IEA Large Tokamak Cooperation

REPORT FORM to Secretariat (Workshop) (Form C)

Workshop Number: W70

SUBJECT: "Key ITER Disruption Issues"

Date: Oct 7- Oct 9, 2009

Place: Culham Science Centre, Abingdon, UK

Name(s) of attendees: (All names of attendees are listed in the attachment.)

Brief description of the activities in the Workshop W70

The W70 workshop on "Key ITER Disruption Issues" was jointly co-hosted by UKAEA Culham and the EFDA-JET organisation, and was held in conjunction with the 3rd meeting of the ITPA MHD Topical Group. Consideration of disruption related issues is driving several key design issues for ITER and so it was highly timely to hold a workshop on these issues. The workshop was attended by just over 40 participants, and 2 participants from JAEA joined the meeting by teleconference.

The disruption issues identified at the workshop by the ITER IO as requiring most urgent attention include (i) radiation asymmetries during disruption mitigation; (ii) sideways forces from halo current asymmetries; (iii) improvements to the disruption database to include halo current data; (iv) development of improved numerical models for halo currents; (v) limiter heat loads during vertical displacement events (VDEs); (vi) associated with massive gas injection (MGI) mitigation the quantities and species needed to suppress runaways, and the resulting current quench rates; and (vi) other possible control measures for runaway electrons (including resonant magnetic perturbations and killer pellets). Many of the presentations at the workshop were related to these key issues and working groups under the auspices of the ITPA MHD Topical Group were established to tackle several of the most urgent issues.

The workshop was structured around sessions on disruption mitigation, halo currents, disruption statistics and databases, runaways and heat loads, and disruption modelling (the detailed agenda is attached). In the *disruption mitigation session* data was presented on MGI radiation asymmetries in AUG and C-MOD, also very promising first results from the shotgun pellet injector on DIII-D were presented, as were surveys of MGI mitigation results in JET and DIII-D, and the avoidance of disruptions by ECRH application in FTU and AUG. The *halo current session* included updates on results in NSTX and JET, modelling of halo widths in DIII-D, a detailed description of the basis for the wall touching kink mode model including comparisons with JET and projections for ITER, comparisons of halo modelling with the TSC and DINA codes, and a description of halo modelling plans (by the US, Japan and India) for ITER. The *session on disruption statistics and databases* included a novel analysis of root disruption causes in JET, an update on the international disruption database status, and presentations on historical beryllium disruption rates and disruption position excursions in JET. In the *session on runaways and heat loads* there were presentations on runaway control in Tore Supra and in DIII-D (using resonant magnetic perturbations), on modelling the runaway current plateaus in JET, and on the runaway electron wall heat loads in JET. The final *session on disruption modelling* included a presentation on the status of TSC modelling, JT-60SA disruption modelling, M3D halo current modelling, DINA modelling including radiation opacity, and NIMROD modelling of mitigated DIII-D disruptions. The workshop concluded with summary presentations from each session chair.

Overall the workshop discussed the latest results on key disruption issues for ITER and concluded forward plans in the most urgent areas under the auspices of the ITPA MHD Topical Group.

Agenda for IEA Workshop (W70) on Key ITER Disruption Issues

Wednesday 7 October 2009

8.30	Registration	

Opening session

9.00	Disruption Issues	T Hender
9.30	Key ITER issues in disruptions and their mitigation	M Sugihara
10.10	**Coffee**	

Disruption Mitigation Chair **A Isayama**

10.30	Disruption mitigation in AUG and implications for ITER	G Pautasso
11.00	Disruption Mitigation with Shattered Pellets: Applicability to ITER	L Baylor
11.30	First disruption mitigation experiments on DIII-D using the new Shotgun Pellet Injector	N Commaux
12.00	Results from the DIII-D Disruption Mitigation Database	J Wesley
12.30	**Lunch (Culham restaurant)**	
13.30	ECRH to prevent disruptions in FTU and AUG	B Esposito
14.00	Spatial distribution and dynamics of disruption mitigation radiation	B Granetz
14.30	Massive gas injection experiments at JET	M Lehnen
15:00	ITER disruption mitigation by fast injection of massive Li killer pellets	S Mirnov
15.20	**Coffee**	
15.35	Report on Joint Expt MDC-1 (Disruption Mitigation by Massive Gas Jets)	M Lehnen
15.50	Discussion on mitigation issues	Led by A Isayama

Halo Currents Chair **A Sen**

16.30	ITER VDE and disruption modelling with TSC – comparison with DINA results	I Bandopadhyaya
17.00	Update on halo current results	M Sugihara
17.30	Understanding disruptions in tokamaks	L Zakharov
18.00	Scaling JET Disruption Data to ITER	S Gerasimov
18.30	**Close meeting**	

Thursday 8 October 2009

Halo Currents (contd) Chair **A Sen**

8.30	Halo current analysis and simulation of ITER disruption scenarios (Remote)	S Miyamoto
9.00	Disruptions and halo currents on NSTX - update	S Sabbagh
9.25	Halo current modelling and diagnostic plans on DIII-D	N Eidietis
9.55	JET halo currents	V Riccardo
10.20	**Coffee**	

10.45	Discussion on halo current issues	Led by A Sen

Disruption statistics and databases Chair **T Strait**

11.15	A statistical analysis of root causes of disruptions at JET	P de Vries
11.35	Status of the International Disruption Database	J Wesley
12.10	Beryllium wall Ip quench rates in JET	D Howell
12.25	**Lunch (Culham restaurant)**	
13.25	Statistical analysis of plasma position excursions during JET disruptions	M Johnson
13.40	Discussion on statistics and database issues	Led by T Strait

Runaways and heat loads Chair **V Riccardo**

14.10	RE control in Tore Supra	C Reux
14.40	Runaway current plateau scaling during fast disruptive events in the JET Tokamak	J Martin Solis
15.10	**Coffee**	
15.50	Heat loads on JET first wall due to runaway electrons	G Arnoux
16.20	Experiments applying RMP for runaway electron deconfinement in DIII-D	N Eidietis
16.40	Discussion on Runaways and heat loads	Led by V Riccardo

Disruption Modelling Chair **J Wesley**

17.10	TSC disruption modelling	S Jardin
17.40	M3D nonlinear simulations of tokamak disruptions	R Paccagnella
18.10	**Close meeting**	

Friday 9 October 2009

Disruption Modelling (Contd) Chair **J Wesley**

8.30	Status of disruption analysis in JT-60SA (remote presentation)	M Takechi
9.00	DINA analysis of post-disruptive ITER plasma with taking into account of radiation trapping effects	V Lukash
9.30	Disruption mitigation and runaway electron modelling for DIII-D	V Izzo
10.00	**Coffee**	
10.30	Discussion on modelling issues	Led by J Wesley

Summary Session

11.15	Each session chair to present a 15min summary of key progress and issues	
12.30	**Close of workshop**	

List of participants for the IEA W70 workshop (held in conjunction with the 3rd ITPA MHD TG meeting)

Surname	First Name	Party
Arnoux	Gilles	EU
Bandyopadhyay	Indranil	India
Baylor	Larry	USA
Benkadda	Sadruddin	EU
Cavinato	Mario	EU
Chapman	Ian	EU
Commaux	Nicolas	USA
de Vries	Peter	EU
Eidietis	Nicholas	USA
Esposito	Basilio	EU
Gerasimov	Sergei	EU
Granetz	Robert	USA
Gribov	Yury	ITER
Hender	Tim	EU
Howell	David	EU
Isayama	Akihiko	Japan
Izzo	Valerie	USA
Jardin	Stephen	USA
Johnson	Mike	EU
Koslowski	Rudi	EU
Lenhen	Michael	EU
Liu	Yi	China
Lukash	Victor	Russia
Martin Solis	Jose	EU
Matsunaga	Go	Japan
Mirnov	Sergey	Russia
Paccagnella	Roberto	EU
Pautasso	Gabriella	EU
Pustovitov	Vladimir	Russia
Ramos	Jesus	USA
Reux	Cedric	EU
Riccardo	Valeria	EU
Sabbagh	Steven	USA
Sauter	Olivier	EU
Sen	Abhijit	India
Strait	Edward	USA
Sugihara	Masayoshi	ITER
Villone	Fabio	EU
Waelbroeck	Francois	USA
Wang	Xiaogang	China
Wesley	John	USA
Zakharov	Leonid	USA

Remote participants

Surname	First Name	Party
Miyamoto	Seiji	Japan
Takechi	Manabu	Japan

IEA Large Tokamak Cooperation

REPORT FORM to Secretariat (Workshop)
(Form C)

