JOINT ASSESSMENT OF SPECIFIC SITES AD HOC GROUP

Clarington Site

JASS Ad-Hoc Group Meeting Findings

Toronto 12-15 September 2002

Version 6.0

(24th January 2003)

0. INTRODUCTION

0.1 Record of the Meeting

The first JASS Ad-Hoc meeting has taken place in Toronto, on September 12th to 15th 2002.

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

Related site proposal documents have been delivered to the members of the ad-hoc group the 5th of September for chapters 1 to 4 and the 9th of September for Chapter 5 (Financial Aspects).

The JASS ad-hoc group took note of the various presentations by the Canadian proponent team 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, the neighboring Darlington Nuclear Generating Station and St Mary's Cement plant, as well as the communities of Toronto and Clarington.

The ad-hoc group noted that, due to its specific financing model, the Canadian site offer will need to be clarified concerning also the costs of the non-common area, the required infrastructures and site preparations.

The ad-hoc group also noted that documentation from the Canadian submission in the Financial area, is for the time being limited to the site specific JASS criteria and does not include information more broadly related to Canada's participation to the ITER implementation, which should in the Canadian view be discussed under the Negotiation process.

The ad-hoc group jointly drafted the findings that follow and that will be the basis, together with the other sites proposals analyses, 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.

A number of issues relating to Privileges and Immunities have been identified and noted as they arose.

The ad-hoc group will meet for the second meeting in Rokkasho, Japan, on October 2nd to 5th.

0.2 The Clarington Site

Canada's proposed site for ITER is located at Clarington, Ontario, (see figure 1) and is currently licensed for nuclear use. The Clarington site is located on the shore of Lake Ontario about 60 km east of Toronto, between the 4x900 MWe Darlington Nuclear Generating Station and the 2-million t/a St Mary's Cement Plant (see figure 2).

The proposed site is approximately 180 hectares, and was previously designated for a second nuclear generating station, no longer being considered. The physical characteristics of this location have been extensively studied for the once-planned second nuclear station, and these past studies, as well as current site investigations, support the siting of ITER on that land. The land is currently owned by OPG who has agreed to pass ownership of this land to the ITER Legal Entity (ILE). The southern portion of the land, between the rail line and the lake (see figure 3), measuring approximately 90 hectares, will be dedicated to the ITER facilities. This area provides for flexibility during construction as well as space for future expansion of the facilities.

The proposed ITER site has the following significant physical attributes:

- Access – equipment can be delivered to the site by road, rail, ocean-going ships, and barges.
- Topography – the site has been pre-graded for the previously planned nuclear station, and over the planned ITER secure facilities, the change in grade is about 10 m.
- Geotechnical – the site is characterized by a strong limestone bedrock at about 25 m depth under a very dense glacial till.
- Hydrogeological – control of groundwater during construction has been well demonstrated during the Darlington plant construction.
- Seismic – Clarington has no history of seismic activity as was determined during the extensive studies for the safety analysis and siting of the Darlington nuclear station.
- Meteorological – the site is located in one of the more temperate regions of North America, with no history of floods, tornadoes, and other severe weather conditions.
- Water supply – the site is served by municipal potable water supply and sewage treatment facilities that will provide capacity for the ITER site during construction and operation, with capacity for expansion as well. Industrial water from the Darlington station is available in quantities well in excess of ITER's needs.

The proposed site is adjacent to a major 500 KV node of the Ontario electrical transmission grid, supported by 30,000+ MW of installed generating capacity. This grid is also strongly connected to adjacent states and provinces. The combination provides a secure and stiff grid, which can satisfy ITER's steady state and pulsed power demands and reliability criteria.

Tritium is produced as a by-product in CANDU reactors and separated and stored at the Tritium Removal Facility on the adjacent Darlington site. Tritium will be available to ITER in sufficient quantities for its needs over its planned life-cycle. Furthermore, tritium can be transported to the ITER site without crossing any public access property, hence without requiring extensive permitting and regulation.

Canada has a long history of licensing nuclear facilities and the recent revision of the nuclear control act specifically addresses fusion facilities. A productive dialogue has been established with the nuclear regulator. Further, the regulator has determined that a limited environmental assessment study will be adequate to support the license. A licensing "road map" has been developed that is compatible with the ITER schedule.

The St Mary's Cement Plant dock has been used in the past to offload heavy equipment of the magnitude of those planned for ITER. This docking facility is now undergoing an expansion. The dock will be connected to the site by a heavy-haul road to allow for easy transfer of material onto the ITER site. Further, the existing rail spur at St Mary's Cement Plant is available to handle rail-shipped equipment. These access points can be seen in figure 3, and are subject to an agreement with St Mary's Cement Plant.

The community immediately around the ITER site shows unanimous support for the facility, and is receptive to those coming to work at ITER. The local community provides a wide range of life-style options, from urban to suburban to rural. The local community is adjacent to the Greater Toronto Area (GTA), which is the sixth largest metropolitan area in North America with all the attendant cultural and life-style advantages of a large community, served by extensive public transportation systems that extend into the area of the ITER facility. The GTA's Pearson airport is an international air transportation center with direct flights available to all major cities in the world, and served by many international air lines. This airport is within an hour's drive west of the proposed ITER site.

Canada, a member of the G-8 and of OECD, is a technologically advanced country and has had significant background in fusion technology research, especially in the area of tritium extraction and purification, as well as in small tokamak physics studies. Canada has developed and sustains an independent nuclear power system, CANDU, and participates in space research programs, especially with the development of remote handling systems and robotics for such applications as the space shuttles and the International Space Station.

