MODERN DIGITAL CONTROL OF NUCLEAR REACTOR’S POWER

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Nuclear reactors are high responsibility technology (HRT), i.e. high performance technology with respect to the safety level. On the other hand, they are also complex dynamic systems. The complex dynamic systems are systems having non-linear static characteristics and are described by differential equations with time-varying parameters.

One of the main control channels in the reactor is the power control channel. The power output of the nuclear reactor is adjusted by varying the neutron flux in the reactor core. This is ensured by controlling the position of the control rods made of a neutron poison.

The control system of the neutron flux refers to a complex dynamic system. It consists of elements with non-linear characteristics: a floating actuator and a regulatory device. Thus, the group of reactivity control rods for controlling reactivity in a reactor core and the reactor itself are the complex dynamic system. Nowadays control systems for the position of the control rods are based on relay or pulse relay controllers.

The neutron flux control system should have a minimum overshoot with the smallest settling time. Using typical controllers, this is difficult. Improving the control systems performance in order to increase safety is relevant. It requires considering the use of modern control theory, such as the model predictive control (MPC) methodology [1]. This paper proposes a study of the transients in the control loop of the neutron flux, using both digital controllers [2] and the above described approaches, by means of a priori simulations. It is shown that, in this latter case, the number of the actuator inclusions of the control rods is smaller compared to relay or pulse relay controllers.

REFERENCES

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