process is explained in more detail later in this document.

CONCLUSION SITE REQUIREMENTS

Cadarache fulfils all the ITER site requirements.

The generic design, as well as the corresponding planning and costs do not have to be changed. More space on the site is available. CEA has already started the necessary authorisation procedures and a large part of the necessary modifications (such as roads) have been taken on by local en regional authorities.

Design Assumptions

As for the ITER site requirements, the design assumption have been analysed one by one and the situation in Cadarache has been compared with the generic site. Depending on the assumption the situation can be more or less favourable. Where the situation is more favourable the benefits have been identified. Where the situation is less favourable the necessary compensatory measures have been identified.

LAND

> **ITER Design Assumption:**
Land area: additional 30 ha, close to site Assumption widely satisfied
> **Assumption widely satisfied**

A 180 ha are available for the complete site.

> **ITER Design Assumption:**
Topography: maximum elevation change less than ± 10 m
> **Assumption a priori not satisfied, small adaptations are proposed**

The natural ground is hilly and therefore buildings are implemented on four different platforms to reduce the overall excavation. All nuclear buildings will have their foundations on limestone:

- **Platform 1, 316 m** above sea level: pulsed and steady state power high voltage substation areas;
- **Platform 2**, **314 m**: magnet power conversion buildings;
- **Platform 3, 310 m**: cooling towers;
- **Platform 4, 308 m**: all other buildings.

The host partner will realise the necessary excavations.

> **ITER Design Assumption:**
Geotechnical: No hard rock removal (possible exception tokamak building 25 m)
> **Assumption a priori not satisfied, small adaptations are proposed**

The topsoil is partially limestone and the underground is totally limestone. Hard rock will have to be removed from under some buildings. The host partner will realise the necessary excavations.

During a ground surface review, no major singularity, which could have shown underground problems, was found. A very detailed geological investigation was performed and has confirmed the good quality of the ground. This investigation included:

- **Geological measurements using seismic refraction**: the objective was to identify faults. The programme has covered most of the ITER area.
- **Drillings, destructive drillings and core samples**: the objective was to determine the soil composition and characteristics, necessary for the design of the building foundations. Some of these drillings are equipped with water level probes and are recorded. These 60 m deep drillings are concentrated mainly on the area where the nuclear buildings are foreseen.
- **Geotechnical tests, dilatometry and cross-hole tests**: the objective was to measure the dynamic characteristics of the soil, to be used for the foundation design and further seismic modelling.

> **ITER Design Assumption:**
Groundwater 10 m below nominal, since tokamak embedment is 25 m, engineered ground water control might be necessary
> **Assumption satisfied**

The geotechnical studies have indicated that there are no problems with groundwater levels.

> **ITER Design Assumption:**
> **Seismic characteristics. The situation in Cadarache is slightly different from the generic design. There are no consequences on the design of the tokamak building**

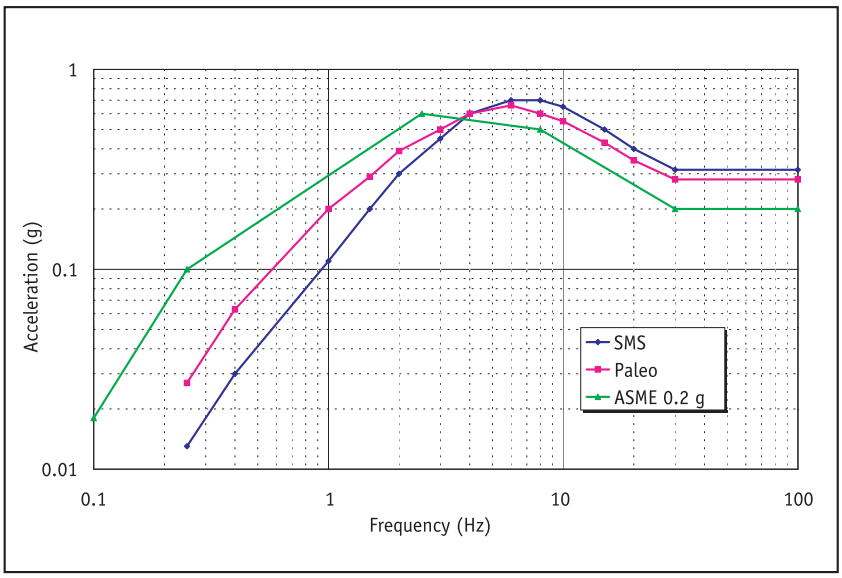
The French safety regulations require taking into account the actual seismic conditions at Cadarache, which are, a priori, slightly higher than those taken for the generic ITER site. The impact is rather minimal and the induced extra cost is reasonable.

The design of the safety classified buildings has been made by the ITER team in accordance with the guidelines of ASME and the U.S. NRC, with the objective to be applicable to a wide range of sites. The primary scaling parameter used in the construction of the acceleration versus frequency spectrum is the design maximum ground acceleration, which has been assumed to be 0.2 g for the generic ITER site. At Cadarache, the "Règles Fondamentales de Sûreté" (RFS) require the use of two excitation spectra:

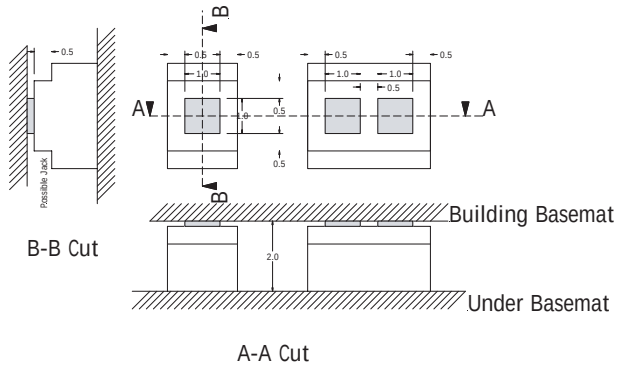
- the so-called "Séisme Majoré de Sécurité" (SMS): magnitude 5.8, distance to the epicentre 7.1 km, leading to a design maximum ground acceleration 0.315 g;
- the "Paléoséism": magnitude 7, distance 18 km, leading to a design maximum ground acceleration 0.281 g.