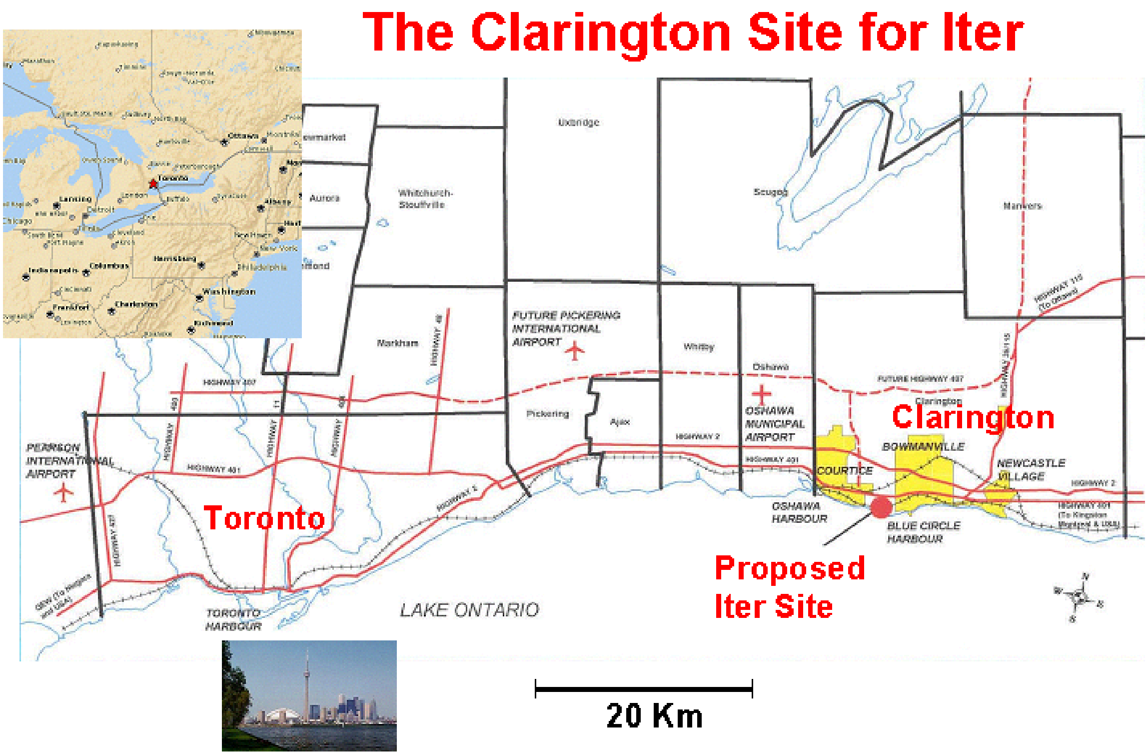

Figure 1: Location of the Iter facility in Southern Ontario

Figure 2: Aerial photo of the proposed Iter site between St. Mary's Cement Plant and Darlington Nuclear Generating Station (Darlington perspective)

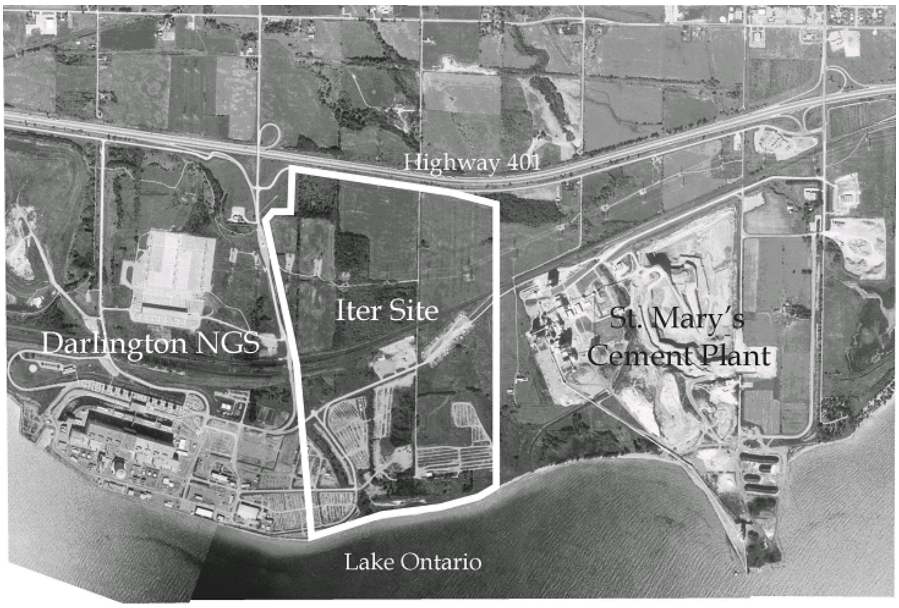

Figure 3: Aerial view of proposed Iter site

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 proposed Clarington ITER site is located on the shore of Lake Ontario, approximately 60 km east of Toronto, Ontario. The site is bounded by Lake Ontario to the south, Darlington Nuclear Generating Station to the west, MacDonald-Cartier Freeway (Highway 401) on the north, and St. Mary's Cement Plant (formally Blue Circle Cement Plant) to the east. The entire proposed ITER site is approximately 180 hectares and is divided into northern and southern halves by an easement for the Canadian National Railway. The southern portion of the site is approximately 90 hectares and currently about 25 hectares have been set aside for the ITER secured perimeter.

The current landowner is Ontario Power Generation (OPG), the regional power generator. Ontario Power Generation has committed to transfer ownership of the proposed ITER site over to the ITER Legal Entity. The land was previously designated for construction of a second nuclear power plant by OPG.

Both options of ownership or lease of land by the ILE appear possible also from the licensing standpoint and the actual arrangement may be decided on a later stage in consideration of taxation, decommissioning, etc. In both cases the ownership after the de-activation phase would go back to the Host.

The ITER layout proposed for the Clarington site presents very little changes from the original generic layout developed by ITER.

The requirements on land for siting ITER have been all satisfied by the Clarington site.

Land availability exceeds what is strictly required by the project such to allow flexibility in the site layout and expansions. The non-specific buildings and services (i.e. visitor centre, medical services, cafeteria, fire fighting, water storage tanks, etc.) can be easily accommodated in the available land or be shared with the adjacent OPG facility.

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, comprising data from more than 80 boreholes over the entire site.

