ITER In-Cryostat Maintenance Study

J. Reich[1], J-J. Cordier[1], D. van Houtte[1], D. Evrard[2], E. Mercier[3], T. Popa[1], B. Doshi[1]

1: ITER Organization, CS 90 046, 13067 St Paul lez Durance Cedex, France

2: Sogeti High Tech, 180 rue René Descartes, 13857 Aix en Provence, France

3: AREVA CNIM KAH System Engineering Support, CS 50497, 13593 Aix en Provence Cedex 3

Corresponding author: Jens.Reich@iter.org

The ITER In-Cryostat maintenance study is an important precondition to guarantee the operation over the ITER lifetime. The ITER operation time is subdivided mainly into two phases:

1. Commissioning and Hydrogen phase (non-nuclear operation phase)
2. Deuterium/Tritium phase (nuclear DT phase)

The commissioning phase includes the initial phase of assembly. Within the first phase the ITER components will be tested; afterwards they will go into operation.
The In-Cryostat maintenance shall facilitate all operations that could be required by In-Cryostat systems and the Cryostat itself. In cases of failures or unlikely events (e.g. earthquakes) it is necessary to provide man and tool access to In-Cryostat components.
Overall functions which have to be implemented are:

- Inspection of components including leak localization (helium, water, air)
- Repair and replacement of component (instrumentation, parts or complete components)

It is presumed that most of component failure would occur at the beginning of the operational phase. This failure rate is expected to be very unlikely when ITER is being operating during the nuclear phase.
For maintenance activities it is assumed that:

- The intervention frequency on each component is limited during its lifetime (e.g. inspections/repair during global shutdown).
- Most of these interventions will be required during the inactive phase. According to ALARA rules maintenance activities will be planned in order to minimize the required human interventions during the active phase.

During active phase only necessary maintenance will be allowed to keep ITER machine in operational condition. Radiation levels will have to be taken into consideration and monitored by Safety.
The inspection and repair requirements on the components and systems are defined by the systems responsible officers (RO). These requirements were collected; they will be summarized in the In-Cryostat maintenance requirement document.
In the frame of the RAMI analysis the various maintenance actions have been required depending on the criticality (occurrence x severity) level of failure regarding normal operation of ITER during any phase including major shutdowns.
The access to these components has to be studied and assessed by safety.
Different tools have to be designed to perform the maintenance actions. As there are quiet all heavy components to be handled and removed, humans cannot perform the work without semi hands-on tools. The required permanent fixtures and tools are considered and designed. Full RH tools are not precluded.
The paper summarises the process of the ITER In-Cryostat maintenance current investigations. The conceptual design of needed access and tools for specific maintenance actions and their interfaces to the Cryostat design are introduced.