FLOWNEX®
SIMULATION ENVIRONMENT

# FLOW BALANCING

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## NUCLEAR POWER INDUSTRY

## CUSTOMER PROFILE:

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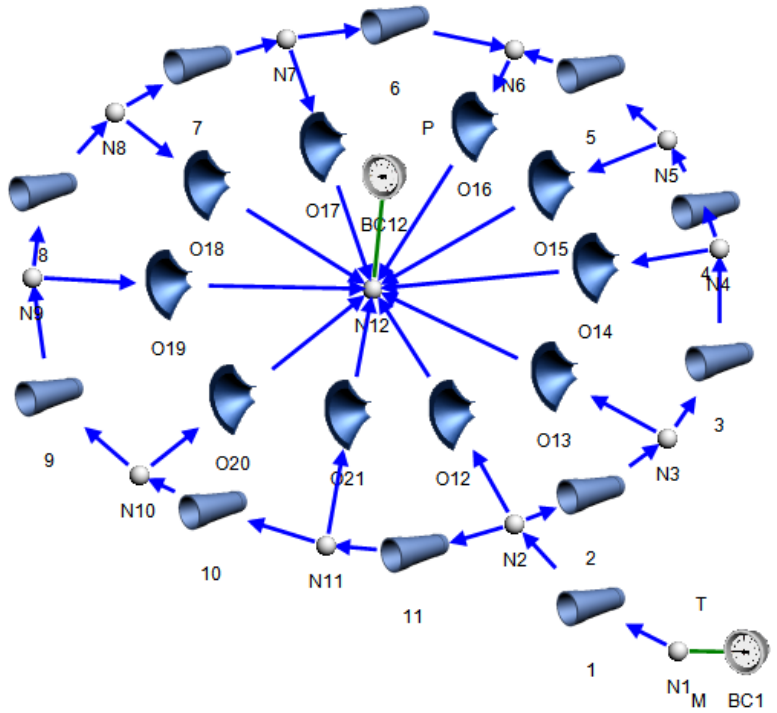
## BENEFITS:

- Quickly determine resistance requirements to ensure balanced flow, i.e. Orifice sizes, valve openings and pipe diameters.
- Ensure equal flow distribution in branching systems.
- Flownex solves for conservation of momentum in a system, this ensures flow distribution in various branching lines is calculated by the solver.

## SOLUTION:

The results show that the flow distribution will be acceptable for all flow rates envisaged during the operation of the water jacket.

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## INTRODUCTION

This case study demonstrates the flow balancing that was investigated as part of the design of a water jacket. The water jacket is used to cool a cylindrical test section that forms part of a highly specialized experimental facility.

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## SYSTEM DESCRIPTION

The configuration considered in this example is shown in Figure 1.

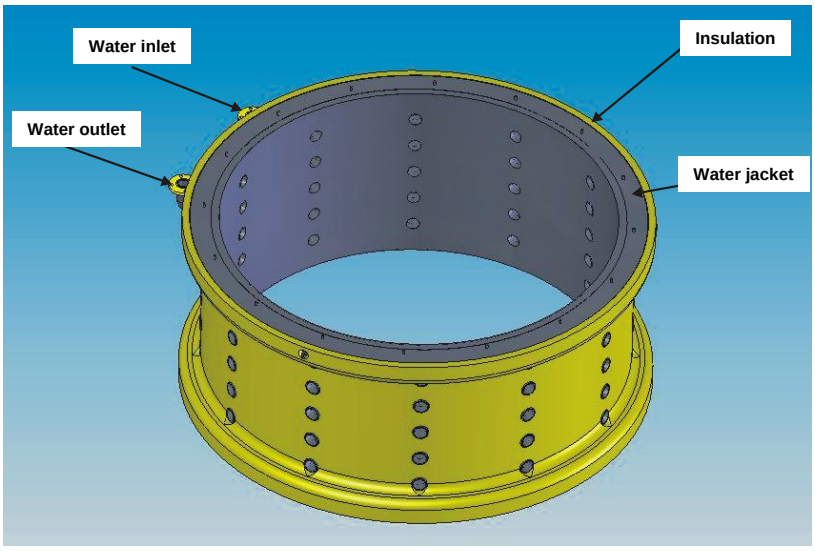


Figure 1: Solid model of the water jacket layout.