The north shore of Lake Ontario is formed by a relatively flat terrace situated 9m above Lake Ontario and extending about 600m north from the shoreline. The foundation conditions in the area proposed for ITER consist of thick layers of dense glacial soils (till) overlying bedrock layers. The bedrock is dominated by hard durable limestone with about 2m of shaly limestone bedrock overtop. The hard, durable limestone level is relatively flat (~5m/km slope), and is found at an approximate depth of 25m below the existing ground surface. It is sound, strong, and possesses good rock mass qualities. The joint spacing is generally wide and joints are normally tight.

The load bearing capacity of the glacial till is fairly consistent over its vertical range, and is about 40 tons/m^2. The load bearing capacity of the bedrock is at least 250 tons/m^2.

The site conditions at Clarington fulfill all geotechnical requirements set out by ITER for foundations of structures.

It is understood that no change to the embedment of the Tokamak building would be required for the Clarington 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-mineralized 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

Clarington municipal water supply services are sufficient to meet the plant requirements. The water is supplied to the site by pipeline in an existing access corridor. The system was utilized during the construction of Darlington Nuclear Power Plant, and continues to supply the Darlington plant with potable quality water for personnel and industrial use. The existing main has a branch connection supplying the Darlington Nuclear plant, and an additional branch dedicated solely to ITER will be constructed from this existing main. This new branch will be approximately 0.5 km long.

The average capacity of 0.2 m^3/min (200 m^3/day average) required by ITER can be supplied by the existing water treatment plant and pipeline, which is also capable of supplying potable water for 3,000 persons during the construction phase.

To meet peak demands, estimated as 3 m^3/min, one or more storage tanks will be provided for situations such as fire fighting and other extreme conditions. The estimated specific cost for a water storage tank to satisfy the need to deliver peak water demands for situations such as fire fighting and other extreme conditions is $480,000.[1]

[1] A number of requests for additional information in the Clarington JASS Ad-Hoc Group Meeting Findings (Version 4.1) were to evaluate the cost impact of technical alternatives chosen by Canada. This applies to both the non-common scope of supply and the host supplied on-site and off-site infrastructure. When requested, these cost estimates are provided in the appropriate section in this report, with additional back-up information available in the CA Addendum. Furthermore, unless identified as *incremental*, Canada has confirmed that all of these costs are within the estimates that were utilized in the preparation of the Canadian Offer of June 7, 2001, and hence are fully provided for in the current Canadian Offer to Host ITER.

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

It is planned to connect ITER to the existing Clarington municipal sanitary sewage system for sanitary waste disposal. This is the same system currently employed for Darlington Nuclear plant. It is also planned to dispose of ITER industrial sewage via the municipal sewage systems.

The cooling tower blowdown, which contains different contaminants and is much larger in quantity, will be collected, tested and treated as necessary before discharging to Lake Ontario through a purpose-built pipeline with dispersion terminals away from the shore and deep in the lake. The estimated cost for a cooling tower blowdown pipeline with dispersion terminals away from the shore is estimated to be $520,000.

A new sewage treatment plant is to be made available in 2006 and it would accept ITER sanitary sewage. ITER may require the construction of a pumping station and 3.5 km pipeline to deliver its sanitary sewage for treatment. The cost of a pumping station and a 3.5 km long pipeline to deliver sanitary and industrial sewage to the Municipal Sewage treatment plant is estimated at $2,000,000.

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

The Darlington Nuclear Generating Station rejects waste heat directly to Lake Ontario via once-through condenser cooling. Under existing licenses and restrictions, Darlington can take additional water from Lake Ontario. Ontario Power Generation, the operator of Darlington Nuclear Generating Station, has agreed to supply makeup water to ITER. This water will be taken from the generating station forebay.

In Clarington, the ITER heat rejection requirements will be met by the installation of mechanical draft cooling towers. The use of plume abated towers is very rarely mandated and they will likely not be required or used at the Clarington site. However, the possibility does exist and as such the estimated incremental cost for plume abatement is provided. The estimated *incremental* cost for cooling tower plume abatement is $4,500,000 to $6,000,000. The range results from the various options for optimizing the cooling system design to suit plume abatement.
Cooling towers have been shown to represent, for the ITER conditions, a cheaper solution than a once through system using lake water.

The supply of raw water from Ontario Power Generation will require a water-taking permit from the province, as ITER will be taking water directly from the power plant forebay. This is regulated under the Ontario Water Resources Act, which manages water taking to ensure that the resource is not overexploited, especially during drought conditions. The application for a water-taking permit can be submitted to the province upon approval of the environmental assessment, and the permit will be available within 3 months thereafter.

The cooling tower blowdown will also require an approval under the Ontario Water Resources Act. The application for the wastewater permit will need to demonstrate that the discharge meets the provincial water quality standards. This blowdown will be included with storm water runoff in a single wastewater permit for the discharges to Lake Ontario (excluding the discharges to municipal sewer systems). All of the supporting studies for the approvals under the Ontario Water Resources Act will be completed during the environmental assessment and will be reviewed by the province as part of the agency consultation process. The provincial permits can be obtained within approximately 3 months of completion and approval of the environmental assessment.

The blowdown from ITER will require the construction of a new discharge into the lake as described in 1.1.A.4.

The requirements on heat sink can be satisfied for the Clarington site.

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

The Clarington ITER site is directly adjacent to a major node on the Ontario 500kV electrical grid (with about 30 GW generating power).

The proposed option is to have two parallel, single-circuit 500kV lines connected directly to the adjacent 500kV Bowmanville switching station. This switching station, located 900m from the ITER plant is a totally enclosed SF6 Gas Insulated Switchgear System. These lines will meet both ITER pulsed power and steady state electrical requirements.

The existing 500kV switching station at the Darlington site will require expansion. At ITER site substations, a step-down transformer would be required to convert the 500kV to 6.9kV.

The site can be made compatible with the ITER requirements.

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.

The Clarington site is accessible by road, railroad, ocean going ships and barges.

