WIVENHOE POWER STATION

Foreword

Wivenhoe Power Station is a showcase for the world in its application of advanced technology, and with its impressive capabilities is an enormous asset to Queensland's electricity supply industry, and in turn to the people of Queensland.

Each year our industries and domestic consumers are using more power. The demand for electricity is growing at over 6% a year, more than in most States. The State Government, through the Queensland electricity supply industry, accepts the challenge of keeping pace with this growth in demand.

Without new power stations such as Wivenhoe, Tarong, Callide B and Stanwell, currently under construction, there would not be enough electricity to meet future needs.

The Government's foresight in undertaking the construction of both Wivenhoe Power Station and Wivenhoe Dam has meant that water and power needs, as well as flood mitigation, are being achieved by the one project.

The staffs of the Co-ordinator-General, State Electricity Commission, Queensland Water Resources Commission, Snowy Mountains Engineering Corporation and other consultants and contractors deserve special commendation for their dedication to the difficult and challenging job of building the State's first pumped storage power station.

Sir Joh Bjelke-Petersen, K.C.M.G.
Premier and Treasurer of Queensland

Completion of Wivenhoe Power Station is a landmark in the State Government's ongoing commitment to provide new electricity generating facilities when they are needed.

Now that Wivenhoe's two 250 megawatt units are fully operational, the industry has a greater flexibility in meeting the demand for power during the morning and evening peak periods.

Pumped storage power stations are among the most economical means of generating electricity for use during peaks, if low-cost power is available during the night to pump water into the storage dam. At present, Wivenhoe's low-cost power is provided by Gladstone and Tarong Power Stations.

The $245 million Wivenhoe Power Station is part of a $3 000 million commitment in power station development planned for Queensland between now and the year 2000.

Those people who have played a part in the realisation of this special power station can be proud of their contribution to Queensland.

Ivan J. Gibbs
Minister for Mines and Energy

With Wivenhoe Power Station, Queensland becomes a world leader in the technology of remotely controlled pumped storage hydro-electric generating plant.

The range of operations encompassed by the station's complex automatic control equipment is believed to be unique in the western world.

In an emergency, the station can switch on automatically in less than 20 seconds to compensate for a failure in another part of the State's electricity system.

Usually, the station is remotely controlled from State Control Centre in Brisbane.

Already Wivenhoe is proving a valuable addition to the State's electricity generation facilities.

Neil Galwey
State Electricity Commissioner

The power station opening is indeed a memorable moment in the history of the Wivenhoe Project.

As constructing authority for the overall Project, the Co-ordinator-General's role has been to oversee three undertakings — Wivenhoe Dam, Wivenhoe Power Station and Split-Yard Creek Dam — and to co-ordinate Government departments in land resumptions, road works and other activities.

Preliminary work on Wivenhoe Project began in the mid-1960s when it was foreseen that rapid increases in water usage in Brisbane and surrounding areas would necessitate the construction of a major dam by the 1980s.

I extend my personal congratulations to everyone who contributed to the successful completion of this major part of the Project.

Sydney Schubert
Co-ordinator-General

Wivenhoe Dam will help meet southeast Queensland's water needs into the 21st century.

The Queensland Water Resources Commission is proud of its role in designing and supervising the construction of this dam, and Split-Yard Creek Dam, for the Co-ordinator-General.

Although Split-Yard Creek Dam is 40 times smaller than Wivenhoe Dam, it is large enough to store energy for use during peak electricity demand periods.

We commend the efforts of all associated with Queensland's first pumped storage hydro-electric project for overcoming the many construction challenges which we shared.

Don Beattie
Commissioner for Water Resources

Pumped Storage Schemes

Wivenhoe is the first pumped storage hydro-electric power station to be built in Queensland.

A pumped storage scheme differs from a conventional hydro-electric project in that it recycles a limited amount of water between a high level and a low level reservoir. A conventional hydro-electric power station uses water once only. Since a pumped storage scheme does not require an abundant supply of water, it is appropriate for a locality such as southeast Queensland where scarce water supplies must be conserved.

As in all hydro-electric power stations, water flows down from the high level reservoir through turbines which drive the generators to produce electricity.

In a pumped storage scheme, this water is held in the lower storage from which it may be pumped back to the upper reservoir to be used again when needed. The generators are designed so that they may be operated as electric motors to drive the pumps, using power from the State grid.

