Case Study

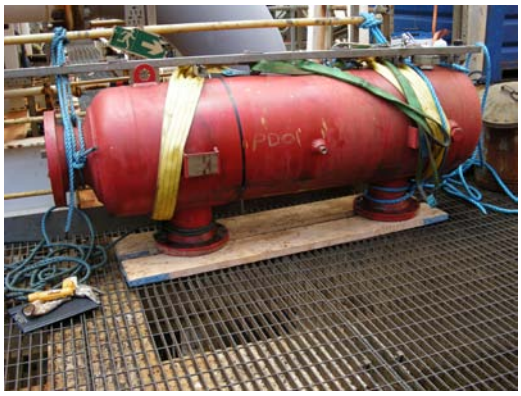
Whittaker Engineering

CFD Design and Analysis of a Gas Damper

Company Profile

Founded in 1983, the last 25 years has seen Whittaker Engineering develop into a respected and reliable contributor to the North Sea oil industry. Whittaker Engineering provides in-house manufacturing, engineering design and analysis for the offshore oil and gas industry. Their highly skilled engineers are able to create innovative and unique solutions that are tailored to individual circumstances.

Background



Gas dampers draw gas or oil from the seabed and transport it to a storage tank. Upstream of the gas damper a scrubber extracts moisture from the flow. On entering the gas damper assembly, the flow velocity of the gas or oil is reduced, and any remaining water/moisture content that might have slipped through is removed. Downstream, the gas is compressed and sent off to storage ready for transportation.

Any moisture that has condensed on the wall of the gas damper should roll down the cylinder surfaces and collect into a drain hole. However it has been found that as the vessel rolled in the sea, moisture tended to spill into the outlets and did not get to the drain. Water droplets were then exiting the gas damper into the compressor causing them huge damage. This in turn was leading to large down time on the compressors.

Analysis

IDAC were required to provide CFD design analysis work. The work was carried out in two parts as follows:

- CFD analysis on the existing design of the gas damper
- CFD analysis on the new design of the gas damper

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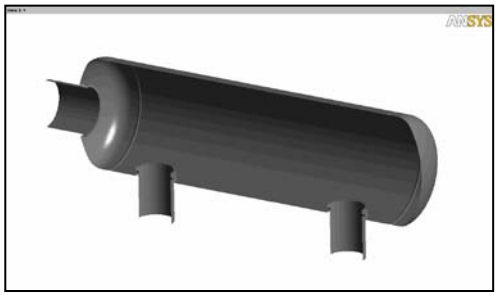
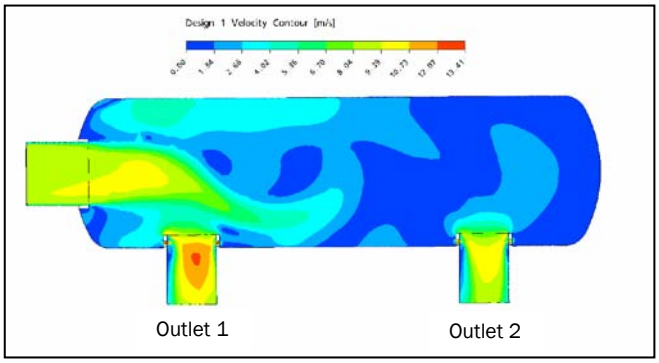


The geometry of the gas damper comprised of a cylinder with two outlets at the bottom and one inlet at the side. The graphic to the far left shows the half symmetry model.

The geometric model was defeatured using ANSYS DesignModeler and then meshed using prisms and tetrahedral meshes. A boundary layer mesh, based on the global length scale Reynolds number was also placed on the walls. Once a volumetric mesh had been created, a transient solve was set up in CFX-Pre using a single-phase fluid, properties of which were specifically created to model the saturated gas.

The CFD domain was set up to run with the same atmospheric pressure as when in operating conditions, with pressure and mass flow boundary conditions defined at the outlets and inlet. Other details pertinent to the analysis are listed below:

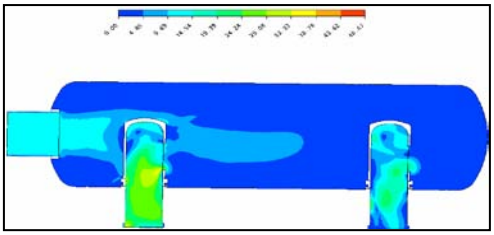
- using CFX Expression language, outlets were kept 90 degrees out of phase
- a specific material was created for the saturated gas, which included molecular weight, density and thermal properties
- no buoyancy effects were studied

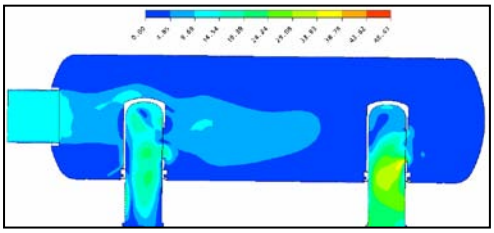


The original design showed unequal velocities and mass flow rates through each outlet. The flow was biased towards Outlet 1, rather than making it all the way to Outlet 2 as seen in the graphic above. In order to force the flow onto Outlet 2, the geometry was changed, such that each outlet protruded further into the cylinder.

On analysing the new model, it was found that both outlets were performing better in terms of 'sharing' the total fluidic loading. As seen in the images below, when each outlet is opened to its maximum flow rate condition, both situations show similar mass flow rate values exiting the gas damper.

Design Benefit





The down time of the compressors had direct financial implications. To reach a quick and effective solution, it was decided to conduct a CFD analysis, as several models could be created, edited and run at the same time. Once the basic model had been established and verified, changing the geometry marginally, while keeping all other parameters constant meant very little time was needed for each different set-up. This meant more time was dedicated to analysis solving and post processing. The client also gained further understanding into some of the other issues surrounding the old design, such as unequal mass flow rates between the two outlets.

With both outlets performing equally in the new design the compressors downstream of the gas damper were also being stressed equally. Having met the design criteria, the redesigned gas damper is once again operational onboard a vessel in the North Sea.

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