7/1/2012

IEA Implementing Agreement
for Co-operation on Tokamak Programmes

Annual Progress Report (January 2010 to December 2011) of the Executive Committee

Executive Summary

1. Mission of the IEA Implementing Agreement for Co-operation on Tokamak Programmes (IA CTP) and relevance to the international fusion programme

The objective of this Implementing Agreement (IA) is to enhance the scientific and technological achievements of the Tokamak Programmes by means of co-operative actions for the advancement of the Tokamak concept. This IA is one of the largest co-operations among the fusion IA's under the IEA. The achievements of these Tokamaks under this IA provided essential data and operating experience for ITER and the advancement of the Tokamak concept.

2. Current foci and objectives of the Implementing Agreement for Co-operation on Tokamak Programmes

Current scientific foci of Tokamak experiments are: ITER baseline discharge simulation (start-up, flat-top, landing); candidate steady state scenarios for ITER and DEMO (long-duration sustainment of high plasma pressure, high bootstrap current discharges); qualification of hybrid scenarios for ITER; cross-machine experiments on plasma edge, L-H power threshold in He plasmas, Internal Transport Barriers; control of disruptions using massive gas injection; control of edge localised modes by perturbing magnetic configuration, using pellet injection and so on; characterisation of plasma instabilities (resistive wall modes, neoclassical tearing modes); effect of ITER Test Blanket Modules on plasma behaviour, material erosion, migration re-deposition and fuel retention; effect of wall conditioning; effect of plasma rotation on confinement and MHD.

The objective of these investigations is to advance the scientific basis for the burning plasmas in Tokamaks and contribute to the resolution of the issues identified in the

ITER Research Plan and to prepare for ITER scientific exploitation. ITER will be the first burning plasma experiment to demonstrate the scientific and technical basis of fusion energy. The IEA CPT scientific exchanges to carry out these investigations are accomplished through coordinated experiments and supporting data analysis and computational modelling using the current Tokamaks participating in the European Fusion Research Programme JET(Culham), Tore Supra (Cadarache), ASDEX Upgrade (Garching), MAST (Culham), FTU (Frascati), TEXTOR (Jülich), TCV (Lausanne), COMPASS (Prague) and ISTTOK (Lisbon); JT-60 (Japan), KSTAR (Korea); the U.S. national devices (DIII-D, CMOD and NSTX); Aditya and SST-1 in India, and many university researchers. The International Tokamak Physics Activity (ITPA), operating under the auspices of ITER, identifies high priority research tasks for ITER in close coordination with the ITER Organization, and proposes experiments and modelling activities to resolve them. The IEA IA-CPT holds annual workshops, in close cooperation with the IEA Plasma Wall Interaction in TEXTOR (PWIT) IA, the Stellarator – Heliotron Concept IA, the Tokamak leaders and the ITPA on "Implementation of the ITPA coordinated research recommendations". The CTP-ITPA Planning Meetings for Joint Experiments (JEX) were held on 13th -15th December 2010 “Workshop W72” and on 12th -14th December 2011 at the Château de Cadarache “Workshop W73”.

The current foci of large Tokamak technology are the development of negative-ion-source-based neutral beam injector (N-NBI) for JT-60SA and ITER, tritium and remote handling in JET (including the installation and tests of the ITER-like Wall materials in JET), as well as diagnostic improvements. In general, it is considered that the interactions between IEA/ITPA/ITER work well, with the primary path for the proposal of experiments being the ITPA Topical Groups.

3. Highlights and accomplishments during the reporting period December 2010 – December 2011

In the EU, an Independent Panel appointed by the Director General of DG Research in the European commission has reviewed the potential contribution of JET to ITER and the strategic orientation of the EU fusion programme in the next EU research framework programme “Horizon 2020”. This assessment have stressed that JET is vital for ITER; with a strong support for the full exploitation of the ITER-like Wall plus a DT phase; and a further extension is possible provided an international framework for JET exploitation is established. There was a strong support for fusion as an energy source but the review panel requested a profound restructuring of the organization of the Programme in the EU. A working group is being set up to prepare a new organization. The JET experimental programme in 2011 and 2012 focus on the full characterisation of the ITER-like Wall; following the successful start up of JET in 2011 after the shutdown to install the ITER-like Wall.

The ASDEX-Upgrade Tokamak in Garching showed n=2 ELM suppression, with 2 x 4 off midplane coils. FIRE (Fast Injection by Rupture disk Explosion Technique) for disruption mitigation has been successfully developed in Tore-Supra (Cadarache). In TCV, Sawtooth pacing was achieved, when Sawtooth-stabilizing ECCD is removed at a pre-defined time since the last crash, triggering the next crash. ELM mitigation was also achieved by operating at negative triangularity. In MAST, experiments with different resonant magnetic perturbations showed mitigation of ELMs but no suppression was achieved so far.

As for the JT-60SA programme being promoted jointly by Japan and EU, nine procurement arrangements for the Japanese contributions (76% of the total Japanese procurement cost) have been launched between the Implementing Agencies, JAEA and F4E by November 2011. Twenty-four of sixty-two EF (equilibrium field) superconducting conductors and six of twenty-eight CS (center solenoid) superconducting conductors have been successfully provided in JAEA Naka Institute, and manufacture of nine (out of ten) pancakes for the EF4 coil has been completed at the manufacturer's factory by November 2011. Two 40 degree sectors of the vacuum vessel have been successfully manufactured in JAEA Naka Institute. The earthquake had made no serious damages to the facilities and equipments to be utilized for JT-60SA. Seven procurement arrangements (66% of the total European procurement cost) for the European contributions have also been signed by November 2011, including TF coil manufacture. The JT-60SA Research Plan has been discussed widely both in JA and EU fusion research communities, and the Version-3 will be completed by the end of 2011 with approximately 230 co-authors (150 from 15 JA laboratories, 80 from 21 EU laboratories).

In the US, the Alcator C-Mod facility operation for research in fiscal year 2011 accomplished 14.5 weeks, 97% of the originally planned 15 weeks. Operations have been restarted in November 2011 with a currently planned total of 17 research weeks in fiscal year 2012 (FY2012). One focus of the 2011 research campaign was the extension of the I-mode operational regime to quasi-steady conditions (pulse length much longer than the characteristic times for energy and particle confinement in the hot plasma).

Following the installation and successful commissioning of one neutral beam line to allow for variable off-axis injection and completion of other diagnostic and system improvements, DIII-D carried out 18 weeks of physics operation in 2011. A series of validation experiments confirmed the off-axis deposition, heating, and current drive of the off-axis NBI. Off-axis NBI was then utilized to extend the operational space and performance of steady-state advanced Tokamak scenarios. Stationary discharges with $q_{min} > 2$, $\beta_N = 3$ were achieved, limited by the available co-NBI power. NSTX completed 4.2 run weeks of operation in FY2011, conducting high priority experiments addressing the FY 2011 joint research target and other FY 2011 research milestones. In transport research, the first successful nonlinear microtearing simulations for NSTX predict reduced electron heat transport at lower collisionality consistent with the measured electron confinement scaling.