The comparison between the generic site (ASME 0.2 g) and Cadarache site specific Design Response Spectra is shown.

Studies were launched to estimate the capacity of the Tokamak Building, as designed by the ITER team, to cope with Cadarache seismic conditions and to determine the necessary adaptations and reinforcement if any. Two studies were made in parallel:

- 

- Response of the ITER tokamak building to the Cadarache spectrum: a 3D mesh of the building was made and then a spectral analysis. About 150 eigenmodes have been identified in all directions, between 0 and about 20 Hz. Main modes in the horizontal directions are in the range 3.6 – 3.7 Hz. Within this frequency range, the Cadarache spectrum and the ITER spectrum are rather similar. Stress computations show that the building, as it is now designed is able to withstand the Cadarache seismic conditions without any major reinforcement. However, a few weak points have been identified at the level where the superstructure is connected to the upper slab. This problem is not sitespecific and the attachment would have to be redesigned independent of site-specific.
- Study of the use of paraseismic bearings for the ITER tokamak building: These bearings are commonly used as supports for bridges and more specifically for nuclear buildings. Due to the excellent quality and homogeneity of the limestone in Cadarache, it would be possible to use such bearings for ITER. A preliminary design and layout have been proposed, leading to a decrease in the overall acceleration on the building and then on the equipments to 0.1 g, i.e. two times less than for the ITER design. Significant savings are expected in the design of the building and all inner equipment. The interfaces with nearby buildings will need to be checked carefully. The principle of paraseismic bearings is shown.



Both options (local reinforcement of tokamak building and the use of paraseismic bearings) are feasible, using safe and proven methods, and show that the implantation of ITER is possible in Cadarache, with respect to the seismic level, without major modifications as compared with the generic design.

In the hypothesis of paraseismic bearings, the interface between the building and outer equipment must be carefully studied. An evaluation on the benefits of paraseismic bearings will have to be made. The impact on cost and schedule are expected to be minimal.

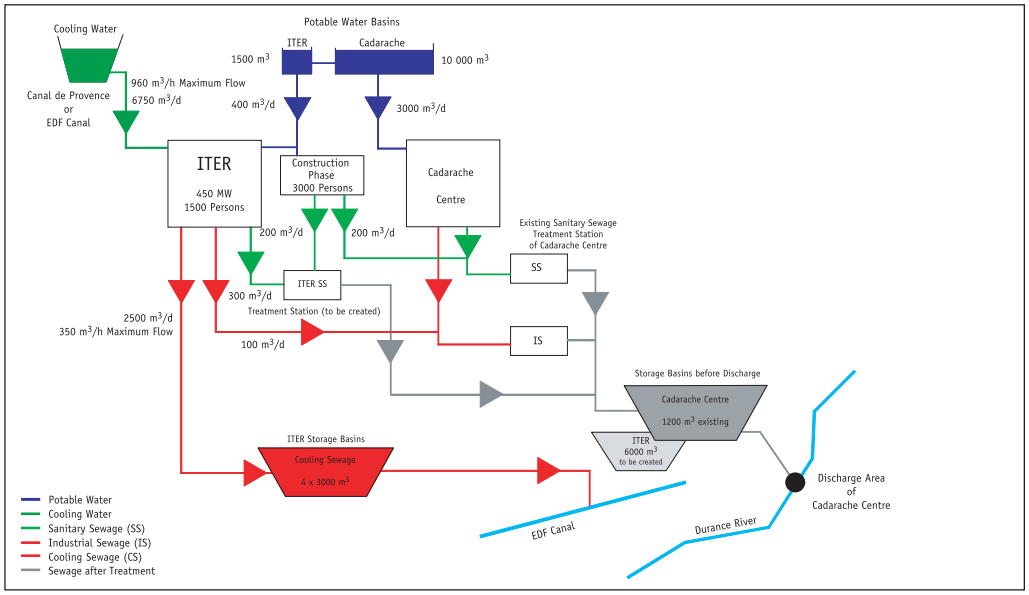
> ITER Design Assumption: Meteorological characteristics
> The situation is in Cadarache is slightly different, in general more favourable

- The humidity is on average lower in Cadarache which allows a reduction in size of the cooling towers.
- The maximum air temperature has been 40.1°C over 40 years. This has no impact on the design of the cooling towers, because the air is very dry under these conditions.
- The maximum relative humidity is 100% in Cadarache. This has no impact since this high relative humidity only occurs during limited periods when the temperature is low.

WATER SUPPLY AND INDUSTRIAL SEWAGE FOR HEAT REJECTION SYSTEM

> **ITER Design Assumption:**
Total fresh water requirement: 16 m³/minute (average), No pulsing: 5 m³/minute, Industrial sewage: 3000 m³/day.

