# The Bistable flow in a Nuclear Power Plant. A bifurcation in the fluid flow in the recirculation loop, modelling and simulation.

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## ABSTRACT

In boiling water reactors, where there are coolant recirculation systems, using recirculation pumps and jet pumps, there are problems of changes in the value of the flow, with no apparent reason and with no change in operating conditions. This phenomenon is called bistable flow because the flow rate fluctuates between two values.

This phenomenon has been widely studied, because of the implications on the efficiency of nuclear power plants and to prevent problems in thermal and power limits of the reactors. The results of recent studies carried out are:

- The phenomenon can be considered as a transition induced by turbulence.[2]
- Resonance character is consistent with that approach.
- The bistable flow is related with the geometry of the recirculation pipes. (cross pipe).[1]

In this work a CFD simulations was done and, two solutions for the same set of initial conditions were calculated. This situation is estimated a bifurcation in the Navier-Stokes equation in the geometry and with the boundary and initial conditions of the plants.

The solution has been studied and one is associated with the low flow rate and the other with the high flow rate. The low flow rate presents a swirling behaviour inside the pipes, so the pressure drop is higher and thus the energy looses. The high flow rate is a fully developed turbulent flow with no structure. Other results of the flow rate signal analysis is that the low flow rate situation is a resonant situation, with a inner frequency. The high flow rate situation has no dominant frequencies. The analysis of the autocorrelation function of the low and high flow rates, shows that there is a structured phenomenon for low flow and there´s no structure in the high flow rate situation. These results confirm the presence of static vortex in the low flow rate situation and fully developed turbulence and chaotic behaviour in the high flow situation.

The difference in the present work is that the analysis is done about the inner structure of the flow, and not about the structure of occurrence or the oscillation frequency [3]

## REFERENCES

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