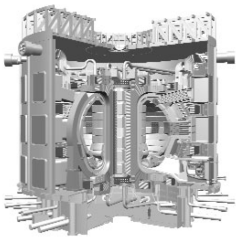

ITER ITA NEWSLETTER

No. 13, FEBRUARY 2004

IAEA

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, AUSTRIA

ISSN 1727–9852

COMMON MESSAGE FROM SECOND PREPARATORY MEETING FOR MINISTERIAL MEETING FOR ITER

Delegations from China, the European Union, Japan, the Republic of Korea, the Russian Federation, and the United States of America met at the IAEA headquarters in Vienna on 21 February 2004 to advance the ITER negotiations.

The delegations recognized the intensive work done following the Ministerial Meeting for ITER that took place on 20 December 2003.

The delegations agreed to convene a meeting of experts in early March for a joint appreciation in common terms of a number of key topics *), in order to bring the further technical analysis to completion.

ITER Parties will continue their discussions, including further exploration of a broader project approach to fusion power.

All delegations reaffirmed their commitment to the consensual process towards joint implementation of ITER.

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*) Key topics: Transport; Seismicity; Licensing Issues including Codes and Standards; PF Coil Manufacture; Cost Issue; Climate; Scientific, Technological and Industrial Environment; Living Conditions; Readiness and Preparedness for Siting

PROGRESS ON BUILDING DESIGN AND SITE LAYOUT, AND PREPARATION FOR PROCUREMENT

by Dr. R. Haange, Head of Site, ITER Naka JWS

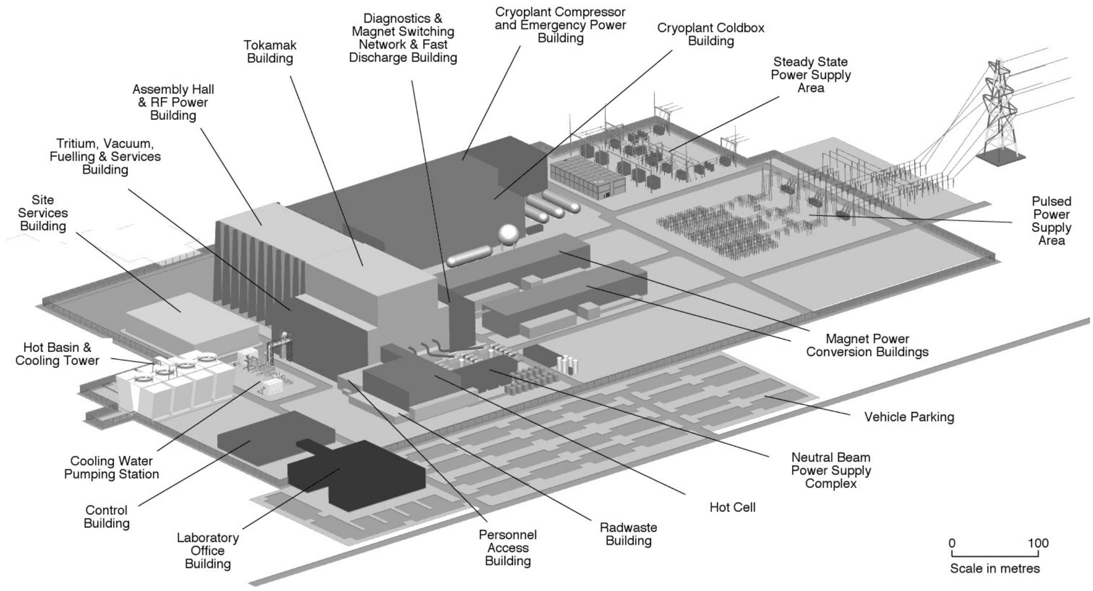
1. Introduction

The ITER site layout and buildings (figure 1) retain many of the major features worked out for the original 1998 design of ITER. By mid-2001, the design had been adjusted to take account of the reductions in size of the tokamak and in the performance and capability of its supporting plant systems, with a view to providing a building construction cost reduction near the target of 50%.

Following the Final Design Report (FDR), work has mainly concentrated on developing detailed designs of the time-critical buildings, so that procurement can be initiated as soon as the ITER site has been selected and the ITER Legal Entity (ILE) has been set up. In addition, work has been devoted to improving layout from a functional point of view, to save cost and to provide additional space for potential future upgrades.

The present status of the site layout and buildings is that, with the exception of the hot cell building, designs are available for the ITER buildings and site layout, in different degrees of detail, ready for final review as soon as the drawings and 3D models have been updated.

The overall site layout may have to be further adjusted in accordance with the characteristics of the chosen site, as the relative orientations of incoming electrical power, outgoing sewers and main site access roads may differ from those assumed for the generic site. However, the indications are that, for the potential sites, this



Latest bird's-eye view of generic site

aspect of site layout will be rather minor. Having available all building blocks for the generic site, such an adaptation will not require significant effort.

2. Optimization of Building Design and Site Layout after 2001

The ITER site layout is determined by the functions of the various plant systems provided in support of the ITER tokamak. These systems are located in different buildings on the ITER site. Changes in the plant layout inside buildings can, therefore, have an important impact on the overall site layout. The general layout of the site assumes electrical power comes in from the west, heat rejection is on the east, access into the main building for assembly is from the south, and removal of waste is from the north. These orientations are purely notional, determining only the relative positions.

As a result of increased detailing of the buildings and site layout for the procurement specification, further important modifications since the July 2001 description in the FDR have been foreseen, driven by

- improved detailing of the functional specification of the buildings and the equipment in them;
- design improvements of both buildings and equipment, with a view to obtaining increasingly realistic cost margins within the original estimates;
- design progress/evolution.

These foreseen changes are described below. The review and approval process is not complete and not all of the updated designs and layout described here may be adopted.

2.1 Combine Switching Network Building with Diagnostic Building

The switching network building has been combined with the (enlarged) diagnostic building. To enable the combination, the diagnostic building has been somewhat enlarged in footprint and two floor levels have been added. At the same time, the self-standing diagnostic building has been attached to the tokamak building, and placed on the same basemat. This gives some important improvements in terms of avoiding relative movements between the diagnostic and the tokamak buildings, and hence the diagnostic penetrations and others are easier to design and are now considered more reliable. Also, this change reduces the length of the large busbar systems and places the switching network resistors (SNR) and fast discharge units (FDU) on the same basemat as the tokamak. Moreover, the tokamak complex as a whole becomes a much more symmetric structure, as the diagnostic building on the west side more or less balances the tritium plant building on the east side, reducing torque during a seismic event. The coolant water station, originally inside the switching network building, has now been placed inside a light structure, just south of the magnet power conversion buildings.

