Hydrostatic testing

Global Energy Associates Ltd
International Gas Consultancy and Training

Strength testing of higher-pressure systems using air or nitrogen incurs a risk of failure such that if it did happen in a catastrophic manner the results would be similar to those from a moderate sized bomb! For this reason UP/1 recommends strength testing with water but there is little guidance on the subject other than in IGEM TD/1.

Hydrostatic testing will occur at 1.1 x MIP or 1.5 x MOP whichever is the greater. Thus the design of the pipework and all fittings to be tested MUST be able to withstand the pressure. This fact MUST be verified with the designer before starting any work! At 20 bar, 1.5 MOP is not an insignificant increase in pressure! It is acceptable (and indeed wise) to remove all pre-tested components such as regulators, valves, meters and instrumentation!

UP/1 and TD/1 give advice on Safety Zones around the pipework whilst under test. Risk assessments, safety procedures, site security, Permits to Work, Safety officers, liaison with Emergency Services arev vital matters for consideration before any work takes place.

In UP/1, hydrostatic testing is recommended for 200 mm NB pipe and larger above 2 bar MOP. For PE pipes, above 3 bar MOP is recommended. See Table 1 UP/1. A note to the table importantly also says hydrostatic testing should be applied where the Strength Test Pressure STP exceeds 3.5 bar for 200 mm NB and larger for metallic pipes OR where the STP exceeds 10.5 bar for metallic pipes up to 150mm NB.

For most above ground pipework it would not be normal to erect the pipe and test in situ as the extreme weight of the pipe + water will require much heavier supports. One cubic metre of water will weigh one tonne and that is in 50m of 150mm pipe!

It is also absolutely vital that only clean water is used and that there is no trapped air in the water filled pipework. To achieve this the water is generally allowed to stand for many hours to release any air 'dissolved' in the water. Any trapped air can be extremely dangerous if there is a failure. To check all is clear, IGEM TD/1 recommends that this is performed by a plotting on a graph the rate of pressure rise against the volume of water being pumped into the pipe. Accurate metering and pressure measurement are thus essential for larger systems. It also almost goes without saying that the water will freeze under cold ambient conditions. Antifreeze must not be used without taking advice from a specialist Test Engineer.

With systems operating up to say 7 bar, normal carbon steel pies will be used and the main issue of using water is that of rusting if left in for too long. At higher pressures, austenitic steels may be used and the water MUST be treated to ensure it is low in chlorine/halogens as these can attack the steel and lead to subsequent failure during use. Chemicals will normally be needed although in some cases storage of the water in an open tank for several days can clear the chlorine.

The problem of draining and drying following testing is also an issue if it is strung up at high level or buried in a trench. Normally, the hydrostatic test will be carried out on sections constructed at ground level followed by drying and sealing off the sections with a plastic seal/cap. Draining of the treated water can be a problem on some sites and approval from the Environment Agency will often be needed prior to disposal.

Drying can be by a cloth pull-through on small systems or by blowing a sponge swab through with compressed air. For applications using gas engines, compressors or gas turbines that require much higher dryness conditions, the use of a vacuum pump may be more appropriate to guarantee the right and safe conditions. For pipe runs greater than about 50m, it may be sensible to locate a vacuum pump at say 25% and 75% lengths to ensure good drying. The target vacuum should be less than 10 mbar and will need to be left at that level for several hours to ensure dryness.

It is fair to say that hydrostatic testing of larger systems requires some expensive calibrated test systems to accurately measure the changes in water pressure and temperature as well as the pumped flow of water to maintain the pressure. As with pneumatic testing, the filled water temperature can have significant effects on the test results. A knowledge of pipe materials and calculations based upon the properties of the steel pipe are essential for many systems; significantly at 0.3 Design Factor, different hydrostatic procedures kick in.