EFFECT OF MASSIVE GAS INJECTION ON TRANSPORT PROCESSES IN PLASMA OF T-10 TOKAMAK

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On modern plasma machines, active research is being conducted on the problem of controlled and smooth quenching of a plasma discharge in order to develop a technology to prevent uncontrolled plasma disruptions in ITER and other machines of a reactor scale. A contribution to these studies was also made by work previously performed on the T-10 tokamak [1].

High reliability and redundancy are important for plasma quench systems, since even a single disruption can lead to significant damage to the reactor camera. Many technologies developed on modern tokamaks cannot be applied at ITER without modification for the conditions of high neutron fluxes and remote maintenance. The capabilities of such systems as the vacuum system of the reactor, the tritium cycle, the protection units of neutral beam injectors and diagnostics should also be taken into account.

On the T-10 tokamak, four plasma perturbing systems of gas and pellet injection [1,2] could be used to study the plasma disruption: a massive gas injection system using the PMGI-7 movable gas valve, a stationary impulse gas valve, injectors of solid hydrogen and impurity pellets.

The report discusses how to use active systems in different ways for initiating a disruption and in its three successive phases: thermal quench, the early current quench and the late current quench. In order to initiate a disruption, injection into the plasma core regions with the help of hydrogen or impurity pellet injector is preferable. The similar situation is for the plasma thermal energy output during thermal quench. At the early current quench, the purpose of the injection is to prevent the formation of runaway electron beams; into a cold plasma after a thermal quench, it is preferable to use a massive gas injection using a movable valve located close to the plasma. In the final quench phase, a multiple massive gas injection is used to suppress the still-arisen runaway electron beams.

The report presents the results of quench simulations in the T-10 tokamak, including discharges using active systems to impact on plasma. Using the code ASTRA [3], the effect of gas injection on thermal quench was considered.

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References

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