Australian Construction Achievement Award 2010

BOGONG
HYDRO ELECTRIC SCHEME

MacDow

McCONNELL DOWELL
CREATIVE CONSTRUCTION™

Our construction and maintenance expertise in all phases of the water cycle ensures we are a supplier of choice for our clients.

ROCKSOLID

INTRODUCTION

McConnell Dowell's work on the landmark Bogong Hydro Electric scheme included the construction of a new underground hydro electric power station and a network of tunnels and shafts near Falls Creek, in the Victorian ski fields.

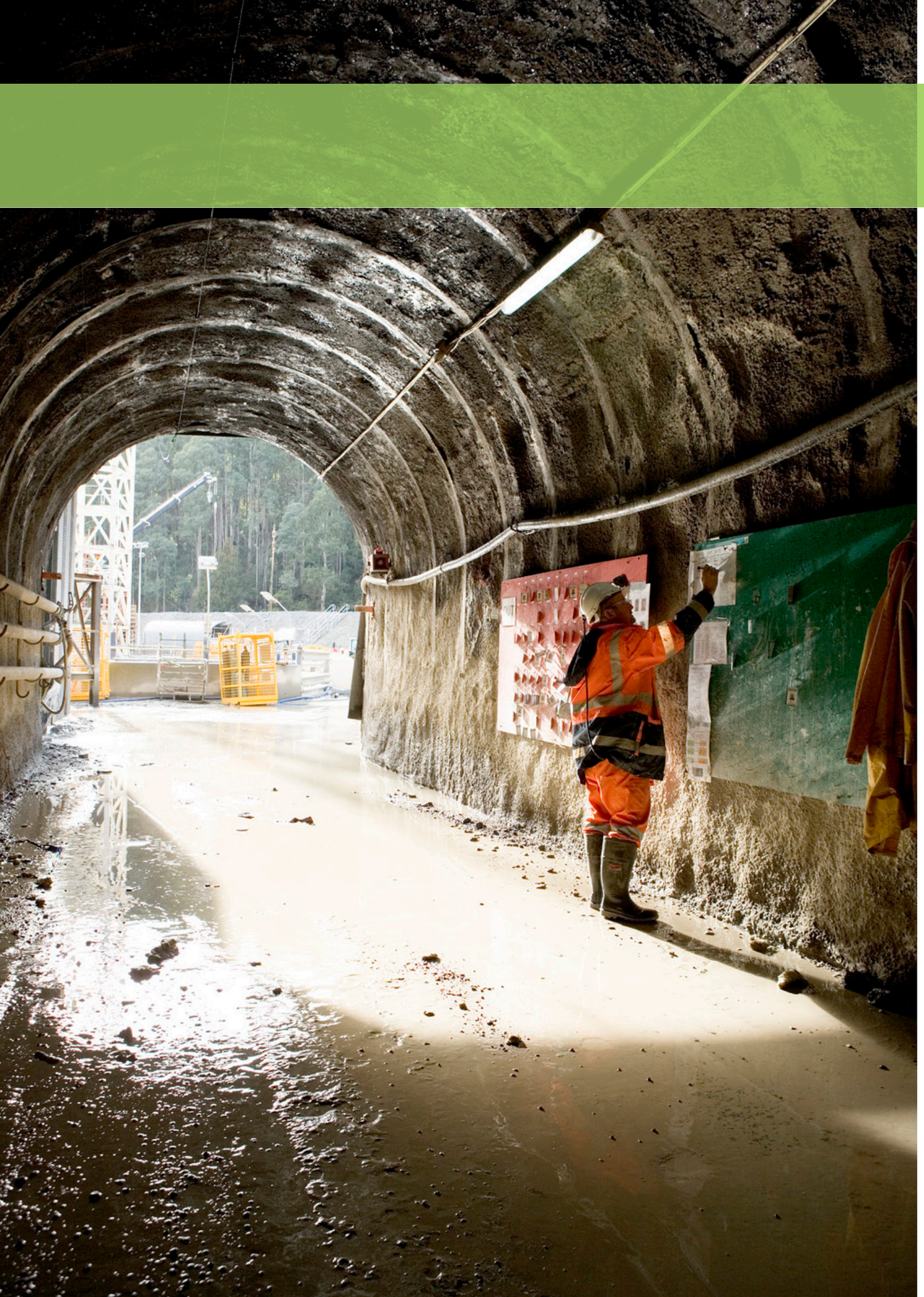
This forms part of AGL Southern Hydro's strategic energy framework for the supply of green peak demand power. It harnesses the Rocky Valley and Pretty Valley branches of the East Kiewa River and existing water resources released from the Mackay Creek Power Station to generate 140 MW of renewable power.