> **Assumption satisfied**



The water supply scheme is shown. This design takes into account both the site requirements and design assumptions. The climate in Cadarache, warm but very dry in the summer, allows the overall dimensions of the cooling towers to be reduced, the wet bulb temperature in Cadarache being 24°C (against 29°C in the hypothesis taken by ITER).

ENERGY AND ELECTRICAL POWER

> **ITER Design Assumption:**
Electrical power reliability. ITER Plant pulsed electrical supply

> **Small difference with the Assumption. No significant impact on the ITER design.**

The reliability of the local electricity network is higher than the ITER assumption. The network can provide active power steps significantly larger than those required by ITER scenarios, inducing a saving on the design. Due to the fact that the Cadarache site is located far from the electrical power stations, an additional voltage drop compensator will need to be installed. Overall, extra costs and economies will compensate each other.

TRANSPORT AND SHIPPING

> **ITER Design Assumption:**
ITER site accessible by major highway connecting to major ports of entry and centres of commerce.
Air transport: ITER site located within reasonable commuting time from airport with connections to international air service.
Rail and waterway transport: ITER site will have rail and waterway access. Railway is assumed to connect to major manufacturing centres and ports of entry.

> **Assumptions are satisfied, taking into account the ways of communication already serving the site**

Cadarache is located close to the A51 motorway and has its' own motorway exit. National and departmental roads are nearby. An international airport and a TGV (high speed train) station are reached within one hour (see description in "socio-cultural aspects"). A local railway line is a few kilometres away on the other side of the Durance valley. The nearest harbour is located at 70 km distance. A reference route for the transport of the large and heavy ITER pieces has been established. This route or maybe a more direct route can be used for all necessary shipments.

EXTERNAL HAZARDS AND ACCIDENT INITIATORS

> **ITER Design Assumption:**
External hazards: ITER site not subject to significant industrial and other man-made hazards
External (natural) accident initiators

> **Assumptions satisfied**

A full evaluation of all external hazards and accident initiators forms part of the licensing process. The ITER design conforms to French licensing requirements.

INFRASTRUCTURE

> **ITER Design Assumption:**
Industrial: access to industrial infrastructure, manufacturing resources and materials
Workforce: competent operating and scientific workforce can be recruited or can be relocated to neighbouring communities

> **Assumption satisfied**

The industrial and scientific background of the region is very rich (see description in "scientific and industrial background"). Even more, CEA Cadarache offers an important logistical and technical support as well as a scientific environment of the highest order (see foreword).

> **ITER Design Assumption:**
Socio-economic infrastructure: communities not further than 50 km from site with socio-economic infrastructure

> **Assumption satisfied**

Within a 50 km radius cities, towns and villages can be found. The Provence region is a very popular tourist destination and provides an excellent quality of live (see description in "sociocultural aspects").

REGULATORY ASPECTS AND DECOMMISSIONING

> **ITER Design Assumption: General decommissioning: Dismantling of ITER responsibility of new organisation within host country. ITER plant deactivation work.**
> **Assumptions are satisfied**

It is foreseen today that the ITER Legal Entity (ILE) will exist from the construction start-up until the Definitive End of ITER Operation. It is proposed to have an agreement signed between CEA and the ILE that would clearly state that CEA will take care of decommissioning and waste management after the Definitive End of Operation. This agreement will have to provide financial provisions as well as technical guidelines to ensure that dismantling and waste disposal takes place according to French regulation (see section on decommissioning in "licensing" section).

CONSTRUCTION PHASE

> **ITER Design Assumption: Water, sewage and power supplies for construction force of up to 3000 people**
> **Assumption satisfied**

All the support installations necessary for ITER (new potable water storage basin, new sanitary sewage station) will be built at the start of the construction phase. The ITER sanitary sewage station is designed for 1500 persons, for the other 1500 persons, the existing Cadarache station will be used. The electrical power needed during the construction phase will be provided by the construction of new lines and a specific switchyard providing 10 MW; a further 5 MW, needed for magnet testing, will be provided by the final ITER supply line. The ITER site will be close to the Tore Supra location (see photo) and will benefit from this proximity.

CONCLUSION DESIGN ASSUMPTIONS

Most of the ITER generic design assumptions are already perfectly fulfilled and where a difference exists, an evaluation of the additional work has been made. Certain aspects are more favourable in Cadarache. This allows certain modifications that could lead to economies. The modifications are minor both inside and outside the fence.

The generic design does not have to be changed significantly. The exceptions to the design assumptions are easily adaptable, with only a small financial impact. The planning can be maintained. An evaluation of the advantages of paraseismic bearings will have to be undertaken; there again the impact on cost and planning will be small.

Scientific and Industrial background

Although the region (Provence Alpes Côte d'Azur) is strongly geared towards tourism, it possesses nevertheless a broad spectrum of industrial activities, ranging from heavy industry to high technologies. Some key figures:

- 40 % of the national microelectronics production;
- 35 % of the French oil refining;
- 25 % of the steel production in France;
- 10 % of the national chemical production;
- World's foremost producer of helicopters;
- World leader of the smart card.

Apart from the large industrial groups that have set-up around Aix/Marseille and Nice/Sophia-Antipolis, the region has a dense fabric of small and medium-sized enterprises and is very much oriented towards the service industry. The rate of new business creations illustrates its dynamism. The region has a strong research potential, classed second French region in public research, with well-known universities and the presence of the main French research organisations. Private research is also strong, in particular in the field of high-tech microelectronics and telecommunications.

Finally, various structures take on the task of ensuring an interface between industry and research, to achieve a true synergy between innovative manufacturers and advanced research.

