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**Abstract Title:** Hydraulic Joint pushes the limits in curved microtunneling

**Abstract Theme:** Trenchless Project Planning, Design, Construction, and QA/QC, New Products and Materials

**Abstract:**

Using a recently completed penstock of a hydro power project in Switzerland as an example, this paper shows the capabilities of today's technologies regarding curved microtunneling. In highly permeable coarse gravel with boulders, a 540 m (1770 ft) long, 3.2 m (126 inch) ID / 3.8 m (150 inch) OD pipe had to be pushed in a 3D compound S-curve alignment with radii as small as 280m (920 ft). The pipe line had to cross under existing infrastructure like a sewer line, railway line and an old arch channel with an overburden of partly as low as 1 m (3 ft). On the last part of the drive the machine was steered steeply upwards to minimize the depth of the receiving pit and therefore the dewatering systems resulting in significant cost savings. VMT's SLS-Microtunneling LT navigation system ensured the proper alignment. The 280 m radius was done by the use of 3 m (9.8 ft) long pipes. This was accomplished by the application of the Jackcontrol Hydraulic Joint (Jackcontrol System), which allows large joint rotation angles without reduction of jacking forces. On this drive, the gap between the pipes on the inside of the smallest radius was 12 mm (1/2 inch) wide while on the outside it was 75 mm (3 inches). Due to the Jackcontrol real-time monitoring system, the pipes remained without any damage and the Jackcontrol joint design ensured the water tightness of the pipe coupling successfully.