During the fourth campaign of KSTAR in 2011, emphasis was placed on active ELM control using various methods such as: non-axisymmetric (NA) magnetic perturbations, supersonic molecular beam injection (SMBI), vertical jogs of the plasma column, and edge electron heating. By applying n=1 NA field, different ELM control effects were observed: from the full suppression of ELMs to even the excitation of ELMs depending on the poloidal phasing of NA field coils. The newly installed SMBI system was also used for ELM control and a mitigated ELM state was sustained by optimised SMBI pulse during several hundreds of ms. Using the versatile in-vessel control coil, fast vertical jogs of the plasma column were made; and ELM frequency locking to the 50 Hz vertical jogs was observed with high probability of ELM triggering.

The repair and refurbishment of the SST-1 machine has been completed. All magnets and current leads have been individually tested at 4 K. Machine assembly is in progress and engineering commissioning will commence soon. Recent Experiments in the ADITYA Tokamak have focussed on Electrode Biasing experiment and LH transition; RF heating experiments with ICRH and pre-ionization experiment in support of SST-1 plasma Initiation.

Further details on the status and plans of the parties can be found in the Annex 1.

There were 26 personnel assignments and scientific exchanges among the Parties completed during this period. A list of the exchanges is shown in the Annex 2.

The 2nd Executive Committee Meeting of the IEA Implementing Agreement for Co-operation on Tokamak Programmes was held in Cadarache, France, on Thursday 15th December 2011. The minutes of this meeting is shown in the Annex 3.

Summary Reports on Workshops W72 and W73 is shown in the Annex 4

4. Future strategy

The 2nd Executive Committee Meeting of the IEA Implementing Agreement for Co-operation on Tokamak Programmes provided the opportunity to discuss the future strategy of this IEA IA.

A one-time extension until 30 June 2012 was approved by the CERT in December 2010 and the Committee agreed that it would present the Request for a further Extension to the FPCC in February 2012 and then to the CERT at the meeting in June 2012.

India has joined the IEA Implementing Agreement for Co-operation on Tokamak Programmes in April 2011; China and the Russian Federation have been invited to join.

Co-ordination of the programme towards ITER in co-operation with other Tokamak programs naturally draws the interest of all Parties for the ITER IO to join the Implementing Agreement for Co-operation on Tokamak Programmes. The strategic importance as well as the legal issues involved will be clarified in the coming year ahead of a decision on this matter.

5. Collaborations inside/outside IEA

The close coupling between the ITPA, the ITER organization, the IEA FPCC, and the IAEA IFRC provide the opportunity to streamline international collaborations in fusion research, with its priority for the success of ITER in achieving its key scientific and technological objectives. In recognition of the change of the world fusion programme into this new era, symbolized by the establishment of the ITER Organization, collaborations inside/outside IEA have to be strengthened in view of support and supplement ITER towards DEMO.

The IEA Implementing Agreement for Co-operation on Tokamak Programmes homepage (http://www-jt60.naka.jaea.go.jp/lt/), open to all IEA IA's and the public; will be hosted by the EU from January 2012.

6. Message to policy makers

The IEA Implementing Agreement for Co-operation on Tokamak Programmes has been effective in further developing Tokamak research to reach break-even conditions and in developing the necessary databases for the next step device ITER and a steady-state Tokamak reactor. This Agreement provides leadership in coordinating ITPA joint experiments with other Tokamak related IEA IA's. Now, with the participation of Korea and India as Contracting Parties and the revision of the Large Tokamak Implementing Agreement to the new Implementing Agreement for Co-operation on Tokamak Programmes, Tokamak-related activities in FPCC are streamlined. Productive interactions with ITPA, the ITER International Organisation and the IFRC will be further enhanced if other fusion countries such as China, and the Russian

Federation, join the IEA CTP Agreement in the future in order to facilitate science and technology exchanges among the domestic programmes of all ITER Members.

7. List of attachments

A1 : Status and Plans of The Parties

A2 : List of Personnel Exchanges

A3 : Minutes of Executive Committee meeting in Aix-en-Provence, France.

A4 : Summary Reports on Workshops

Annex 1

The Status and Plans of the Parties

EU

JET

An Independent Panel appointed by the Director General of DG Research in the European commission has reviewed the potential contribution of JET to ITER and the strategic orientation of the EU fusion programme in the next EU research framework programme "Horizon 2020". This assessment have stressed that JET is vital for ITER; with a strong support for the full exploitation of the ITER-like Wall plus a DT phase; and a further extension is possible provided an international framework for JET exploitation is established. There was a strong support for fusion as an energy source but the review panel requested a profound restructuring of the organization of the Programme in the EU. A working group is being set up to prepare a new organization.

The JET experimental programme in 2011 and 2012 focus on the full characterisation of the ITER-like Wall. Experiments during this phase will be at moderate input power, to reduce the risk of early damage of the wall (system commissioning) and take samples from wall in an intervention during the 2nd half of 2012. During 2010, detailed preparation of the experiments was carried out, with the development of over 200 proposals for experiments, from which ~50% were selected for execution. These experiments will cover the demonstration of sufficiently low fuel retention of the ITER-like Wall; the assessment of the power handling of the ITER-like Wall; investigate beryllium & tungsten erosion, migration and deposition and material mixing and the development of ITER operation regimes with the ITER-like Wall.

ASDEX-Upgrade

ECRH power in ASDEX-Upgrade will be further increased from the present system: $\geq$ 4 MW @ 140 GHz, allowing ECRH-only type I ELMy H-mode. The plan is to extend to 8 MW, installed ($\geq$ 7 MW in plasma) with 10 s pulse length until 2016. This will also allow some j(r)-tailoring through ECRH. The ICRH antennae will undergo modifications to demonstrate W-compatibility, with a wider limiter to reduce antenna box currents; B-coating of antenna limiters in 2012 and new 3-strap antennae in 2012/2013 in collaboration with ASIPP.

In-vessel coils will be completed successively from the 2 x 4 off midplane coils that showed n=2 ELM suppression in 2011 to 2 x 8 coils in 2012 that will allow n=4. Mid-plane coils will be added until 2015 with 12 individual power supplies in 2014.

ECCD deposition will be feedback controlled from 2012 and ECRH mirrors will be adjusted in real time on the 50 ms timescale, so different algorithms can be tested aiming at MHD feedback control of (N)TMs (disruptions), Sawteeth, and the current profile.