More power is used to pump the water back uphill than can be recovered while the station is generating, yet a pumped storage scheme is one of the most economical means of generating electricity at certain times of the day.

In the morning and the early evening, homes and factories create maximum demand for electricity. During these peak demand periods, a pumped storage power station generates power, but later during the night when demand tapers off, the station pumps water back to the high level storage for re-use the next day.

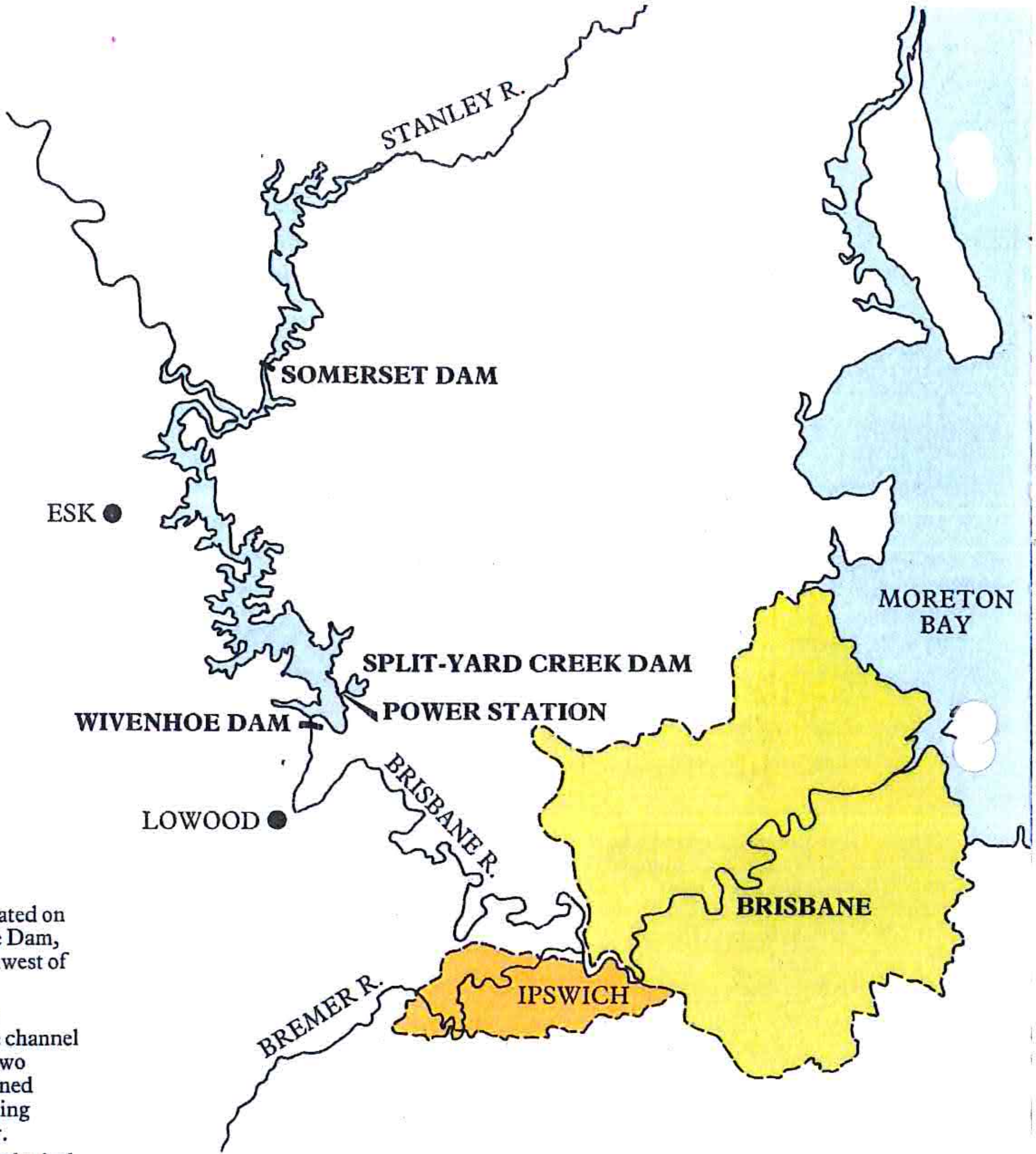
This off-peak pumping uses surplus energy available from the high-efficiency base load power stations elsewhere in the State's power system.