INDUSTRY IN THE REGION

Although the region around Cadarache is dominated by the service industry, it has nevertheless a large industrial activity, and also other sectors such as construction and agriculture are present.

With a Gross Domestic Product (GDP) of 73000 M€ in 1999, the region produces 7 % of the national wealth, and is classified in third place behind Ile-de-France (Paris) (29 %) and Rhône- Alpes (9 %).

The building and civil engineering sector, very strongly present in the region, is very dynamic as a consequence of the tourist industry. The construction site for the TGV Méditerranée (3800 M€) strongly contributed to a return of growth after the economic slow-down in the mid-nineties. Local governments (departments, region, communes) have since 1998 increased their investment in construction. In years to come it will stay at an important level, because of current projects and those still to be finished.

The region has a large number of innovative companies: it is the second region of France for the start-up of new businesses by researchers (about 30 per year).

It should be noted that the region, which has several exceptional natural sites among its assets, strives to apply a development policy that allows highly protected zones and zones for industrial use to coexist.

SCIENTIFIC RESOURCES

ITER is not the first large research installation to be build in the region. For more than 40 years scientific instruments have been constructed, mainly in Cadarache. The CEA research centre is one of the important economic players in the region.

The region has in total 11 000 researchers. It appears in second place after Ile-de-France in public research (6 500 researchers) and in third place for private research (4 500 researchers) behind Ile-de-France and Rhône-Alpes.

With about 700 M€, civil public spending on research and development (R&D) in the region represent 8.5 % of national expenditure. This is divided up between university research (28 % in 6 universities), the "Centre National de Recherches Scientifiques" (CNRS, 18 % in Marseille and Sophia-Antipolis) and public applied research organisations (54 %).

With about 1000 M€, the regional internal spending on R&D by private companies represent5.8 % of national expenditure.

Various structures encourage technology transfer between industry and research establishments in the region. Several regional technology centres exist, covering a large variety of domains. Cadarache has its own network of technological distribution.

PROFESSIONAL RESOURCES, JOBS

The region proposed to host ITER has a strong labour potential, in very varied disciplines. It is defined by the relative importance of the tertiary sector and industry. The region has a large public works industry, but the service sector remains dominant.

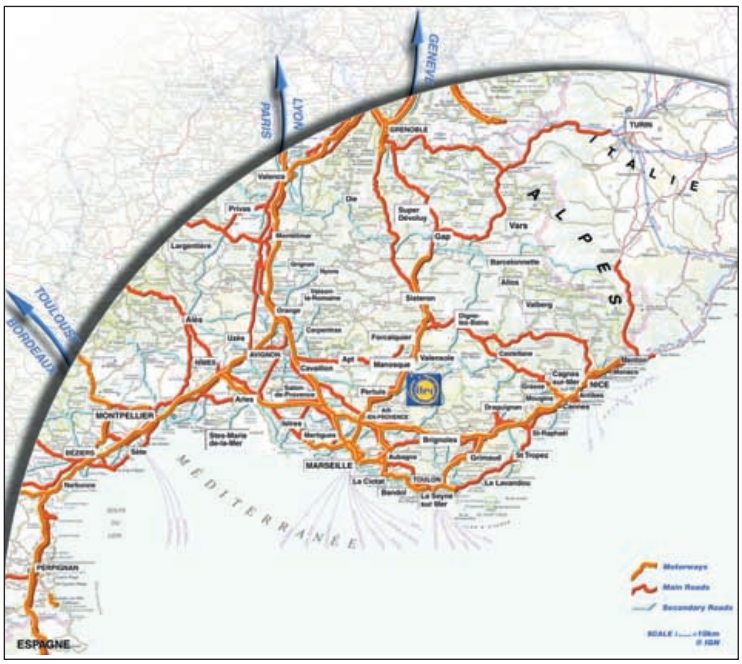
The economic recovery of the last few years has brought more prosperity to the region. It is clear that the evolution has brought changes at a structural level, both in the nature of the economy and the long-term prospects.

The region also has seen an increase over the years in the number of new companies. In 1999, with 10.4 companies created for every 100 existing, the region had the strongest rate of growth in France.

Socio Cultural Aspects

LOCATION, ACCESS AND TRANSPORT

The proposed host region for ITER is remarkably well equipped in means of communication and transport, access to the site is very easy.



The proposed site for ITER construction is located in the southeast of France, at Cadarache, to the south of the confluence of the Durance and Verdon rivers. The CEA-site ("Commissariat àl'Energie Atomique") houses 18 nuclear installations and Tore Supra (Association Euratom-CEA).

Cadarache is located close to the A51 motorway linking Aix-en-Provence (35 km South West) with the Alps. The centre has it's own motorway exit. National and departmental roads are also located nearby. A TGV (high speed train) line between Marseille/Aix and Paris links the cities in 3 hours. Two major international airports are located in the region (Marseille-Provence and Nice-Côte d'Azur) providing an excellent connection to the rest of Europe and the world. Marseille is the third largest harbour in Europe and the biggest in the Mediterranean.

CLIMATE

Provence and the Mediterranean coast (the famous "Côte d'Azur") are always seen as the land of sunshine and blue skies. Indeed, exceptional sunshine (2,500 hours per year on average) is a feature of the region's climate, which ranges from the very mild weather of the Mediterranean to the more varied weather patterns of the mountains.

The climate is one of the cornerstones of the quality of life in the region, as it is possible to practise a wide variety of activities, each season offering an array of opportunities.

The seaside is an hour away from the proposed ITER site and the ski slopes in the southren Alps can be reached within 1 1/2 hours.

