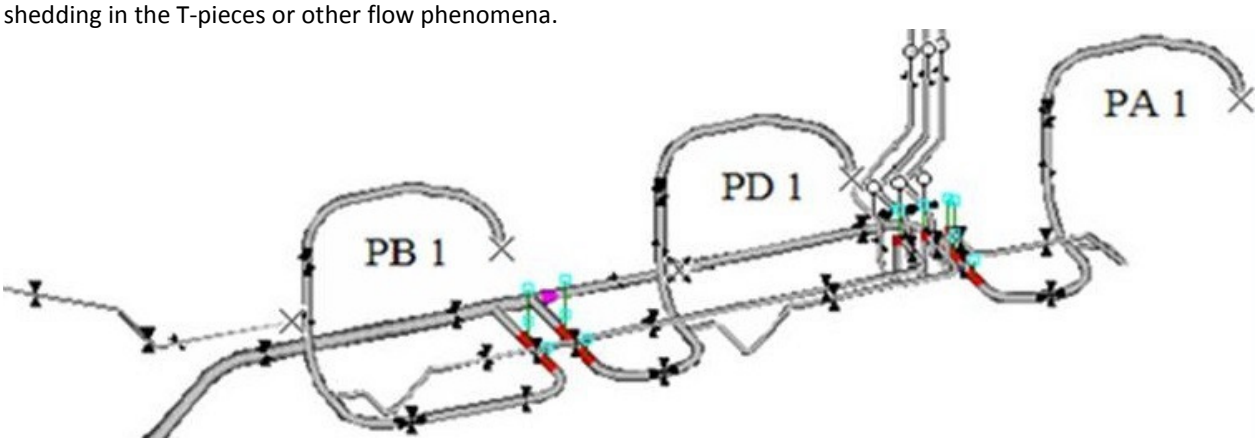
FS Dynamics is a focused and independent consultancy company providing highly skilled competence within fluid- and structural dynamic analysis. We are recruiting excellent engineers with equality and diversity in mind and can offer our employers competence development, a work environment surrounded by satisfied and motivated colleges at the leading consultancy company within technical calculations.

Master Thesis work about

Using CFD to investigate cause of vibrations in feed water system

FS Dynamics has a well-developed cooperation with Swedish and Finnish nuclear power industry where FS Dynamics contributes with experience and deep theoretical knowledge within various simulations. One of the Swedish nuclear plants has problems with vibrations close downstream of the feed water pumps, causing deformed and broken supporting stays. The feed water system has three pumps connected in parallel, where one is connected straight on the main pipe and the other two connects through two T-pieces next to each other, see figure below. At normal operation two of the pumps are running while the third is in stand-by. At the moment the two pumps connected to the T-pieces are running and both high and low frequency vibrations are observed. A possible cause to the vibration is standing waves in the system caused by vibrations produced by the pump or flow-induced oscillations from vortex shedding in the T-pieces or other flow phenomena.



The idea of the present Master Thesis proposal is to analyze the conditions in the system in three steps from large system scale to small local scale. First a system model is built including all relevant pipes and components and thermo-hydraulic (1D) simulations are performed for different configurations of two pumps running and one in stand-by. The simulations are performed for normal operation and the blade-passing frequency is included. In the second step an intermediate model is prepared including some pipe length before and after the two T-pieces where the second and third pump is connected to the main pipe. Steady-state (3D) RANS (CFD) simulations for one or several pumping configurations are performed. Results from the thermo-hydraulic simulations are used as boundary conditions. The main reason for the RANS simulations is to supply boundary conditions for the local study in step three where the two T-pieces are modeled and detailed time-resolved LES is performed in order to study possible vortex shedding. If clear frequencies from vortex shedding are found, the analysis in the first step is re-run with a source of oscillations at the tees.

Since the cause of the vibrations is unknown, the project plan may change as the work proceeds if new insights in the vibration problems are done. However, in order to keep a high education level of the Master Thesis project all three methodologies (thermo-hydraulics, RANS and LES) will be performed in the project. The project is of a high technical level and if it is successful it will be of great benefit within the nuclear power industry.

Outline of the project:

1. Literature study of previous work regarding vibrations and analysis methodology.
2. Build system model and run thermo-hydraulic simulations with Relap5.
3. Build intermediate CFD-model and perform RANS simulations.
4. Build local CFD-model and perform LES.
5. Evaluate the results from thermo-hydraulics and CFD.
6. Summary in report.

The assignment is suitable for one student with genuine interest of technical simulations within fluid dynamics. The assignment is done at FS Dynamics's office in Stockholm at supervision of two experienced engineers within CFD and thermo-hydraulics.

Ori Levin, PhD
Manager Fluid Dynamics Stockholm

Phone: +468-410 532 65
E-mail: ori.levin@fsdynamics.se