## Lösenord: APROS_2023

## TASKS:

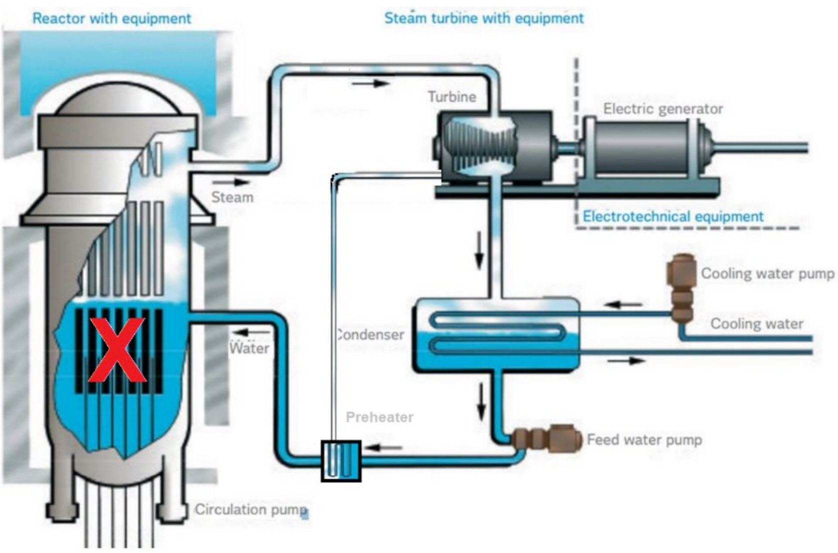
1- Consider the following two scenarios,
2- Describe briefly how you do expect the system to behave during each transient. (how the parameters that you consider to be relevant such as power, pressure, flowrates, void, levels, temperatures, etc. will change?)
3- Send a report with your prediction and explanation for these cases to me.
4- As soon as I receive your report, I will send the password for the file "SH2705_2023_Alt-exam-plots" containing plots of different parameters to you.
5- Study the graphs of the event and compare the results with your prediction, is everything according to your prediction? If not explain what you think is the reason for these discrepancies.
6- Complete your report, prepare a presentation for us to have a zoom meeting for final questioning and grading.
7- You need to send your reports to me before July 27$^{th}$ and have your presentation before July 29$^{th}$ if you need your credits to be registered before July 31$^{st}$.

## The model

The reactor is a generic Nordic Boiling Water Reactor (BWR), with a core length of 3.7 meters and a nominal power at 2500 MW. The neutron flux is approximated with 2 energy groups (i.e. fast and thermal neutrons) using the diffusion approximation. The time dependent behavior of the reactor is referred as the reactor dynamics and consist of 6 delayed neutron feedbacks. Decay heat is simulated by the ANSI/ANS-5.1-1979 standard. This decay heat is correlated to the nominal power. The reactor simulation model is constructed with several scramming mechanisms, some directly coupled from accident initiating events, and other by deviations of key process parameters. Values for different plant parameters and SCRAM limits are as follows

| **Parameter** | **Value** |
|---|---|
| Power | 2500 MWth |
| Pressure steam dome | 70 MPa |
| Recirculation flow rate | 7800 kg/s |
| Feedwater flow rate | 1350 kg/s |
| Water level above the core | 4.3 m |
| Feedwater temperature | 185° C |
| Safety Release Valves flow rate | 1200 kg/s |
| **Property** | **SCRAM limit** |
| High nominal power | 106 % |
| Low coolant level | > 3.1 m |
| High coolant level | < 5.0 m |
| Steam Pressure | > 7.4 MPa |
| Wetwell liquid temperature | > 35° C |