The Pellet injection capabilities will be further enhanced with > 100 pellets / discharge with freely programmable timing. The combination with RMP ELM suppression with pellets leads to increased fuelling efficiency with increased emphasis on operation at n > nGW (up to n/nGW = 1.5 in 2011). The HFS MGI valves show promising results with a fuelling efficiency more than factor 2 higher than LFS MGI in 2011. The divertor will be equipped with solid W-tiles with higher power handling capability than the present W-coatings on C and a PWI station for dedicated PWI studies will be installed.

Tore Supra

The Tore Supra H&CD capability in 2011 includes LHCD with Klystrons 8x 500kW/210s + 8 x 700kW/CW and 1 PAM + 1 FAM launchers; an ICRH system with a power of 9MW for 30 s or 3MW for long pulse. A new concept Faraday screen has been designed to minimize the RF sheath potential. The ECRH system includes 700kW x 5s. In 2012, the full H&CD capability of 16x700kW/CW klystrons+ 3MW ICRH for more than 200s (9MWx30s) will be available. The objectives are to validate Passive Active Multijunction (PAM 3.7GHz) concept foreseen for ITER; validate 700kW/3.7GHz/CW klystron and validate ITER 5GHz mode converter prototype developed at IRFM at low power level. The First set of eight 3.7GHz CW klystrons validated on plasma, delivering 520kW- 620kW each (80% - 100% of capability), routinely 500kW/10s and 440kW/43s. Low reflection (-40dB) / High efficiency (99%) 5GHz mode converter prototype has been demonstrated and RF the modelling (ALOHA code) validated. FIRE (Fast Injection by Rupture disk Explosion Technique) has been successfully developed and first experiments were carried out in April 2011.

FTU

The main experimental programme ended in May 2011 due to an explosion of two secondary breakers (20kV) on the LH system, the failure of the McPherson UV spectrometer and a short circuit on the Electro-Optic Probe used for dust detection. The experimental programme continued until July, for the commissioning of new front mirrors real time steerable ECRH Launcher; some ECRH and OH experiments on density limit (recycling, Li/B/Mo) and some new diagnostic commissioning. During the summer-autumn Shutdown: the ECRH antenna was inspected, refurbished and reinstalled the LH fully refurbished, new 12 arm power divider commissioned. The Mc Pherson UV spectrometer heads have been repaired, recalibrated and reinstalled and the electro-Optic Probe refurbished and reinstalled. FTU is restarting Operations in the mid November devoted to plasma, diagnostics and systems re-commissioning. The 2012 programme will be focussing on tearing mode control, sawtooth control; disruption avoidance (LH fast e-); assisted breakdown (Fast Camera) and OXB heating with the new RT EC Antenna. LHCD will be used at high plasma density to complete the scan at higher Power of the control of the electron temperature by ECRH; the control of metallic impurities (W-Mo) by impurity seeding; the study of low W ionisation states and high power operation with the Liquid-Lithium-Limiter.

TCV

The general TCV mission is to contribute to the physics basis for ITER scenarios; DEMO design and Tokamak concept improvement. The EC heating consists of Second harmonic ECRH (X2) 6 gyrotrons at 83GHz, with 3 MW and Third harmonic (X3) 3 gyrotrons at 118GHz with 1.5 MW. Sawtooth pacing was achieved, when Sawtooth-stabilizing ECCD is removed at a pre-defined time since the last crash, triggering the next crash. ELM mitigation is achieved by operating at negative triangularity.

A shutdown is foreseen between January-July 2011 for flywheel generator maintenance, various machine and diagnostic refurbishments and upgrades; in particular, to perform the repair to the third X3 gyrotron source.

Research focus areas in 2012 will be on: Transport in shaped L- and H-mode plasmas; scenarios with internal transport barriers and developments towards steady-state operation; H-mode and ELM control; ECH and ECCD physics; advanced plasma control; edge and core electron-dominated turbulence; advanced shaping and innovative divertor concepts, and related edge physics and preparation for medium term upgrades with additional X3 power and direct ion heating by NBI.

MAST

The recent MAST program focussed on ELM mitigation with RMPs, combined with MHD modelling (flows, resistivity) and pump-out due to deformations near X-points. Experiments with different n=2,3,4 and 6 mitigation of ELMs was observed but no suppression achieved so far. MAST developments and plans includes diagnostics: Microsecond microwave imaging array for EBW to get pedestal J(r); beam emission spectroscopy for ion-scale turbulence; neutron camera (scanning) for fast ion distribution; Retarding Field Energy Analysers for ion temperature & ion energy and fast high resolution pedestal ion temperature and flow measurements. MAST operates until January 2012, and then from November 2012 to June 2013. The longer term upgrade includes an innovative divertor, including super-X divertor; higher B, off-axis NBI, with the expected restart in 2015.

COMPASS

COMPASS main features includes an ITER-like geometry with a single-null-divertor; a clear H-mode in ohmic regime expected; two new neutral beam injection heating systems and new comprehensive system of diagnostics focused on the edge plasma. The two new NBI heating systems have been developed, installed and commissioned. These systems enable co- or balanced injection. The COMPASS Tokamak programme for 2012 includes edge physics studies in the area of turbulent transport, including the H-mode transition and the physics of the pedestal power decay length in the SOL towards ITER; Resonant Magnetic Perturbation technique; understanding the penetration of RMPs into the plasma edge; understanding the role of 3-D effects on flow dynamics (e.g. viscosity, zonal flows). Development and validation of diagnostic concept advanced probes for fast ion temperature measurement (tunnel probe, ExB analyzer) and plasma potential measurement (ball pen probe).

TEXTOR

The present TEXTOR programme focusses on the plasma-wall interactions with the emphasis on lifetime of plasma facing components and tritium retention and the Dynamic Ergodic Divertor basic mechanisms with resonant magnetic perturbations.

The PWI test facility with air lock limiter system allows analysis of surface and plasma processes; PWI under extreme power loads; Detailed benchmarks of PWI codes (ERO-Tridyn); Pilot experiment for new concepts (e.g. WF6 injection) and development of novel PWI diagnostics. In adition, Global PWI studies include the Impact of disruptions on PFCs, disruption mitigation and ICRF wall conditioning. The plan for 2012 inlcudes a total of 16 weeks + 3 weeks of contingency of machine operation, in order to conduct experiments on ICRF conditioning, disruption heat loads, melt layer motion, material migration, gap deposition, Edge transport with RMPs, runaway losses and test of first mirrors.