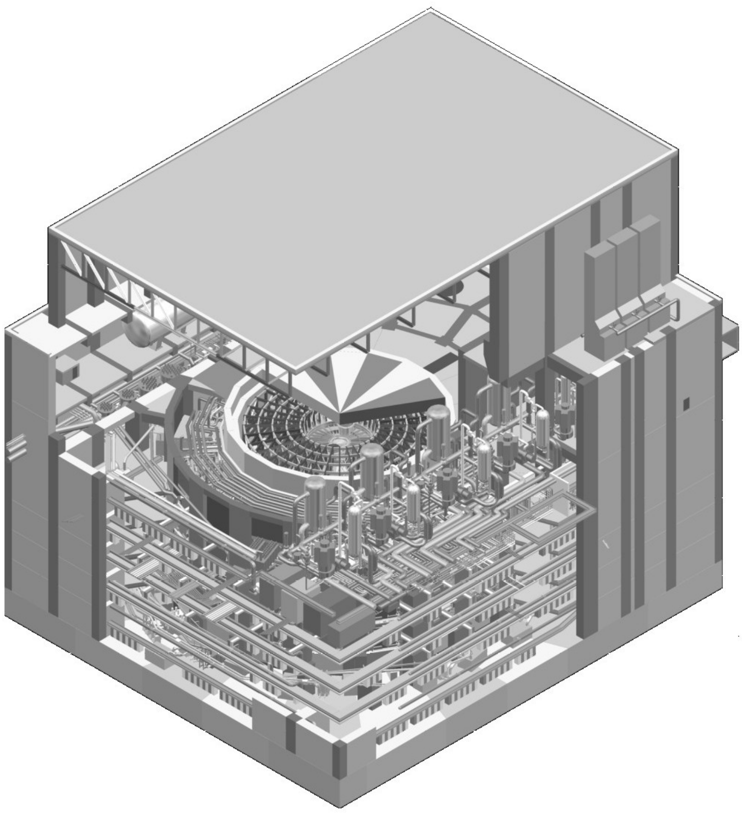
2.2 Move Location of Hot Cell Facility

In earlier layouts the hot cell (HC) facility, which includes the hot cell building with the attached radwaste and personnel access buildings, was set north of the tokamak building. The entrance from the tokamak building to the HC was through the large main lift, and the entrance corridor was along the inside of the east wall of the HC. The HC facility has now been moved as far as possible to the east, so that the entrance corridor to and from the main lift is along the inside of the west wall of the HC. The main reason for this change was to allow simplified, rather straight routing of the neutral beam (NB) high voltage lines, reducing their lengths and number of elbows. This increases reliability and reduces cost. The added (important) advantage of this move has been to allow installation of the NB lines inside the tokamak building using large prefabricated and pretested modules. Originally, access to the NB cell for installation was only feasible via the main lift, which required the large beamlines to be assembled in situ from small parts.

The NB power supply area has been rearranged north of the tokamak building.

The relocation of the HC building is not a simple move, but requires detailed redesign work. This is also required for the personnel access and radwaste buildings, which interconnect with the HC building. Moreover, the access into the tokamak complex has now moved from the west to the east side of the buildings. This has involved the move of the main office and control buildings also to that side.

The office and control buildings were previously placed at the SE corner of the site. However, as the main human access will be required through the personnel access control building, from where the HC, radwaste, tritium plant and tokamak buildings are accessed, the new location for the main office building in the NE corner gives a much shorter and more direct route.



Tokamak building cutaway showing services routing

2.3. Exchange the Cryoplant Cold Box and Compressor Buildings

The size of these buildings is determined by their initial function, i.e. for the on-site fabrication of the poloidal field coils. An industrial study has been made that showed that the footprint of the buildings had to be increased substantially over the size required for their later use for the cryoplant, to enable coil fabrication as per the ITER construction schedule.

The advantage of also exchanging their function is that both buildings now provide ample space for the plant systems collocated in them, so that any (limited) future upgrades can be handled within the available space. Moreover, the helium compressors for the isotope separation cold box of the tritium plant, as well as the compressors for some additional small cryopumps, can now all be moved into the cryoplant compressor building. This puts all the very noisy systems in one building and is also advantageous from a maintenance point of view.

Even in the event of the installation of additional equipment and of one additional cryo-compressor station, as almost certainly will be required for long (steady state) burn plasma discharges, space inside the building would still be sufficient to also incorporate the emergency power supply generators, although this would require the construction of special containments using concrete walls to provide fireproof segregated areas for the redundant diesel generators. These were previously located in a separate building.

2.4 Move Coolant Systems from the Assembly/RF building to the Site Services Building

An area of 35 m x 12 m footprint inside the assembly hall, approximately 6 m high, was previously earmarked to locate a chilled water unit, heat exchangers and pumps to supply chilled, raw and component cooling water to radiofrequency (RF) power supply systems and to other systems that will be installed in the assembly hall following completion of machine assembly. These coolant systems are now installed instead inside the site services building, alongside similar systems. The installation can proceed while assembly operations of the main machine are still in progress and, more importantly, the freed space inside the expensive assembly hall is available for any future upgrade of the RF systems. This does require, however, a modest enlargement of the less expensive, steel frame type site services building.