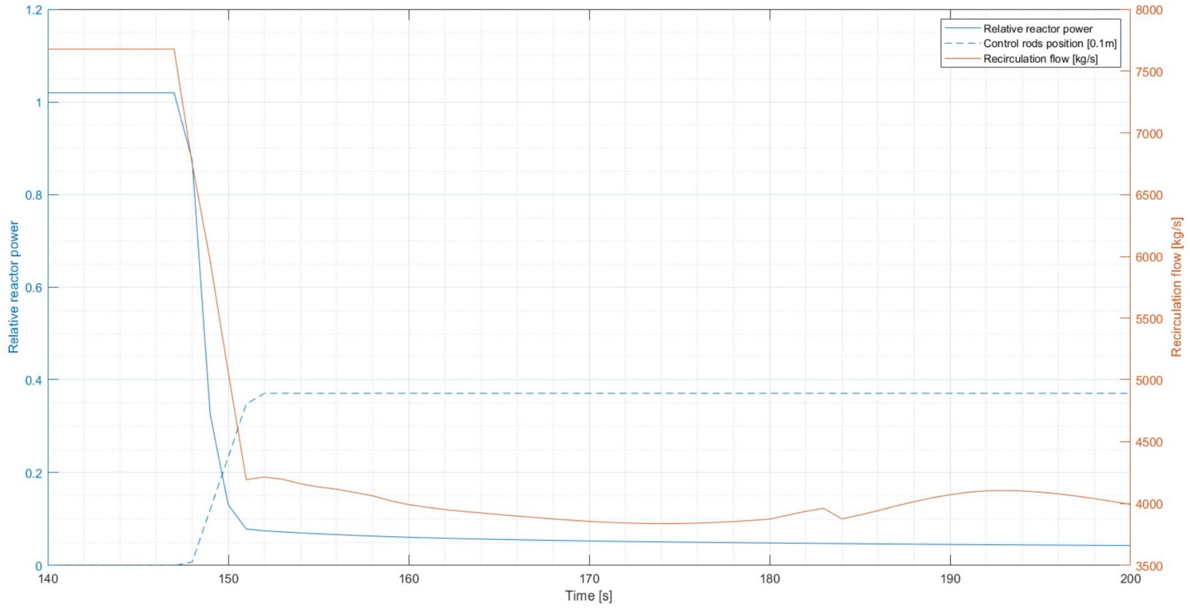
## Case 1- Manual activation of the reactor SCRAM

