JOINT ASSESSMENT OF SPECIFIC SITES AD HOC GROUP

Cadarache Site

JASS Ad-Hoc Group Meeting Findings

Cadarache 3-6 December 2002

Version 5.0

(24th January 2003)

0. INTRODUCTION

0.1 Record of the Meeting

The third JASS Ad-Hoc meeting has taken place in Cadarache, France, on December 3rd to 6th, 2002.

The assessment is being conducted in accordance with the dispositions set out in the NSSG-4 Attachment 8.

The JASS ad-hoc group took note of the various presentations by the European proponent team (for the Cadarache Site) in the fields applicable to the JASS.

In order to properly assess the submitted documentation, the ad-hoc group had also the opportunity to visit the proposed site location and the neighbouring community.

The ad-hoc group jointly drafted the findings that follow and that will be the basis, together with the analyses of other site proposals, for the final JASS report to be submitted to the Negotiators.

The present document may be updated on the basis of additional material requested by the Ad-Hoc group or supplied by the proponent team and made available in a timely manner.

The ad-hoc group identified the need to bring to Negotiators level the suggestion to allocate all costs associated with transportation between the Host's port of entry and the actual Site to the Host itself. Such provision in the cost sharing would greatly simplify the issue of domestic transportation costs and liabilities-issues applicable to all sites.

The ad-hoc group also noted that a security agreement will have to be signed between the Organization and the Host in order to coordinate the security policies and possible interventions in the case of incident or accident on either the CEA site or the ITER site. Since the Host will be responsible for decommissioning after deactivation of the ITER facility, clear agreements on allowed materials, neutron fluxes, activation levels and related matters will have to be established. If the ITER experiments require an increase in the initially agreed values, agreement by the Host will be required.

The ad-hoc group will meet for the fourth meeting Vandellos, Spain, on 11th to 14th December 2002.

0.2 The Cadarache Site

The Cadarache candidate site for ITER is situated (see figure 1) 40 km north of the city of Aix-en-Provence in the Provence-Alpes-Côte d'Azur region of France. The ITER site is located on the North-East (outside the fence) of the existing Cadarache nuclear centre. The land area covers 180 ha and will be made available by the French state for ITER use for the duration needed for construction, operation and deactivation of the installation. The provided land area satisfies the ITER needs leaving margin for flexibility (see figures 2 and 3).

The proposed ITER Site has the following significant physical attributes:

- Access – equipment can be initially delivered to a harbour that is about 100 km from the site. Significant infrastructural modification will have to be put into place to allow this roadway to be traversed by heavy transporters. The French Authorities have made a commitment to provide such modifications.
- Geotechnical – the Site is characterized by a limestone soil structure, just below grade level, and can be prepared to meet the ITER specifications.
- Hydrogeological – the groundwater level is below the basemat of the tokamak building.
- Seismic – The seismic characteristics of the Site have been studied in detail and found similar to the generic design assumptions.
- Meteorological – the weather conditions are favourable and well within the design assumptions.
- Water supply – the Site is served by generous local water supply.

The ground is characterised by a large mass of limestone, onto which all nuclear buildings will have their foundations. Both geological studies and samples taken at the location of ITER tokamak building confirmed a bearing capacity of at least 100 t/m^2. For the other buildings, the underlying limestone layer can easily satisfy the required support of long-term surface load of 25 t/m^2.

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. The 400 kV line is already connected to the existing fusion facility of Tore Supra while a new 4 km 225 kV double line and a new switchyard will be constructed on the nearby High Voltage line. The connected grid provides a secure supply, which can satisfy ITER's steady state and pulsed power demands with a high level of reliability.

Cadarache is located at a road distance of ~100 km from a to-be-constructed roll-on/roll-off dock. A reference transportation route has been identified from there to the site. A detailed study has been performed for the implementation of all necessary road modifications and upgrades to show that transportation by road of the ITER heavy components would be viable; no significant technical difficulty has been identified.

France is a country where a total of 127 Nuclear Facilities in operation. There are well-established regulations concerning the transportation and storage of nuclear waste. Moreover, the licensing of nuclear installations follows a standard practice in France, a country producing more than 80 % of its electricity by means of nuclear power plants. No new specific administrative procedures or regulations will have to be developed for ITER.

The proposed Site is accessible by A51, a 4-lane motorway running north from Marseille to Aix-en - Provence and then further north past Cadarache. Access to international travel is via Marseille Airport (~ 45 min. drive) or the Nice Airport (~2 hour drive) and then by way of a number of major European hubs. For personal transport, the high speed train TGV is available between Aix en Provence and Avignon, Lyon, Paris, Brussels and Geneva etc.

The Cadarache site is located in the "Provence-Alpes-Côte d'Azur " (PACA) region that has a surface area of 31,400 km2 and a total population of 4.5 million. Approximately 8% are foreign residents. The nearest towns are Manosque with a population of 20,000 and Pertuis with a population of 18,000 while the nearest city, Aix-en-Provence, is 40 km away and has a population of about 134,000. The major city of Marseille is approximately 70 km away and is the second largest city in France with a population of approximately 800,000.

The PACA region is well known for the variety of lifestyle options it offers. It has a temperate climate and it projects an atmosphere of safety and security in the towns and rural areas in the region around Cadarache. There are a wide variety of cultural attractions throughout the region including museums, festivals, performing arts and concerts. There are also a variety of sports and recreational activities accessible to the public throughout the year.

The community immediately around the ITER Site shows strong support for the facility - there is a record of organizations and individuals who have expressed their support. The local government has already assumed a strong commitment to nuclear energy development and research and more recently the governing councils for 16 towns in the area have confirmed their pledge to host ITER.

European industries participated in the construction and operation of several fusion devices, like JET, Tore Supra, and the R&D projects undertaken during the ITER EDA. Therefore there is a proven domestic industrial capability in all areas of the ITER project. Also in many other fields of science and technology, Europe is at the forefront with examples like CERN, European Space Agency, the European Space Observatory, Arianespace, etc.

In support of the ITER construction and operation, the nearby centre of Cadarache/CEA is one of the major civil nuclear research areas in France with 18 nuclear installations and more than 4000 people working daily at the site, where there is a wide range of facilities and services including medical facilities and services, a library and cafeterias.

Figure 1: Location of the Cadarache proposed Site in Provence

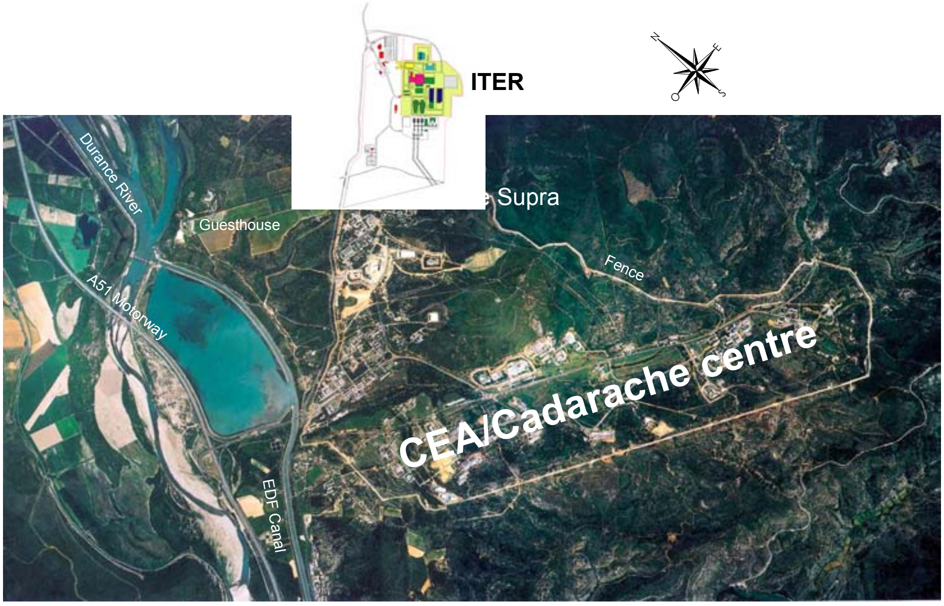

Figure 2: Aerial photo of the proposed ITER Site north of the CEA Centre.

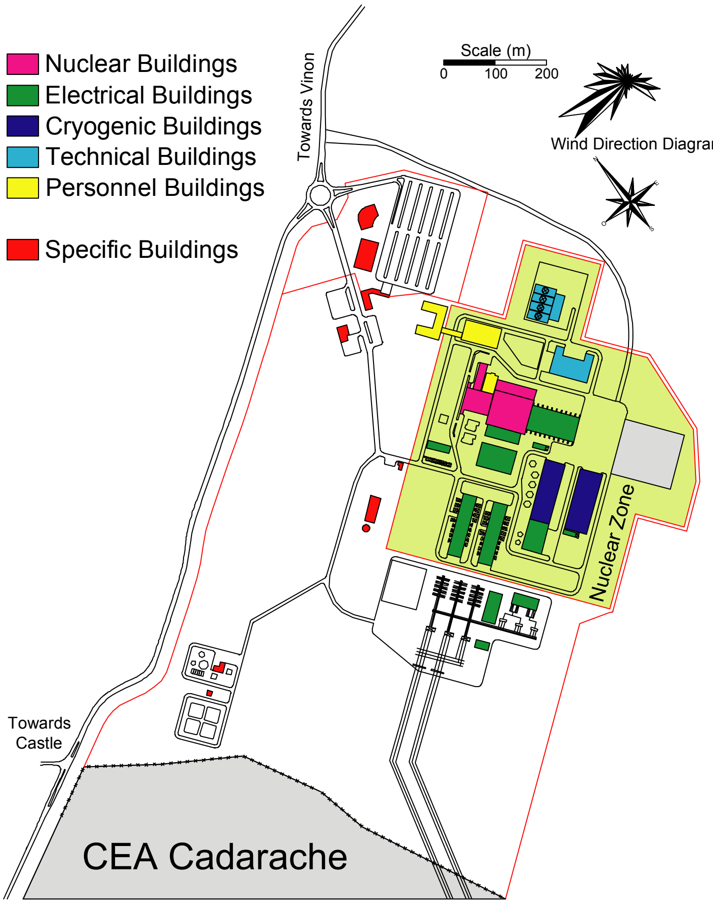

Figure 3: Plan view of the proposed Site

1.0 TECHNICAL ASPECTS

1.1 SITE REQUIREMENTS

1.1.A Land

1.1.A.1 Land Area

Requirement The ITER site shall be up to 40 hectares in area enclosed within a perimeter. All structures and improvements within the perimeter are the responsibility of the ITER project. Land within the perimeter must be committed to ITER use for a period of at least 30 years.

