AIR CUSHION SURGE CHAMBER
a cost-effective solution in hydropower design

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The purpose of the air cushion surge chamber is to damp surges in the headrace pressure tunnel of the underground hydropower plant. It replaces the conventional, open surge shaft, see Figure 1.

The surge chamber is hydraulically connected to the headrace tunnel via a short connection tunnel (Figure 3). Six of the chambers have pressure above 4 MPa, one as high as 7.7 MPa. The volume varies from 2,000 to 110,000m^3. The air cushion itself occupies from 25% to 85% of the cavern volume with typically 2 to 5m depth of the cavern water bed, see Figure 2.

An important provision in a successful design and construction of air cushion surge chambers is the layout and relevant measures regarding the rock stresses acting and the permeability of the surrounding rock masses. The application of a special designed water curtain has proven an effective means of reducing possible air losses during plant operation, as is shown in Figures 2 and 3.

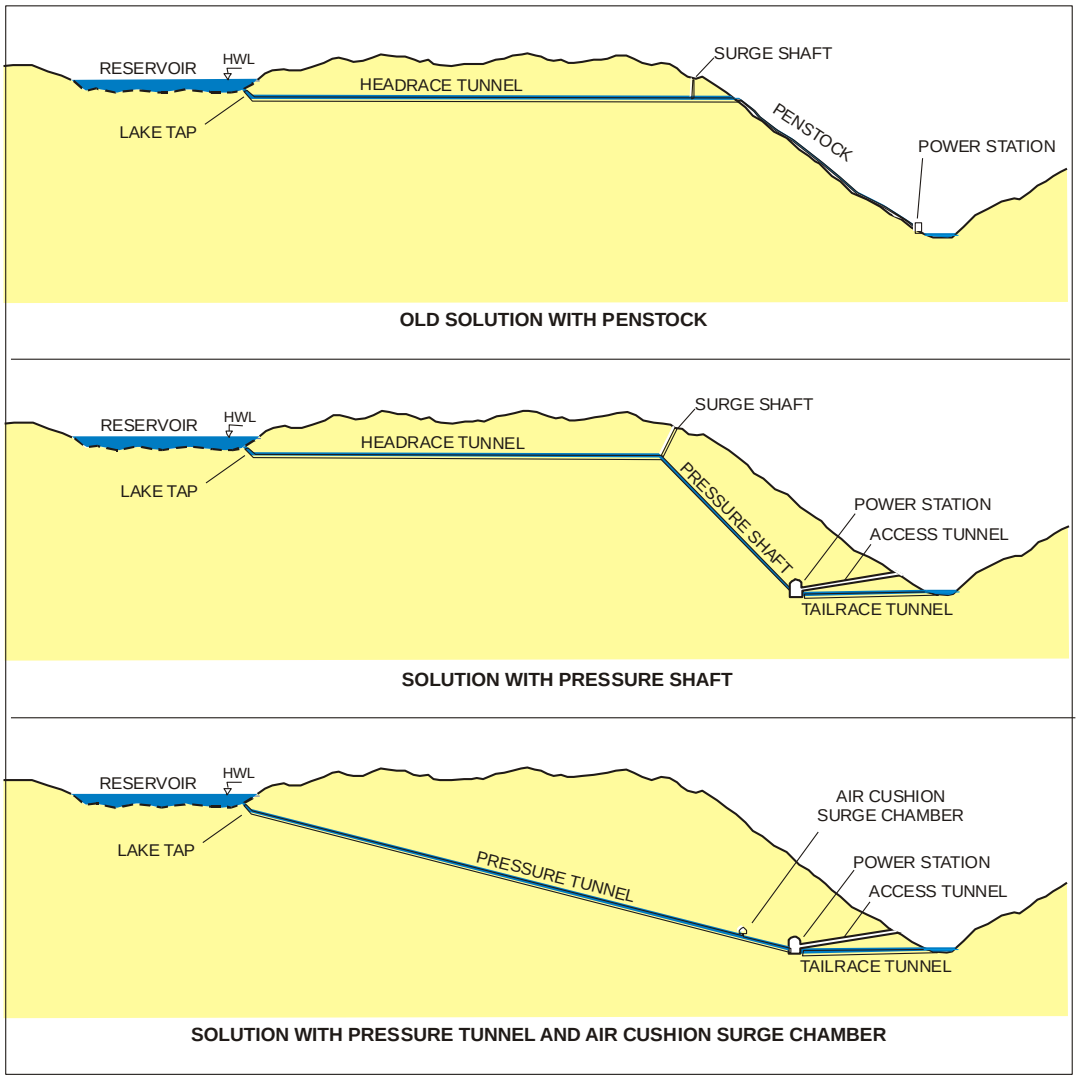


FIGURE 1. DEVELOPMENT IN DESIGN OF UNLINED PRESSURE CONDUITS INTO PRESSURE TUNNEL WITH AIR CUSHION SURGE CHAMBER

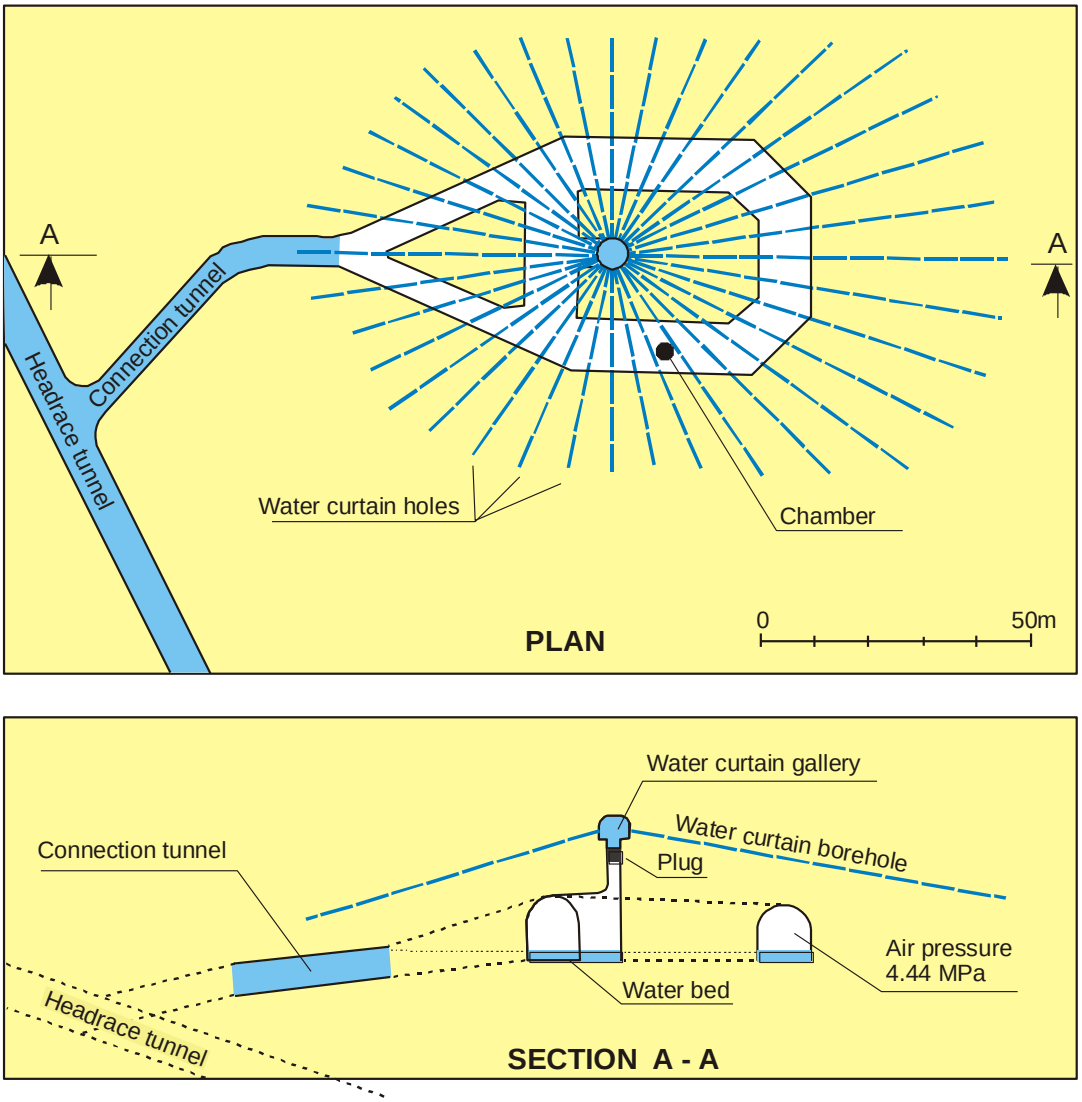
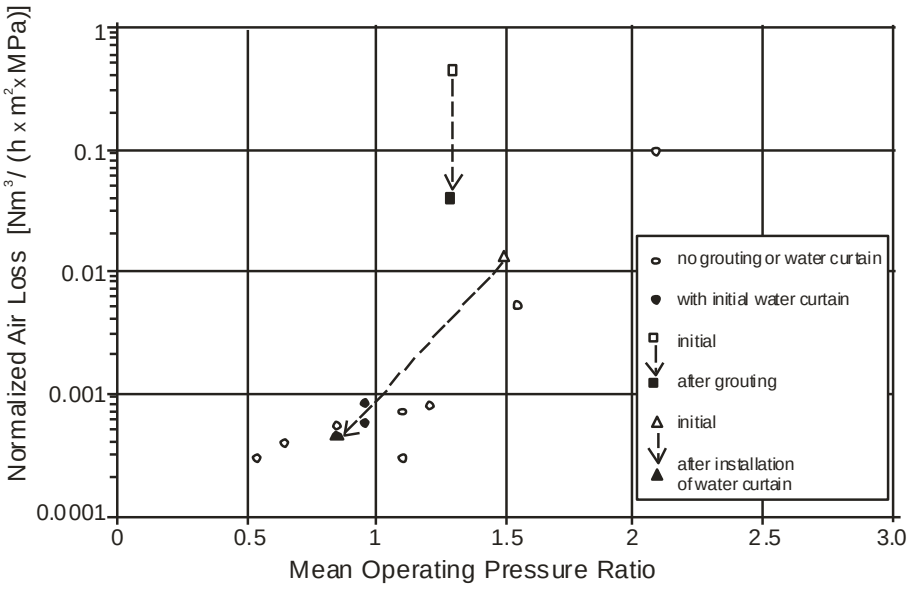


FIGURE 2. LAYOUT OF THE AIR CUSHION SURGE CHAMBER AT TORPA HYDROPOWER PLANT, DESIGNED BY NORCONSULT



In addition to the layout of the chamber, the calculation of air loss and the design of mechanical equipment as well as the surge calculations are vital features in the air cushion surge chambers.

A total number of 10 air cushion surge chambers have been constructed in Norway, the first one has been in operation since 1973. All together they provide more than 200 years of experience.

FIGURE 3. AIR LOSS IN NORWEGIAN AIR CUSHION SURGE CHAMBERS. AS SEEN, WATER SEALING BY GROUTING AND ESPECIALLY INSTALLATION OF A WATER CURTAIN HAS REDUCED THE AIR LEAKAGE.