2.5 Improve Tritium Plant Layout

The processing and storage systems with the main tritium inventories have been moved below ground level, providing increased protection against external events. As a result, the safety-related chiller units have had to be moved out of the basemat level. These provide chilled coolant for safety systems inside the tokamak complex (and HC). To avoid crossing the seismic gap with the coolant pipes (except for the HC), it is advantageous for these units to remain inside the tokamak complex. However, space for these large units was not found and therefore it was decided to put them on the roof of the tritium plant and the diagnostic building as redundant systems.

To reduce the fire loading in the tritium processing areas, and especially the risk of fire initiation, all control and power cubicles have been moved into special rooms separated from the processing rooms by fire barriers. The rooms are on the south side inside the tritium plant building.

2.6 Layout of Steady State Electrical Power Supplies

Considerable effort has been spent on investigating the layout and development of the detailed design of the steady state electrical power supplies, in terms of layout and design of load centres and distribution panels, as well as sizing and routing of cables into the main tokamak building and tritium plant and distribution of cabling around the plant and the site. A task with the EU Participant Team has recently produced a large amount of information. This is being further refined to achieve acceptable deployment of cabling and cubicles inside the main tokamak building. The information is also used for the design and layout of the utility tunnels on the site.

The safety-related power has to be routed through seismically qualified tunnels, in redundant paths separated by fire barriers, into seismically qualified, redundant load centres and from there to the loads in seismically qualified buildings.

Two seismically qualified load centres at the SW and NW sides of the main tokamak complex are used to provide the low voltage, safety-relevant power for these buildings. Very powerful heaters are used in both the heat transfer systems inside the tokamak building and in the tritium plant. These cannot be powered by medium or high voltage, and this results in a vast amount of 400 V cable bundles from load centres through the tokamak and tritium building to their loads. This leads to long cables and to very large cable tunnels and vertical cable shafts, which therefore also need to be large inside the buildings. Moreover, it requires the two safety-related load centres to be increased considerably in footprint for many non-safety-relevant loads. Therefore, it has been decided to have two additional load centres (for non-safety-relevant loads) installed on the roofs of the tritium and the diagnostic buildings, inside light, metal frame structures.

Although the full information is still being developed, it is assumed that, for routing of power and control cables inside the tokamak building, there will be cable trays along the inside of all four outer perimeter walls at every floor level (see figure 2), reaching from floor level to just underneath the ducts for local air coolers. The original idea was to have a double row of trays above power and control cubicles deployed in this area, but the available space at the vacuum vessel port levels is in that case not adequate. Moreover, the results of R&D done by both the EU PT and the JA PT indicate that the fluctuating magnetic fields in these areas are too strong for many conventional components inside these cubicles.

Therefore, the present strategy is to place cubicles needed for plant operation in the corners of the tokamak building, where the magnetic field strength is considerably lower, or to place them in adjacent buildings. Initial layouts have been produced for cubicles in the diagnostic building and near the load centres on the roofs of the tritium and diagnostic buildings.

2.7. Design and Layout of Utility Tunnels

Utility tunnels are used to interconnect piping networks and cables between buildings and areas at the ITER site. As stated before, cables are divided into two trains that have to be fully separated in fireproof compartments, including cable tunnels. Tunnels are also needed to route piping for the water circulation system that feeds water from the cooling tower cold basin to users and returns it to the hot basin near the cooling tower. A pipe break would fill the tunnels with water, as the basin volumes are much larger than the volume of the tunnels. Therefore it is necessary to strictly separate the cable tunnels from the piping tunnels. Space on the site is limited. Moreover, crossing of tunnels leads to complex structures. Therefore it has been decided to route, in general, the cable tunnels above the piping tunnels but as independent, segregated and watertight containments, having separate access points, ventilation etc.

