International Summer School 2013

Selected issues of safety engineering and exploitation of nuclear power plants in the context of EU energy policy

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nuclear reactor simulator

" The investigation and analysis of the main reactor parameters variation during perturbations and accident situations part I"

Laboratory is devoted to simulate and analysis of the main reactor parameters variation during abnormal perturbations and accident situations.

Exercise 1. Pressurizer operation

This is a test of the Pressurizer for reactor pressure set-point control. The user can enter a new set-point value of the reactor pressure, different from the panel indicated, and the pressurizer will respond to reach the desired value.



Figure 1. Interface of the nuclear power plant simulator with complete set of working parameters

Please click at "M" for manual control for **Pressurizer/Press Stpt** in the lower right reactor control panel and enter the new set-point value of the reactor pressure, as follow:

a) 140 Kg/cm²

b) 155 Kg/cm²

Then the system will evolve into a new stabilized status corresponding to that condition. After the new value has been entered, please observe the following parameters:

- a) Pressure RCS, Flow Pressurizer Spray,
- b) Pressure RCS, Power Pressurizer Heater.

To get results of this transient, please click the upper tool bar's "View" or lower tool bar's "Plot" and select the parameters, the transient plots you want to obtain for.



Figure 2. Changes of flow pressurizer spray and power pressurizer heater

Exercise 2. Uncontrolled Moderator Dilution

This is an event characterized by an inadvertent addition of unborated water into the reactor coolant system via the reactor makeup portion of the chemical and volume control system. This has the effect of adding reactivity to the reactor and results in reactor trip on high OPDT.

The power and RCS temperature will be increasing until the high power scram setpoint is reached in approximately 350 seconds. High Pressure injection soon follows the reactor trip in order to maintain pressurizer level. The plant trip automatically shuts off steam supply to the turbine and if outside power is available, the steam dump valves open permitting steam dump to the condenser.

To initiate uncontrolled moderator dilution event, please select malfunction #14 (Moderator Dilution) from the malfunction list in the upper tool bar's "Code Control".

In order to obtain the specified reactivity insertion rate $1.5 \cdot 10^{-5}$ _k/sec, please set the malfunction parameters as follow:

- delay time: 10 seconds
- ramp time: 500 seconds
- failure fraction: 50%

The proposed parameters to be observed are as follow:

a) Power Turbine Load, Power Core Thermal,

- b) Flow SG A Steam, Flow SG A Feedwater, Pressure SG A,
- c) Temperature RCS Average, Temperature Cold Leg A, Temperature Hot Leg A,
- d) Pressure RCS, Level Pressurizer, Flow HPI,
- d) Reactivity Soluble Boron, Reactivity Mod Temperature, Reactivity Fuel (Doppler).

Please use a transient plots to get the response of the key parameters to the dilution accident.



Figure 3. Changes of power core thermal and power turbine load during uncontrolled moderator dilution