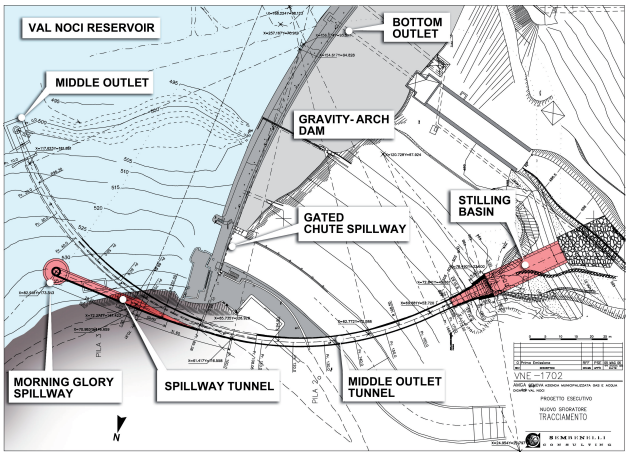
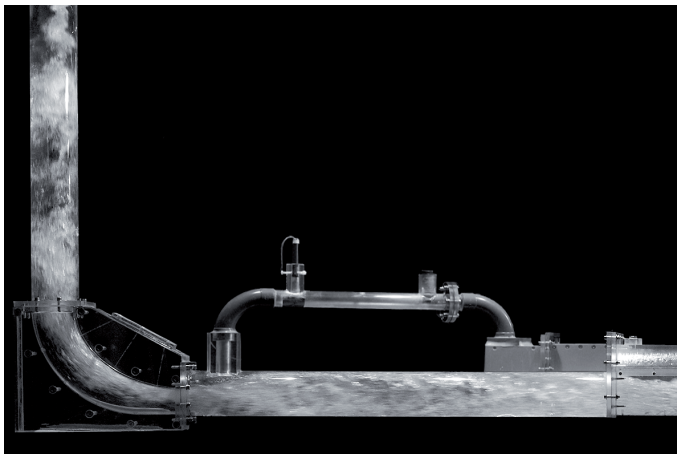
Morning Glory Spillway of the Val Noci Dam
Physical Model Investigation (2008)

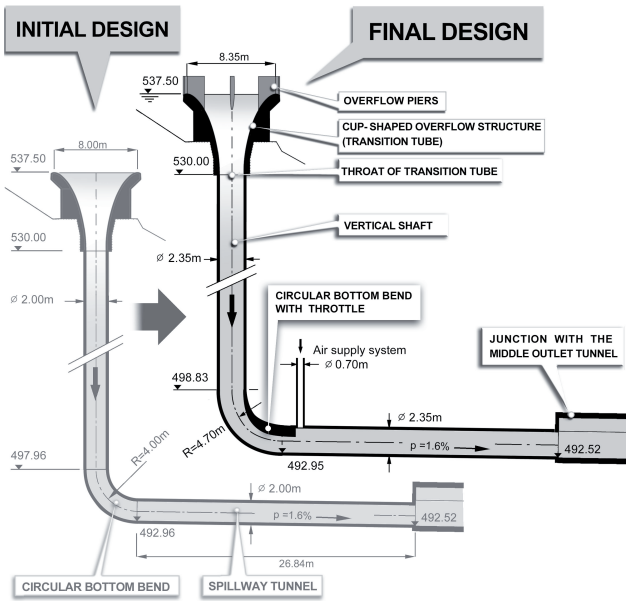
Mediterranea delle Acque operates the Val Noci reservoir in Montoggio (Italy) for the water supply of the city of Genoa. The Val Noci reservoir is stored by a 56 m high dam which impounds a volume of 3.3 Mio m^3 usable storage. Three existing spillway structures, i.e. a gated chute spillway, a middle and a bottom outlet serve to discharge floods. A recent estimation of the flood hydrograph shows, that it exceeds the installed discharge capacity. To counter this shortage Mediterranea delle Acque plans to erect an additional morning glory spillway. It will use the existing middle outlet tunnel for a cost saving design.



Plan view of the Val Noci dam with the existing spillway structures, the middle outlet tunnel and the projected morning glory spillway



Side view of the vertical shaft, the bottom bend, the air supply system and the spillway tunnel in its modified design (without overflow piers). Serve instantaneous pressure fluctuations up to 20 mWC are caused by the intermittent collapse of air core bathtub vortex at submerged inflow conditions



Layout of the morning glory spillway in its initial and final design

The performance of the morning glory spillway had to be verified. In the physical model with a scale factor of 25 the project design as handed in by the client was investigated first. These model tests on the original design showed that, by the transition from free to pressurized flow condition in the vertical shaft, the up scaled minimum pressures drop below the vapour pressure, resulting in a change of phase from water to vapour, i.e. water column separation. This phenomenon would cause strong vibrations at prototype site and consequently structural damage and limited spillway capacity.

VAW optimised the original design of the morning glory spillway by widening the vertical shaft and installing a throttled bottom bend. Furthermore, VAW added overflow piers at the morning glory crest to ensure radial flow in the overflow structure avoiding air-entraining vortex formation. Thereby, the required discharge capacity of 75.1 m^3/s is ensured and extreme pressure fluctuations in the vertical shaft are limited. An air supply system is installed behind the throttle to ensure free aeration of the spillway tunnel.

Keywords:	morning glory spillway, bathtub vortex, two-phase flow, cavitation, hydrodynamic pressures, overflow piers
Commissioned by:	Mediterranea delle Acque S.p.a., Genova
Project status:	Completed 2008

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