Bases The minimum area for the ITER site is predicated on sufficient area for the buildings, structures and equipment with allowances for expansion of certain buildings if required for extension of the ITER programme.

The time period is specified to cover the construction (~10 years) and operations (~20 years) phases. Beyond that, the requirements for any decommissioning will be the responsibility of the Host Country.

JASS Criteria

1) Location, area
2) Present ownership and status, required to fit the site requirements, if any
3) Duration of use, transfer of ownership or lease
4) Constraints on use, if any
5) Proposal on specific site layout

The Cadarache site is 40 km North of the city of Aix-en-Provence in the Provence-Alpes-Côte d'Azur region of France. The ITER site is located on the North-East (outside the fence) of the existing Cadarache nuclear centre. The land availability of 180 ha exceeds the site requirements thus allowing flexibility in the layout and possible expansions.

The land area covers 180 ha and will be made available free of charge by the French state for ITER use for the duration needed for construction, operation and deactivation of the installation. The provided land area satisfies the ITER needs leaving margin for flexibility.
Additional information is available in Section 4.

The land is currently owned by the French state (Ministry for Agriculture) and is administrated by the National Office of Forestry, a public institution.

There will be no specific constraint on the use of the land.

The Cadarache Site is suitable for the generic layout.

The Cadarache Site has satisfied all the requirements on land for siting ITER.

1.1.A.2 Geotechnical Characteristics

Requirement The ITER site shall have foundation soil bearing capacity adequate for building loads of at least 25 t/m^2 at locations where buildings are to be built. Nevertheless, it is expected that it will be possible to provide at the specific location of the Tokamak Building means to support the average load of 65t/m^2 at a depth of 25m. The soil (to a depth of 25 m) shall not have unstable surrounding ground features. The building sites shall not be susceptible to significant subsidence and differential settlement.

Bases The ITER Tokamak is composed of large, massive components that must ultimately be supported by the basemat of the structures that house them. Therefore soil bearing capacity and stability under loads are critical requirements for an acceptable site. The Tokamak Building is composed of three independent halls on separate basemats, but served by the same set of large, overhead bridge cranes. Crane operation would be adversely affected by significant subsidence and differential settlement.

JASS Criteria

1) Complete geotechnical profile of the site. Geotechnical studies of the site should be referenced and available for examination by the JASS assessment team.
2) Proximity of a stable bedrock layer should be quantified, as should the estimated bearing capacity of this layer.
3) Demonstrate the manner in which excavation will take place for the concrete buildings, and to outline conceptual options for foundation structures. Excavation quantities should be estimated for construction at the site

The site has been already characterized with extensive geological studies, including drillings to a depth of 60 m and refraction measurements performed on the tokamak building area. Initial investigations on the rest of the site have also been performed.

The ground is characterised by a large mass of limestone onto which all nuclear buildings will have their foundations (See also Section 1.2). Both geological studies and samples taken at the location of ITER tokamak building confirmed a bearing capacity of the soil of at least 100 t/m^2. For the other buildings the required support of long-term surface load of 25 t/m^2 can be satisfied by the underlying limestone layer.

Excavation will partly be done by means of explosives, with an excavation of 550 000 m^3, and filling 325 000 m^3, foundations are established in the rock as foreseen in the generic ITER design.

The site conditions at Cadarache fulfil all geotechnical requirements set out by ITER for foundations of structures. No change to the embedment depth of the Tokamak building would be required for the Cadarache Site.

1.1.A.3 Water Supply

Requirement The ITER site host shall provide a continuous fresh water supply of 0.2 m^3/minute average and 3 m^3/minute peak consumption rates. The average daily consumption is estimated to be about 200 m^3. This water supply shall require no treatment or processing for uses such as potable water and water makeup to the plant de-mineralised water system and other systems with low losses.

Bases The ITER plant and its support facilities will require a reliable source of high quality water. The peak rate of 3 m^3/minute is specified to deal with conditions such as leakage or fires. This water supply is not used for the cooling towers or other uses which may be satisfied by lower quality, "raw" water.

JASS Criteria
1) Capacity of potable water and industrial water
2) Plan of the water supply and the system
3) Status of the water supply
4) Sources of the water supply, and restrictions, if any

Cooling water supply will be assured by gravity from Canal de Provence, a neighbouring canal with no history of cessation of water supply.

It is proposed to use for ITER's potable and industrial water the existing Cadarache pumping station, that currently has a capacity of 2 000 m^3/h, highly oversized with respect to Cadarache and ITER needs.

The host will provide all connections to fence of the ITER site.

1.1.A.4 Sanitary and Industrial Sewage

Requirements The ITER site host shall provide sanitary waste capacity for a peak ITER site population of 1000. The host shall also provide industrial sewage capacity for an average of 200 m^3/day.

Bases The ITER project will provide sewer lines to the site perimeter for connection to sewer service provided by the host. The peak industrial sewage rate is expected to be adequate to deal with conditions such as leaks and drainage of industrial sewage stored in tanks until it can be analyzed for release. Rainwater runoff is not included in industrial sewage.

JASS Criteria
1) Industrial sewage capacity
2) Plan of the sewage system
3) Status
4) Regulations on industrial sewage

ITER's needs will be met by the existing Cadarache facilities.

The sanitary waste and industrial effluent requirements are within the existing authorisations for the Cadarache CEA centre. Extra effluent treatment installations and intermediate storage basins will be constructed for the ITER facility outside of the fence.

The current capacity of the centre for industrial sewage is 100 m^3/h of which around 30 m^3/h are used at the moment. The ITER needs would add around 8 m^3/h to this.

The generic ITER sewage will meet the local environmental regulation concerning water pollution.

For cooling water, see Section 1.1.B.

1.1.B Heat Sink

Requirements The ITER site shall have the capability to dissipate, on average, 450 MW (thermal) energy to the environment.

Bases ITER and its associated equipment may develop heat loads as high as 1200 MW (thermal) for pulse periods of the order of 500 s. The capability to dissipate 1200 MW should be possible for steady state operation which is assumed to be continuous full power for one hour. Duty Cycle requirements for the heat sink at peak loads will not exceed 30%. The average heat load would be no more than 450 MW for periods of 3 to 6 days.

JASS Criteria

1) The maximum energy allowed to dissipate to the environment
2) Regulations and/or restrictions on energy dissipation to the environment

Only the cooling tower option has been proposed for the Cadarache Site. The cooling towers are ~20% smaller than the generic design as a consequence of the lower wet-bulb temperature during the summer.

Two large irrigation/hydro-power canals are located close to the Cadarache centre and each one can provide the necessary cooling water for ITER. The proposal is to provide the needed water by gravity from the canal de Provence. ITER will use less than 1% of the available water in the canal and such a margin will provide additional flexibility in the design and performance of the cooling system.

The blow-down water from the cooling towers will be discharged into the Durance River, making use of the existing discharge outlet of Cadarache (See also Section 2). An appropriate bypass may be used, during hot days, to reduce the outlet temperature into the river which is limited to 30 degrees.

Permits for water use and discharge are available.

1.1.C Energy and Electrical Power

ITER Plant Steady State Electrical Loads

Requirement The ITER site shall have the capability to draw from the grid 120MW of continuous electrical power. Power should not be interrupted because of connection maintenance. At least two connections should be provided from the supply grid to the site.

Bases The ITER Plant has a number of systems which require a steady state supply of electrical power to operate the plant. It is not acceptable to interrupt this power supply for maintenance of transmission lines, therefore the offsite transmission lines must be arranged such that scheduled line maintenance will not cause interruption of service. This requirement is based on the operational needs of the ITER Plant.

Maintenance loads are considerably lower than the peak value because heavy loads such as the Tokamak heat transfer and heat rejection systems will operate only during preparations for and actual pulsed operation of the Tokamak.

JASS Criteria

1) Capacity of the steady state electrical power supply
2) Number of lines
3) High Voltage Supply Scheme
4) Status of the supply
5) Construction power requirements need to be defined and addressed for the site
6) High voltage network and its capacity

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. The 400 kV line is already connected to the existing fusion facility of Tore Supra while a new 4 km 225 kV double line and a new switchyard will be constructed on the nearby “Tavel-Boutre” High Voltage line.

An alternative option can be implemented consisting of replacing the existing 4 km single 400 kV line with a double 400 kV line.

During the ITER construction phase, a new double cable line coming from the present 63/15 kV Cadarache switchyard will supply the required electrical power. After construction, this line may be also used, during ITER operation, as an additional emergency independent supply.

See also Section 1.2.C.

1.1.D Transport and Shipping

1.1.D.1 Maximum Size of Components to be Shipped

Requirement The ITER Site shall be capable of receiving shipments for components having maximum dimensions (not simultaneously) of about:

- Width - 9 m
- Height - 8 m
- Length - 15 m

Bases In order to fabricate the maximum number of components, such as magnet coils and large transformers, off site, the ITER site must have the capability of receiving large shipments. For the reference case, it is assumed that only Poloidal Field Coils will be manufactured on site, unless the possibility of transporting and shipping these large coils is proven feasible. For the same reason, it is also assumed that the CS will be assembled on site from six modules, unless it proves feasible that the Assembly may be supplied as one large and complete unit. The cryostat will be assembled on site from smaller delivered parts. The width is the most critical maximum dimension and it is set by the Toroidal Field Coils which are about 9 m wide. The height is the next most critical dimension which is set by the 40° Vacuum Vessel Sector. A length of 15 m is required for the TF coils. The following table shows the largest (~100 t or more) ITER components to be shipped:

Largest ITER Components to be Shipped

Component	Pkgs	Width (m)	Length (m)	Height (m)	Weight (T) Each Pkg
TF Coils	18	9	14.3	3.8	280
VV 40° Sector	9	8	12	8	575
CS Modules	6	4.2	4.2	1.9	100
Large HV Transformer	3	4	12	5	250
Crane Trolley Structure*	2	(14)	(18)	(6)	(600)

* Crane dimensions and weight are preliminary estimates.

PF Coils and CS Assembly**

Component	Pkgs	Width (m)	Length (m)	Height (m)	Weight (T) Each Pkg
PF-1	1	9.5	9.5	2.4	200
PF-2	1	18.5	18.5	1.9	200
PF-3	1	25.5	25.5	1.2	300
PF-4	1	26.0	26.0	1.2	450
PF-5	1	18.2	18.2	2.4	350
PF6	1	10.8	10.8	2.4	300
CS Assembly	1	4.2	18.8	4.2	850

** **Note that transportation and shipping of the PF Coil and of the CS Assembly are not requirements, but could be considered an advantage**.
Note, too, that the PF Coils dimensions are for the coil and connection box envelope, and that for each coil there are vertical protrusions of ~1.5 – 1.8 m for the terminals.

JASS Criteria

1) Availability of the port where the heavy and large components can be landed. (The maximum size of the ship which can be docked, availability of the landing facilities and the customhouse, etc.)
2) The allowable maximum size and weight of the transportable components.
3) Map of the transport route from the port to the site
4) Status of the route and reinforcement of the port, roads and bridges, if any
5) Constraints, if any, on the transport of large and/or heavy components due to site topography.

Cadarache is located at a linear distance of 70 km from the most convenient industrial harbour (“Fos-sur-mer”). A reference transportation route has been identified from there to the site. The necessary modifications have been identified by the public offices in charge of roads and highways according to the study performed by a large company specialized in very heavy transportations.

The “Brûle-Tabac” wharf, in the “Fos-sur-mer” industrial harbour, can accept ships up to 80000 tons dead weight and will be used for initial unloading the ITER largest components. These will subsequently be moved on a set of Self Propelled Modular Transporters (SPMT) loaded on an existing roll-on / roll-off barge for transfer through the nearby ”Étang de Berre” lake. From there to Cadarache the distance by road is 96 km and will be covered using the same SPMT’s.

Significant structural modifications will need to be carried out along the way, including the construction of a new roll-on/roll-off dock, widening and development of some road segments, reinforcing of bridges and road segments, roundabouts and tight turns alterations.

Specific sections of the route will be closed to other traffic during the transport. It is proposed to transport loads during the night in order to minimise interference with the normal exploitation of the roadways. The company contracted by the proponent to perform the detailed study estimated that three nights will be necessary to transport the heaviest components (TF and VV sectors) from the sea to Cadarache.

The Cadarache Site meets the site requirements on transport and shipping provided the infrastructure modifications along the land connection to the sea are put into place. A detailed study has been performed concerning such modifications; no significant technical difficulty has been identified and the French Authorities are committed to provide such modifications if ITER is sited in Cadarache.

The Cadarache site excludes the possibility to receive the largest PF coils.

1.1.D.2 Maximum Weight of Shipments

Requirement The ITER Site shall be capable of receiving about a dozen of components (packages) having a maximum weight of 600 t and approximately 100 packages with weight between 100 and 600 t each.

Bases In order to fabricate the maximum number of components, including magnet coils, off site, the ITER site must have the capability of receiving very heavy shipments. The single heaviest component (Vacuum Vessel Sector) is not expected to exceed 600 tonnes. All other components are expected to weigh less.

JASS Criteria
None specified

See section 1.1.D.1.

1.1.E External Hazards and Accident Initiators

No Compulsory Requirements.

General

There are no compulsory requirements.

1.1.F Infrastructure

No Compulsory Requirements

General

There are no compulsory requirements.

1.1.G Regulatory and Decommissioning

Details of the regulatory framework for ITER will depend on the Host Country. At a minimum the Host's regulatory system must provide a practicable licensing framework to permit ITER to be built and to operate including, in particular the following:

1. the transport of about 25 kg tritium during the course of ITER operations
2. the acceptance and safe storage of activated material arising from operation and decommissioning.

The agreement with the Host should provide for the issue of the liability for matters beyond the capacity of the project that may arise from ITER construction, operation and decommissioning.

JASS Criteria

1) Experience and expertise of the tritium transport.
2) Regulations on the tritium transport.
3) Plan on how tritium will be shipped to the proposed site over the life of the project.
4) Arrangements to cover liabilities beyond the capacity of the project needs to be covered in the description.
5) Regulations, practices and plan for the deactivation, storage and decommissioning of ITER and its materials.

France and in particular CEA has experience in tritium handling, transport, and management. Issues associated with the international transportation of tritium have been studied indicating that the most effective way of transportation is when tritium is stored as a metal tritide. The currently licensed JAERI tritium transport container, capable of storing 25 g of tritium, is considered as reference. However the qualification of a container is being considered in CEA to transport up to 300g of Tritium in one package.

Given its favourable safety features, ITER will be classified as a Nuclear Facility (INB) of the Laboratory or Fuel Plant type (as opposed to Nuclear Power Plant). As a INB, in accordance to French regulations, it will fall under the Nuclear Liability Act. In this frame, the responsibilities of the operator are limited to ~90M€ for an accident arising in the installation towards third Party damages. Above these amounts, under the responsibility of the operator, the victims would be compensated according to the Paris convention. Moreover the Organization has to have and maintain insurance or other financial guarantee, to the level of risk to be covered. Such a financial guarantee needs to be agreed by the French Ministry of Economy and Finances.

France is a country where a total of 127 Nuclear Facilities are in operation. There are well-established regulations concerning the transportation and storage of nuclear waste whose packaging and final disposal depend on their classification. In France four categories of waste are considered depending on nuclide specific activity and half-life:

- TFA: Very low activity (Très Faible Activité),
- A-Type: Low and medium activity with short half life,
- B-Type: Medium activity and long half life,
- C-Type: High activity and long half-life (no type C in ITER).

Such classification leads, in the ITER specific case, to about 31 000 tons of nuclear wastes with 60 % of TFA, 30 % of A-Type and 10 % of B-Type. Specific treatments such as decontamination or detritiation, and radioactive decay are foreseen to reduce the amount of B-type waste. Specific packaging for Beryllium contaminated B-type waste is under development.

See also Section 5.

In Cadarache, the plan for de-activation and decommissioning is in agreement with the 2 phases of the reference ITER scenario. Different options have been studied for phase 2 (final dismantling and disposal). Established technologies will allow the dismantling of the facility and handling of waste, which will be characterized and packaged for final disposal.

1.2 SITE DESIGN ASSUMPTIONS

The following assumptions have been made concerning the ITER site. These site design assumptions are uniformly applied to all design work until the actual ITER Site is selected.

1.2.A Land

1.2.A.1 Land Area

Assumption During the construction it will be necessary to have temporary use of an additional 30 hectares of land adjacent to or reasonably close to the compulsory land area. It is assumed this land is available for construction laydown, field engineering, pre-assembly, concrete batch plant, excavation spoils and other construction activities.
During operating phases, this land should be available for interim waste storage, heavy equipment storage and activities related to maintenance or improvement of the ITER Plant.

Bases The assumptions made for the cost and schedule estimates are based on construction experience which uses an additional area of 25 hectares. Only a very limited amount of vehicle parking space (5 hectares) is allocated to the compulsory area, whereas similar amount will be required to satisfy temporary needs during construction.

JASS Criteria

1) Location and area of additional land used to support construction
2) Present ownership and present state, required work to fit the Site Requirements, if any
3) Duration of use, transfer of ownership or lease
4) Constraints on use, if any
5) Proposal on the specific site layout

See also point 1.1.A.

A sufficient amount of land is available so as to allow for flexibility in the site layout as well as satisfy temporary needs during construction.

1.2.A.2 Topography

Assumption The ITER site is assumed to be a topographically "balanced" site. This means that the volumes of soil cuts and fills are approximately equal over the compulsory land area in Requirement A.1. The maximum elevation change for the "balanced" site is less than 10 m about the mean elevation over the land area in the compulsory requirement.

JASS Criteria
1) Map of the site, difference of elevations
2) Plan of the land preparation, including areas set aside to handle soil storage.

See also section 1.1.A

The land will be prepared by the Host to accommodate ITER. Buildings will be laid out on four different platforms to optimise the overall excavation with all nuclear buildings, at the same level, having their foundations on limestone:

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

Excavation will partly be done by means of explosives, with an excavation of 550 000 m^3, and filling 325 000 m^3, foundations are established in the rock as foreseen in the generic ITER design.

1.2.A.3 Geotechnical Characteristics

Assumption The soil surface layer at the ITER Site is thick enough not to require removal of underlying hard rock, if present, for building excavations, except in the area under the Tokamak Building itself, at an excavation level of about 25 m.

JASS Criteria

1) Soil Configuration and characteristics

See also Section 1.1.A.2

At the Cadarache site, the topsoil is partially limestone and the underground is totally limestone. For this reason hard rock will have to be removed from under some buildings in the excavation work.

Detailed geological investigations were performed including a) geological measurements using seismic refraction, b) drillings, c) geotechnical tests, and d) survey of the groundwater levels. These investigations led to the conclusion that the underlying geotechnical characteristics are appropriate for ITER siting.

1.2.A.4 Hydrological Characteristics

Assumption Ground water is assumed to be present at 10 m below nominal grade, well above the Tokamak building embedment of up to 16m below nominal grade. This assumption will require engineered ground water control during the construction of the Tokamak building pit.

JASS Criteria

1) Known groundwater characteristics and control experience at the entire site, supported by site inspection reports available for review by JASS assessment team
2) Plan for management of groundwater during and after excavation/construction

At the ITER Site, the groundwater table has been measured for the year 2002 (a particularly wet year) to be between -51 m and -25 m below grade. Should this finding be confirmed in the coming years, groundwater management will not be necessary during construction and operation.

1.2.A.5 Seismic Characteristics

Assumption The ITER seismic design specifications for the applicable Safety Importance Class (SIC) are based on an assumed seismic hazard curve. Using the IAEA seismic classification levels of SL-2, SL-1, and SL-0 and the assumed seismic hazard curves, the following seismic specifications are derived:

SIC	IAEA level	Return Period (years)	Peak** Ground Acc.
1*	SL-2S 85% tile	10^4	0.4
2,3	SL-2 50% tile	10^4	0.2
3	SL-1 50% tile	10^2	0.05
4***	SL-0	short	0.05

* No ITER components in this class

** Peak Ground Acceleration is for both horizontal and vertical components in units of the gravitational acceleration, g.

*** SIC 4 components, the seismic specifications are not derived probabilistically - local (uniform) building codes are applied to this class. A peak value of 0.05g is assumed equal to the SL-1 peak value.

Bases Safety assessments of external accident initiators for facilities, particularly when framed in a probabilistic risk approach, may be dominated by seismic events. Assumed seismic hazard curves are used in a probabilistic approach which is consistent with IAEA recommendations for classification as a function of return period. The selection of the assumed seismic hazard curve is relevant to regions of low to moderate seismic activity. Prior to site selection, specification of the peak horizontal and vertical ground acceleration provide the ITER designers guidelines according to the methodology to be used for seismic analysis, which will rely on a specified Ground Motion Design Response Spectrum and a superposition of modal responses of the structures (according to NRC recommendations). After site selection the actual seismic specifications will be used to adjust the design, in particular by adding seismic isolation, if necessary.

JASS Criteria

1) Seismic design approach/guideline; e.g. deterministic/probabilistic, seismic classes, levels, and design standard
2) Seismic design conditions(data); e.g. Historical records of earthquakes, data of active faults, design seismic motion, and location of seismic excitation
3) Specification and assessment of Seismic isolator, if necessary

The French safety regulations require taking into account site-specific seismic specifications for Cadarache.

In Cadarache two similar Design Response Spectra must be considered in place of the assumed levels of ASME spectra SL-2. While both of these spectra are more intense at Zero Period (ZP), their strength is less than the ASME design assumption for frequencies below 4Hz. As the building main mode is at about 4Hz and the main models of the tokamak below that, the main responses of building and tokamak will be quite similar to the generic assumption.

Nonetheless, an analysis has been carried out to verify the capacity of the Tokamak Building, as designed by the ITER team, to cope with Cadarache seismic conditions and to determine the necessary reinforcements, if any. This study was performed with and without using seismic isolator bearings. Both options are feasible 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. More work is in progress for the verification of the floor response spectra and their impact on the equipment at all levels.

1.2.A.6 Meteorological Characteristics

Assumption A general set of meteorological conditions are assumed for design of buildings, civil structures and outdoor equipment, as follows:

- Maximum Steady, Horizontal Wind ≤ 140 km/hr (at 10 m elevation)
- Maximum Air Temperature ≤ 35 °C (24 hr average ≤ 30 °C)
- Minimum Air Temperature ≥ -25 °C (24 hr average ≥ -15 °C)
- Maximum Rel. Humidity (24 hr average) ≤ 95% (corresponding vapour pressure ≤ 22 mbar)
- Maximum Rel. Humidity (30 day average) ≤ 90% (corresponding vapour pressure ≤ 18 mbar)
- Barometric Pressure - Sea Level to 500 m
- Maximum Snow Load - 150 kg/m^2
- Maximum Icing - 10 mm
- Maximum 24 hr Rainfall - 20 cm
- Maximum 1 hr Rainfall - 5 cm
- Heavy Air Pollution (Level 3 according to IEC 71-2)

Bases The assumed meteorological data are used as design inputs. These data do not comprise a complete set, but rather the extremes which are likely to define structural or equipment limits. If intermediate meteorological data are required, the designer estimates these data based on the extremes listed above. Steady winds apply a static load on all buildings and outdoor equipment.

JASS Criteria

1) Temperature
2) Humidity
3) Rain fall
4) Wind velocity
5) Snow fall
6) Atmospheric pressure (elevation)
7) Availability of meteorological database of site characteristics over a period of years.

All meteorological design assumptions are met in the Cadarache Site.

1.2.B Heat Sink

Water supply and industrial sewage for Heat Rejection System

Assumption The JCT has selected forced draft (mechanical) cooling towers as a design solution until the ITER site is selected. At 30% pulse duty cycle (450 MW average heat rejection) the total fresh ("raw") water requirement is about 16 m^3/minute. This water makes up evaporative losses and provides replacement for blowdown used to reduce the accumulation of dissolved and particulate contaminants in the circulating water system. During periods of no pulsing the water requirement would drop to about 5 m^3/minute.
Each blowdown action will lead to a peak industrial sewage rate of 3000 m^3/day.

Bases The actual ITER Site could use a number of different methods to provide the heat sink for ITER, but for the purposes of the site non-specific design, the induced draft (mechanical) cooling towers have been assumed. These cooling towers require significant quantities of fresh water ("raw") for their operation. For 450 MW average dissipation, approximately 16 m^3/minute of the water is lost by evaporation and drift of water droplets entrained in the air plume, and by blowdown. This water also supplies make up to the storage tanks for the fire protection system after the initial water inventory is depleted. Cooling towers may not be suitable for an ITER site on a seacoast or near a large, cool body of fresh water. Therefore open cycle cooling will be considered as a design option.

JASS Criteria

1) Cooling Tower System:
   - Water supply capacity and restrictions for the cooling system;
   - Capacity of the drainage and blowdown flow for the cooling system; and
   - Seasonal air temperatures and humidity levels, wet bulb temperatures.
2) Sea Water Cooling System/Once through Cooling System:
   - Distance from the coast;
   - Allowable increment in the temperature of the sea water; and
   - Average water temperatures and seasonal variations.

Mechanical draft cooling towers can be easily accommodated on the Site to satisfy the required heat rejection capability. Two large irrigation/hydro-power canals are located close to the Cadarache centre and each one can provide the necessary cooling water for ITER. The proposal is to provide the needed water by gravity from the canal de Provence. ITER will use less than 1% of the available water in the canal and such a margin will provide additional flexibility in the design and performance of the cooling system.

1.2.C Energy and Electrical Power

1.2.C.1 Electrical Power Reliability During Operation

Assumption The grid supply to the Steady State and to the Pulsed switchyards is assumed to have the following characteristics with respect to reliability:

Single Phase Faults – a few tens/year 80%: $t < 1$ s
- a few / year 20%: $1\ s < t < 5$ min
where t = duration of fault

Three Phase Faults - a few/year

Bases ITER power supplies have a direct bearing on equipment availability which is required for Tokamak operation. If operation of support systems such as the cryoplant, TF coil supplies and other key equipment are interrupted by frequent or extended power outages, the time required to recover to normal operating conditions is so lengthy that availability goals for the Tokamak may not be achieved. Emergency power supplies are based on these power reliability and operational assumptions.

See also section 1.1.C

The electrical power reliability over a period of 10 years has been shown to satisfy the site design assumptions by a large margin.

Network Reliability Factors over the last 10 years

	Single Phase Faults per year	Three Phase Faults per Year
Steady State Supply (225 kV)	0.67	0.033
Pulsed Supply (400 kV)	2.2	0.25

1.2.C.2 ITER Plant Pulsed Electrical Supply

Assumption A high voltage line supplies the ITER "pulsed loads". The following table shows the "pulsed load" parameters for the ITER Site:

Characteristic	Values
Peak Active Power* ,#	500 MW
Peak Reactive Power	400 MVar
Power Derivative*	200 MW/s
Power Steps*	60 MW
Fault Level	10-25 GVA
Pulsed Power Period**	1000 s
Pulse Repetition time	1800 s

from which up to 400 MW is a quasi steady state load during the sustained burn phase, while the remaining 80 – 120 MW has essentially pulse character for plasma shape control with a maximum pulse duration of 5 – 10 s and an energy content in the range of 250 – 500 MJ.