WELCOME CENTRE

A welcome centre is foreseen from the start of the construction phase. The role of the welcome centre will be to assure personnel arriving from abroad a comfortable and easy "administrative" insertion into the French system.

The welcome group will have 5 major preoccupations:

- Education
- Housing
- Administration
- Information and assistance
- Employment for spouses

The group will be jointly supervised by the ITER host legal structure and the French administration and will have as members:

- One trilingual person: Russian, English, French
- One trilingual person: Japanese, English, French
- Several other bilingual members: English, French
- Several representatives from the French administration.

The group will be charged to:

- Inform new arrivals on their rights and obligations
- Assure the interface with the French administration
- Assist staff with completion of administrative forms (translation, documents to be supplied)
- Manage relations with housing and property agencies for housing needs upon arrival
- Facilitate in all circumstances the daily lives of the staff and their families: provide addresses and information of a general character (childcare, security, health care, transport, etc.)

Some practical examples:

- o Residence permits (European Union and outside EU)
- o Work permits (European Union and outside EU)
- o Drivers licence: equivalence, validation
- o Car importation: administrative issues and registration
- o Tax issues: local taxes, income tax

Furthermore, French language lessons will be organised for staff and families with the aim to make them self-sufficient. These lessons, estimated at around 100 hours, will start with individual lessons followed by group sessions in order to promote social interaction.

These provisions will be formalised in the form of an agreement signed between the host ITER legal structure and the different administrative authorities.

EDUCATION

The rector's office at the Academy of Aix-Marseille, which comes under the authority of the ministry of national education, is carrying out a study to propose changes or adaptations of the existing infrastructures, with the strong possibility of building a new international establishment, to accommodate children from the families of ITER personnel arriving from abroad. In general, the region continuously develops in the education field and new lycées and collèges are under construction in neighbouring communities.

In France, schooling is compulsory from the age of 6 upwards, for a minimum duration of 10 years. **In public establishments, teaching is given free of charge** until the baccalaureate is obtained.

International public schools and international sections within schools, exist in the region and the creation of new establishments could be envisaged.

Private establishments following a foreign curriculum (American, Japanese or English, for example) also exist in France, particularly in the Provence-Alpes-Côte d'Azur region.

FRENCH SYSTEM:

- From 0 to 3 years: nurseries ("crèches", in all villages).
- From 3 to 6 years: nursery school ("maternelle", in all villages).
- From 6 to 10 years: Primary school (in all villages)
- From 11 to 14 years: Secondary school ("collège"): in towns.
- From 15 to 18 years: Secondary school (lycée and professional lycée, in towns and cities)

The baccalaureate allows entrance to French higher education.

The Academy of Aix-Marseille is a great university place, with around 100 000 students, French and foreign. Higher education and high quality research with an international reputation are well established. Six universities are located in the region, situated in Aix-en-Provence, Marseille, Avignon, Toulon and Nice. The region also has highly rated engineering schools. Also in nearby cities (Grenoble, Montpellier, Lyon and Nice) a wide selection of higher education establishments is provided.

INTERNATIONAL LYCÉES AND INTERNATIONAL SECTIONS, EUROPEAN SCHOOLS:

Foreign pupils receive schooling either free of charge in public establishments that already exist in the national education system, or in fee-paying private establishments. All children, regardless of their nationality, can benefit from the pre-school structures. The education system that will be developed for ITER will provide for all needs. Both for those who stay for a long period and for those who come to Cadarache for shorter visits. Twelve European schools already exist in Europe and it is possible to construct a school along these lines.

HOUSING

The region proposed to host ITER has a very large and highly diversified housing pool, with a high level of availability. Neighbouring communities are preparing already the possibility to welcome new arriving families of the ITER project.

The real estate trade in France has expanded greatly since the 1990s, underpinned by economic recovery. The upswing has become more marked in recent years, reaching unprecedented levels in 2000 and continuing in 2001, especially due to favourable borrowin conditions instituted by government measures. Economic recovery has also resulted in a return to higher levels of purchasing power.

There is a growing trend in the market for new properties. In 1998, the number of new constructions started increased (+10 %) as well as the number of building permits issued (+25 %). The underlying trend is also favourable, with growth of between 10 and 15 %.

The increase in tourism, particularly from abroad, sustains growth in the real estate market. Many wish to buy property in France, which will either be a holiday home or subsequently becomes the main residence.

The real estate agencies are also flourishing. 500 new agencies opened in 1999 and 600 in 2000. Internet is becoming an impressive tool, allowing virtual visits, the distribution of advertisements that can be consulted from anywhere in the world, thereby opening up the markets.

The choice of residence is linked to the proximity of the work place and the availability of educational establishments. The short distances separating the villages and towns from the potential buyers' work place and the favourable traffic conditions allow a large choice.

For CEA personnel 180 individual houses and 200 apartments are available for rent in Aix-en-Provence, Manosque, Pertuis and Jouques. This facilitates the arrival of the personnel. During the construction of Tore Supra, mid 1980s, extra housing was provided for fusion staff coming from the Paris and Grenoble regions. This service can be provided again for the needs of ITER staff.

HEALTH CARE

The French health care system is one of the best in the world. The available equipment and health care staff levels in the region are above the French average.

The quality of the health care system is very good in France. This capacity has recently been highlighted by the World Health Organisation, which ranked France as the most successful health care system in the world.

In France, the health care system is supported by the social security administration. This administration, under government control, is responsible for ensuring solidarity among those eligible for public relief without discrimination on grounds of age, income or state of health.