By rail, the main Toronto-Montreal Canadian National Railway line traverses the 184 Ha site in the middle in the east-west direction. A spur line off the main line of the CNR can be used for off-loading objects transported by rail to about 900m of the Tokamak building.

By water, the site is bounded on the south side by Lake Ontario. Lake Ontario is accessible for nine months of the year (April – December) from the Atlantic Ocean through the St. Lawrence River to Montreal, and then via the St. Lawrence Seaway to the lake. The St. Lawrence Seaway can accommodate ocean-going ships up to 220m length, 23m wide and drawing 8m or less. For the Great Lakes, there are heavy deck barges of 23m width and with capacities of up to 6000 tonnes. On Lake Ontario itself, there are barges up to 30m wide.

St. Mary's Cement Plant, next to the ITER proposed site, has an existing dock suitable for ocean-going ships or barges. These facilities were used during construction of the Darlington Nuclear Station for off-loading of large, heavy components. The distance from this dock to the ITER heavy equipment lay-down area and Tokamak hall is approximately 2 km. There are also nearby port facilities for ocean-going ships at Oshawa (approximately 20km away) and Port Hope (approximately 30km away), for shipments that can be then transported by road and/or rail to site.

The highway access is via a multi-lane limited access freeway (Ontario Highway 401), which connects to all major highways and freeways in and around the greater Toronto area. For this mode of transportation, objects greater than 4m in height or width will require oversize permits, and special precautions will be also required for objects taller than 5m.

There are some modifications presented by the proponent to be required to the existing Clarington site to accommodate ITER. These include:

- New bridge over the Canadian National Railway line
- Permanent roadways and parking facilities outside the ITER security fence.
- New Site Access Road and Modifications to the highway interchange.
- Refurbishment of the OPG rail siding facilities.
- Construction, expansion and reinforcement of roadways from the ITER site to the shipping facilities.
- Possible refurbishment of St. Mary's dock facilities.

A justification and cost evaluation of each of the above modifications has been provided. In addition the transport solution has been evaluated in full and is included in an Appendix to the CA Addendum information.

Generally the Clarington site appears to meet all the site requirements on transport and shipping allowing for a certain flexibility in the methodology of transport including the possibility to receive the largest PF coils.

The time availability of the St Mary's docks has been clarified to show that there is more than sufficient time available for the ITER requirements (see CA Addendum).

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

It appears that the specified weights can be handled by the St. Mary's Cement Plant dock provided that structural modifications of the dock, taking into account off-loading methods, and the roadways from the dock to the ITER site are put into place. These modifications and procedures are fully described in the CA Addendum.

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.

Canada has extensive experience in the transportation of elemental tritium, tritiated heavy water, and tritium contaminated materials. Tritium for ITER will be entirely available at the nearby Darlington station Tritium Removal Facility (TRF).

Since the ITER facility will be located adjacent to the Darlington site, there will not be any need for the tritium to be "shipped" along public roads. The regulations on transportation allow for the Conditional Transfer of tritium from the TRF directly to the ITER facility without applying the prescribed regulations, as long as it can be shown that equivalent precautions are being observed for the transfer.

The CNSC requires proponents and operators of nuclear facilities to propose decommissioning plans. A "preliminary decommissioning plan" is submitted at the time of the application for a license to construct. The decommissioning plans must be sufficiently detailed in order to enable credible estimates of the amount and availability of financial guarantees required to implement the plans.

The decommissioning plan for a nuclear facility include definitions of the various phases of the work, including any "deactivation" periods, and the end-state objectives of each phase, including any predicted requirement for long term institutional controls. The plans include the various areas, components and structures to be decommissioned, expected hazards, disposal and dismantling strategies, and environmental effects.

The CNSC needs to be satisfied that the licensee or its successor has the financial and human resources necessary to carry out its responsibilities. Measures to fund decommissioning may include: cash, letters of credit, surety bonds, insurance, and expressed commitments from a government (either federal or provincial).

The proposed Clarington site appears to fulfill all the ITER requirements pertaining to aspects related to Tritium handling and transport and acceptance of activated material arising from operation and decommissioning.

See section 5 for issues regarding decommissioning costs

The aspects covering the point of "Arrangements to cover liabilities beyond the capacity of the project needs to be covered in the description" (JASS criteria point 4) has not been addressed by the proponent. These will be addressed in the "Agreement on the Establishment of the International Fusion Energy Organization for the Joint Implementation of the ITER Project".

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

Detailed information regarding the topography of the site is available. The northern half of the site generally drains west to east with a maximum relief of 25m. This flows continues until it is intercepted on the St Mary's property by a creek (Darlington Creek) that flows south in Lake Ontario. More specifically, the northeast portion of the site flows to the northeast and then south to Lake Ontario through a ravine that connects to the creek. The southern half of the site below the CNR tracks generally drains north to south with a maximum relief of 15m to the southwest and 10m to the northeast. A ridge in the westerly 1/3 of property acts as a divide on the property. The southwestern portion of this site drains to the southwest then south over the shoreline escarpment, which is another 15-20m drop.

Several site grading options were evaluated for the site. General design constraints were:

Minimize total drop across the site to less than 5m
Grade from north to south
Maximum grade of 0.5%
Parking lot grades of 1-2%
Ditch grades up to 0.5%
Minimizing costs
Maximizing site development ease
Storm drainage to flow to southwest corner

Excavation volumes ranged from 2,627,000 m^3 to 610,000 m^3. Fill volumes ranged from 22,400m^3 to 706,000 m^3. The final design option chosen will be one that achieves the highest score for site use and cost effectiveness.

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

The foundation conditions in the area proposed for ITER consist of thick layers of dense glacial soils (till) overlying bedrock layers. The bedrock is mostly hard durable limestone with about 2m of shaly limestone bedrock overtop. The hard, durable limestone level is relatively flat (~5m/km slope), and is found at an approximate depth of 25m below the existing ground surface.

The proposed site is therefore compatible with this ITER design assumption.