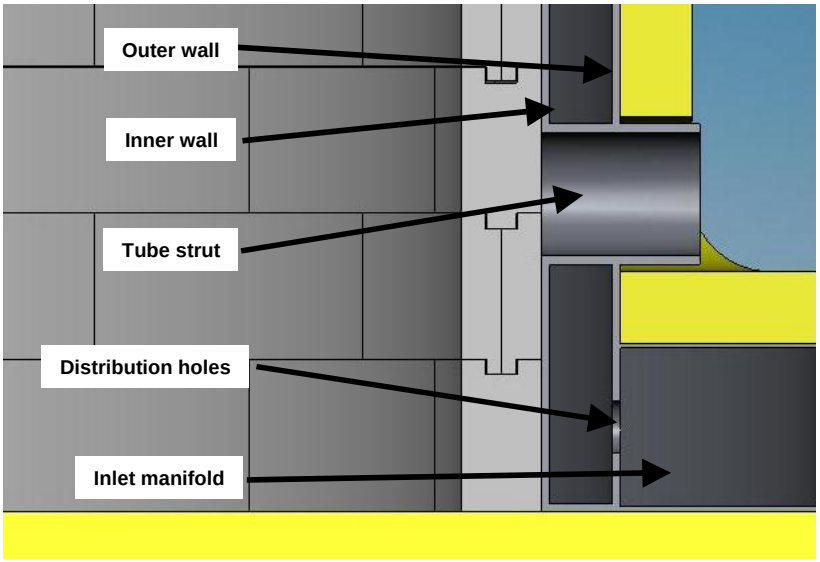


Figure 2: Detail of the inlet manifold and water distribution holes around the circumference.

The water jacket consists of two co-axial large-diameter stainless steel walls kept apart by several short tube struts welded onto the respective walls. The radius of the inner wall is 1.2 m. The water jacket is fitted with an inlet manifold at the bottom with a cross-sectional area approximately equal to that of a 100 mm diameter pipe. The detail is shown in

Figure 2. The cooling water enters via a single inlet pipe on the manifold and is distributed around the circumference via ten distribution holes with 25 mm diameter. The cooling water flows upwards between the walls and around the struts and leaves the water jacket via the outlet manifold at the top through a single outlet pipe.

## OBJECTIVE OF SIMULATION

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## FLOWNEX MODEL

The Flownex model of the system is shown in Figure 3.