KOREA

KSTAR

Experimental Highlights

During the fourth campaign of KSTAR in 2011, emphasis was placed on active ELM control using various methods such as: non-axisymmetric (NA) magnetic perturbations, supersonic molecular beam injection (SMBI), vertical jogs of the plasma column, and edge electron heating. By applying n=1 NA field, different ELM control effects were observed: from the full suppression of ELMs to even the excitation of ELMs depending on the poloidal phasing of NA field coils. The newly installed SMBI system was also used for ELM control and a mitigated ELM state was sustained by optimised SMBI pulse during several hundreds of ms. Using the versatile in-vessel control coil, fast vertical jogs of the plasma column were made; and ELM frequency locking to the 50 Hz vertical jogs was observed with high probability of ELM triggering. A change in the ELM behaviour was seen when edge ECCD was applied, but ELM control by modifying edge current still needs further analysis. The aforementioned ELM control experiments were supported by advanced diagnostics such as electron cyclotron emission imaging (ECEI). The ECEI pictures of suppressed/mitigated ELM states showed apparent differences when compared with uncontrolled ELMy states. Further analyses are on-going to explain the observed

ELM control results. H-mode operation has been stabilized by baking the PFC up to 350 C with boronization and by improving the plasma shape control. Typically at Ip=0.6 MA, 5 second flattop of H-mode could be obtained. Plasma current touched 1 MA for 2 seconds for testing the machine capabilities. KSTAR has been routinely operated with a plasma current of 0.6 MA and a pulse length of up to 10 seconds. Poloidally three and toroidally four picture framed internal coils (already installed in 2010) has been hooked up to temporary DC power supplies for RMP application. n=1 magnetic perturbations with various toroildal phasing and n=2 with parity change could be applied. A new SMBI system has been developed in collaboration with SWIP China. This SMBI has been used not only for ELM control, but also for the cold pulse applications for the study of non-locality in transport. Although only one NBI ion source has been operated this year, the energy has been increased from 90 keV to 100 keV with 1.6 MW and long pulse NBI operation has been tested up to 300 sec at 0.9 MW. Newly installed 170 GHz, 1 MW gyrotron system has been operated for ECH/ECCD studies. This gyrotron has been developed by JAEA for ITER and tested for the first time in KSTAR in collaboration with JAEA experts. Disruption mitigation experiments by massive gas injection system (MGI) have been carried out.

Regarding diagnostics, the ECEI system has produced interesting data regarding the ELM behavior and other transport studies. The CES system has produced profiles for ion temperature and toroidal rotation and the pedestal structure has been identified. One of the extensively used diagnostics was the XICS (X-ray Crystal Imaging System) which measures the plasma rotation under various experimental conditions and heating mix. The infra-red camera system has been installed and used for monitoring PFC surface temperatures. A Scintillator probe system for fast ion loss detection has been installed and tested with a slow frame camera. Prompt losses of NBI ions have been identified.

<u>Plan for 2012</u>

In 2011, the operation boundary of KSTAR will be extended by adding another NBI ion source and obtaining H-mode at Ip of 1 MA. The H-mode will be further refined with the feedback control of various shape parameters. With the increased plasma performance, the study of ITER relevant physics issues such as ELM control will be more strengthened. Close collaboration with theory and the modeling group will be promoted to increase the predicting and interpreting capabilities in the experiment.

INDIA

SST-1

The repair and refurbishment of the SST-1 machine has been completed. All magnets and current leads have been individually tested at 4 K. Machine assembly is in progress and engineering commissioning will commence soon. All 16 TF magnets, 130 thermal shields (80 K) 8 vessel modules and 8 vessel sectors and the sixteen 5 K helium cooled shields have been tested. The helium cryogenics system is operating with a 99.9 % reliability. A series of focused experiments have been planned towards demonstrating SST-1 as a magneto-mechanical device capable of steady state plasma experiments prior to any attempts on the first plasma. The engineering validation phase would begin from January 2012.

Aditya

Recent Experiments in the ADITYA Tokamak have focussed on Electrode Biasing experiments and LH transition; RF heating experiments with ICRH and pre-ionization experiment in support of SST-1 plasma initiation. A tungsten electrode of 0.5 cm of diameter and 1 cm length has been placed inside the Last Closed Flux Surface of Aditya Tokamak and has been biased positively and negatively at different potentials. Preliminary experiments using a Second harmonic heating scheme in ICRF range have been conducted after the successful commissioning of the 200 kW ICRH system in the frequency range of 20-40 MHz. Preliminary results show that the electron heating takes place from 200 eV initial temperature to 300 eV final temperature with an input RF power of 80 kW. In initial experiments to optimize plasma formation, it was observed that at higher magnetic field when the resonance layer is in front of the antenna the plasma spreads toroidally but radial spread is limited up to the resonance layer.

JAPAN

JT-60 Programme

As for the JT-60SA programme being promoted jointly by Japan and EU, nine procurement arrangements for the Japanese contributions (76% of the total Japanese procurement cost) have been launched between the Implementing Agencies, JAEA and F4E by November 2011. Twenty-four of sixty-two EF (equilibrium field) superconducting conductors and six of twenty-eight CS (center solenoid) superconducting conductors have been successfully provided in JAEA Naka Institute, and manufacture of nine (out of ten) pancakes for the EF4 coil has been completed at the manufacturer's factory by November 2011. Two 40 degree sectors of the vacuum vessel have been successfully manufactured in JAEA Naka Institute. The earthquake had made no serious damages to the facilities and equipments to be utilized for JT-60SA. Seven procurement arrangements (66% of the total European procurement cost) for the European contributions have also been signed by November 2011, including TF coil manufacture. The JT-60SA Research Plan has been discussed widely both in JA and EU fusion research communities, and the Version-3 will be completed by the end of 2011 with approximately 230 co-authors (150 from 15 JA laboratories, 80 from 21 EU laboratories).

Disassembling and removing existing components in the JT-60 machine hall started in April 2011 and will be completed in 2012. The upper supporting structures of the JT-60 Tokamak have been removed. Most of the perpendicular NB injectors to be reused on JT-60SA have been removed from the JT-60 machine hall to the depository building. One 40° toroidal sector of the vacuum vessel has been cut off and removed by November 2011 so as to provide an opening through which the toroidal field coils can be pulled out. All toroidal coils will be disassembled by the end of March 2012, and then the vacuum vessel will be removed. So far, it is also going as scheduled.

As for the development of ECH/ECCD system for JT-60SA, development of a dual-frequency gyrotron (110 GHz and 138GHz) was started in order to enable ECH/ECCD in the core plasma region at the toroidal field of 2.3 T without losing the capability of the 110 GHz EC wave. The gyrotron design has been completed in 2011. The fabrication of the gyrotron will be completed by the end of March 2012 and the test will be started in FY2012.

