

TREVIICOS

The Boone Dam Project



Tennessee Valley Authority (TVA) has completed a seven year US\$326M (£259M) project to remediate the Boone Dam in the US state of Tennessee

by Ettore Zanatta

Boone Dam, located upstream of Kingsport, TN (USA) is owned and managed by TVA. Built in 1953, the barrier has an 850-ft long concrete gravity dam section, and an 850-ft long earthen embankment dam. The resulting Boone Lake has a capacity of 75,800 acre-feet. A sinkhole was discovered near the downstream toe of the dam

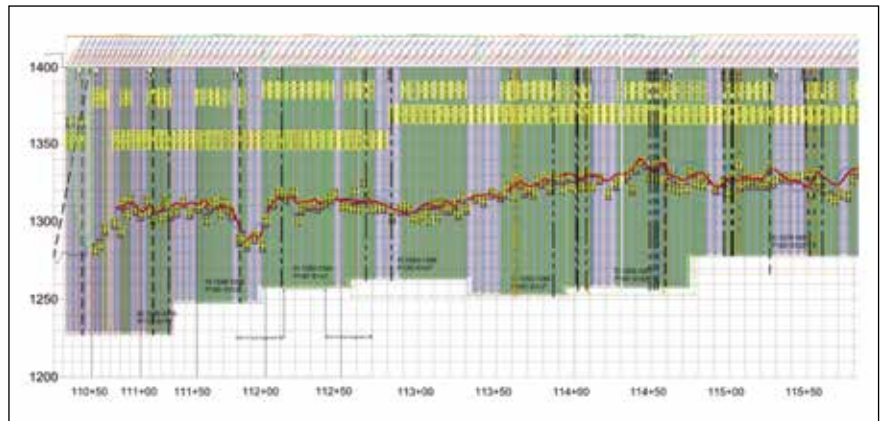
in October 2014, and soon after TVA observed turbid discharge exiting from the riverbank downstream of the dam, indicating potential dam safety issues. In July 2015, TVA announced plans to construct the Boone Dam Internal Erosion Remediation Project, an erosion barrier through the dam and its foundation, consisting of works aimed to mitigate the risk of potential dam failure due to internal erosion and safely

return the dam and reservoir to normal operations. The program included five components: Low mobility grouting, high mobility grouting, stability berms, cutoff wall, crest floodwall.

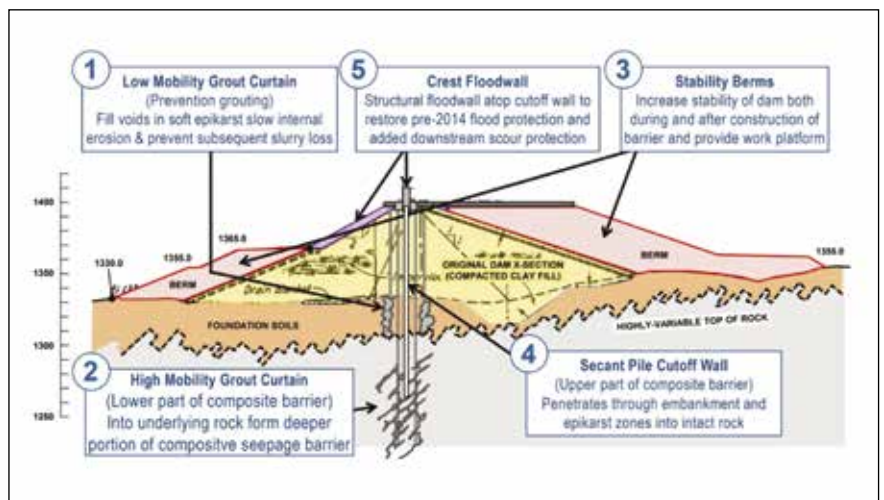
The jobsite

After the completion of the preliminary enabling grouting works, in 2018 TNJV, a Joint Venture formed by Treviicos and Nicholson, was awarded the contract for the installation of the cutoff wall. With the working platform at approximately elevation 1,400 feet and the bottom elevation of the cutoff wall as low as 1,230 feet, the wall has a resulting maximum depth of approximately 170 feet, and is formed by a single row of secant

piles extending through embankment, foundation soils, and weathered rock into intact rock up to 170 feet below crest, including tie-in of wall on sloping face of existing concrete dam. The technology of the secant piles was chosen after consideration of a number of cutoff wall construction methods for having lower dam safety concerns, and to maintain strict alignment and overlap requirements while penetrating through a challenging mixture of soil and highly weathered rock within the upper portions of the dam's foundation. The cutoff is keyed into the sloping face of the existing concrete dam, forming a continuous composite seepage barrier could along the entire alignment of the earthen dam. Over 300 50-in dia. secant piles were installed to create 850-ft long secant pile barrier, totaling 113,000 square feet of cutoff wall, and 27,000 cubic yards of concrete for backfilling. Verification of the verticality, embedment and concrete quality of each element forming the wall was critical. The secant piles were installed using a combination of equipment and techniques: piling rigs were used to drill through the embankment and the alluvial, to depth of approximately 100 ft, using segmental casings. Reverse