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

Two groundwater regimes are identified at this site. One regime is located within the overburden soils and another is situated in the uppermost zone of limestone bedrock. At the ITER site, the groundwater table is located about 2m below the existing ground and for this reason groundwater management is necessary during construction and operation.

Groundwater control during construction at the ITER Site will be managed using conventional, cost effective measures. This has been demonstrated in the construction of the adjacent Darlington NGS.

The long term management of groundwater will also be conventional.

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 Clarington site has no history of seismic activity.

The details of the seismic conditions for the Clarington site have been re-examined and are provided in the CA Addendum - Appendix 2, *"Site Specific DBE"*, November, 2002. It shows that the SL-2 earthquake at the site, with a return period of 10,000 years, would have a peak acceleration of 0.09 g.

It therefore appears that the design assumptions of ITER are satisfied with margin by the Clarington proposed site.

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.

The meteorology of the Clarington site is well characterized by four distinct seasons, a variety of precipitation types, and the influence of the Great Lakes.

The primary concerns with respect to climate are temperature, precipitation and wind velocity. The mean daily temperatures for the region range from approximately –6.3C in January to 19.8C in July. The average daily maximums and minimums approach 25.5C in the summer and –10.7C in the winter. The highest temperature ever recorded was 36.0C. It should be noted that Lake Ontario will moderate the local temperature variation at the ITER site relative to locations further inland. Precipitation occurs quite uniformly during the year. Total annual precipitation averages 860mm, of which less than 15% occurs as snow. Precipitation occurs on approximately 140 days of the year, with a maximum daily average rainfall of 90.5mm and a maximum daily average snowfall of 30.0cm. The dominant wind pattern is from the west. Locally, the general wind pattern is modified by lake effect breeze, onshore during the morning and offshore in the evening. Onshore winds are more frequent. Average wind speeds from the predominant wind direction ranged from 15-23 km/hr. The average annual frequency of tornadoes is ranging from 0.8 to 1.2 tornadoes per 10,000 square kilometres.

The table below compares ITER design assumptions with conditions at Clarington. Some of the design assumptions, such as the max. snow load, are exceeded but their impact on the design is considered rather small.

Meteorological Parameter	ITER	*Clarington*
Maximum Steady Wind Speed, km/hr	140	105
Maximum Air Temperature, degrees C	35	36.0
Maximum Air Temperature, 24 hr average, degrees C	30	19.8
Minimum Air Temperature, degrees C	-25	-34.5
Minimum Air Temperature, 24 hr average, degrees C	-25	-6.3
Maximum Relative Humidity, 24 hr average, percent	95	95
Maximum Relative Humidity, 30 day average, percent	90	90
Elevation above sea level, m	<500	75
Maximum Snow Load, kg/m^2	150	214
Maximum Icing, mm	10	15
Maximum Rainfall, 24 hrs, cm	20	14.5
Maximum Rainfall, 1 hr, cm	5	5*
Worst Case Air Pollution (IEC 71-2), Level	3	3

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.

See also section 1.1.B

Preliminary sizing indicates that four mechanical draft cooling towers are adequate to meet ITER requirements, with a total capacity of 500 MW. The total area required by the towers is estimated to be 18m x 66m, including a 5m deep concrete basin located beneath the towers, with a capacity of 6200 m^3. Cooling water would be gravity fed from the cold basin, through a 2m diameter pipe to the system pumps and heat exchangers.

The best option available to discharge the blowdown water is direct discharge to the lake.

Once through cooling was also considered as an option having the advantage of providing lower temperature cooling water (17C lower than the cooling tower option), which could reduce the size and cost of ITER heat exchangers. A disadvantage of this option is that it requires a larger intake pipeline from the Darlington NGS forebay. Once through cooling would also require a new out flow system into Lake Ontario, which would require additional environmental permitting and could prove to be very costly. Therefore, this is not the preferred option.

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

Data obtained from Hydro One, the Ontario electricity transmission company, confirms that the 500kV system reliability satisfies the reliability criteria stipulated by ITER. There has been no unscheduled line outage during the past ten years on any one of the four 500kV circuits between the Bowmanville TS 500kV and Cherrywood TS 500kV facilities.

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

Two parallel, single-circuit 500kV lines will be connected to the ITER pulse substation directly from the Bowmanville TS 500kV switching station, located 900m from the ITER plant.

The connections would be made such that either line can be removed from service for maintenance or repairs without imposing restrictions to ITER plant operation.

The ITER site is directly adjacent to a major node on the Ontario electrical grid, which appears to be able to satisfy all ITER plant electrical needs, irrespective of the status of the Darlington generating units.

Preliminary modeling of the interaction between ITER electrical loads and the Ontario power grid has been performed. Pulse power loads were modeled under these varying conditions:

- A step active power loading 0 to 500 MW and a step reactive power loading of 0 to 240 MVAr and 0 to

800 MVAr; and

- A less severe active power loading of 0 to 500 MW in 3s (in steps of 60 MW and 100 MW) and a reactive power loading of 800 MVAr in 3s (in steps of 80 MVAr and 200 MVAr).

The study shows that even under the rather extreme condition (not required by ITER operation) of a step of active power of 500MW, acceptable frequency and voltage deviations were obtained when compared with those specified by the Independent Market Operator (IMO), the body that regulates the Ontario power system.

Discussions between Iter Canada and Ontario Power Generation confirm that the generators at Darlington are not governed primarily by demand, but by supply, and hence they are isolated to a large extent from the power surges imposed by ITER. Therefore, there is no anticipated fatigue torsional stress problems with respect to the Darlington generators. During the implementation phase of ITER, Ontario Power Generation will conduct a more comprehensive study based on the final design and experimental program for ITER, and if there are any changes to the torsional impacts, the appropriate remedial action will be implemented.

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

The Clarington site has no special requirements with regard to external hazards, except because the proposed site is adjacent to the nuclear generating station. Because of this, the local area will be subject to emergency evacuation but will benefit from increased security, including the diversion of local air and boat traffic.