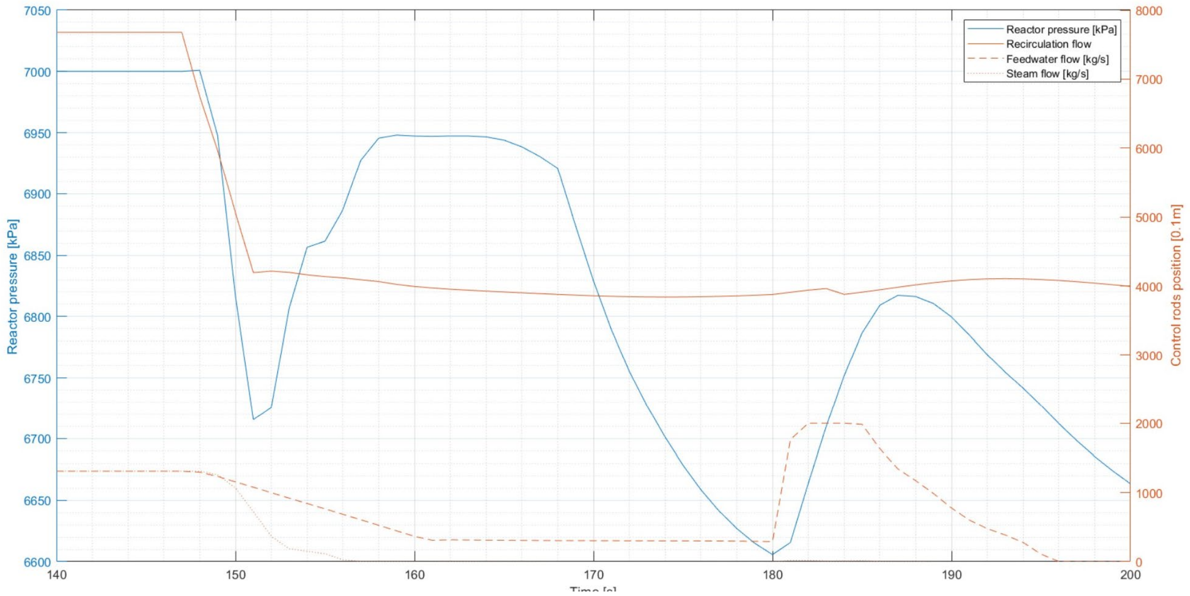


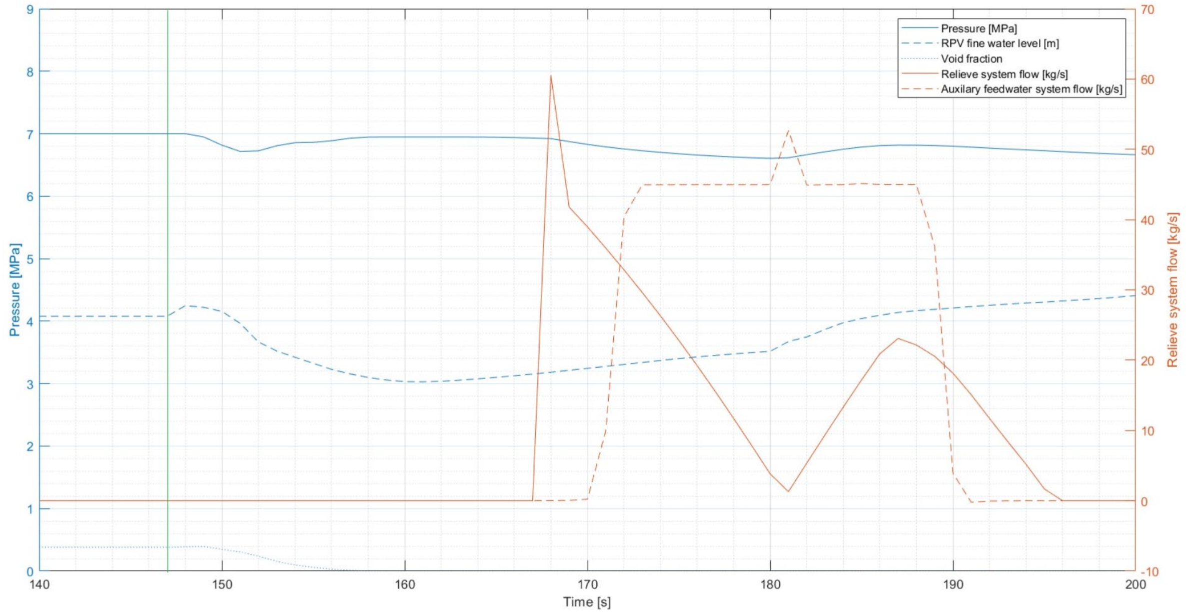

Assume that the reactor is manually scramed by operators during normal operation at nominal power.

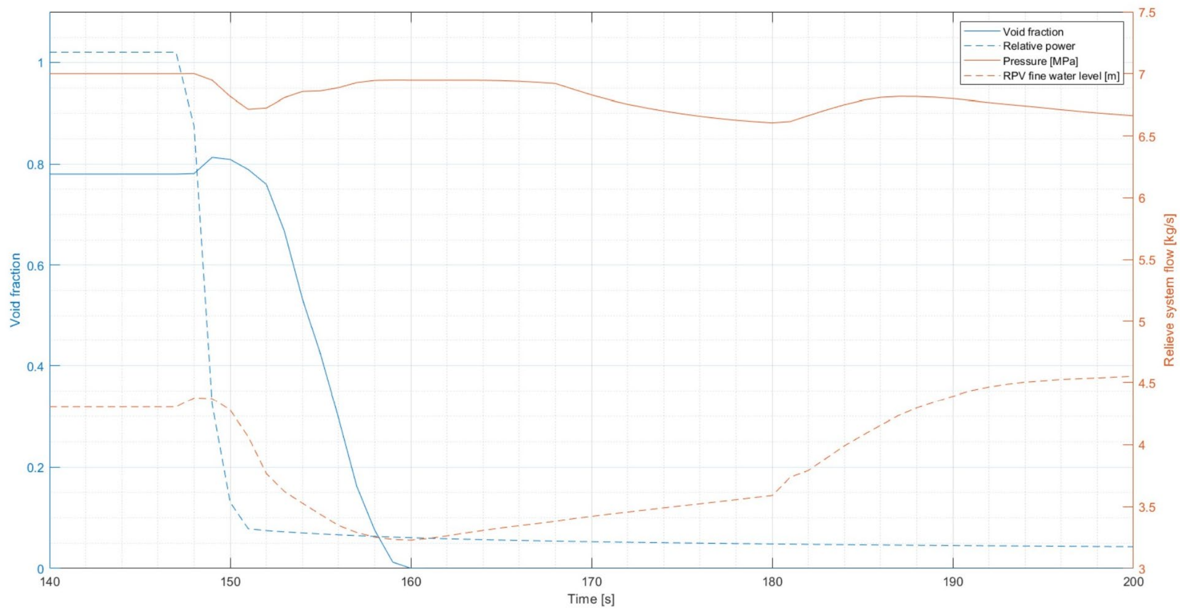
Contemplate what will happen with the system? How will the power and pressure behave? How will the main recirculation flow, feed water flow, steam flow, void and water level in the vessel change? what will happen to the auxiliary feed water system and ADS system?