In order to provide high current negative ion beams of 22 A at 500 keV for JT-60SA N-NBI, the ion source is designed to have large acceleration grids with multiple apertures, around which the electric field is concentrated. The vacuum insulation of the large acceleration grids with multiple apertures has been systematically measured for the wide range of the grid area (S) and number of the apertures (N). The sustained voltages varied with $S^{-0.13}$ and $N^{-0.15}$ in the range of $S=0.004\text{-}1m^2$ and N=0-1280, respectively. This is the first scaling for the sustained voltage of the multi-aperture grid in the world. The grid area and number of apertures in the JT-60SA negative ion source are being designed based on this scaling. This scaling is also useful for designing the ITER negative ion accelerator, which is foreseen to have a similar grid.

US

Alcator C-Mod

Alcator C-Mod facility operation for research in fiscal year 2011 accomplished 14.5 weeks, 97% of the originally planned 15 weeks. We have restarted operations in November, 2011 with a currently planned total of 17 research weeks for FY2012. Details of the day-to-day operation can be found at http://www-cmod.psfc.mit.edu/cmod/cmod_runs.php, which includes links to run summaries, miniproposals, and engineering shot logs.

A significant number of facility and diagnostic upgrades have been completed in the last year or are in progress: complete refurbishment of the Diagnostic Neutral Beam, used for many important plasma parameter profile measurements including ion temperature, current density, and rotation; upgrades to high resolution imaging x-ray spectrometers; addition of a polarimeter laser system to measure current profile and magnetic fluctuations; edge reflectometers to measure density profiles in front of microwave and radio frequency launchers; upgrades to turbulence diagnostics including core reflectometery, Electron Cyclotron Emission diagnostics, Phase Contrast Imaging and Gas-Puff Imaging; construction and installations of an advanced, field-aligned, Ion Cyclotron RF antenna aimed at a dramatic reduction of impurity sources during high power plasma heating; a unique accelerator facility designed to probe surface conditions following each plasma discharge for plasma-wall-interaction studies.

One focus of the 2011 research campaign was extension of the I-mode operational regime to quasi-steady conditions (pulse length much longer than the characteristic times for energy and particle confinement in the hot plasma). Additionally, we are beginning to explore the detailed physics of the fast particle and reduced energy transport seen near the edge of I-mode plasmas. Finally, I-mode operation has been accessed over a significantly broadened range of plasma parameters. All of these advances are important in evaluating the prospects for applying the regime to ITER and fusion reactors.

As part of a nationally coordinated joint research program, C-Mod is studying the detailed physics of the high confinement (H-mode) pedestal, the region of suppressed turbulence and enhanced confinement near the edge of the Tokamak plasma. In combination with complementary studies on the DIII-D and NSTX facilities, and focused collaborations with theorists and computational modelers, these experiments have been used to test numerical models of the plasma behavior, and to aid in extrapolations to make predictions for ITER.

One of the key tools available for non-inductive current drive, required to maintain the Tokamak configuration in steady-state, is the use of high powered microwaves which can be injected into the torus with phase velocity strongly directed along the toroidal direction. Under the right circumstances of wave frequency, plasma temperature and density, and magnetic field, the waves will penetrate into the hot plasma, and preferentially damp on epithermal electrons (i.e. those with energies about a factor of 10 higher than the average thermal energy). The resulting transfer of momentum to the electron distribution is primarily toroidal, causing a net current drive. C-Mod experiments in the last 18 months have focused on detailed studies of unexpectedly low current drive efficiency at relatively high plasma density, and significant strides have been made in increasing our understanding of the dominant phenomena. Using that information, we are formulating plans for additional investigations, as well as possible hardware design upgrades to improve the current drive efficiency.

The formation of nano-filaments, or "fuzz", on the surface of high temperature refractory metals exposed to low-energy helium plasmas has been well documented in linear plasma devices around the world. However, until now, these nano-filaments have never been grown inside a Tokamak. The high power density and refractory metal walls of Alcator C-Mod makes it well suited to achieve the surface conditions necessary to grow this fuzz ($T_{surface}$ > 900 K, Γ_{He+}>10^{22} $m^{-2}s^{-1}$, 10 eV < E_{He+}< 150 eV). In the C-Mod lower divertor there are a set of tiles ramped ~2^o into the parallel plasma flux for thermal load analysis with a nearby tungsten Langmuir probe ramped ~11^o. In the most recent C-Mod run campaign, we were able to achieve the necessary surface temperatures for fuzz growth on these ramped tiles. On the last day of the campaign, shots were dedicated to accruing growth time at these conditions, which resulted in ~12 s of total growth time. Examination of the surfaces after removal from C-Mod revealed the growth of fuzz on the tungsten Langmuir probe as indicated by an optically dark surface, and confirmed by examination with a Scanning Electron Microscope (SEM). The nano-filaments look quite developed for such a short amount of growth time, which may extrapolate to very thick layers of fuzz growth in a long-pulse device such as ITER. The consequences of these fuzz layers on reactor performance and lifetime remain unclear. There was no observable fuzz growth on the nearby ramped molybdenum tiles or calorimeters. Possible reasons for this lack of fuzz are the higher sputtering rates of molybdenum as compared to tungsten, interference of boron plasma impurities and deposits, or the electrically/thermally isolated and more steeply ramped tungsten probe reaching and remaining at the correct temperature range for fuzz growth for a longer time than the molybdenum tiles. Follow-up experiments on the DIONISOS linear plasma facility at the PSFC are planned to clarify the lack of fuzz growth on the molybdenum surfaces.

DIII-D

Following the installation and successful commissioning of one neutral beam line to allow for variable off-axis injection and completion of other diagnostic and system improvements, DIII-D carried out 18 weeks of physics operation in 2011. A series of validation experiments confirmed the off-axis deposition, heating, and current drive of the off-axis NBI. Off-axis NBI was then utilized to extend the operational space and performance of steady-state advanced Tokamak scenarios. Stationary discharges with

$q_{min} > 2$, $\beta_N = 3$ were achieved, limited by the available co-NBI power. In addition, $q_{min} \sim 1.5$, $\beta_N > 3.5$ discharges were maintained for nearly two current relaxation times (~ 3 secs). Various studies took advantage of the off-axis NBI capabilities to document the effect of off-axis NBI on Alfven eigenmode and RWM stability.