Man-made hazards, such as transportation of hazardous material via the CNR line or via Lake Ontario were examined as part of the licensing process for Darlington Nuclear Generating Station. Rail hazards were addressed by the establishment of an earthen berm between the CNR line and Darlington Nuclear Plant. Excavation spoils from ITER will also be used for a similar purpose to extend the existing berm on the ITER site and provide an identical level of protection. Highway or lake transportation hazards are sufficiently distant from the ITER buildings to minimize the need for any active mitigation.

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.

Extreme weather conditions such as high winds and tornadoes have been examined. Tornadoes have been observed at the Darlington site but are quite rare and not powerful.
Many of these weather conditions were used to establish the design conditions for the Darlington Nuclear Generating Station. A similar design basis can also be applied to the ITER design. Generally, these conditions are not more severe than ITER assumptions.

No mechanism has been identified which could lead to a flooding event at the site.

There is no history of land slides in the area. To counter possible effects of erosion over time, the site design and layout has also taken into consideration the 100-year shore erosion limit (the Regulatory Shoreline).

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.

The Greater Toronto Area has availability of residential, commercial, industrial, social and recreational facilities. Major employment areas include finance, manufacturing of transportation equipment, primary metals and metal fabricating, printing and publishing, retail trade and rubber and plastics manufacturing. The Durham Region, with multiple internet service and telecommunications providers has provided the ability to fulfill all ITER needs in high speed data connections.

Overall the region appears to satisfy the needs of ITER with a robust industrial infrastructure including scientific and engineering resources, manufacturing and materials construction, radioactive and non-radioactive analysis, hazardous waste handling and disposal, as well as research institutions.

Canada has had significant R&D programs in many areas, including nuclear energy, primarily fission. Canada had developed and sustains an independent nuclear power system, CANDU, through extensive R&D facilities in Chalk River, Ontario. Canada's fusion technology research program is limited, and had been largely focused in the area of Tritium extraction and purification, as well as small tokamak physics. There are also additional R&D programs in plasma physics, aerospace studies, robotics, high energy physics, and information technology.

Public support for the ITER project has shown to be strong in the area, which seems favorably disposed towards nuclear energy in general.

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

Operation support and skilled personnel needed for ITER are readily available from the labor force currently present in Clarington and the neighboring communities

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 (Decommissioning 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 (Decommissioning 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

The consortium that is being proposed to undertake the execution of the Canadian contributions to the ITER facilities has already demonstrated sufficient experience and competence in similar size projects.

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.

1) Road transport

The JASS Ad-hoc Group was given the opportunity to visit the proposed site, located approximately 60 km east of downtown Toronto, and to check evidences regarding access and transport.

The proposed site is accessible by highways 401 and 407 running parallel to the lake north bank, which connect to Pearson International Airport. Highway 407 is being extended through the region of Durham and the municipality of Clarington (completion planned end of 2005), connecting with highway 35/115 which runs to the northeast towards Ottawa.

The exit provides direct access from highway 401 to the site. Two municipal roads link the municipality of Clarington to the site.

Major centers of the Greater Toronto Area (GTA) are accessible within 1 hour by car.

2) Air Transport

The nearest international airport is Pearson International (north-west of Toronto) accessible by highway 401 within 1 hour by car. It has international connections with many major cities all over the world by major international airlines. It is expected that a second international airport will be opened at Pickering (about 30 min.) within the next 10 years.

3) Rail and Waterway Transport

A complex local and national railway network is accessible. The commuter system that currently ends in Oshawa will be extended to Bowmanville with a possibility of including a station just north of the ITER site. As to the delivery of equipment by railway, the existing rail spur at the Saint Mary`s Cement Plant is available subject to formal agreement with that company.

The proposed site is connected to the Atlantic Ocean via the St. Lawrence seaway. Docking facilities exists at the neighboring St. Mary`s Cement Plant, which is favorable for their use during ITER construction as stressed in the Minutes of a recent meeting between representatives from ITER Canada and St Mary`s Plant. These docking facilities are currently being upgraded significantly. They could provide a direct entry point to the ITER site (distance: 1.75 km), see section 1.1 D above.

There are other nearby port facilities within 20-30 km. No transport restrictions should arise for large/heavy components.

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

1) Living Environment

The Ad-hoc group was given the opportunity to tour Toronto`s as well as Clarington`s surroundings and to meet local representatives and personalities. This visit was introduced by a 1 hour presentation by the President of the GTA Marketing Alliance.

2) Education

A thorough presentation was given of the Canadian education system from junior Kindergarten level to College/University level.
There is a range of specific international education available to the children of ITER families in the various locations in which they might choose to live. No specific plan was given regarding the possible establishment of an International School that would be mostly dedicated to ITER family needs. It was however stressed that efforts would be made to meet the special needs of children of the ITER families. Special emphasis has been placed on the children’s transition from the school system in their home country to a system in Canada and back again.

Emphasis was put on the International Baccalaureate Program (IB), intended to provide advanced placement in Universities worldwide. The IB is available as part of the publicly funded system. In Clarington itself, there are new schools under construction and the Board of Education will establish an IB program if the need is identified.

Universities and Colleges offer instruction over a wide range of disciplines. With respect to access to Universities by incoming students having a national baccalaureate or equivalent level, it was stressed that each University has its own admission criteria. Therefore each application will be treated on an individual basis and contacts should be taken sufficiently early in time with respect to University admission timetables.

In his presentation of the recently created University of Ontario Institute of Technology (OIT), the President of OIT explained that classes are planned to start in 2003, with the University planning to grow to accommodate 55,000 students in the future. He also spoke of his aspirations to have a close relationship with ITER. For example, ITER staff taking part time teaching posts at the University. Also the University may adapt certain of its courses to provide trained personnel for ITER. The University will be a professional school with 90% of its programs in energy, engineering and sciences. There will be an Alternative Energy Centre of Excellence specializing in research into sources such as fusion.