The construction of the underground power station included the excavation of the station box, a top down excavation utilising secant pile walls, rock anchors and excavation in rock to 25 m below the ground. The massive box was created from which 30,000 cubic metres of material was excavated, and the power station structure required over 10,000 cubic metres of concrete.

Pivotal to project success was the co-ordination of the crucial mechanical equipment including turbines, generators, draft tubes, inlet valves and scroll casings. These massive individual pieces required installation as the power station was constructed from the depths of the excavation.

Community engagement was also vital. MacDow supported enhancing the services of the Bogong Village Outdoor Education Centre with improved outdoor activities areas, and by providing upgrades to walking tracks and local roads. Community interaction groups were regularly convened and awareness programmes kept stakeholders fully informed.

Bogong is the largest hydro project in Australia for 25 years.



ACHIEVED OUTCOMES AGAINST TARGETS

Safety Initiatives Programme

Construction involved several areas of high risk activities, including tunnelling activities 400m deep, shaft excavation up to 150m deep, use of high energy explosives and working in an Alpine environment. Safety initiatives developed and implemented include:

1. Risk Workshops for all Tunnelling and High Risk Activities;
2. Proactive Safety in Design Processes;
3. Active Risk Register; and
4. Safety Culture Programme.

Time and Programme

The project programme was challenging as limited geotechnical information was available for the design and construction works. Significant time was required for the completion of the generating units, and the power station structure had to be completed before these works could commence. Several key initiatives were undertaken by MacDow to facilitate early power generation.

Initial Value Engineering

- Optimised power station sizing and layout;
- Re-alignment of key interfaces and of power station tailrace; and
- Net Cost Benefit sizing of penstock liner size to satisfy hydraulic and economic efficiency.

Construction Initiatives

- Development of an accelerated civil program, reducing the construction time of the power station structure from 16 to 12 months;
- Relocation of the existing flood protection bank to provide additional construction and storage areas on site;
- Construction of a major retaining wall at the power station entrance to provide early access into the loading bay area; and
- Redesign of the turbine level walls to enable turbine / generator alignment procedures to be accommodated.

Environmental Rehabilitation of Natural Waterways

Due to a scaling back of the original scheme in the 1950s, the dam and the power station were not constructed. As a result, the tailrace flow from the McKay Creek Power Station was discharged directly into the East Kiewa River creating intermittent dangerous flows within the river and significantly degrading the aquatic ecology.

With this new construction, the tailrace waters from McKay Creek Power Station are now diverted via the underground waterway to the power station and released directly into Junction Dam. This returns the Pretty Valley Branch of the East Kiewa River back to its natural state and improves the aquatic ecology.

Environmental Mitigation

Other environmental challenges included the large amount of excavation and construction work within the Alpine National Park and adjacent to pristine mountain streams. To prevent pollution of the surrounding environment, MacDow implemented strict environmental procedures, including:

- All roads and carparks created were sealed with bitumen to prevent transport of sediment via vehicles' wheels;
- A water treatment plant installed on site, treating all site water prior to discharge; and
- The extensive use of explosives was required for the excavation with up to 3 blasts per day. The portal for the tunnel was immediately adjacent Bogong Village and significant effort was expended on developing blasting patterns which minimised the blast vibration and noise. Intensive community consultation and notification was undertaken both prior to and during the 11 month blasting period.