The health insurance covers risks linked to illness, accidents at work, industrial diseases, disablement, death and also covers maternity costs. The insured benefit from all health care with no limit to the number of consultations or prescriptions.

The region has more than 43 000 beds for adults in medical establishments, for short, medium and long-term care. There are two regional hospital complexes, each of which includes a medical research centre, and 38 conventional hospital centres. The presence of medical research centres allows patients to benefit from the latest health care techniques, thereby increasing the chances of recovery. In surgical and obstetric wards the region had a total of 23 153 beds in 1999, i.e. a ratio of 5 beds for every 1 000 inhabitants. These beds divided between 55 public and 119 private establishments, provide what is qualified as short-term care. There are 8,227 general practitioners and 8,627 specialists in the region, i.e. an overall ratio of 267 doctors for 100,000 inhabitants, which is above the national ratio (198 for 100,000 inhabitants).

The extent of the region's medical facilities places it third in France. It has earned a solid reputation in the fields of surgery, medicine, gynaecology and obstetrics, convalescence and rehabilitation.

In terms of major medical equipment, the region fulfils the needs of the population perfectly. The facilities at its disposal, both in terms of beds and equipment, give the region relative autonomy regarding hospital care (medicine, surgery and obstetrics). Additionally, it attracts 6 % of patients from surrounding regions.

On account of the good motorway network installed around the research centre, access times to the casualty wards are short. The ones furthest away are in Marseille, Toulon and Nice, in which case helicopter transport is used. However, for the zone under consideration, the services of these sites are only called on to deal with extreme cases involving acute drug intoxication or requiring immediate neurosurgery for babies, children or adults.

The Medical Service, present at Cadarache, also provides emergency care for staff.

Art of living

The art of living in the Provence-Alpes-Côte-d'Azur region stems from the extraordinary variety of its landscapes, the benefit of an exceptional climate, the richness of its culture, the joviality of its inhabitants and their love of outdoor life. This region truly offers quality of life of the highest order. Its character as a host territory is rooted in its tradition and its history, making it a place where everyone finds one or more reasons to settle down, whether for a short while or a lifetime.

Although the region is well known for the sunshine and the blue skies, the climate is more varied, due to the proximity of the Mediterranean in the south and the Alps in the north. The landscapes are rich and varied. A large number of nature reserves and regional parks have been established in the region.

A varied and rich history has left its marks on the surrounding area, dating back to pre-historic times. Greek and Roman influences are clearly visible. Many different festivals are organised in towns, cities and villages. Theatres, cinemas and other cultural venues are located throughout the region, with important centres in cities as Aix-en-Provence and Marseille.

The region has always been a favourite amongst artists. Van Gogh, Signac, Bonnard, Renoir, Cézanne, Gauguin, Matisse and Picasso have all painted in the region. Pétrarque, Mistral, Gide, Daudet and Giono are well known authors from the region.

French gastronomy is renowned the world over. The region profits from the rich cultural and traditional background to make the Provencal kitchen very attractive and fresh local produce are often used. Needless to say, with nine “Appelations Contrôlées” wine goes hand in hand with the delights of the Provencal kitchen.

Due to the proximity of the mountains (1 1/2 hours) and the sea (1 hour) many different sports can be pursued.

It is therefore understandable that the region is one of the most popular tourist destinations in the world, however it is still possible to find a quiet spot as well. The photographs speak for themselves.

Licensing Aspects

The main objective of the licensing process is to obtain authorisation to build and operate a nuclear installation. Within the French licensing framework there is no need to develop a special regulatory procedure for fusion. The licensing process is formalised in France by two decisions at government level: the "Décret d'Autorisation de création (DAC)", required to start construction and the "Décret d'Autorisation de Rejets et de prélèvements d'Eau (DARPE)", required to start operation.

The licensing procedure is based on a continuous technical dialog between the installation owner and the Safety Authority "Direction Générale de la Sûreté Nucléaire et de la Radioprotection" (DGSNR – formerly DSIN), assisted by technical experts. The authorisation procedures and the continuous dialog define the roadmap toward a Licence.

ITER: INSTALLATION NUCLÉAIRE DE BASE (INB)

According to French regulation the ITER device will be classified as a nuclear Installation called "Installation Nucléaire de Base" (INB) due to the expected tritium inventory and the expected waste generation during the lifetime of ITER.

ITER OPERATOR

The operator is responsible for the safety and environmental impact of the installation from the beginning of construction to the final step of decommissioning. The current hypothesis is that the future operator will be the ITER Legal Entity (ILE).

START FOR THE LICENSING PROCEDURE

In order not to delay the licensing procedure, the "Commissariat à l'Energie Atomique" (CEA) has in cooperation with the International Team started early in 2001 the procedure of the safety objectives definition and safety analysis.

ROADMAP TOWARD A LICENCE

DOS: " Dossier d'Options de Sûreté"

The first step of the licensing process is the preparation of the "Dossier d'Options de Sûreté" (DOS), which defines major risks and proposed means for avoiding or mitigating them. It describes briefly the installation, proposes general safety objectives and explains how it is planned to implement these in the installation. This document was completed at the end of 2001 and has recently been submitted by the CEA to the French Safety Authorities from whom an advice is expected by the end of 2002.

RPrS: « Rapport Préliminaire de Sûreté »

The second step of the licensing process is the preparation and the assessment of the "Rapport Préliminaire de Sûreté" (RPrS). The RPrS consists of a detailed description and a comprehensive safety analysis of ITER. Therefore a detailed description of the local implantation is necessary. The preparation of the main contents of this document, which will include three volumes, has been undertaken at the beginning of 2002. Key elements of the RPrS to be developed and related tasks have been identified and launched by the CEA and other European institutions associated with the project.