3) Hospitals and Clinics

With the exception of dental coverage, free medical care is provided to all Canadians citizens and residents with special privileges. It was clarified that ITER staff and relatives would enjoy an equivalent status, to be defined in the agreement that would be concluded on privileges and immunities.

Following this agreement (that should involve Ontario`s authorities) it is proposed that the individuals would not be called to contribute to fund the Ontario Health Insurance Plan. In this respect, the situation of ILE remains to be defined.

There is a high concentration of major medical facilities in the Greater Toronto Area, which includes the Durham region. The number of doctors per inhabitant is about 1 per 400 inhabitants for the Toronto city and about 1 per 1,000 in the Durham region. There are a number of medical facilities in the area surrounding the Clarington site that provide a full range of services including emergency services.

4) International Cultural Environment in Neighboring Cities

Clarington is the nearest municipality community with a population of about 71,500, expected to double in the coming 20 years. It is located in the Durham region, with a population of about 500,000.

Much of the social infrastructure (schools, hospitals, houses) has been established in the recent years and is therefore equipped to modern standards.

The GTA is Canada largest metropolitan area and the sixth largest in North America with a population of about 5.3 million. It is characterized by a large ethnic diversity. A variety of worship options are available. In Clarington itself, for example, 17 different faiths have established facilities and services.

Toronto has many fine restaurants, shopping areas, parks, recreation and sports facilities, professional sports teams and cultural attractions including live theatres, opera, the symphony, pop concerts, lectures, museums, as well as the acclaimed Toronto International Film Festival.

As to job opportunities for spouses of ITER staff, current employment conditions in the Toronto area are good (diversified, growing opportunities). The municipality of Clarington, through partnership with the Durham region and the Clarington and Durham Business Communities, would create a specific Employment Center to identify employment opportunities for ITER spouses. Evidences provided include a letter from the senior representative of Human Resources Development of Canada, supporting the initiative. Quantitative information was given on job market, job growth, and the strength of the economy.

It shall also be said that in order to favor the process of helping incoming families to settle, a Centre for ITER Family Services would be set-up (a local community initiative) offering continuous services beginning before ITER families arrive and lasting after they have returned to their home country to ensure a smooth transition.

A variety of life style options exists encompassing urban, sub-urban or country environment. A wide range of dwelling options is available, including single detached, semi-detached, or row houses, as well as apartments at reasonable economic conditions. Data were provided on prices in the Clarington municipality, which indicated very good value for money.

A factor that may influence decision by ITER staff on their place of living is children's education. Access to international schooling is better close to Toronto. In this case staff would be faced with a much longer daily commuting time to the site and much higher house prices. Conversely living in the Durham region offers quick access to the site and relatively cheap accommodation but less attractive international education environment.

It is noted that the new Clarington fire station has been located to give a rapid response (within 6 minutes) to incidents at the Darlington Nuclear Generating Station. This could remove the need for ITER to have its own Fire Station facility on site.

Climatic conditions do not present any notable adverse characteristics to living in the area.

As to safety and security, it was emphasized that Toronto is rated as one of the safest cities in the world.

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 nuclear regulatory framework is well defined in Canada and ITER is regulated as a Class-1 nuclear facility under the Nuclear Safety and Control Act (NSCA). The Canadian licensing process for ITER requires a formal environmental assessment (screening level only) under the Canadian Environmental Assessment Act (CEAA). These two parallel legal procedures are administered by the Canadian Nuclear Safety Commission (CNSC).

It is noted that the regulatory process is non-prescriptive and that the CNSC board grants licenses based on presentation of proponent submission by members of the CNSC staff, according to their own analysis of the proposals and consideration of comments by the public. Further, the Commission hearing, open to the public, is the last technical appeal to challenge the licensing decision.

(2) Safety design approach/guideline

The CNSC sets high-level requirements to meet the safety objective of "no unreasonable risk". The proponent develops the safety design approach and technical implementation along with the requirements through dialogue with the CNSC staff.

At this time, a non-profit organization has been established in Canada (The Iter Institute) as the surrogate for the non-existing ILE, to carry on this dialogue with the CNSC staff. The Iter Institute acts in technical matter in agreement with International Team, as design authority representative of the future ILE.

The CNSC approach is risk-based but does not require probabilistic safety analysis. ITER safety criteria would be similar to those established for small reactors. The CNSC would accept the FDR safety design approach. The dose limit at an appropriate site boundary is defined by the law, from which results the maximum site radioactive release. The administrative release limit will be a fraction of this maximum and will be proposed by the proponent to be agreed by the CNSC. The tritiated liquid release limit to the lake at Clarington is orders of magnitude above the limits in some other locations.

(3) Steps of licensing procedures

The licensing steps are for site preparation (not required for the Clarington site), construction, operation, decommissioning and site abandonment. The construction license requires safety report to verify conformity of the facility design to the safety requirements. The operating license requires the updated safety report including final design data, safety analyses and results of commissioning tests. The CNSC should agree on the operational procedures and the organization put in place to run the facility.

The screening level environmental assessment studies are in progress and will be submitted to the CNSC staff for review. Then, the CNSC staff will present their review to the Commission for its decision.

(4) Road map

It is noted that the construction license will be granted through the Commission hearing only to the ILE after its formal establishment. The formal licensing process which is expected to last 18 months, will start after the nomination of the Director General and definition of the future organization during the envisaged Transitional Activities.

(5) Design standards and QA
Canada for its nuclear program has established its own code and standards, but it is matter of agreement between the proponent and the CNSC to agree the codes and standards to be used to guarantee the ITER safety. The Iter Institute will propose technical standards for ITER based on the FDR design and technology. In Canada, ASME can be accepted as the basis of the agreement with the CNSC. A Canadian code expert suggested that the level of reliability to be attained for ITER would be equivalent to ASME SC. VIII or SC. III ND. The Iter Institute, in an agreement with the International Team, would propose a QA program based on ISO-9000-2000 and IAEA 50-C/SG-Q. The CNSC should approve its safety-related portions. The components fabricated outside Canada could be inspected, when needed, by inspection authorities of the country of fabrication, according to an approved quality program.