Research in support of ITER focused on ELM control, disruption mitigation and avoidance, simulating the effect of Test Blanket Module (TBM) magnetic field perturbations, and extending the performance envelope of ITER baseline and advanced inductive discharges. ELM control research was carried out in three areas; use of resonant magnetic perturbations (RMPs) for ELM suppression, extending QH-mode to ITER-like conditions, and test of ELM pacing using repetitive pellet injection (i.e., pellet pacing). The RMP research focused on developing an improved understanding of the processes leading to ELM suppression. Full ELM suppression was achieved with a single-row I-coil in the ITER shape at $q_{95} = 3.1$, providing a proof of principle of achieving ELM suppression in the ITER baseline scenario. ELM suppression was also obtained with n=2 RMPs at low collisionality. Attempts to reproduce n=2 ELM suppression at high collisionality as was observed at ASDEX-Upgrade were unsuccessful. Rapid n=3 RMP toroidal phase shifts and n=2 RMP rotation revealed rigid displacements near the separatrix with some evidence of an island-like displacement at the top of the pedestal. The QH-mode operating space was extended to co-NBI torque through the use of non-resonant magnetic fields to apply a counter torque to maintain QH-mode conditions. Pellet pacing experiments demonstrated the ability to controllably trigger ELMs at 60 Hz repetition rate, roughly a factor of 10 faster than the natural ELMing rate. Disruption mitigation studies demonstrated the ability to reliably control the runaway electron channel following a disruption, providing a platform for testing techniques for dissipating the runaway electron energy benignly. TBM experiments focused optimizing the error field correction specifically for the TBM and then assessing the effect of the improved correction on rotation. In addition, a new IRTV view of the TBM allowed an assessment of fast ion losses associated with the TBM perturbations. In support of the 2011 Joint Research Target, a series of experiments were completed to test various models of the scaling and inter-ELM evolution of the pedestal structure. Comparisons indicate good agreement with the EPED1 model over a wide range of conditions.

Detailed physics studies were also performed to characterize predator-prey-like feedback loops with the turbulent fields just prior to the L-H transition, extensive comparisons of the main ion toroidal rotation with carbon rotation over a wide range of conditions, measurements of the SOL impurity flow using a novel coherence imaging technique, and test of electron and ion stiffness models for turbulence utilizing perturbative techniques.

NSTX

NSTX completed 4.2 run weeks of operation in FY2011, conducting high priority experiments addressing the FY 2011 joint research target and other FY 2011 research milestones. In transport research, the first successful nonlinear microtearing simulations for NSTX predict reduced electron heat transport at lower collisionality consistent with the measured electron confinement scaling. For electron temperature gradient-driven turbulence, a reduction in high-k fluctuations consistent with a reduction in electron heat transport is observed at outer plasma minor radii. The first systematic scalings of low-k turbulence have been determined using a beam-emission spectroscopy (BES) diagnostic. Measurements indicate that poloidal correlation lengths in the ELM-free H-mode pedestal increase at higher electron density gradient. In boundary physics research, a very high flux expansion "snowflake" divertor has been further investigated, and new results indicate the snowflake can substantially reduce (up to factor of 7) the peak heat flux through a synergistic combination of high flux expansion and detachment leading to a radiative snowflake divertor. NSTX also contributed to the FES joint research target (JRT) by analyzing the evolution of H-mode pedestal, height, width, and gradients, as well as density fluctuations, during the inter-ELM cycle. Key findings include: 1) the pedestal pressure height $p_{total-pedestal}$ saturates only in the last 30% of the ELM cycle at low and intermediate Ip, and not at all at high Ip > 1 MA, 2) the $p_{total-pedestal}$ increases quadratically with Ip, and increases with lower divertor triangularity, but appears to be independent of toroidal field, 3) the pedestal pressure width in physical space increases during the ELM cycle, and appears to be independent of Ip, and 4) the pedestal width in normalized poloidal flux space increases as the square root of pedestal beta normalized to the poloidal magnetic field. In lithium research, new analysis indicates the electron confinement improves continuously with increasing lithium evaporation inside the vacuum vessel and that further confinement increases may be possible. With lithium, an enhanced pedestal H-mode with very high confinement of τ_E / $\tau_{E\text{-ITER H98y2}} \leq 1.7$ was observed. In stability research, new calculations indicate reduced collisionality is stabilizing for resistive wall modes (RWM), but only near kinetic resonances. The RWM state space controller including 3D model of plasma and wall currents was implemented for the first time on NSTX which successfully sustained a high normalized beta ~ 6 plasma. The state space controller could allow more flexible control coil positioning for ITER. Fast-ion redistribution associated with low-frequency MHD has been measured using a fast-ion D-alpha (FIDA) diagnostic. The redistribution is caused by n=1 and weaker n=2 kink-like global instabilities, and this redistribution can affect the stability of Alfven eigenmodes, RWMs, and other MHD. NSTX also explored the effects of aspect ratio, shaping, and current profile on MHD stability in preparation for NSTX Upgrade operation. Operation was successfully sustained at normalized beta above 4 for several current redistribution times at the Upgrade aspect ratio and elongation. A wide range of integrated scenario simulations were also performed indicating that 1MA and 100% non-inductive scenarios should be stably achievable with ITER-like H-mode confinement by optimizing the Upgrade injection source mix, plasma position, and electron density. In non-inductive plasma formation research, coaxial helicity injection can reduce by up to 40% the flux required to achieve 1MA, and simulations using the Tokamak simulation code (TSC) for NSTX project favourably to NSTX Upgrade with up to a factor of two increase in closed-flux current predicted.

Following a planned outage to implement facility and diagnostics enhancements, a turn-to-turn electrical short occurred within the toroidal field (TF) coil inner bundle. An investigation of the damaged TF bundle revealed that the cause of the electrical short was a gradual deterioration of the insulation between TF conductors. Rather than repair the damaged inner bundle, PPPL and DOE decided to proceed with the NSTX Upgrade project six months earlier than planned.

Annex 2

List of Personnel Exchanges in 2011

			PERSONNEL ASSIGNMENTS FOR Jan. 2011 – Dec. 2011				
		NO.	TITLE	PARTICIPANTS	Days	Starting Date	Ending Date
1	JT-60 to US	JU101	Participation to the DIII-D experiment on Momentum transport and intrinsic rotation	M. Yoshida	28	31/7/2011	27/8/2011
2	JT-60 to US	JU102	Participation to the DIII-D experiment on RWM	G. Matsunagai	11	27/7/2011	6/8/2011
3	JT-60 to US	JU102	Participation to the DIII-D experiment on RWM	M. Takechi	14	11/9/2011	24/9/2011
4	EU to US	EU89-2	Physics of ECE and toroidal rotation	M Zerbini	54	22/11/2010	14/01/2011
5	EU to US	EU100	Comprehensive comparisons of measurements against edge code predictions	M Groth	22	01/12/2010	22/12/2010
6	EU to US	EU102	To participate in joint experiments to study the dependence of momentum pinch on collisionality (TC-15)	T Tala	11	09/01/2011	19/01/2011
7	EU to US	EU101	To compare JET and DIII-D results on the outermode	E Solano	54	10/01/2011	04/03/2011