* These power parameters are to be considered both positive and negative. Positive refers to power from the grid, while negative refers to power to the grid. Power variations will remain within the limits given above for the maximum power and for the power derivatives.

** The capability to increase the pulse power period to 3600 s is also assumed.

Bases The peak active power, the peak reactive power and the power steps quoted above are evaluated from scenarios under study. Occasional power steps are present in the power waveform. The supply line for pulsed operation will demand a very "stiff" node on the grid to meet the assumption.

JASS Criteria

1) High voltage lines (plan)
2) Capacity of pulse electrical power supply (active and reactive)
3) Demonstrate that the site meets the criteria listed in the site assumptions through a technical study in conjunction with the electrical system operator: Impact of voltage, reactive power and system harmonics should also be addressed; Impact of ITER pulses of various lengths (from a few seconds to 3000 s), on the steady state power supply, and on grid
4) If a supplemental system is required, what are the design options and impacts on ITER, with respect to additional facility requirements, modifications to site interfaces, additional land area, potential additional hazards, impacts on ITER operation, etc.

See also section 1.1.C

The network's Active Power capability allows a steady state power of 620 MW with active power steps > ± 500 MW (instead of the limit of ± 60 MW assumed). It is estimated that the Power Shedding System included in the ITER design is not needed in Cadarache. However, the relatively low network Reactive Power capability would require an increase of the local fast static compensation system from 440 MVAr to 675 MVAr.

As an alternative to the 225 kV line, it would be possible to supply both Steady State and Pulsed Power Supply systems by the 400 kV system, building a new 400 kV double line (to comply with ITER requirements for Steady State Power Supplies) that would be derived from one of the two 400 kV lines presently existing. The derivation point would not need a new switchyard as the new lines are considered as part of the existing "Tavel-Boutre" connection. The new double line would be built in place of the present one supplying Tore Supra, within the CEA property, and therefore no environmental or licensing problems are expected.

1.2.E External Hazards and Accident Initiators

1.2.E.1 External Hazards

Assumption It is assumed the ITER Site is not subject to significant industrial and other man-made hazards.

Bases External hazards, if present at the ITER site, must be recognized in safety, operational and environmental analyses. If these hazards present a significant risk, mitigating actions must be taken to ensure acceptable levels of public safety and financial risk.

JASS Criteria
If any
1) Aircraft and air routes
2) Factories, industrial complexes, and nuclear facilities

While the Cadarache Site has no special requirements with regard to external hazards, some measures must be taken regarding external hazards as described in the so-called "Règles Fondamentales de Sûreté" (RFS) for nuclear installations. These consider among other elements, historical records that have been used to determine frequency of events. External risks related to industrial and other man-hazards have been considered and, in the preliminary safety analysis, no consequence on the generic design has been identified.

The ITER site will be subject to the emergency planning of the Cadarache nuclear centre.

As an example, the frequency of an impact of a Lear-jet or Cessna plane has been evaluated (10^{-6} /year) and an assessment on the building design performed; such preliminary study indicates that this event can be coped with minor modifications of the tokamak building superstructure.

1.2.E.2 External (Natural) Accident Initiators

Assumption It is assumed the ITER Site is not subject to horizontal winds greater than 140 km/hr (at an elevation of 10 m) or tornadic winds greater than 200 km/hr. The ITER Site is not subject to flooding from streams, rivers, sea water inundation, or sudden runoff from heavy rainfall or snow/ice melting (flash flood). All other external accident initiators except seismic events are assumed below regulatory consideration.

Bases The wind speeds specified in this requirement are typical of a low to moderate risk site. Tornadic winds apply dynamic loads of short duration to buildings and outdoor equipment by propelling objects at high speeds creating an impact instead of a steady load. The design engineer uses the tornadic wind speed in modeling a design basis projectile which is assumed to be propelled by the tornado. This design basis is important for buildings and structures that must contain hazardous or radioactive materials or must protect equipment with a critical safety function.

ITER is an electrically intensive plant, which would complicate recovery from flooded conditions. This assumption does not address heavy rainfall or water accumulation that can be diverted by typical storm water mitigation systems. For the purposes of this assumption, accidents involving fire, flooding and other initiators originating within the ITER plant or its support facilities are not considered external accident initiators.

JASS Criteria

1) Historical records of hazard caused by strong winds and high water.
2) Historical records of floods.
3) Historical records of land slides.

There is no record of floods at the location of the Site. The Site does not present risks of soil erosion, landslide, excessive slanting, and avalanche.

1.2.F Infrastructure

General Bases The ITER Project is sufficiently large and extended in duration that infrastructure will have a significant impact on the outcome. Industrial, workforce and socioeconomic infrastructure assumptions are not quantitatively stated because there are a variety of ways these needs can be met. The assumptions are fulfilled if the actual ITER site and its surrounding region already meets the infrastructure needs for a plant with similar technical, material and schedule needs as ITER requires.

1.2.F.1 Industrial

Assumption It is assumed the ITER Site has access to the industrial infrastructure that would typically be required to build and operate a large, complex industrial plant. Industrial infrastructure includes scientific and engineering resources, manufacturing capacity and materials for construction. It is assumed the ITER Site location does not adversely impact the construction cost and time period nor does it slow down operation. The following are examples of the specific infrastructure items assumed to be available in the region of the site:

- Unskilled and skilled construction labor
- Facilities or space for temporary construction labor
- Fire Protection Station to supplement on-site fire brigade
- Medical facilities for emergency and health care
- Contractors for site engineering and scientific services
- Bulk concrete materials (cement, sand, aggregate)
- Bulk steel (rebar, beams, trusses)
- Materials for concrete forms
- Construction heavy equipment
- Off-site hazardous waste storage and disposal facilities
- Industrial solid waste disposal facilities
- Off-site laboratories for non-radioactive sample analysis

Bases Efficiency during construction and operation of a large, complex industrial facility varies significantly depending on the relative accessibility of industrial infrastructure. Accessibility to infrastructure can be demonstrated by comparable plants operating in the general region of the site.

JASS Criteria

1 Engineering resources and mfg capacity:

1) Accessibility to the industrial infrastructure with integrated experience in large projects especially for power plants and fusion facilities. The infrastructure would include:
   - Capability for fabrication of large components (e.g. vacuum vessel, PF coils, etc.);
   - High speed international communication network available to ITER;
   - Pool of neighbouring research oriented companies and their experience and competence relevant to a big project;
   - Facilities for supplying construction materials and equipment to the ITER site;
   - Off-site laboratories for non-radioactive analysis and their capacity; and
   - Handling requirements and restrictions on hazardous waste handling and disposal.

2 Scientific and research resources:

1) Already existing research facilities in the field of fusion, nuclear, and science.
2) Advanced computational facility, academically informative environment.
3) Broad and stable community support for the fusion research.

European industries have participated in the construction and operation of several fusion devices, like JET, Tore Supra and the R&D projects undertaken during the ITER EDA. Therefore there is a proven domestic industrial capability in all areas of the ITER project. Europe is amongst the leading countries in the development of nuclear fusion and it does so at a number of scientific and research institutes. Also in many other fields of science and technology, Europe is at the forefront with examples like CERN, European Space Agency, the European Space Observatory, Arianespace, etc.

The regional infrastructures have allowed the construction in 1984 of Tore Supra. Furthermore construction of the RES (“Réacteur d’Essais”, new nuclear reactor for training of submarine teams) is currently underway on the CEA Cadarache site. The TGV Méditerranée (super fast train between Marseille and Paris, running since June 2001) is a good example of how construction labour forces can be mobilised in the region.

A fire protection service is available on the CEA Cadarache site. A local medical service is provided on the CEA/Cadarache centre for emergency care and for staff medical supervision.

The CEA/Cadarache centre is connected through a dedicated 34 MB/s line to the city of Grenoble and from there to Paris. Although the present network at Cadarache can cope with the immediate requirements of the ITER initial site, the requirements of ITER during operation will require an evaluation and specification, to take into account redundancy, traffic priorities and necessary international high-speed communications. It is foreseen that the Cadarache centre will be connected to a 1GB/s link within 3 years.

The Tore Supra is a superconducting Tokamak, known worldwide, whose scientific and technological programme is oriented mainly towards long plasma discharge studies. About 300 researchers, engineers and high level technicians work daily on Tore Supra, but also on international programme (ITER EDA, JET, etc.). Moreover CEA Cadarache is a major nuclear research area in France with 18 nuclear installations and more than 4000 people.

1.2.F.2 Workforce

Assumption It is assumed that a competent operating and scientific workforce for the ITER Plant can be recruited from neighbouring communities or the workforce can be recruited elsewhere and relocated to the neighbouring communities.

It is also assumed that ITER has the capability for conducting experiments from remote locations elsewhere in the world. These remote locations would enable "real-time" interaction in the conduct of the experiments, while retaining machine control and safety responsibilities at the ITER Site Control Facility.

Bases The workforce to operate, maintain and support ITER will require several hundred workers. The scientific workforce to conduct the ITER experimental program will also require several hundred scientists and engineers. The assumption that these workers and scientist/engineers come from neighbouring communities is consistent with the site layout plans which have no provisions for on-site dormitories or other housing for plant personnel.

A significant scientific workforce must be located at the ITER Site as indicated in the Assumptions. However, this staff can be greatly augmented and the experimental value of ITER can be significantly enhanced if remote experimental capability is provided. The result of the remote experiment is that scientific staffs around the world could participate in the scientific exploitation of ITER without the necessity of relocation to the ITER Site.

Remote experimental capability is judged to be feasible by the time of ITER operation because of advances in the speed and volume of electronic data transfers that are foreseen in the near future.