| Time | Event |
|---|---|
| 00:00 | Steady state |
| 01:27 | SCRAM activated |
| 01:29 | Steam line isolation valve are closed |
| 01:35 | Turbine trip |
| 01:47 | ADS activate |
| 01:57 | Auxiliary feed water activates |

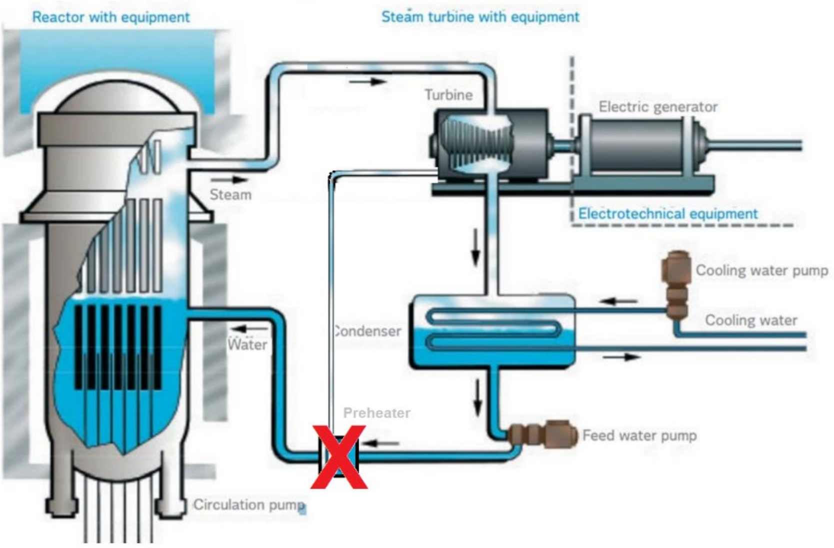



Pressure [MPa]
RPV fine water level [m]
Void fraction
Relieve system flow [kg/s]
Auxilary feedwater system flow [kg/s]
Pressure [MPa]
Relieve system flow [kg/s]
Time [s]


Void fraction
Relative power
Pressure [MPa]
RPV fine water level [m]
Void fraction
Relieve system flow [kg/s]
Time [s]