RPrS submission by ILE to French Safety Authorities

The RPrS will be prepared under the auspices of EFDA. It is foreseen that ILE or the CEA in direct liaison with the International Team could submit the document by the end of 2003. The RPrS will be examined by the technical services of the Safety Authority and at the end of the process the Safety Authority will ask for the advice of a "Groupe Permanent" advisory board at national level.

Débat public

The ITER project may be submitted to a "Débat Public", as it is stated in French law (loi Barnier, 95/101 and "loi sur la démocratie de proximité", February 2002: any new large project or installation may be submitted to a public debate during its conception phase). The objective of the debate is to launch an overall countrywide discussion on the socio-economic and/or environmental consequences of the project. An independent commission is in charge of surveying this process and giving the conclusions, which cannot last more than six months. CEA is exploring how and when it may be initiated.

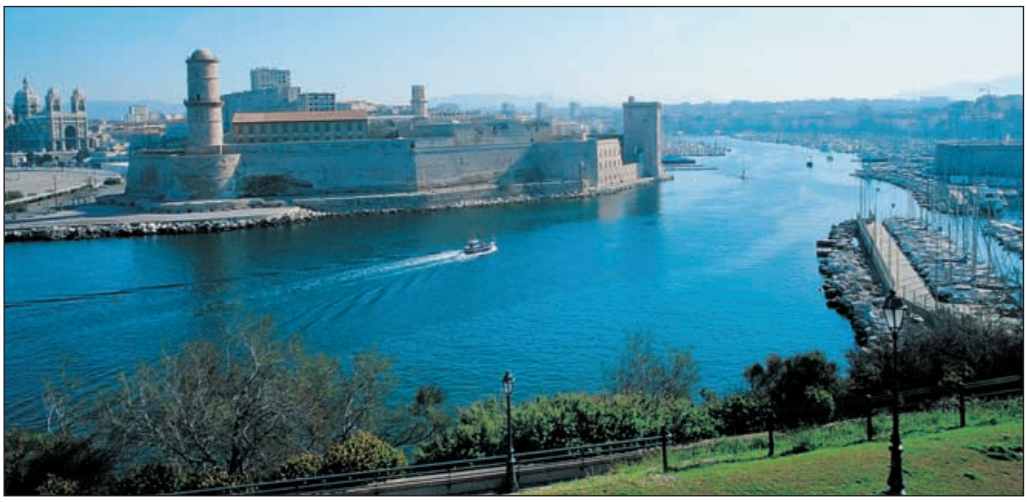
Final steps: DAC, DARPE and Public Enquiry

The licensing process will finish with the "Décret d'Autorisation de Création" (DAC) signed by at least the minister for the environment and the minister for industry and the "Décret d'Autorisation de Rejets et de Prélèvements d'Eau", (DARPE) approved by the ministers of environment, industry and health. The administrative procedures to obtain these authorisations will be started in parallel to the RPrS at the beginning of 2003.

A Public Enquiry will also be made at this step. It is a consultation process among the local communities in a radius of about 15 km from the proposed site. Issues as external effects resulting from the construction and operation of the installation will be debated.

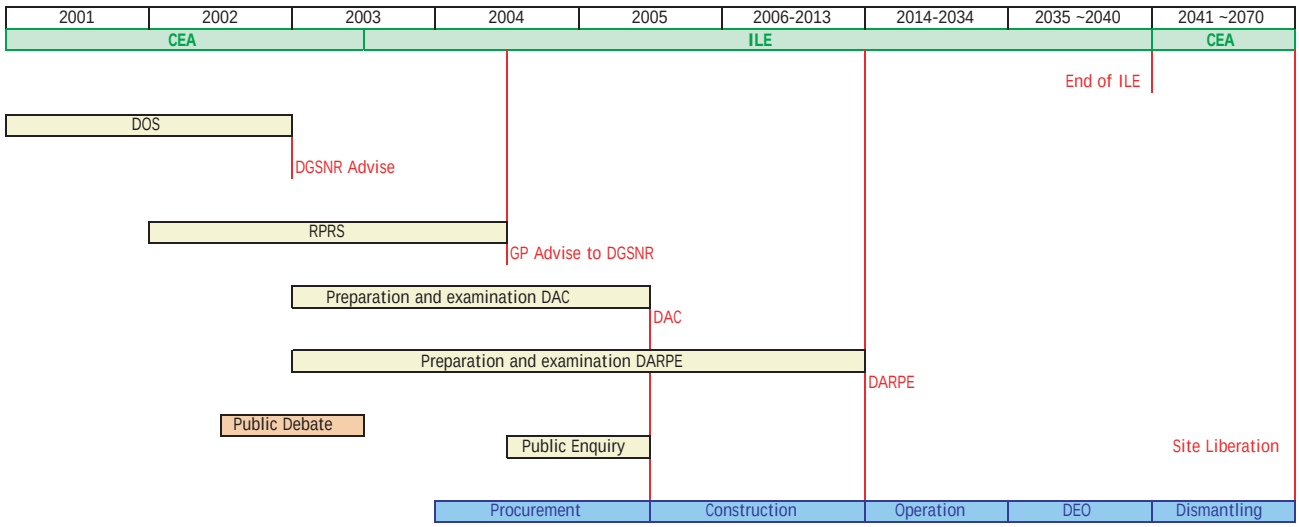
Decommissioning provisions

Since it is foreseen today that the ILE will exist from the construction start-up until the Definitive End of ITER Operation, it is proposed to have an agreement signed between CEA and the ILE that would clearly state that CEA would take care of decommissioning and waste management after the Definitive End of Operation. This agreement will have to provide financial provisions as well as technical guidelines to assure that dismantling and waste disposal takes place according to French regulation.