JASS Criteria

1) Define the pool of site engineering and scientific services and staff available to support ITER construction and operation with reference to their experience
2) Define the pool of construction labour available at or near the ITER site with reference to their experience, and the facilities needed to maintain and house the required workers drawn from this base

See also 1.2.F.1

The European Fusion Program includes 21 contracts of associations with Euratom, and a total of about 1700 professionals. Within this force are 300 skilled people (including ~50 foreigners on long term contracts) from Tore Supra who cover many fusion areas, as theory, modelling, experimentation, plasma engineering, fusion technology. The CEA/Cadarache centre (4100 people, among which 2400 CEA employees) and CEA in general also host many of the engineering competences required for the construction and the operation of ITER (project engineering, technical areas as electrical and water supply, safety, waste management).

Ten universities are located within a 250 km radius of the site, and are linked with CEA by collaboration agreements. The region possesses a broad spectrum of industrial activities, ranging from heavy industries to high technology. A few key figures: 40 % of the national microelectronics production, 35 % of French oil refining, 25 % of France's steel production, 10 % of the national chemicals production. The building and civil engineering sector is a strong activity in Provence counting nearly 30000 enterprises.

1.2.F.3 Socioeconomic Infrastructure

Assumption The ITER Site is assumed to have neighbouring communities which provide socioeconomic infrastructure. Neighbouring communities are assumed to be not greater than 50 km from the site, or one hour travel. Examples of socioeconomic infrastructure are described in the following list:

- Dwellings (Homes, Apartments, Dormitories)
- International Schools from Kindergarten to Secondary School
- Hospitals and Clinics
- Job Opportunities for Spouses and other Relatives of ITER workers
- Cultural life in a cosmopolitan environment

Bases Over the life of the ITER plant, thousands of workers, scientists, engineers and their families will relocate temporarily or permanently to the communities surrounding the ITER site. These people could comprise all the nationalities represented by the Parties. This "world" community will present special challenges and opportunities to the host site communities.

To attract a competent international workforce international schools should be provided. Teaching should be partially in the mother tongue following programmes which are compatible with schools in each student's country of origin. All parties should assist with the international schools serving these students.

The list of examples is not intended to be complete but it does illustrate the features considered most important. The assumed 50 km distance should maintain reasonable commuting times less than one hour for workers and their relatives.

JASS Criteria

See 1.2.F.1 and Section 2 (Socio-Cultural Aspects)

1.2.G Regulatory and Decommissioning

1.2.G.1 General Decommissioning

Assumption During the first phase of decommissioning, the ITER operations organization places the plant in a safe, stable condition. Dismantling may take place decades after the "deactivation" phase. Dismantling of ITER is assumed to be the responsibility of a new organization within the host country. The ITER operations organization will provide the new organization all records, "as-built prints", information and equipment pertinent to decommissioning. Plant characterization will also be provided for dismantling purposes after "deactivation".

Bases Experience and international guidelines (IAEA Safety Series No. 74, 1986, "Safety in Decommissioning of Research Reactors") stress the importance of good record keeping by the operations organization as a key to decommissioning success.

JASS Criteria

See Section 1.1.G and Section 3 (Licensing Aspects) and Section 5.2 (Decomissioning costs)

1.2.G.2 ITER Plant "Deactivation" Scope of Work

Assumption The ITER operations organization will develop a plan to put the plant in a safe, stable condition while it awaits dismantling.

Residual tritium present at the end of ITER operations will be stabilized or recovered to secure storage and/or shipping containers.

Residual mobile activation products and hazardous materials present at the end of ITER operations will be stabilized or recovered to secure storage and/or shipping containers such that they can be shipped to a repository as soon as practical.

ITER deactivation will include the removal of in-vessel components and their packaging in view of long-term storage. This removal from the vacuum vessel will be done by personnel and remote handling tools, trained for maintenance during the previous normal operation.

Liquids used in ITER systems may contain activation products, which must be removed before they can be released to the environment or solidified as waste. It is assumed that all liquids will be rendered to a safe, stable form during the "deactivation" phase, and afterwards no more cooling will be necessary

ITER "deactivation" will provide corrosion protection for components which are vulnerable to corrosion during the storage and dismantling period, if such corrosion would lead to spread of contamination or present unacceptable hazards to the public or workers.

Bases It is recommended (IAEA Safety Series No. 74, 1986) that all radioactive materials be rendered into a safe and stable condition as soon as practical after the cessation of operations.

JASS Criteria

See Section 1.1.G and Section 3 (Licensing Aspects) and Section 5.2 (Decomissioning costs)

1.2.H Construction Phase

General requirements for the construction phase (except land) are very dependent on local practice. However, water, sewage and power supplies need to be provided at the site for a construction workforce of up to 3000 people.

JASS Criteria

1) Provision of potable water, sewage (3000 men)
2) Provision of electrical power during the construction
3) Demonstration of general familiarity with the requirements associated with a large construction site. Accordingly, the availability of adequate site facilities, construction offices, temporary construction buildings, amenities buildings, etc. needs to be demonstrated

See section 1.1.A.3 for potable water

See section 1.1.C for electrical power

2.0 SOCIO-CULTURAL ASPECTS

2.A ACCESS AND TRANSPORT

2.A.1 Highway Transport

Assumption The ITER Site is accessible by a major highway, which connects to major ports of entry and other centres of commerce

JASS Criteria

1. Major streets access
2. Highway access
3. Transport restrictions for large/heavy components.
4. Commuting distances and times from major centres, ports etc.

2.A.2 Air Transport

Assumption The ITER Site is located within reasonable commuting time from an airport with connections to international air service.

JASS Criteria

1. Access to international airports
2. Number of international flights

2.A.3 Rail and Waterway transport

Assumption It is assumed the ITER site will have rail and waterway access. The railway is assumed to connect to major manufacturing centres and ports of entry.

JASS Criteria

1. Major railway access
2. Major waterway access
3. Transport restrictions for large/heavy components

See also section 1.1.A for land description and 1.1.D for transport and shipping.

Information contained in this section was provided by CEA.

1) Road transport

The JASS Ad-hoc Group visited the proposed Site, located approximately 40km (~ 30 min. drive) northeast of Aix en Provence and 70km (~ 45 min. drive) from Marseille Airport. This enabled the Group to observe the access and transport conditions.

The proposed Site is accessible by A51, a 4-lane motorway running north from Marseille to Aix-en-Provence and then going further north past Cadarache. There is an exit from the motorway at Cadarache. A frequent, regular public bus service is available from Marseille Airport to Aix en Provence.

In addition, there are CEA bus services to the Cadarache site from a number of towns and villages in the surrounding area, such as from Manosque, Pertuis and Aix en Provence. These could be extended to the ITER employees and visitors under an agreement between the Organization and the CEA.

To drive on the roadways, ITER personnel and their dependants require either an international driver's license, if staying for a short period of time, or a French driver's license. If staying for a period longer than 1 year, it is necessary, for non-EU citizens, that a French driver's license be obtained. This requires taking the home country driver's license to the Prefecture office, where it will be converted to a French driver's license. Car insurance is compulsory and insurance companies recognize an individual's driving record from countries of origin where reciprocal arrangements are in place.

<u>2) Air Transport</u>

Access to international travel is via Marseille Airport (~45 min. drive) or the Nice Airport (~2 hour drive) and then by way of a number of major European hubs. For example, there are frequent flights to the airports in Paris, Frankfurt, Madrid and Amsterdam. The TGV (Train a Grande Vitesse) from Paris' Charles de Gaulle Airport to Marseille and Aix-en-Provence offers another transfer option.

<u>3) Rail and Waterway Transport</u>

For personal transport, the TGV is available between Aix-en-Provence and Avignon, Lyon, Paris, Brussels and Geneva etc. There is a regional rail network for daily transportation between local centres such as Marseille, Aix-en-Provence, Manosque, Pertuis and the nearby Alps.

Docking facilities are available at the Marseille Fos Harbour. In addition, there are ferry services to nearby Mediterranean islands.

2.B SOCIAL INFRASTRUCTURE and LIVING CONDITIONS

Assumption The ITER Site is assumed to have neighbouring communities which provide socio-economic infrastructure. Neighbouring communities are assumed to be not greater than 50 km from the site, or one hour travel. Examples of socio-economic infrastructure are described in the following list:

1. Dwellings (Homes, Apartments, Dormitories)
2. International Schools from Kindergarten to Secondary School
3. Hospitals and Clinics
4. Job Opportunities for Spouses and other Relatives of ITER workers
5. Cultural life in a cosmopolitan environment

JASS Criteria

1) Living environment
2) Education (international schools, facilities)
3) Hospital and clinics
4) International cultural environment in neighbouring cities.
    - Name of the City, population
    - Summary of the urban function
    - Job opportunities for spouses of ITER workers.
    - Variety of lifestyle options
    - Safety and security
    - Cost effectiveness
    - Local services
    - Local worship options
    - Access to international travel
    - Cultural attractions
5) Serviced provided for long and short term visitors from abroad including volunteers' supports

Representatives of each subject area provided the information contained in this section. This was arranged by CEA.

1) Living Environment

Information has been provided by CEA, experts from housing agencies, and local Authorities.

The practical locations for ITER family residents are expected to be in the three larger towns surrounding the site – Aix en Provence (~40 km), Manosque (~20 km) and Pertuis (~25 km) - as well as many surrounding villages. There is a wide variety of accommodation available for rental or purchase in these areas. Any foreign national is free to rent or purchase accommodation. There are plans in this area to increase the stock of housing by 14% over the next 10 years.