Workshop Number:	**W71**
SUBJECT:	**Eighth Joint Workshop on Large Tokamak, Poloidal Divertor and TEXTOR IA's "Implementation of the ITPA Coordinated Research Recommendations"**
Date:	**15-16 December 2009**
Place:	**KSTAR Research Center (National Fusion Research Institute, Daejeon, KOREA)**
Name(s) of attendees:	(**All names of attendees are listed in the attachment.)**

Brief description of the activities in the Workshop W71

The Workshop was the eighth in the series and was held jointly by the three tokamak-related IEA Implementing Agreements (IAs) and the International Tokamak Physics Activity (ITPA). The ITPA has been operating under the ITER auspices since February 27, 2008. The ITER Science and Technology (S&T) Department was well represented at the meeting with the attendance of the Deputy Director General (DDG) and the Assistant DDG at the meeting, and most of ITPA TG chairs or deputy-chairs attended and reported TG activities with the participation of two TG spoke-persons by televideo from San Diego and Naka. The scope of the workshop was to include discussions of a broad range of ITER physics R&D needs in addition to the planning of Joint Experiments. While recognizing that the ITPA is the most effective international body in place for generating coordinated experiment plans across a wide range of fusion research topics, the Workshop aimed to stimulate and facilitate increased multi-machine Joint Experiments amongst the various tokamak programmes.

The Workshop was attended by ~ 29 participants on site and 2 by televideo from San Diego and Naka, including the Chairs (or Deputy Chairs) and additional ExCom members of the three tokamak-related IEA IA's, the Chair and additional members of the ITPA Coordinating Committee, the Chairs (or their representatives) of the seven ITPA TG's, representatives of the ITER IO, the Programme Leaders representing 12 major world tokamaks (JET, JT-60U, DIII-D, AUG, C-MOD, TCV, Tore Supra, TEXTOR, NSTX, MAST, EAST and KSTAR). Representatives of FTU and the Russian, HL-2A tokamaks were unable to attend the Workshop. Specifically, the Workshop:

- reviewed the status of implementation of the ITPA/IEA coordinated experiments among the major world tokamaks;
- discussed new proposals made by the ITPA which would benefit from coordination of joint experiments among the major world tokamaks; and
- considered the implementation of these proposals on the major world tokamaks and through agreements such as the three tokamak-related IEA IA's.

An oral report from the last Workshop (E. Oktay) was followed by a Report from the ITPA Coordinating Committee Chair (R. Stambaugh) on the status of the implementation of the IEA/ITPA Joint Experiments between the various tokamaks for 2008, a Report on the ITER Research Needs (D. Campbell) and a Proposal from the

ITPA TG's for new Joint Experiments between the various tokamaks for 2010 (R. Stambaugh). The Programme Leaders indicated their level of commitment to the new Joint Experiments. The commitments made by the various tokamak Programme Leaders were confirmed, and consolidated by R. Stambaugh, after the Workshop.

Extra ExCom of the LTA was met to discuss on the new membership to LTA and on the status of the revision of the new draft agreement.

Name	Country	Institute
Campbell, D.	IO	S&T
Chuyanov, V.	IO	S&T
Fasoli, A.	EU	TCV
Giannella, L.	EU	EC
Hawryluk, R.	US	PPPL
Hwang, Y.	KO	SNU
Ide, S.	JA	JAEA
Kaye, S.	US	PPPL
Kim, W.C.	KO	NFRI
Kwon, M.	KO	NFRI
Lee, G.S.	KO	NFRI
Lipschultz, B.	US	MIT(video)
Lloyd, B.	EU	Culham
Marmar, E.	US	MIT
Mori, Masahiro	JA	JAEA
Oh. Y.K.	KO	NFRI
Oktay, E	US	OFES
Park, H.	KO	POSTECH
Ryu, C.M.	KO	POSTECH
Samm, U.	EU	TEXTOR
Saoutic, B.	EU	CEA
Shimada, M.	IO	S&T
Shinohara, K.	JA	JAEA(video)
Stambaugh, R.	US	GA
Strait, E.	US	GA
Taylor, T.	US	GA
Van Dam, J.	US	U Texas
Wan, B.	CN	ASIPP
Watkins, M.	EU	JET
Wilson, H.	EU	U York
Zohm, H.	EU	MPIPP