Quality – Waterway Guarantees

The ultimate performance of the power station was defined by the waterway performance. The contractual criteria was to deliver 38cumecs of water to the twin 140MW turbines with a guaranteed pressure of 4.13MPa. The maximum head loss was set at 18.0m over a static water system head of 426m. Performance testing of the waterway yielded headloss of only 12m. This is a 50% improvement in waterway efficiency and translates to 2.3MW of additional power development for the lifetime of the project.

TASK COMPLEXITY, DIFFICULTY AND OPTIMISATION

Community Considerations

The project is located adjacent the Bogong High Plains Road between Mt Beauty and Falls Creek Ski Resort. This is a narrow and winding single lane road with relatively high volumes of traffic, particularly in the ski season between June and October each year. Significant consideration was given to minimising the impact that construction traffic would have on road users. The following initiatives were implemented by MacDow:

- An on-site concrete batching plant was established to minimise additional heavy vehicle traffic;
- Construction of an additional access road for heavy vehicles, minimising heavy vehicle traffic through Bogong Village;
- Rehabilitation and re-sheeting of the Village road at the completion of the project;
- Installation of a micro filtration plant for the Village water supply and replacement of the old asbestos cement supply line with HDPE pipe; and
- Several community initiatives were also implemented.

Logistics

Minimal level areas were available for the establishment of amenities, storage of large quantities of construction material, mobilisation and assembly of large tunnelling equipment (the tunnel boring machine being 140m long). Significant planning and set up works were required to optimise the areas available.

PROJECT DELIVERY, LEADERSHIP AND MANAGEMENT

Innovations in Design and Value Engineering

The initial tender process yielded unfeasible pricing. A series of complex design and value engineering workshops were developed between the owner (AGL) and MacDow in order to provide a workable solution. These outcomes included:

- Power Station changes, including raising the power station level;
- Innovations in use of excavated spoil;
- Review of geology and use of hydro-fracturing analysis to optimise tunnel liner length and diameter;
- Changes to tunnel lengths and alignments; and also construction methodologies.

The ultimate result was a price reduction, enabling the project to proceed.

Innovations in Construction

Shaft Construction:

- Use of raise-boring techniques instead of blind sinking for shafts, resulting in better waterway efficiency and greater station efficiency.

High Pressure Tunnel plug construction:

- Significant development of the concrete mix to enable pumping 800m into the tunnel and to keep hydration to a minimum.

Steel lining of the HPHT:

- A specialised rail-bourn pipe transporter was sourced from Europe and adapted for the Project. This enabled the 3m diameter, 12m long, 30T liner sections to be transported 700m underground with a clearance of 300mm on the sides and to be positioned to within +/- 15mm.

Industrial Relations

The project involved several parties with industrial working agreements with various unions. As the principle contractor, MacDow managed all site IR without any industrial dispute or lost time.

Enduring social benefits

Sustainability and Re-Use of Tunnel Rock
Over 300,000T of extremely hard granodiorite rock was removed during this excavation. Federal and State funding was secured for the construction of an all weather road across the Bogong High Plains, linking Falls Creek Ski Resort and the Omeo Highway. This road was completed in April 2009 and has created a new Alpine touring circuit, bringing additional tourism to the area.

Training of Local Personnel

MacDow's standard practice of engaging local personnel where possible to supplement the skilled workforce bought additional benefits. Significant training for roles such as shot firers, drillers, machine operators and locomotive drivers was undertaken and a number of these employees have remained with MacDow on new tunnelling projects, including the Adelaide Desalination Plant.

Relationship-driven Outcomes

As the project was undertaken in a State National Park, there was very limited ability to collect relevant geological or geotechnical information. Many of the construction challenges were associated with difficult, unpredictable or unforeseen geological conditions. The ability to overcome these challenges was due to a strong relationship developed between MacDow and AGL based on trust, confidence and expertise. Construction challenges and mitigation measures developed include:

- Flood prevention measures;
- Dealing with unforeseeable tunnel conditions;
- Working together to develop a mechanism to provide cost optimisation in the areas of:
  - Waterway efficiency;
  - Power Station efficiency and layout;
  - Steel liner design optimisation;
  - Tailrace alignment; and
  - Bifurcation and manifold design and construction.

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