Advanced Modeling of Rock Scour at Gated Spillway

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This paper describes the evaluation of scour at a gated spillway founded on gneiss. The flood of record occurred at the dam shortly after construction and scoured approximately 21,000 CY of material. A 200-feet wide, 30-feet deep scour hole formed 300-feet downstream of the end of the concrete chute. Following this scour event, the right side of the concrete chute was extended downstream. A second flood occurred later requiring discharge from one gate which caused additional scour. In order to understand risk, a scour analysis of the spillway was performed. The analysis included a detailed geotechnical investigation including rock coring and strength tests, seismic field and laboratory tests, and geologic mapping. Hydraulic loading conditions were developed through a computational fluid dynamics (CFD) model of the spillway, scour hole and downstream river. Scour was modeled using the Comprehensive Scour Module (CSM). This is the first study where CFD was used in the CSM model and the results compared well with expected behavior based on previous physical model experience. Future scour predictions were developed for three different gate combinations. Coupled with flood frequency analysis, the depth of scour profiles for 12 to 480 hours of gate operation allowed the dam owner to evaluate risk and determine if risk reduction measures were necessary. This paper summarizes how CFD modeling, seismic testing, and scour modeling can be used to improve dam safety.