8	EU to US	EU103	Data analysis on plasma rotation and on the Quiescent H-mode (QHM) and participation in ITER Test Blanket Module mock-up experiments on DIII-D	F Nave	42	02/10/2011	12/11/2011
9	KO to EU		Development of Integrated Modeling for NTM with the effect of ECH	Kyungjin Kim	96	30/3/2011	3/7/2011
10	KO to EU		Training for impurity transport code SANCO	J.Hong	12	6/6/2011	17/6/2011
11	KO to EU		Training for data analysis code UTC	J.Hong	5	15/8/2011	19/8/2011
12	KO to EU		MARTe software platform used for plasma real time control at JET	S.W. Yun	5	17/10/2011	21/10/2011
13	KO to EU		ELM study for ITER	O. Kwon	50	30/6/2011	18/8/2011
14	KO to EU		ELM study for ITER	Jeongwon Lee	50	30/6/2011	18/8/2011
15	US to KO	UK-301	Assist Operations on KSTAR	Mueller	10	29/6/11	8/7/11
16	US to KO	UK-302	Neutral Beam Comissioning	Grisham	5	4/8/11	10/8/11
17	US to KO	UK-308	Operation with isoflux boundary control	Eidietis	10	20/6/11	2/7/11
18	JP to EU	JE155	Measurements of LH wave non-linear behavior using RF probes and reflected power spectra analysis	T. Ohsako	19	10/10/2011	28/10/2011
19	US to EU (IPP)		Joint experiments on ELM suppression by RMPs	T. Evans	11	19/04/2011	29/04/2011
20	EU to US (GA)		Joint experiments on fast particle driven MHD modes	M. Garcia-Munoz	45	01/08/2011	14/09/2011

21	EU to US (PPPL)		Princeton University Advisory Panel	S. Günter	4	10/05/2011	13/05/2011
22	EU to US (GA)		Joint experiments on NBCD	J. Hobirk	17	18/05/2011	04/06/2011
23	EU to US (PPPL)		Reconnections studies on MRX	V. Igochine	31	11/08/2011	11/09/2011
24	EU to US (GA)		Joint experiments on ELM suppression by RMPs	W. Suttrop	5	12/09/2011	16/09/2011
25	EU to US (DoE)		Participation in mid-term review	H. Zohm	5	04/06/2011	08/06/2011
26	EU to US (GA)		Participation in DIII-D Programm Advisory Committee (PAC)	H. Zohm	6	12/02/2011	17/02/2011

Annex 3

Minutes of Executive Committee meeting in Aix-en-Provence, France, 15th December 2011

Attendance

Myeun Kwon (Chair, KO), Duarte Borba (Secretary, EU), Steve Ecktrand (US), Ruggero Giannella (EU), Jong-Gu Kwak (KO), Yutaka Kamada (JP), Woong-Chae Kim (KO), Masahiro Mori (JP), Kouji Shinohara (JP), Michiya Shimada (ITER-IO), Raghvendra Singh (IN), Mickey Wade (US), Randy Wilson (US).

Approval of the Agenda

The Agenda was adopted

IA-CTP Membership Status

India has joined the IA-CTP in April 2011. China and Russia have been invited to join. The ascension of China is pending internal approval and the ascension of Russia is under discussion.

Since a framework for collaboration between ITER and other Tokamaks is needed, the ITER participation in the CTP-IA was discussed in previous occasions. The ITER DG supports ITER joining the CTP but this is being checked by the ITER legal office. There is also the need to check with the IEA legal office the possible participation of ITER in the CTP-IA.

Executive Committee Membership

The Executive Committee Membership list was checked and revised. The delegations from the US and Korea updated their membership list and sent a revised version of the Executive Committee Membership to the Secretary.

Table: Revised Executive Committee Membership

Name	Delegation	E-mail Contact	
Francesco Romanelli	EU	francesco.romanelli@jet.efda.org	Member
Ruggero Giannella	EU	ruggero.giannella@ec.europa.eu	Member
Duarte Borba	EU	duarte.borba@efda.org	Alternate
Hartmut Zohm	EU	hartmut.zohm@ipp.mpg.de	Alternate
Predhiman Krishan Kaw	IN	kaw@ipr.res.in	Member
R. Jha	IN	rjha@ipr.res.in	Member
Masahiro Mori	JP	mori.masahiro02@jaea.go.jp	Member
Yutaka Kamada	JP	kamada.yutaka@jaea.go.jp	Member
Yoshihiko Koide	JP	koide.yoshihiko@jaea.go.jp	Alternate
Kouji Shinohara	JP	shinohara.koji@jaea.go.jp	Alternate
Naoyuki Oyama	JP	oyama.naoyuki@jaea.go.jp	Alternate
Jong-Gu Kwak	KO	jgkwak@nfri.re.kr	Member
Yeong-Kook Oh	KO	ykoh@nfri.re.kr	Member
Jin-Yong Kim	KO	jykim@nfri.re.kr	Alternate
Woong-Chae Kim	KO	woong@nfri.re.kr	Alternate
Steve Eckstrand	US	steve.eckstrand@science.doe.gov	Member
Randy Wilson	US	jrwilson@pppl.gov	Member
Earl Marmar	US	marmar@psfc.mit.edu	Alternate
Punit Gohil	US	gohil@fusion.gat.com	Alternate
Mickey Wade	US	wade@fusion.gat.com	Alternate

Review and Approval of the minutes from the previous meeting.

The chairman reviewed the minutes from the previous meeting and the minutes were adopted.

Reports on the Completed Workshops and Personnel Assignments for Jan. 2011 – Dec. 2011

The Workshop and Personnel Assignments reports were presented by the different parties and adopted.

Proposals for Workshop and Personnel Assignments and Remote Participation for Jan. 2012 – Dec. 2012

The proposal for Workshops and Personnel Assignments were presented by the different parties an adopted with the following comments. The proposals for experiments in DIII-D should be put forward through the respective experiments forum. It was also clarified that the proposals for exchange of personnel from KO to

JP will be conducted under a bilateral agreement not through the CTP-IA. The references to the task numbers in some of the reports were clarified as referring to the list of tasks in the CTP agreement. Regarding collaborations with India, it was stated that collaborations with JET are in preparation and that some other collaborations with the EU are already taking place, such as collaborations with the TCV Tokamak. The legal framework for these ongoing collaborations will be clarified and the respective input documents regarding the collaborations carried out under the CTP-IA will be submitted to the Executive Committee as appropriate.

Regarding the workshops planned for 2012, it was commented that it is difficult to organise further workshops in even years in addition to the already planned joint experiments workshop in Cadarache in December 2012. Nevertheless, it was suggested to organise a workshop on ELMs in 2013.