➤ Longitudinal section of the cutoff wall



➤ Schematic of the full Boone Dam Internal Erosion Remediation Project, including item 4, performed by TNJV



➤ A Soilmec SR-125 piling rig was used to drill into the embankment
Picture: <https://twitter.com/BooneRepair/status/1278710045535023107/photo/1>

circulation top pile rigs then completed every pile, to a total maximum depth of circa 170 feet, into a rock with peak UCS values as high as 36,000 psi (240 MPa). The concrete for the piles was manufactured in an onsite batch plant operated and controlled by TNJV. The quality of the joints between the elements was of paramount importance for the integrity of the wall. An extensive quality control program provided TVA with an accurate validation of the installed final product for their acceptance. This, in conjunction with an equally extensive quality assurance program, ensured that the cutoff wall was installed meeting or exceeding the stringent requirements of the Project. For instance, as part of this program, vertical deviation was checked by measuring with different instruments and piles were brushed to grant quality joints.



The cutoff wall project

The cutoff wall project started in 2019 and was completed in February 2021, allowing TVA to restore normal operations of the reservoir to pre-2014 levels, 17 months ahead of schedule. The Boone Dam Project was a further achievement in the decades-long experience established by the Trevi Group in the field of Dams and Levees rehabilitation where, in the US alone, TREVIICOS has successfully completed tens of projects using several technologies such as secant piles, cutoff walls, soil mixing, jet grouting, etc. Among these projects several were first of its kind applications: W.F. George (AL), the first secant pile cutoff wall under water ever constructed; Herbert Hoover Dike (FL), fist time installation of cutoff wall by self-hardening-slurry by hydromill for a total of over 8 million square feet; LPV 111 (NOLA - LA), the biggest deep mixing projects ever done outside Japan for the stabilization of approximately 5.5 miles of levee; and Wolf Creek Dam (KY), the largest Dam Rehabilitation project ever done in North America for the installation of a concrete cutoff wall to depths exceeding 280 ft. ■

➤ Backfilling of a pile, using tremie concrete
Picture: <https://twitter.com/BooneRepair/status/1356619037627863045/photo/2>



ITALIAN ABSTRACT

IL PROGETTO BOONE DAM

TREVIICOS, filiale americana di Trevi, si è aggiudicata in joint-venture con Nicholson Construction Company i lavori per la messa in sicurezza della diga Boone Dam, nello stato del Tennessee (USA). La diga è di proprietà della società TVA la quale, nel 2014, ha individuato alcune problematiche strutturali causate dall'erosione interna e ha dovuto necessariamente approntare un intervento di messa in sicurezza per poter riportare il bacino idrico alle normali operazioni. La joint-venture tra TREVIICOS e Nicholson Construction Company ha riguardato la realizzazione di una barriera continua realizzata tramite un'unica fila di pali secanti, tecnologia scelta dopo aver preso in considerazione altri metodi di costruzione. Sono stati installati oltre 300 pali da 50" di diametro, al fine di creare una barriera lunga 259 m, per un totale di circa 11.000 m² di parete e 27.000 m³ di calcestruzzo utilizzati per il suo riempimento. I pali secanti sono stati installati utilizzando una combinazione di attrezzature e tecniche: sono stati utilizzati impianti di trivellazione per perforare il terrapieno fino a una profondità di circa 30,5 m; gli impianti di trivellazione a circolazione inversa hanno poi completato ogni palo, per una profondità massima totale di circa 52 m. Il progetto del muro di separazione è iniziato nel 2019 ed è stato completato nel 2021, consentendo alla TVA di ripristinare le normali operazioni del bacino ai livelli precedenti al 2014, con 17 mesi di anticipo rispetto alla tabella di marcia. Il progetto della diga Boone Dam è stato un ulteriore risultato dell'esperienza maturata dal Gruppo Trevi nel campo del ripristino di dighe e argini dove, solo negli Stati Uniti, TREVIICOS ha portato a termine con successo decine di progetti utilizzando varie tecnologie come pali secanti, muri di cutoff, miscelazione del terreno e jet-grouting.