CONCLUSIONS

The construction and exploitation of ITER will follow the French regulatory framework as foreseen for every nuclear installation. The regulatory procedures are clearly identified and documented. ITER safety and decommissioning requirements are compatible with the French regulations. CEA has already initiated the authorisation procedure by writing the Dossier d'Options de Sûreté, in order to not delay the planning foreseen for ITER construction. The scheme of the complete process is shown on the following schedule with tentative dates consistent with the ITER planning assumptions.



Acronym	French meaning	English Translation or Meaning
ASN	Autorité de Sûreté Nucléaire	French Safety Nuclear Authority
DAC	Décret d'Autorisation de Création	Decree of Authorisation of Creation
DARPE	Décret d'Autorisation de Rejet et de Prélévement d'Eau	Decree of Authorisation for Water Release and Extraction
DEO	Mise à l'Arrêt Définitif (MAD)	Definitive End of Operation
DIN	Division des Installations Nucléaires	In charge of Nuclear Installation Control
DOS	Dossier d'Options de Sûreté	Description of Safety Objectives (not compulsory)
DGSNR	Direction Générale de la Sûreté Nucléaire et de la Radioprotection	ASN Legal Head
GP	Groupe Permanent	Permanent Group (in charge of Request Examination)
ILE	Entité Juridique ITER	ITER Legal Entity (status to be defined)
IRSN	Institut de Radioprotection et de Sûreté Nucléaire	ASN technical Adviser
RPRS	Rapport PrÈliminaire de Sûreté Nucléaire	Initial Safety Report (compulsory, to be borne by ILE)

Conclusion

Cadarache fulfils all ITER site requirements and most of the design assumptions needed for ITER construction.

The Cadarache site appears to be remarkably suited to host ITER: the site has considerable experience in dealing with nuclear installations and hosts broad expertise on magnetic fusion research. The construction of ITER will benefit greatly from the technical, scientific and logistics environment already in existence on the Cadarache centre. The strong infrastructure of the CEA (16000 people) constitutes a considerable benefit for the succes of ITER.

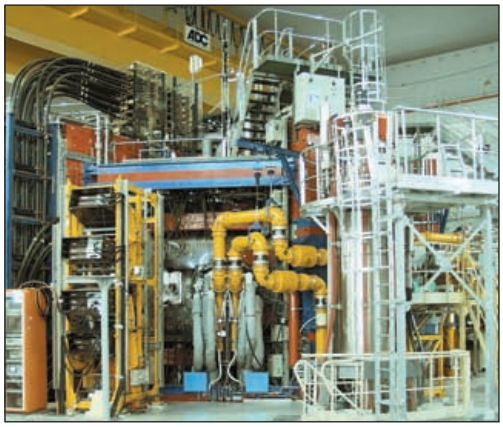
Cadarache fulfils all the requirements as defined for the generic site and has all the conditions necessary to host ITER.

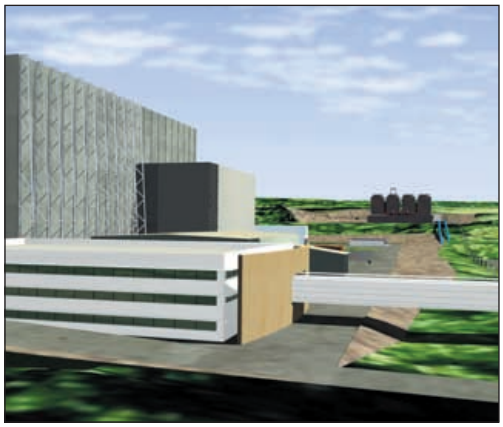
Most of the ITER generic design assumptions are already perfectly fulfilled and where a difference exists, an evaluation of the additional work has been made. Certain aspects are more favourable in Cadarache. This allows certain modifications that could lead to economies. The modifications are minor both inside and outside the fence.

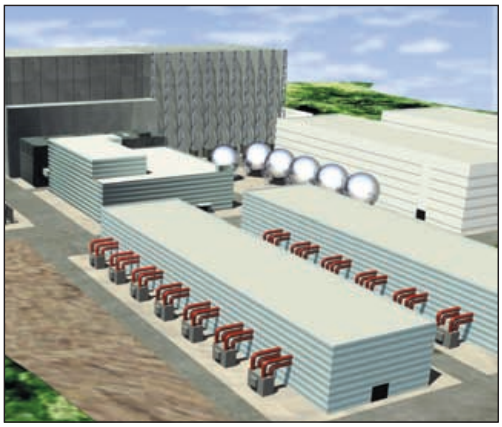
The socio-economic environment of Cadarache is particularly rich and attractive. Scientific and industrial resources are widely available, and the region provides also a large variety of schools, medical care and housing as well as leisure and cultural activities. The existing infrastructures fulfil all possible needs.

Local and governmental authorities, as well as local organisations and associations have shown a great interest for the construction of ITER at Cadarache, by their constant implication in the project. The local and regional authorities have proposed to provide help with all administrative and socio-cultural issues for ITER staff and their families.

The French regulations concerning operation and dismantling of similar installations are compatible with the ITER needs. CEA has started the licensing procedure in order to satisfy the ITER construction planning assumptions.







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