In the present layout the upper level of tunnels is more than 2 m below grade. The 2 m of soil fill achieves an acceptable spread of loads, which is important when tunnels cross roadways. Moreover, it allows crossing of many other utilities that are buried below grade, e.g. fire and potable water ring mains, sewers, storm and industrial drains, street lighting and communication cabling.

Pipes of very large diameter are used for coolant water (up to 2 m) and also for cryogenic lines (1.2 m). In some areas, especially near the site services building and the main pumping station near the cooling towers, there is a proliferation of pipes to be routed in different directions. To avoid large tunnels with complex intersections, a combination of tunnels and pipe bridges will be used in this area. Feed pipes to the heat exchangers inside the tokamak building are routed from the pumping station via a pipe bridge over the road into the tritium plant building. The return pipes are routed along the east wall of the tritium plant building into a pipe trench from where they reach the large collector pipe inside a deep pipe tunnel. A similar approach is foreseen for the feed pipes from the pumping station that connect with systems inside the site service building. The large helium cryogenic lines that interconnect the cryoplant cold box building and the distribution systems located inside the tokamak building now exit the tokamak building and pass along the side wall of the assembly building up to a pipe bridge where they cross the road into the cryoplant cold box building.

3. Site Adaptation and Procurement

Both the European and Japanese potential ITER sites will most likely use seismic isolation of the main tokamak complex. As a result, the detailed design of these buildings and in particular the piping connections to them developed for the "generic" ITER site will require redesign. Also, the footprint of the main tokamak complex will increase, and hence the layout of the utility tunnel network will have to be updated.

After a final review of the building designs for the generic site, the designs must be adapted for the specific site and seismic and other analyses performed to confirm the design, to determine the amount of steel reinforcement required and to provide the floor response spectra for the analyses of the systems and components located in the buildings. Initial seismic analyses assuming seismic isolation, using seismic data for the European and Japanese sites, have indicated that the main tokamak complex building design is acceptable.

A draft Site Facilities Procurement Specification has been written by the International Team. This will require considerable specific input when the site has been selected. Furthermore, the present site layout will have to be reviewed in detail. The generic site has been kept compact. Once a site is available, it may be advantageous to leave a bit more space between buildings, which would also minimize the length of tunnels routed underneath roads. Tunnel construction, including the installation of pipes (cables can be installed after the tunnels have been completed), which must be completed as one of the first site activities, does severely restrict site access, especially when it prevents the timely availability of access roads.

The drafting of the Procurement Specification for the time-critical buildings has commenced with the compilation of a room-by-room description of the functions and facilities. The building models are being updated to show the small, necessary modifications in line with detailed studies.

It is intended to have an internal final review in April 2004 of the site and building details, to obtain formal internal approval for the changes, and then to update the drawings and documentation as necessary for any external review and for procurement.

ROBERT SANTORO †

The ITER International Team was very sad to hear of the sudden death of Robert (Bob) Santoro on 8 March 2004. During the ITER EDA Bob was a leading US member of the Joint Central Team at the Garching Joint Work Site, where he led the neutronics analysis. Bob brought great expertise to this work, and bound together the efforts of his multinational group, as well as others in the Home Teams, resulting in a highly motivated, hard working and tightly knit group of experts in both analytical and computational work. It is not only this legacy that remains with the project, but also the memory of his gregarious and positive personality. Our deepest sympathies go to his wife, Jan, and his family.

Items to be considered for inclusion in the ITER ITA Newsletter should be submitted to C. Basaldella, ITER Office, IAEA, Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria, or Facsimile: +43 1 2633832, or e-mail: c.basaldella@iaea.org (phone +43 1 260026392).

Printed by the IAEA in Austria
April 2004

04-15071