HPP Mauvoisin - Physical model investigation of the conjunction of a dropshaft and a diversion tunnel

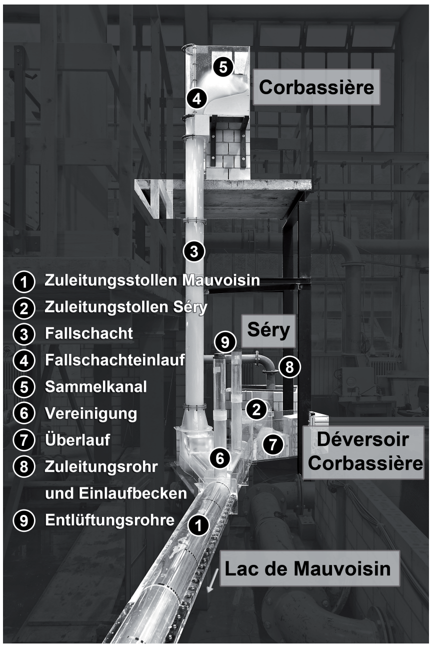

Fig.1

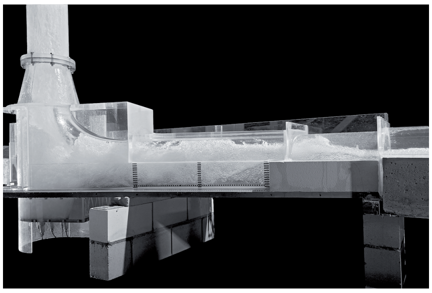
Fig.2

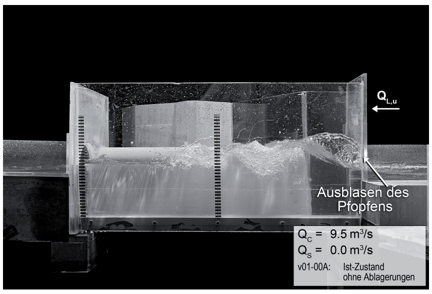

Fig.3

The Mauvoisin reservoir from the Forces Motrices de Mauvoisin S.A. in Wallis (Switzerland) is filled, among other inflows, by water from the Séry and the Corbassière catchment area. Both torrents are diverted through one diversion tunnel. Upstream of the conjunction of the diversion tunnel with a vertical dropshaft (from the glacier runoff catchment Corbassière), surge-like water losses over a side overflow structure in an adit tunnel are observed in prototype. The water losses amount to about 2.3 million m3 per year on average.

Furthermore, sediment deposits up to 0.7 m in the 2.45 m high tunnel are documented downstream of the conjunction.

In a hydraulic model at VAW the cause of the overspill is studied at a scale of 1:10. The model tests show a large air entrainment rate over the drop shaft of more than 500% of the water discharge. Air is carried by the falling water in the vertical dropshaft and is dragged along to the confluence with the diversion tunnel as the air water mixture completely fills the cross section in the outflow. i.e. no air is released through a de-aeration device in the drop chamber as in common design. This leads to slug flow in the diversion tunnel upstream and downstream of the conjunction which induces the surge-like overspill observed also in prototype.

The sediment deposits lead to a decreased discharge capacity of the diversion tunnel, wherefore the overspill is observed at smaller discharges than in the case without deposits.

The optimization measures against this slug-flow and the consequent overspill consist of a rising of the tunnel roof in the conjunction and the removal of the sediment deposits.

Fig.1: Hydraulic model of the conjunction of the dropshaft and the diversion tunnel

Fig.2: Confluence of the dropshaft and the diversion tunnel in the hydraulic model

Fig.3: Blowing out of an air pocket in front of the side overflow structure

Keywords:	dropshaft, diversion tunnel, air entrainment, two-phase flow, stilling chamber
Commissioned by:	Forces Motrices de Mauvoisin SA
Project status:	Completed 2013

Laboratory of Hydraulics, Hydrology and Glaziology
Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie