SESSION ITER

Wednesday, 21 October 1998, at 4.20 p.m.

Chairman: N. Inoue (Japan)

ITER EDA

Paper IAEA-CN-69/ITER/1 (presented by D.J. Campbell)

There was no discussion.

Paper IAEA-CN-69/ITER/2 (presented by R. Parker)

DISCUSSION

R.J. GOLDSTON: The JET team seems quite concerned about a limit of 2% on $\Delta W/W$ at each ELM. Could you comment on this?

R. PARKER: The JET team is correct to be concerned over this level of energy loss per ELM. For ITER, it could mean an unacceptably short lifetime for the divertor armour. The best solution may be to operate in the type II ELM regime, which may be related to the EDA mode found in Alcator C-Mod. More work should be done to elucidate the characteristics of this mode and assess its applicability to ITER.

N. NODA: For the first wall, have you considered applying a low Z in-situ coating on the bare stainless steel surface, such as boronization, which could be more cost-effective than expensive beryllium tiles bonded to stainless steel? If protection against vertical displacement events or disruptions is necessary, stainless steel may be sufficient.

R. PARKER: A stainless steel wall designed for 0.5 MW/m^2 would be quite thin, that is a few millimetres between the plasma and the coolant. Since vertical displacement events could evaporate or melt 1-2 mm per event, such a design would be very risky. Of course, if the first wall heat flux requirement were reduced, the thickness could be increased and the risk of burning through during a vertical displacement event would be correspondingly reduced.

Paper IAEA-CN-69/ITER/3 (presented by J.C. Wesley)

DISCUSSION

Y.K.M. PENG: You referred to an "advanced tokamak" mode example using the ITER designed capabilities and suggested that it might be very difficult to implement. Is this a result of the present design of ITER based on the "first stability" regime, or is it due to the intrinsic difficulties of "advanced tokamak" operation in a more general sense?

J.C. WESLEY: I believe that the difficulties - which centre on the need to obtain a simultaneous combination of enhanced energy confinement, enhanced MHD stability (β_N) and high efficiency and localization for off-axis current drive - are largely generic to reactor-regime tokamaks and to the configuration and parameter limitations that reactor operation imposes on their design.

M.E. MAUEL: Would you comment on the possibilities for plasma rotation control in ITER?

J.C. WESLEY: Up to 50 MW of 1 MeV NBI will probably be available but the final complement of heating/CD systems to be installed remains to be determined, so NBI is not guaranteed. The near-tangential injection geometry provides a rotation/momentum drive source, and variation of the injected power (0-50 MW) will provide a corresponding variation in rotation drive. However, owing to the high beam energy, momentum input is small and hence projected plasma rotation frequencies are relatively low. There is at present no possibility of varying beam injection angle or orientation. Overall, I would say that rotation "control" capabilities will be relatively limited.

Paper IAEA-CN-69/ITER/4 (presented by M. Huguet)

DISCUSSION

C.S. CHANG: A large CS flux swing is needed not only for plasma shaping for advanced mode operation, but also for a robust plasma start-up. With no control capability over stray field, will the CS flux swing as designed be enough for a robust start-up in ITER? I would stress that ECH power cannot be raised too much owing to T_e separation from T_i, which causes runaways - thermal and electrical - and thermal runaways cause plasma collapse!

M. HUGUET: At plasma start-up, stray fields are well controlled by pre-programming the current waveforms in the outer PF coils. At full CS pre-bias, a start-up window with a diameter of 2 m and stray field < 1-2 mT is produced in the vicinity of the outboard limiter. Current waveforms in the PF coils then provide a rate of rise of the vertical equilibrium field of 0.16 Ts^{-1} consistent with the plasma current rate of rise of 0.5 MAs^{-1}. All analysis includes the effect of eddy currents in the vacuum vessel and in-vessel components. We therefore consider that good start-up conditions exist requiring only modest ECH power.

Paper IAEA-CN-69/ITER/5 (presented by R. Haange)

There was no discussion.

Paper IAEA-CN-69/ITER/6 (presented by V.A. Chuyanov)

There was no discussion.