Some typical prices for housing (www.immoprix.com):

- Purchase of new apartments ~60 m^2 (Aix en Provence) – 1950 €/m^2
- Purchase of older apartments ~60 m^2 (Aix en Provence) – 1500 €/m^2
- Purchase of older apartments ~70 m^2 (Manosque) – 870 €/m^2
- Monthly apartment rental 40-130 m^2 (Aix en Provence) –14-9 €/m^2, and less in Pertuis, Manosque and villages.

Additional information including cost of land and houses purchase is available in "Answers to JASS Cadarache Questions" provided by Cadarache team.

Residential broadband internet services are readily available.

2) Education

The information was presented by the Chief of the Local Educational Authority on behalf of the French Ministry of Education.

At a visit to the local senior high school, a thorough presentation was given of the four Options for schooling between the ages of 6 and 18:

1. French School system available on the local network, leading to a French baccalaureate,
2. French School with international section, leading to an International Baccalaureate,
3. European School leading to a European Baccalaureate. This could include additional Japanese, Russian and other sections as needed in order to provide continuity with the home country school programme, and
4. School system of the country of origin.

The first two Options are free for all and the Third Option is free for European citizens. There is a precedent for the schooling to also be free for children of non-European participants. The Fourth Option is privately funded.

With respect to Option Two, a French senior high school with an international section currently exists in Aix-en-Provence. In order to ensure access by a majority of ITER families to such a system, a new secondary school of this type will be built in Manosque. Other schools of this type could also be provided if required.

With respect to Option Three, the French government would appeal to the Board of the European School to establish a European School. This request could include additional Japanese, Russian and other sections as needed in order to provide continuity with the home country school programme. The question of tuition fees in this option for non-European citizens will have to be negotiated between the participants. There is a precedent for this schooling to be free of charge. It should also be noted that the educational programme for Japanese, Russian and other sections in a European school will have to be discussed between the European School Organisation and the different educational authorities.
For the European schools there is already a system to allow pupils from families not involved in the project for which the school has been established to be admitted. This can be done in the form of a contract for a larger group of pupils (normally established between the school and a company) or on an individual basis. For this last category the typical fees per year across various European countries and cities are (school year 2002/2003): Nursery cycle – <1500 €, Primary cycle - ~2000 €, Secondary cycle - ~2750 €.
There is no systematic rule for the equivalence of the French and European baccalaureates with other international or national diplomas. However France has signed an agreement with many other countries about the framework of a case-to-case equivalence of diplomas. The equivalence is based on the study of an individual file prepared by the students.

With respect to Option Four, the French Ministry of Education is ready to provide accommodation in a European School building for this type of programme. The tuition fees will not be borne by the government.
The rental of facilities in a European school building has no known precedent. The French government and/or regional authorities will make available the buildings to the European school; the necessary extension of the facilities could be financed along the same principles, subject to negotiations.
The tuition fees for a private school can't be commented on by the proponent team, however some examples can be given:
- IBS (International Bilingual School of Provence in Aix) : around 6500 € per year (in "5ème" level).

Information was provided on the process of integrating foreign students into the French School system and, by example, on the process of returning to the home system.

Free nursery schooling is available from the age of three to five in French-speaking schools in the local area. Nursery schooling would also be available at European Schools.

French universities being funded by the government, fees are very low for French and foreign students.
The following figures are given, as example, for the Aix-Marseille 2 University :
Inscription fees for 1st and 2nd years, and DEA: 144.51 € including access to library, sports and

preventive medicine.
Welfare system: 171€

3) Hospitals and Clinics

The information was presented by officials of the Regional Health Agency and the Aix General Hospital and was followed by a tour of the facilities.

The French health care system, including medical and dental services, is based on a number of principles including universal access and freedom of choice with respect to facilities and health practitioners.

French families pay a social protection tax and receive free health care. For the European Union ITER families, this French social protection system is applicable.

The ITER Organisation will have the choice either to join the French welfare system, or to join an other existing system or to have its own system. Almost all life risks are covered by the French system: illness, maternity, disability, occupational accidents and illnesses, old age, death, widowhood, family dependence. The possibility that ITER Organisation will use only the healthcare part of the French system will have to be discussed during the negotiations.

The ratio of doctors to people in Provence-Alpes-Côte d’Azur (PACA) region is 1/360. Many doctors are able to communicate in English and there is a translation service available for many languages. Hospitals in the Region regularly provide foreign nationals with a full range of treatments.

There is an established network of hospital care in PACA the Region with three levels:

1. Facilities for basic care, for example at Manosque and Pertuis hospitals,
2. Facilities for more specialized care, for example Aix Hospital, and
3. Facilities for very specialized care, for example at Marseille.

In the case of emergencies, an emergency site can be reached within 30 minutes.
A helicopter service is also available in the event of critical conditions.

4) International Cultural Environment in Neighboring Cities

The Cadarache site is located in the PACA region that has a surface area of 31,400 km2 and a total population of 4.5 million. Approximately 8%, or 360,000 are foreign residents. The nearest towns are Manosque with a population of 20,000 and Pertuis with a population of 18,000. The nearest city, Aix-en-Provence, is 40km away and has a population of about 134,000. The major city of Marseille is approximately 70km away and is the second largest city in France with a population of approximately 800,000.

Dependents of ITER employees will automatically receive a Long Stay Resident Card, which will allow them to apply for a job.

The PACA region is well known for the variety of lifestyle options it offers. It has a temperate climate and it projects an atmosphere of safety and security in the towns and rural areas in the region around Cadarache.

The cost of living in France is slightly above the average for Europe, but is increasing at a lower rate.

According to “OECD, main economic indicators, December 2002”, the comparative price levels, on September 2002, in different countries were:
France – 100, Spain – 83, Germany – 99, UK – 111, Italy – 84, Japan – 149, Canada – 86, USA – 105.

On the other hand, according to “Eurostat, Annuaire 2002”, the price level growth from 1996 to 2000 was:
France – 4.4%, Spain – 9.7%, Germany – 4.9%, Italy – 8.4%, EU-15 – 6.4%.

There is no regional comparison of the price levels officially published in France. Nevertheless, a study made in 1995 by Institut National de la Statistique et des Etudes Economiques shows that household expenses are slightly lower (~ 4 %) in Provence-Alpe-Côte d'Azur than the average in France.

There are 31 places of worship in Aix-en-Provence including Christian churches, mosques, Buddhist temples and a synagogue.

There are a wide variety of cultural attractions throughout the PACA region including museums, festivals, performing arts and concerts. There are also a variety of sports and recreational activities accessible to the public throughout the year.

The Prefecture of the PACA region will establish an organization (a welcome centre) to provide information, guidance and assistance to ITER families for their relocation and daily life. Administrative services are provided in both French and English.

3.0 LICENSING ASPECTS

Roadmap toward a License including construction, operation, decommissioning

JASS Criteria

1) Regulatory framework
2) Safety design approach /guideline
3) Steps of licensing procedures
4) Road map
5) Design standard, QA etc.
6) Restrictions on long lead procurement, site preparation, and financing activities
7) Proponent's commentary on obtaining a nuclear construction, operation, and decommissioning license.

(1) Regulatory framework

The licensing of nuclear installations follows a well-established standard practice in France, a country producing more than 80 % of its electricity by means of nuclear power plants.

The framework for ITER in Cadarache is based upon the regulations of nuclear facilities in France. Following a dialogue with the Safety Authorities, ITER has been classified as a Basic Nuclear Installation called "Installation Nucléaire de Base" (INB), and in particular of the "Laboratory and Fuel Plant" category (as opposed to "Nuclear Power Reactor"), essentially due to the expected tritium inventory and the expected waste generation during ITER life. No new administrative procedure or regulation will have to be developed for ITER.

The French Nuclear Safety Authorities (ASN) depend on the joint authority of the Ministry of the Ecology and Sustainable Development, the Ministry of Industry and the Ministry of Health. Safety Authorities are in charge of the technical and statutory control of the nuclear security and the radioprotection. The Safety authorities a) verify technical aspects of nuclear installations safety, b) control the management of the radioactive waste, c) survey the impact of the nuclear installations, d) control the transport of the radioactive materials, e) survey radioprotection aspects associated to the nuclear safety.

Regulatory examinations and approvals are performed at different phases of the life of the installation: a) for the site selection, b) when major conceptual choices are completed, c) before the start of construction, d) before the start of the operation of the installation, e) regular follow-up throughout the life of the installation, f) before and during the dismantling.

(2) Safety design approach/guideline

Regulations for nuclear safety collected in the Fundamental Safety Rules (Règles Fondamentales de Sûreté -RFS) are divided into those relevant for pressurized-water reactors and those relevant for installations other than reactors. The latter more appropriate to ITER, but some aspects of the approach in the PWR regulations will also be considered.

Clear principles in RFS are the definition of accident sequences and taking all possible steps to minimise the consequences, to the public, the environment, and plant personnel. In all stages of the lifetime of the device, the safety approach is based on the implementation of both ALARA and Defence in Depth principles, which must be demonstrated to Safety Authorities. For each event the objectives are:

- minimisation of exposure of personnel to radiation, at least below regulatory limits;
- limitation of the quantity of radioactive releases, and optimisation of their characteristics;
- limitation of the quantity of radioactive waste produced, and of industrial releases or wastes.

It has been shown that the ITER design has generally followed sound safety principles that are in accord with general requirements of the French safety regulations. The safety analysis of ITER performed so far, mainly as documented in GSSR, can then be presented in a way most likely to meet with approval, and any gaps or deficiencies in the studies may be identified and corrected.