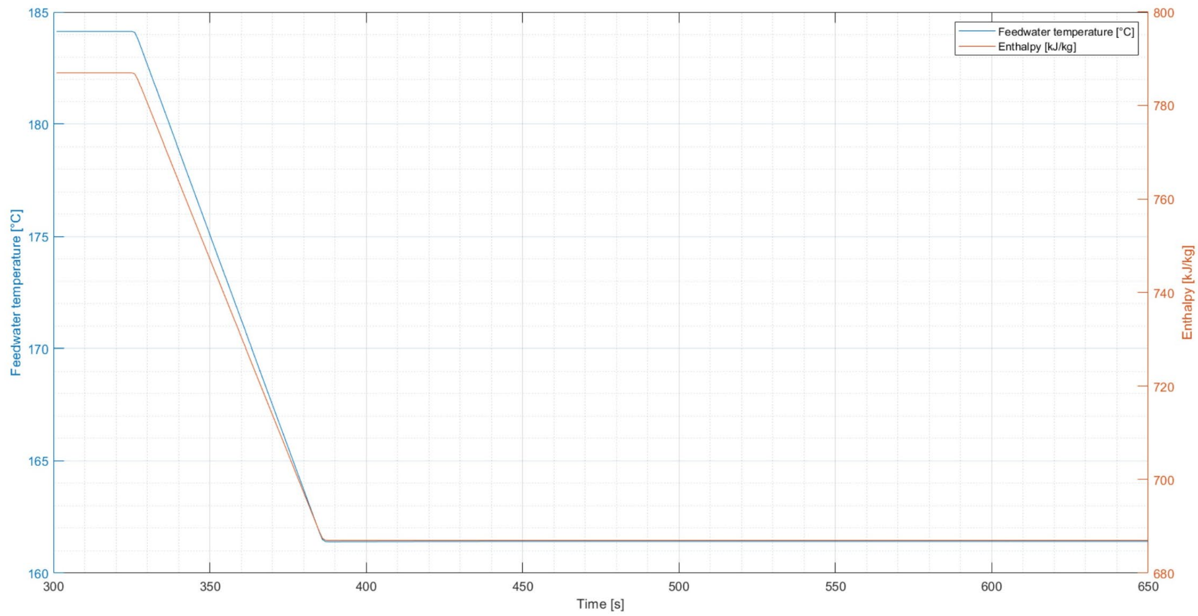
## Case 3- Feed water enthalpy decrease

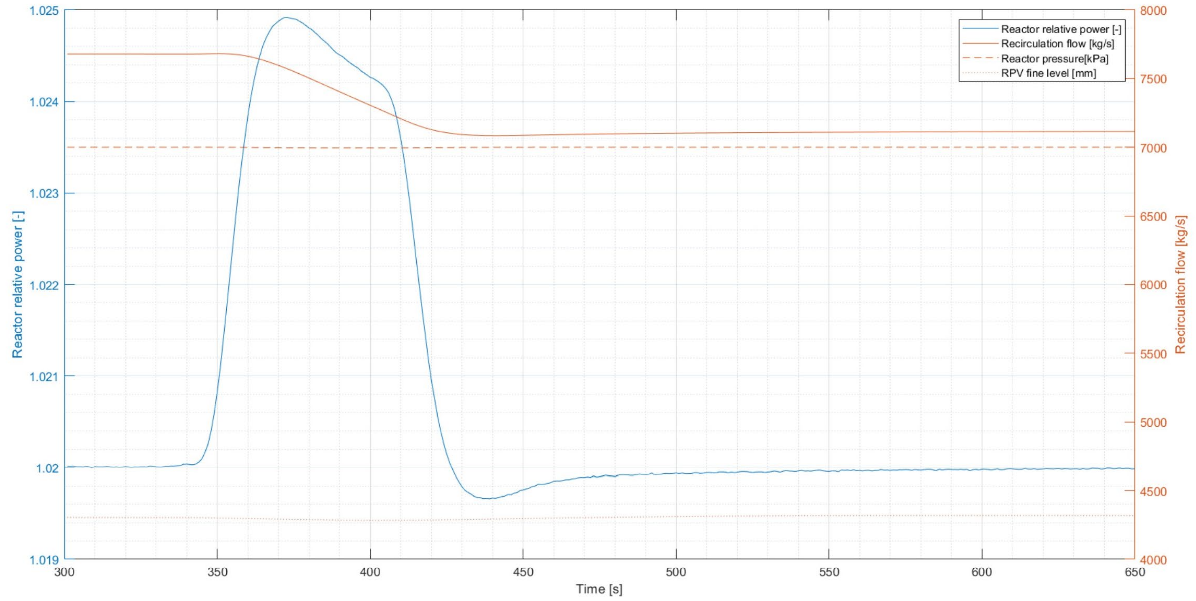


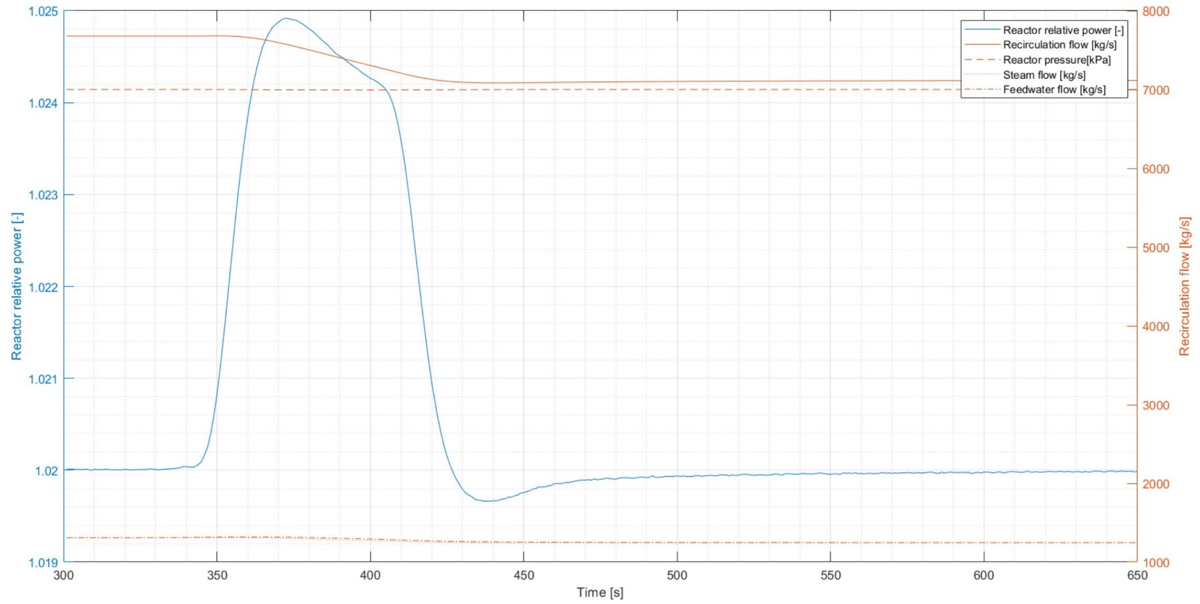

Consider loss of feedwater preheaters during normal operation at nominal power which will results in reduction of the temperature in the feedwater. We assume a very slow rate of temperature decrease from 185◦C to 161.5◦C. during 60 seconds to avoid scram. (consider the Oskarshamn 2 1999 event)

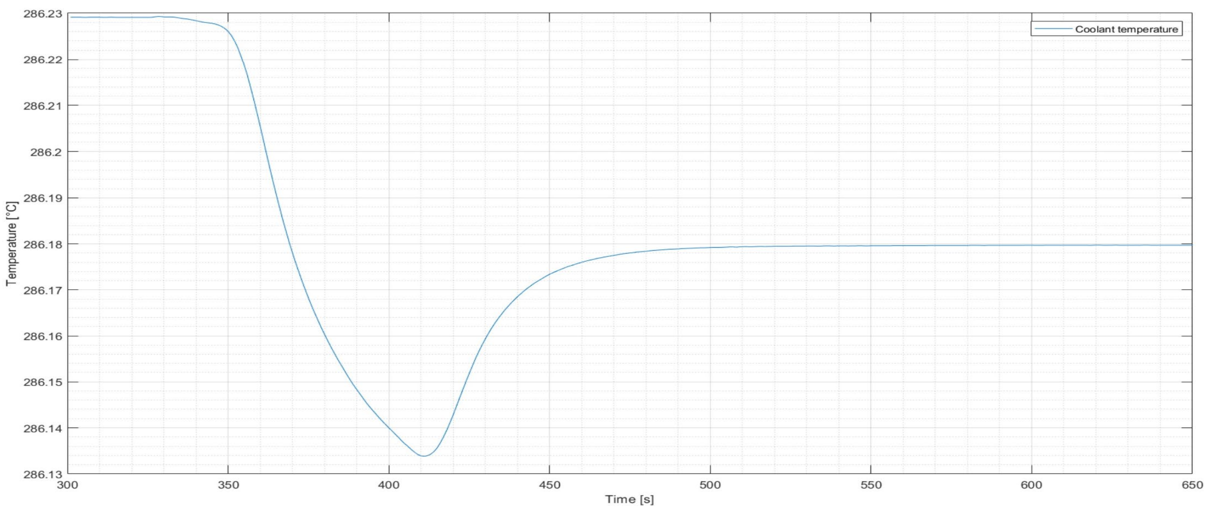
Contemplate what will happen with the system? How will the power and pressure behave? How will the main recirculation flow, feed water flow, steam flow, void and water level in the vessel change? what will happen to the auxiliary feed water system and ADS system? Will this effect the coolant temperature in the core? If yes to which extent?

| Time | Event |
|---|---|
| 0 s | Steady state |
| 326 s | Loss of preheater |
| 343 s | Steam line isolation valve are closed |
| 372 s | Turbine trip |
| 386 s | Feedwater temperature reaches the new setpoint |
| 460 s | New steady state is reached base on the new feedwater temp. |




Reactor relative power [-]
Recirculation flow [kg/s]
Reactor pressure[kPa]
RPV fine level [mm]
Reactor relative power [-]
Recirculation flow [kg/s]
Time [s]


Reactor relative power [-]
Recirculation flow [kg/s]
Reactor pressure[kPa]
Steam flow [kg/s]
Feedwater flow [kg/s]
Reactor relative power [-]
Recirculation flow [kg/s]
Time [s]


Coolant temperature
Temperature [°C]
Time [s]