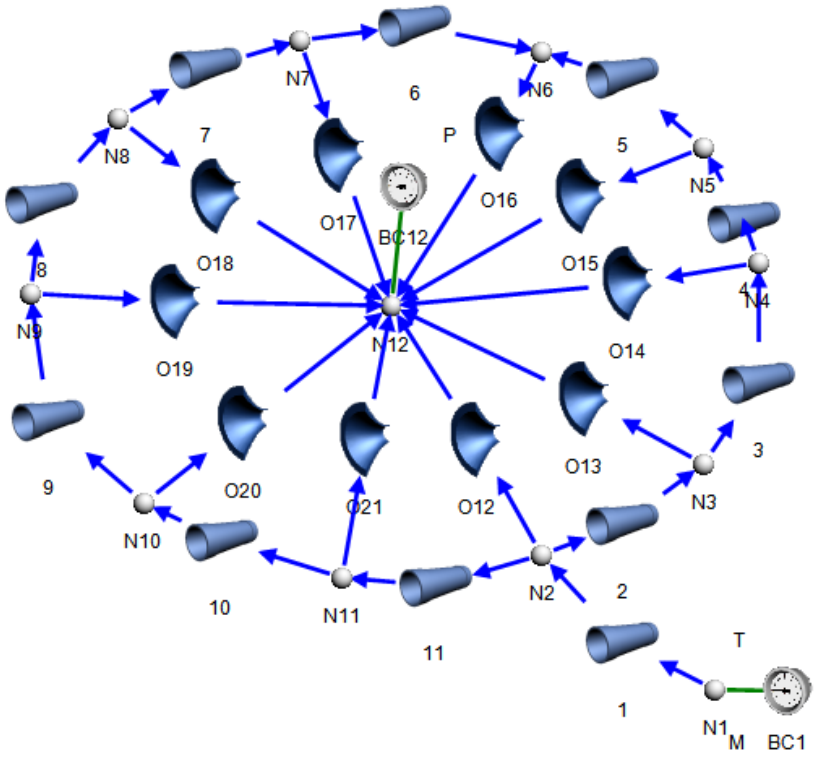


Figure 3: Flownex network of the water jacket inlet manifold and distribution holes.

Node 1 represents the connection to the manifold from the cooling water supply system. Node 2 is situated inside the manifold. Pipe elements 2 to 11 represent the inlet manifold itself, with each section having a length of approximately 750 mm. The flow distribution holes are represented by the orifices elements 12 to 21. Node 12 represents the bottom of the water jacket between the two walls for which a uniform pressure distribution is desired.

## DESCRIPTION OF SIMULATION

The absolute pressure within the manifold of 300 kPa is specified as the boundary value at Node 12. The total mass flow rate is specified as the boundary value in the form of a mass source at Node 1. The simulation was done for various different flow rates from 3.0 kg/s down to 0.05 kg/s as it may vary during the operation of the water jacket.

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## RESULTS

Figure 4 shows the results of the simulations in term of the percentage deviation in flow rate at the different openings for various different total flow rates. From the results it is clear that the higher the total flow rate, the smaller the deviations, i.e. the more evenly distributed the flow will be. It also shows that for total flow rates above 0.25 kg/s the maximum deviation will be below one percent. At very low flow rates the maximum deviation is still below five percent.

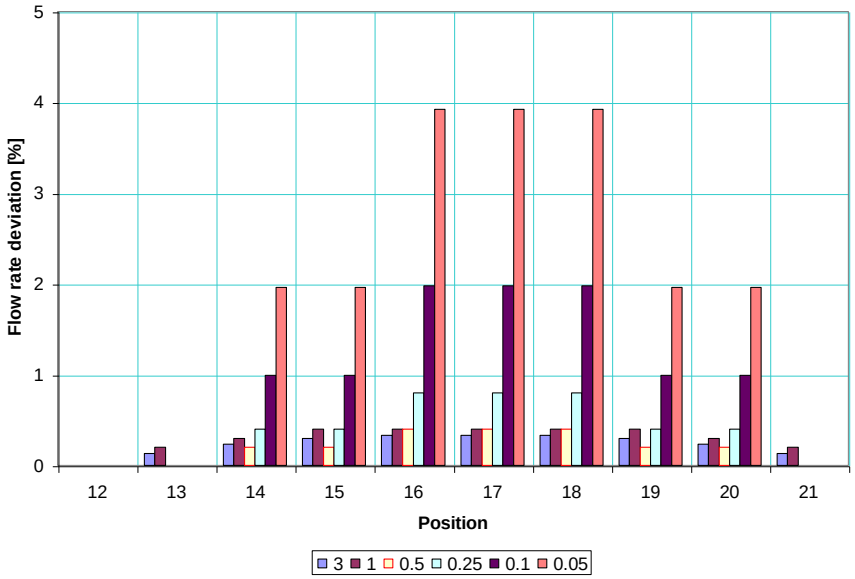


Figure 4: Simulated deviation in flow rate at the different openings for various different total flow rates.

## CONCLUSION

The results show that the flow distribution will be acceptable for all flow rates envisaged during the operation of the water jacket.

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