World Tunnel Congress 2012, Bangkok, Thailand, 20 – 23 May 2012
Tunnelling and Underground Space for a Global Society

Construction Aspects of Power Waterway Tunnel in NN2 Hydro Electric Project, Laos

Lekhak, B.M., Ch. Karnchang Public Company Limited, Thailand,
lekhak@rocketmail.com
Shakya, U., Ch. Karnchang Public Company Limited, Thailand
Nishimura, Y., Previously Ch. Karnchang Public Company Limited, Thailand
Shiraishi, N., Ch. Karnchang Public Company Limited, Thailand
Kitiyodom, P., Geotechnical & Foundation Engineering Co. Ltd., Thailand

ABSTRACT

This paper reviews the Construction aspects of 10.7 m diameter, Power Water Way Tunnel in Nam Ngum 2 Project, Laos through which water is being conveyed from reservoir to turbines. It is a low pressure tunnel consisting of four components: - 10.7 m diameter Main Head Race Tunnel part consisting of a 405m concrete lined section followed by a 60m steel lined section, a transitional manifold steel lined tunnel section with diameter varying from 10.7m to 6.2 m which subsequently trifurcates into 3 inclined penstock tunnels of 5.3 m diameter. Issues covered in this paper cover adjustment of tunnel alignment, tunnel excavation systems, concrete linings, steel linings and grouting aspects of the power waterway.

Due to limitations of the available overburden rock cover to withstand the high internal water pressure inside the headrace tunnel, the lowermost 60m of concrete lining was changed at construction stage to a steel lining after reviewing the available cover in light of hydro fracture test findings, Snowy Mountain and Austrian criteria.

The excavation was covered by conventional drill and blast technique with the standard excavation steps of heading and benching. The geotechnical risks for quartz-rich sandstone and siltstone layer with a minor faults were assessed based on rock mass type and orientation of beddings and joints. For the 52° inclined penstock excavation the raise boring method was used. It involved drilling of a 270mm diameter pilot hole, using a triple-core bit and thereafter enlarging it to 350mm diameter. This hole was then reamed in an upwards direction to 1,500mm diameter and then excavated using the drill and blast method to the full excavation diameter of 5200 mm.

Four rock mass types (each further subdivided into 2 classes) were introduced to design the construction excavation support system. Shotcrete with 1.5 day strength of 6 MPa and 28 day strength of 25MPa was used.

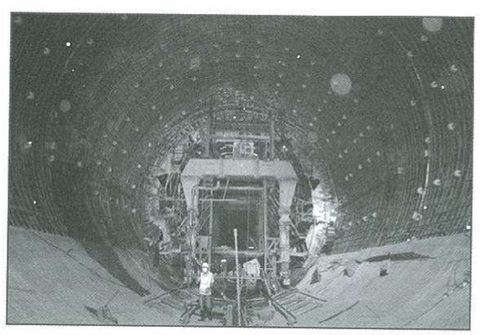

Figure 1 Tailored formwork system

Friction type rock bolts with 100-150kN design tension load were used for the temporary support. Permanent concrete lining was constructed for 600mm thickness with 25MPa concrete in 2 steps: invert and heading.

Concrete was cast in 9m blocks using tailored formwork system (see Figure 1) The steel lining in the waterway designed for a maximum internal pressure of 24 bar and external pressure of 7 bar were installed by specialist subcontractor.

Details on repeated rounds of grouting involved to address consolidation, curtain and cavity grouting in both Concrete and steel lined section under heavily fractured sandstone and interface between Civil contact and steel lining contract are also addressed suitably in the paper (see Figure 2).

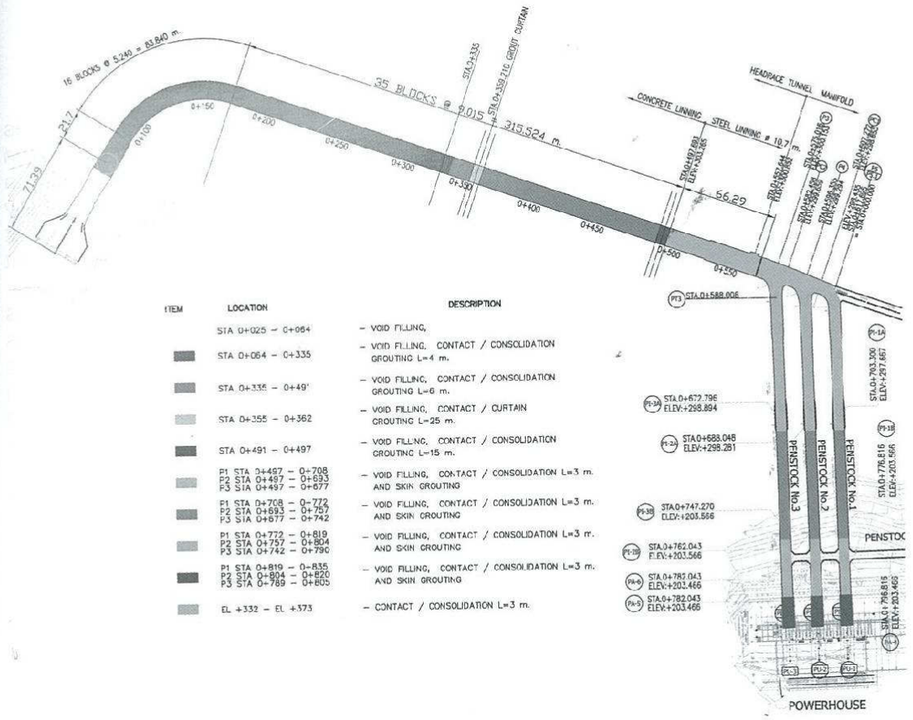

Figure 2 Grouting employed along power waterway route