Discussion on the Annual Progress Report (January 2011 to December 2011) of the Executive Committee

A draft annual report was presented, and commented by the different parties. A number of comments and suggestions were made, including the suggestion to add a reference to the stellarator IA and emphasise the co-ordination of the programme towards ITER in co-operation with other agreements.

The draft report will be further discussed and it will be approved by e-mail within a couple of weeks following the executive committee meeting. The FPCC meeting will take place on 20th January 2012 in Paris. The submission of the report to the FPCC is due at the end of December 2011.

Request for Extension (5 years)

The Chair made a presentation on the process for the CTP-IA 5 year extension request. The 6 year report, the 5 year strategic plan and the criteria questionnaire table need to be finalised by the end of December; and the preparation of these documents were discussed at the meeting. A number of comments were collected and the secretary will implement them and circulate them for approval by e-mail. These include the need to update the documents to reflect the fact that India has joined in April 2011, therefore, a description of the Indian fusion programme is required. Also, an explanation for the closure of the tasks as it was agreed in 2010 is needed. The changes regarding the fact that the new CTP-IA has replaced the LT-IA need to be incorporated. The report from each party needs to be updated taking into account this year's (2011) report.

The answers to the questions on the criteria table need to be finalised. The Chair and the Secretary will finalise draft answers with the help of the Executive Committee members, which will prepare a draft answers according the following allocation. Draft answers to questions A and B will be prepared by Europe; C and D by the US; E and F by Japan; G and H by India; and I and J by Korea. The length of the answers depends on the relevance of the questions, and some of the questions are not relevant to the CTP-IA. It was clear, however, that an extension of 5 years in support of ITER; a long term project should be easy to justify. The justification for the 5 year extension was discussed in a previous meeting in May 2010 and Masahiro Mori will provide a document to all members that include draft answers to the questionnaire. The answers are not complete, but this draft document is a good starting point. It was also clarified that the CTP-IA was extended to the end of June 2012; therefore, an extension is required at the beginning of 2012. The 5 year Work Plan will need also, a reference to the DEMO programme. Jong-Gu Kwak will provide a text on DEMO for the 5 year Work Plan. The description should not be too detailed, since each party has each own specific DEMO road map. This input should be provided by Wednesday 21st December 2011.

Further discussions on any outstanding issues

Migration of the web-page and responsibilities.

The CTP-IA implementing agreement website is now under the responsibility of the EU and it will be hosted at JET, Culham, UK. The new website will be available from January 2012.

Data access to the ITPA public data.

A discussion took place on the data policy for the data from Tokamaks collected under CTP or other bi-lateral agreements. The data belongs to the Tokamaks, but it is proposed that the used of the data will be governed under the terms of the ITER agreement. It was agreed that Yutaka Kamada will distribute a draft document on this matter. This proposal will be submitted for consideration by the CTP-IA executive committee members. The proposal should provide the rational for governing the ITPA data under the ITER agreement. In addition, the members of the CTP-IA will discuss this matter with the legal experts.

Discussion on time and place of next meeting

A proposal was made to have the ITPA Coordinating Committee Meeting, the CTP-ITPA Planning Meeting for Joint Experiments (JEX) and the Executive Committee Meeting of CTP-IA in 3 days, instead of 4 days. This proposal was accepted and the date of these meetings was provisional agreed for the 10-12 December 2012 in Cadarache. This to be confirm after the confirmation of the date of the ITER summer school in India in December 2012.

Chairman's term of office

Steve Ecktrand (US) was elected the new chair for the one year term of 2012.

Summary of the Actions and Decisions

Short term actions in preparation of the FPCC meeting in January 2012:

- Finalise the Annual Report 2011.
- Finalise the documents required for the 5 year extension request, namely, the 6 year report, the 5 year strategic plan and the criteria questionnaire table.

Long Term Actions:

- Check with IEA legal office the possible participation of ITER in the CTP-IA.

Decisions:

- Steve Ecktrand (US) was elected the new chair for the one year term of 2012.
- It was agreed to have the ITPA Coordinating Committee Meeting, the CTP-ITPA Planning Meeting for Joint Experiments (JEX) and the Executive Committee Meeting of CTP-IA in 3 days, instead of 4 days.

Annex 4

Summary Reports on Workshops

The CTP-ITPA Planning Meetings for Joint Experiments (JEX) were held on 13th - 15th December 2010 "Workshop W72" and on 12th -14th December 2011 at the Château de Cadarache "Workshop W73".

Summary of Workshop W72 CTP-ITPA Planning Meetings for Joint Experiments (JEX) 13th -15th December 2010 the Château de Cadarache.

The results of the CTP-ITPA Joint Experiments carried out in 2010 have been reviewed and plans for 2011 proposed. The discussion was summarised in the CTP-ITPA Joint Experiments Mastersheet, which was updated and finalised at the end of February 2011. The Joint Experiments are organised among the ITPA Topical Groups: Transport and Confinement Physics, Divertor/SOL Physics, Integrated Operating Scenarios, Pedestal Physics, MHD, Energetic Particles and Diagnostics. The programme Leaders discussed the proposed list of Joint Experiments, the identification and the implementation of other experiments not on the list. The level of prioritisation and expectation of commitment by each device for the list of proposed Joint Experiments was also agreed.

Summary of Workshop W73 CTP-ITPA Planning Meetings for Joint Experiments (JEX) 12th -14th December 2011 the Château de Cadarache.

Following the same format of previous years the CTP-ITPA Joint Experiments carried out in 2011 and the proposed plans for 2012 were reviewed. In the opening remarks the ITER IO DG O. Motojima stressed the innovations of ITER in Physics and Technology. In the report on the Status of the ITPA activities, Y. Kamada highlighted the ITPA mission to contribute to ITER R&D and the ITER Research Plan and the involvement of 305 scientists from 65 institutes. The results of the ITPA R&D activities have provided a substantial physics basis for the ITER design over the past decade. The ITPA database activities have been fundamental in establishing guiding physics principles for the Tokamak design. Supporting the R&D implemented through the ITPA made an important contribution to numerous aspects of physics analysis during the ITER Design Review such as the Plasma Performance Assessment and Heat and Nuclear Load Specifications. The Topical Group Annual Reports, Joint Experiment Report 2011 and Joint Experiment Proposal 2012 were discussed in detail, according to the usual topics: Transport and Confinement Physics, Divertor/SOL Physics, Integrated Operating Scenarios, Pedestal Physics, MHD, Energetic Particles and Diagnostics. The Programme Leaders discussed the proposed list of Joint Experiments and the implementation of other experiments not on the list; and discussed the level of prioritization and expectation of commitment by each device.