(3) Steps of licensing procedures and
(4) Road map

In France the first step of licensing process is the “Dossier d’Options de Sûreté” (DOS) which gives the safety design guidelines to be followed. The main safety approach must: a) define safety functions, b) identify risks, and c) describe means for risk mitigation and minimization. DOS describes briefly the installation, proposes general safety objectives and explains how these are going to be implemented in the installation. As far as ITER is concerned, this document has been completed at the end of 2001, has been submitted beginning of 2002 by the CEA to the French Safety Authorities who have formally accepted the presented options and proposed recommendations for the writing of the Preliminary Safety Report (see below).

The second step of the licensing process is the preparation and the assessment of the Preliminary Safety Report (“Rapport Préliminaire de Sûreté, RPrS”) . The RPrS consists of a detailed description and a comprehensive safety analysis of ITER. The preparation of the main contents of this document has been undertaken at the beginning of 2002.

The licensing process will finish by 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 d’Effluents 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.

At each of these authorizations, a Public Enquiry will also be undertaken. It is a consultation process among the local communities within a radius of about 15 km from the proposed site. Issues such as the effect on the environment resulting from the construction and operation of the installation will be described.

It is possible that the CEA, if mandated by the Parties, in direct liaison with the International Team could submit the document and receive the authorization pending establishment of the Organization, and then transfer the responsibility to the Organization without changing the nature of the licensing process.

As part of the Road Map, the ITER project will be submitted to a Public Debate (“Débat Public”), as foreseen in French law. The objective of the debate is to launch an overall countrywide discussion on the socio-economic and/or environmental consequences of the project. A special commission is in charge of surveying this process, which cannot last more than six months. CEA is exploring how and when it would be best initiated.

(5) Design Standards and QA

The ministerial decree of 10 August 1984 and the ministerial circular of the same day clarify the main rules of quality assurance and organization that the nuclear installation owner has to follow in the three stages of design, construction and operation of the INB. The French quality assurance for safety related components or equivalent, like the ISO9001, must be followed.

Generally speaking, the nuclear installation follows the code "Rules of Conception and Construction (RCC)" to cover, for different materials (civil engineering, mechanical materials, electric, combustible materials), the design, construction and operation phases. The elaboration of these documents is under the owner’s responsibility. The Safety Authorities examine and review the RCC. In France, no official code is prescribed by the safety authorities, however the choice of the code has to be justified for safety purposes. The safety authorities are open to accept any recognised code and standard.

(6) Restrictions, site preparation, and financing activities

With the exception of the nuclear buildings, there are no restrictions on long lead procurement which can be started regardless of the licensing process, at the owner's risks. Such procurement should however proceed already with recognised QA.

4.0 HOST SUPPORT

4.1 SITE SUPPORT

JASS Criteria

1) Special conditions of the site offer
2) Public /community support
3) Securities (fire services, police)
4) Responsibilities of the host in water supply, electricity supply, and maintenance of the road.
5) Required/recommended relation with local governments and communities
6) Use of existing facilities e.g. libraries, cafeteria, etc.

1) Special conditions of the site offer

The French government is committed to make available 180 ha of land free of rent to the Organization for as long as necessary.

2) Public/community support

Both the local and regional media as well as the population have reacted very positively on the French candidature for ITER. There is a record of organizations and individuals who have expressed their support. For example, the governing councils for 16 towns in the area have confirmed their commitment to the hosting of ITER. Regional Authorities have voted financial support to ITER. CEA has held meetings with elected officials from local communities. At the Week of Science in Marseille in October 2002, several thousand visitors attended the fusion exhibition that included ITER materials.

3) Security

See also Section 2. The Organization will have the choice of using the services of the CEA centre or those of private companies. These would include police and fire fighting services. In the case of CEA, the actual costs to bring the services to the required level and the cost for their use would be charged pro rata to the different users.

4) Responsibilities of the host in water supply, electricity supply and maintenance of the road

The site requirements and site design assumptions for services and road access, both up to the site boundary and to the point of connection to the ITER generic facilities, will be met as part of the host obligations under the Agreement. This same arrangement would apply to the treatment and disposal of effluents.

5) Required/recommended relations with local governments and communities

The Préfet of the PACA region has established a regional steering committee. It is comprised of representatives of all local administrative and regional authorities and CEA. This committee will remain in place during the construction phase and, if necessary, can continue during both the operating and decommissioning phases.

6) Use of existing facilities

There is a wide range of facilities and services at the adjacent CEA site, including medical facilities and services, a library and cafeterias. In addition, a guesthouse and apartment accommodation for short-term visitors is available close by. If the Organization wished to use these facilities and services, arrangements for access would have to be made and the actual costs to bring them to the required level and the cost for their use would be charged pro rata to the different users.

Access to some CEA computing facilities in Grenoble would be available, for example one vector machine and one massive parallel machine. Arrangements for access and payment would have to be made with the service provider.

NOTE: The Ad-Hoc Group notes that the site proponents will present again the information based on the Negotiators decisions on Host/Organization relations with particular respect to questions of responsibility and implementation of the liaison organization.

5.0 FINANCIAL ASPECTS

5.1 OPERATIONAL COSTS

JASS Criteria

1) If a Party wishes, it could include in its proposal operating costs as an element to take into consideration for JASS. The operational costs should be analysed for the Site, considering the main categories of operating costs from the FDR. The same methodology of cost estimate as used for FDR should be used if possible.

The Cadarache site proponent proposes to apply the European market prices for the needed services during the operation phase. The consideration of current market levels leads to savings with respect to the FDR estimate.

For the electricity cost estimate a yearly operation scenario has been established, in consistence with the various operation modes and with the global electrical energy consumption given in the FDR.
This scenario was based on:

- 16 pulses per day, each one 500 second long,
- 5 operating days a week,
- 3 weeks of operation, 1 week of maintenance, all year long.

This scenario corresponds to a 86 GWh/a energy consumption on the pulsed network and to a 568 GWh/a energy consumption on the steady state network.
This scenario has been submitted to two utilities:

- RTE, which has the charge to transport the electrical power in France.
- EdF, which is one possible electricity producer and supplier, and which is the current supplier for Tore Supra.

Both utilities have provided a cost estimation based on this scenario. The cost of electricity was reported to be about 28M€ /a, based on FDR consumption and a unit cost of 0.043 € /kWh. Cost of the transport is roughly 5-10% of the total cost.
It has to be noted that in Europe, the cost of electricity is much higher in winter than in average and that, in the case where ITER will have a long break in winter, the cost of electricity would be significantly reduced.

The proponent indicated that, subject to agreement with the Organization, a number of services might be shared with the Cadarache centre, leading to some savings to the Host or to the Parties, depending on the Host-Organization relations (See Chapter 4).

The tritium fuel cost has been estimated by the proponent according to the ITER FDR at the value of 8 kIUA per year which corresponds to a little more than 10M€ per year.
The feasibility of tritium production of in France by irradiation of lithium-containing ceramics is confirmed, but this cost may be higher by about a factor of 2. The transport from a foreign country is feasible, the ITER organisation will have the choice of supplier depending on price and availability from other source.

The hourly international manufacturing labour cost for year 2000 in France was US$16.83, from which US$8.72 is the direct wage and US$8.11 is the welfare contributions. (Source: German Economic Institute (IDW) reported in the monthly bulletin of European Union economic and financial news, October 2001 issue).

http://www.eurunion.org/news/eurecom/2001/eurecom1001.htm

5.2 DECOMMISSIONING COSTS

JASS Criteria

1) Classification of the radioactive waste
2) ITER Waste management strategy
3) Dismantling strategy
4) Decommissioning costs (as listed in Section 1.1 G - Regulations and Decommissioning)

After deactivation, the decay and decommissioning costs have been estimated at about 550 M€ (2001 values); they include:

- The cost for waste packaging, transportation, and final off-site disposal, which represents around 47 % of the total. The waste volumes have been based on the hypothesis of the ITER International Team (IT). The B-Type wastes form a major part of the costs.
- The dismantling operations as described by IT, which represents 38 %;
- The dismantling operations not foreseen by IT are estimated at 15 %. These include feasibility studies, dismantling of all buildings, sorting, activity measurements, and treatment of the waste.

The cost evaluation that has been performed takes into account different items such as management, support, radioprotection, maintenance, studies, tokamak, hot cells and tritium plant demolition, waste packaging and hardware costs.

France is a country where a total of 127 Nuclear Facility are in operation. For this reason well established regulations are present concerning the transportation and storage of nuclear wastes. Their packaging and final disposal depend on their classification which, in France, is structured in four categories, depending on nuclide specific activity and half-life:

- TFA: Very low activity (Très Faible Activité),
- A-Type: Low and medium activity with short half life,
- B-Type: Medium activity and long half life,
- C-Type: High activity and long half-life (no type C in ITER).

Such classification leads, in the ITER specific case, to about 31000 tons of nuclear wastes with 60 % of TFA, 30 % of A-Type and 10 % of B-Type.

6.0 PRIVILEGES AND IMMUNITIES

JASS Criteria

1) In presenting siting offers the interested Parties should indicate as part of their documentation, how they envisage to meet the project's likely needs in their specific circumstances.

The December 3, 2002 presentation by CEA summarized the French experience on Privileges and Immunities regarding international organizations.

The essential elements of the Privileges and Immunities are intended to be common to all Participants. These elements are being addressed in the Negotiations and they will be described in the Agreement itself.

The establishment of the JASS process did not include a review of Privileges and Immunities. It has been subsequently agreed that when questions with respect to these matters are raised during the JASS process, answers could be provided.