(6) Restriction on long lead procurement, site preparation and financing activities
For the safety-related components, procurements in advance of construction license require CNSC approval. In Canada, the definition of safety-related components would be referred to the FDR design.

(7) Proponent's commentary on obtaining a nuclear construction, operation and decommissioning
The Iter Institute has already started the formal licensing procedures in matter of environmental assessment and dialogue with the CNSC staff.

(8) Regulations and experiences on decommissioning and rad-waste disposal and scope of the final disposal of ITER rad-waste.
The ITER radioactive waste would be managed as "Low-Level" waste according to the Nuclear Safety and Control Act (NSCA). The radioactive waste should be collected, segregated, packaged and transported to a CNSC licensed disposal facility. Chalk River operated disposal could be the candidate.

(9) The ad-hoc group noted that there are no specific issues in Canada related to the storage of Beryllium and Tritium contaminated radioactive waste.

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.

The ad-hoc group noted that the Host / ILE relationship will be dealt with in Canada according to the Joint Implementation Agreement (JIA) (when defined), and cannot be discussed in depth in the JASS process at this time. Until the JIA is defined, there are no specific requirements to be met, but the approach taken appears to be satisfactory.

The ad-hoc group noted that the proponent submission attempted to cover the following areas, as defined in the JASS assumptions:

Special conditions of the Site Offer - There are presently no known special conditions, or restrictions.

Public and Community Support - The community immediately around ITER site shows unanimous support for the facility and is receptive to those coming to work at ITER. The ITER Community Council, already established, will provide on-going support and liaison between the local community, the local government agencies, and the ITER project. See also section 2.

Securities –The site area is served by an extensive and effective set of emergency response services, including police, fire-fighting, and ambulance services. See also section 2.

Responsibilities of the Host in Water Supply, Electricity Supply, and Maintenance of the Roads. It is noted from the submission, in section 1.0, that adequate resources will be made available.

Use of Existing Facilities – There are no on-site existing facilities. Regional facilities, such as libraries, universities and colleges, recreational facilities, etc., will be made available to the staff and families of ITER.

On the specific issue of library facilities, the University of Ontario Institute of Technology has offered to establish a satellite facility for provision of library services at the ITER site. As well, located a few kilometers from the Clarington site, the UOIT library would be available for use by ITER staff. The region surrounding the Clarington site also has a large number of university reference libraries for which arrangements would be made for access by ITER staff, and public reference libraries that would be automatically available. The University of Toronto's Library system with its more than 40 libraries and research centers is one of the most comprehensive libraries in North America.

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.

Documentation in this area from the Canadian submission is for the time being limited to the site specific JASS criteria and does not include information more broadly related to Canada's participation to the ITER implementation, which should in the Canadian views be discussed under the Negotiation process.

Permanent personnel costs

a) The ITER Final Design Report has given an estimate of the number of permanent personnel running the facility excluding services contracted for permanent auxiliary support (Host Support?) or for maintenance. In the FDR, global numbers were about 200 Professionals and 400 Technicians for an annual evaluated cost of 150 IUA and 75 IUA respectively per person of each category.

b) The Canadian submission has mentioned as example the fully burdened annual salaries in 2002 for 2070 hours/year of technical support personnel at the Darlington Nuclear Generating Station (high level managers excluded). These salaries are (details are provided in the CA Addendum):

Supervisor	~ 105-120 kCAN$
Engineer	~ 60-100 kCAN$
Control Technician	~ 90-110 kCAN$
Security Officer	~ 70-80 kCAN$
Assistant	~ 55-70 kCAN$

c) The Trades Staff rates have also been given. The base rate is ~CA $25-33 / hour, with a fully burdened rate of ~CA $55-70 / hour. Details are provided in the CA Addendum.

Electricity costs

Discussions with Ontario Power Generation indicated that the following charges would represent a good approximation of current market rates (Nov 2002):

- energy costs — CA $ 0.043 per kWhr
- distribution costs — none (ITER does its own at the site)
- debt payment — CA $ 0.007 per kWhr
- IMO system costs — CA $ 0.005 per kWhr
- IMO administration — CA $ 0.002-0.003 per kWhr
- transmission cost — none (ITER will be provided with its own transmission line)
- demand cost — none (this is tied to transmission costs, and ITER does its own)

The total cost comes to CA $ 0.058 per kWhr.

Tritium costs

The present market is small compared with the size of ITER needs which are comparable to the whole Canadian production.
Present market value (for grams) is about CAN$ 33M/Kg while the Final Design Report considered value is 10kIUA/Kg, which is approximately half of this "market" value.

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)

a) In Canada there's not formal distinction of waste categories according to their activity level; however waste management procedures and acceptance criteria for storage will depend on this activity level, and the regulators will review their safety suitability.

b) Clearance and unrestricted release for disposal or recycling of very low activity items may be permitted on a case-by-case basis by the regulators. Radioactive waste shall be packaged and transported to a licensed disposal facility for long term storage

c) The dismantling strategy envisaged in the Canadian proposal follows the one proposed in the FDR with a 23 years delay for activity decrease between the two dismantling phases.

d) The Canadian costs for decommissioning have been studied (See Appendix 4, *Clarington Site Decommissioning Costs, December*, 2002 – to follow). This information has been forwarded to the International Team for review at the planned joint meeting on decommissioning scheduled for January 23, 2003 in St. Petersburg.

   Significant changes in the study allowed for calculation of long term storage costs as well as capital costs and operational storage costs. Further, a review of the cost-benefit of decay time and operating vs storage costs resulted in the choice of a decay period of 23 years. The summary of that document shows the following:

Phase	**Estimated cost CAD$**	**Per cent of total**
Decay Period	To follow	
Dismantling	To follow	
Total	To follow	

   The table above does not include any preliminary decommissioning activities to be performed during the operations phase or any activities during the de-activation phase as they will be included in the Organization costs.