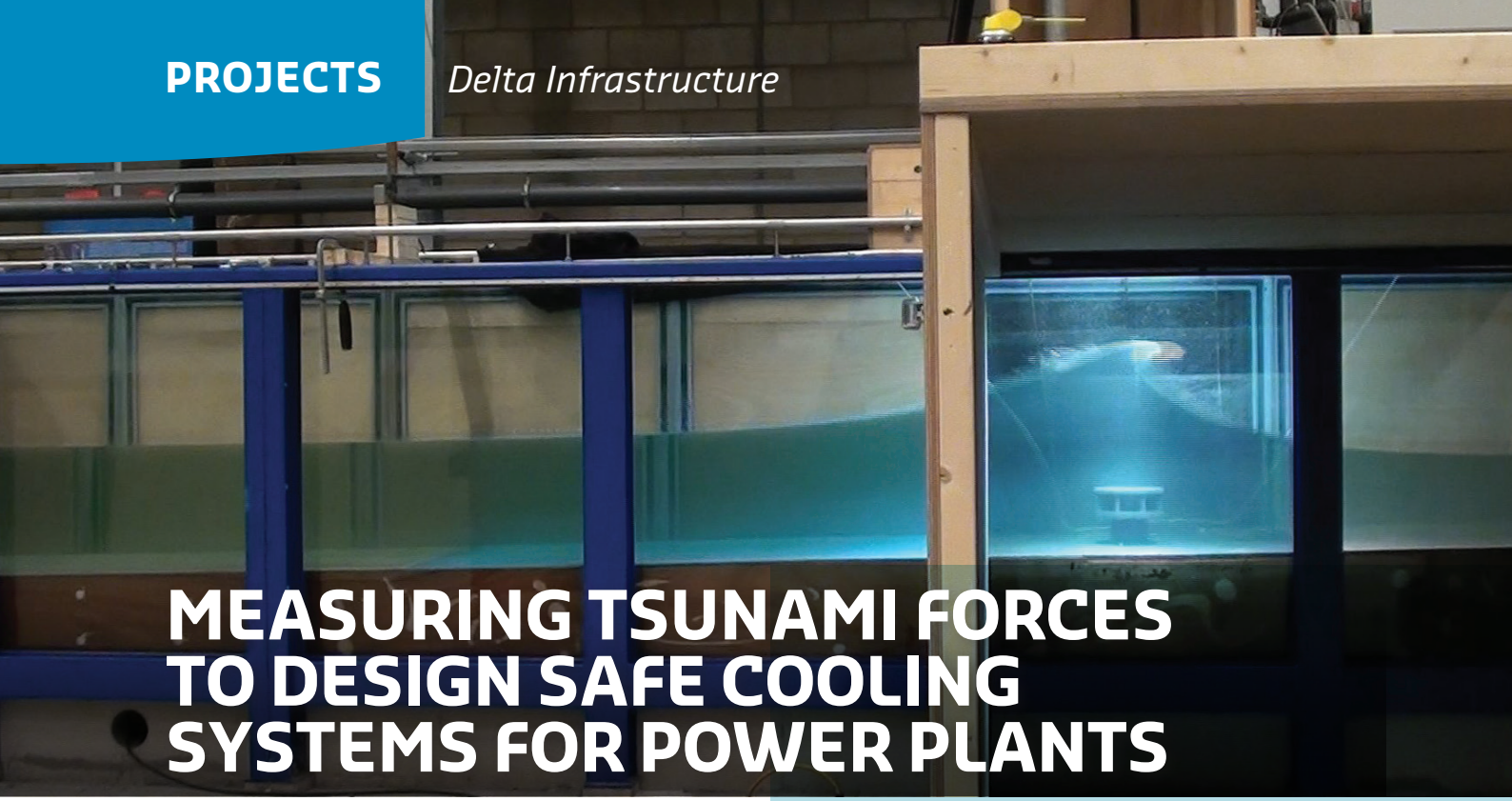


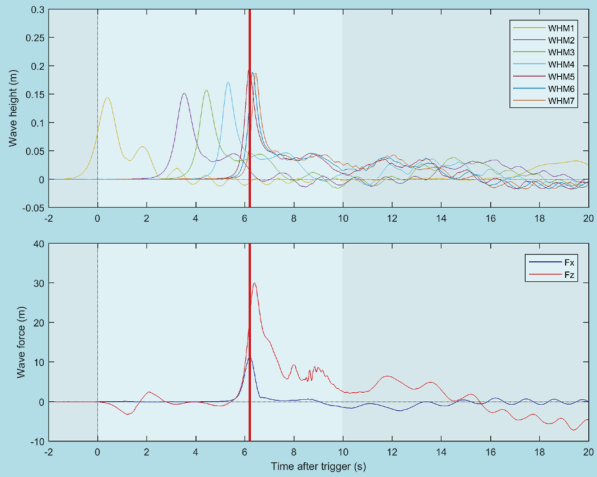
MEASURING TSUNAMI FORCES TO DESIGN SAFE COOLING SYSTEMS FOR POWER PLANTS

Power plants use large amounts of cooling water. To obtain cooling water, large intake structures are generally built near rivers and in coastal regions. Since power stations (nuclear and conventional) in coastal regions could be vulnerable to tsunamis, the forces on these structures need to be determined accurately in order to design them to be tsunami-resistant.

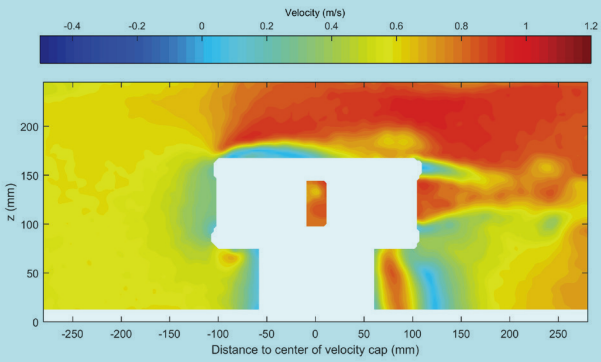
Numerical models like the free, open-source CFD software OpenFOAM are often used to design intake structures of this kind. However, these tools can only provide reliable results when they are calibrated against accurate measurements. Physical scale-model tests were therefore performed at Deltares to measure the forces on an intake structure during a simulated tsunami event. In addition, the flow patterns around these structures were determined using highly detailed PIV measurements. These advanced measurements allow us to establish a thorough understanding of the flow patterns near the intake structure during a tsunami event. This fundamental understanding of the hydraulic behaviour near the intake structure will allow us to make better predictions of the hydraulic loads that occur during a tsunami event. These tests were performed in the Eastern Scheldt flume test facility at Deltares and they will be used in the future as validation material for our numerical models, which can be applied for design purposes.

The Hydraulic Engineering unit regularly conducts hydraulic modelling studies for the design of intake and outfall structures for plant owners or contractors. These studies include a range of assessments that cover, for example, the integrity of the pumps in the pumping station, the potential for recirculation in the plant, the environmental impact of a plant, the design of coastal structures such as breakwaters and the hydraulic verification of the intake and outfall design. The excessive hydraulic forces during a tsunami must be determined for the purposes of designing tsunami-resistant intake structures in order to ensure that there is enough cooling water for nuclear and conventional power plants in the most extreme situations.

Tsunami wave breaking on top of the intake structure



Vertical and horizontal forces on the velocity cap when the tsunami passes by



Detailed measurements of the velocity field around the intake structure using PIV

Contact

Anton de Fockert, anton.defockert@deltares.nl, t +31 (0)88 335 7950