To: Group Leaders/Co-Leaders of U.S. ITPA Topical Groups:

I have attached a list of proposed ITER Physics Tasks during the ITER Transitional Arrangement (ITA) that has been introduced at the International Team/Party Team meeting at Tokyo on July 26. It appears that most of these tasks have been derived from the ITPA High Priority Research Areas. Most of the proposed tasks appear to be in areas in which the U.S. program is extensively engaged in. Some of the request involves evaluation of results and application of codes to ITER relevant conditions. We would like you to review these proposed items in your Topical Group areas and advise us on the following:

1) Which activities is the U.S. program already engaged in and which activities should the U.S. sign up for?

2) What resources beyond those already in the programs would be required to meet the ITER requests in those recommended areas for the U.S.?

3) Which activities would benefit from collaborative effort with other parties?

For those tasks that we can undertake within the existing program funding, please provide information for the task, using the IT format for the Russian tasks listed at the end of the document. (The format indicates December 15, 03 as the end date for these specific tasks).

1.1 Neoclassical Tearing Modes in Inductive Operation (Scenario 2)

1.1.1 Evaluation of NTMs

Scope:

- Evaluation of island onset threshold.
- Calculation of the width of saturated islands.
- Evaluation of the effect of sawteeth on NTMs.
- Evaluation of the effect of pellet injection used for ELMs control and plasma fuelling on NTMs.

1.1.2 Efficiency of far-off axis EC current drive

Scope:

- Benchmarking of the codes calculating efficiency of the far-off axis ECCD.
- Optimisation of the launcher parameters (position of the mirrors and launching angles) to drive maximum current on the flux surfaces $q = 1.5$ and $q = 2$.

1.1.3 Efficiency of NTM control

Scope:

- Calculation of the width of saturated islands with NTM control. Parametric study for given profiles and amplitudes of driven current and width of initial island.
- Development of the requirements to EC current drive.
- Development of the requirements to diagnostics used for NTM control.

1.2 Resistive Wall Modes in Non-inductively Driven Plasma (Scenario 4-like)

1.2.1 RWM control

Scope:

- Calculation of dependence of RWM growth rate on the degree of its instability C_β with different pressure profiles. The parameter C_β is defined as follows:

$$C_\beta = \frac{\beta_N - \beta_N^{\text{no wall}}}{\beta_N^{\text{ideal wall}} - \beta_N^{\text{no wall}}}.$$

- Evaluation effect of the blanket modules on the RWM growth rate.
- Evaluation effect of the vacuum vessel ports on the RWM growth rate.
- Study of RWM control with 3D model of feedback coils (side correction coils). Comparison with 2D model.

- Study of RWM control with feedback coils located inside equatorial ports.
- Production of transfer functions describing evolution of RWM in the presence of active control.
- Optimisation of algorithms for RWM feedback control using the transfer functions obtained in numerical simulations of the open loop system.

1.2.2 Effect of plasma rotation on RWM

Scope:

- Development of the theoretical models describing effect of plasma rotation on RWM.
- Calculation of critical plasma rotation stabilizing RWM (including estimation of the viscosity expected in non-inductively driven plasma).
- Evaluation of the effect of plasma rotation on RWM instability growth rate and its feedback control.

1.2.3 Effect of error fields on RWM

Scope:

- Development of the theoretical models describing effect of error fields on RWM.
- Criterion on error field.

1.2.4 Diagnostics for RWM control and background noise

Scope:

- Development of the requirements to diagnostics used for RWM control.
- Development of the model of background noise expected in ITER sensors used for RWM diagnostics.
- Evaluation of the effect of background noise on RWM feedback control.
- Development of the scenario of currents in side correction coils for the AC losses study.

1.3 Disruptions and their mitigation in Inductive Operation (Scenario 2)

1.3.1 Disruption simulations

Scope:

- Simulations of disruptions (central disruptions and VDEs) with codes validated in experiments.
- Transport simulations during VDEs including impurity generation / transport / radiation loss for the assessment of beta drop during VDEs.
- Codes development towards more realistic models (e.g. blanket modules, 3D halo currents, etc.).

1.3.2 Disruption mitigation by gas injection

Scope:

- Simulation of disruption mitigation by gas injection.
- Design requirements to the system of disruption mitigation.
- Effect of the radiation, produced during gas injection, on the first wall and diagnostic system.
- Production of a detection and control algorithm for the disruption mitigation.

1.4 Plasma control

1.4.1 Control of separatrix separation in Inductive Operation (Scenario 2)

Scope:

- Synthesis of control algorithms and their validation in simulations of simultaneous control of plasma current, shape of the inner separatrix and minimum distance between the inner and outer separatrices.

1.4.2 Multivariable kinetic control

Scope:

- Development of control algorithms and their validation in simulations for simultaneous control of several plasma parameters in ITER. In particular control of fusion power (or Q) with limitation on plasma density, β_N and power to divertor using as actuators power of additional heating, rate of DT fuelling and rate of impurity puffing.

1.4.3 ITER Magnetic Control Simulator

Scope:

- Development of a user friendly code on the basis of free boundary plasma equilibrium code (i.e. DINA) code for simulation of ITER plasma magnetic control in MATLAB environment (ITER Magnetic Control Simulator).
- Validation of the basic code in experiments on plasma magnetic control.

1.5 Plasma transport simulations

1.5.1 Revision of ITER steady state scenario

Scope:

- Plasma transport simulations with the goal to improve ITER steady state scenarios.

1.5.2 ITER Transport Simulator

Scope:

- Development of a user friendly code for simulation plasma transport processes and kinetic control in ITER scenarios (ITER Transport Simulator).
- Development of modules for plasma core, pedestal and divertor for self-consistent integrated simulations.

1.6 Divertor

1.6.1 Divertor operation in transient processes

Scope:

- Simulation of divertor operation in transient processes. Input for the model used in the study of kinetic control.

1.7 Edge pedestal and ELMs in Inductive Operation (Scenario 2)

1.7.1 Edge pedestal

Scope:

- Assessment of the pedestal width and height.

1.7.2 ELMs simulation

Scope:

- Development of the model of ELMs expected.
- Assessment of the energy loss during ELM.
- Evaluation of the gas influx after ELM.