Pumping takes nearly four kilowatt-hours of energy for every three kilowatt-hours of energy produced when generating. But big, efficient units like those at the coal-fired Gladstone Power Station are most economic when running at constant load. This makes the conversion of energy with a pumped storage power station like Wivenhoe during peak and off-peak periods an efficient operation bringing benefits to consumers.

A pumped storage scheme also makes an electricity system more reliable. Like any other hydro-electric operation, pumped storage can respond quickly — in seconds — to any sudden change in demand for energy.

Wivenhoe pumped storage power station is an effective complement to the State's coal-burning power stations which need much more time to start up and reach full load.

Split-Yard Creek Dam control structure.



Site

Wivenhoe Power Station is located on the eastern side of Wivenhoe Dam, about 90 kilometres by road northwest of Brisbane.

The power station is connected to Wivenhoe Dam by an open intake channel and to Split-Yard Creek Dam by two underground steel and concrete-lined tunnels, 420 metres long and varying from 8.5 to 6.8 metres in diameter.

Early excavation work revealed geological conditions which had not become apparent despite extensive preliminary foundation investigations. Consequently, significant excavation remedial measures and redesigning of the main power station structure became necessary.

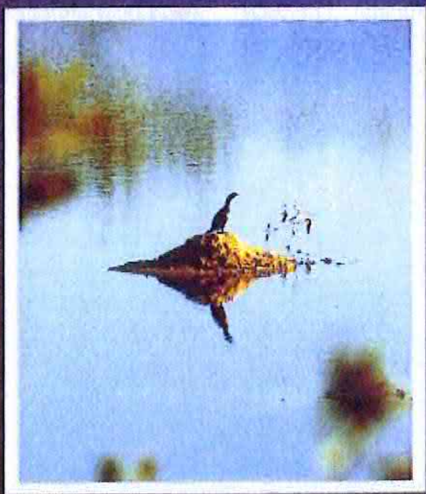
Environment

The power station is on the edge of an attractive area of sub-tropical rainforest, and considerable care has been taken to ensure that the project has caused minimal disturbance to this area.

Abundant bird life in the surrounding rainforest and on the lakes formed by the dam and power station schemes is evidence of the care that was exercised during construction.

The project's planners have been cognisant of the tourism potential of the area and the possibility of establishing a picnic area and lookout near the power station is being investigated.

Split-Yard Creek Dam will not be accessible to the public for safety reasons associated with the large operating fluctuations in water level.



Scenic beauty of Wivenhoe Dam looking across to the power station.

Background

The suitability of the Wivenhoe Dam area for a future water storage had been recognised since the 1890s. Following extensive investigations starting in the mid-1960s, approval was given by the Queensland Government to proceed with a water supply and flood mitigation scheme involving construction of a major dam at Wivenhoe.

When the decision was made to build a dam on the original "Wivenhoe" property, settled in 1840s, the name was retained for the project.

The Wivenhoe pumped storage hydro-electric power station became part of the Wivenhoe Project after a comprehensive study into the economics of this type of power scheme in Queensland. In 1975, the State Government approved the construction of Wivenhoe Power Station.

This involved the construction of a second dam on Split-Yard Creek which would form the upper storage for the power station, with Wivenhoe Dam serving as the lower storage.

The Co-ordinator-General was appointed the constructing authority for the entire project — dams and power station.

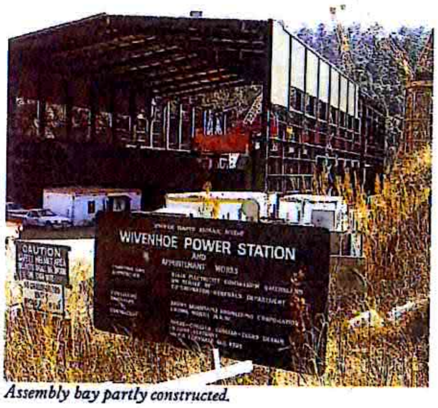
Construction of the power station was undertaken by The State Electricity Commission of Queensland, and Wivenhoe and Split-Yard Creek Dams by the Queensland Water Resources Commission, under delegation from The Co-ordinator-General.

In turn, the State Electricity Commission appointed the Snowy Mountains Engineering Corporation as its consultant for the power station.

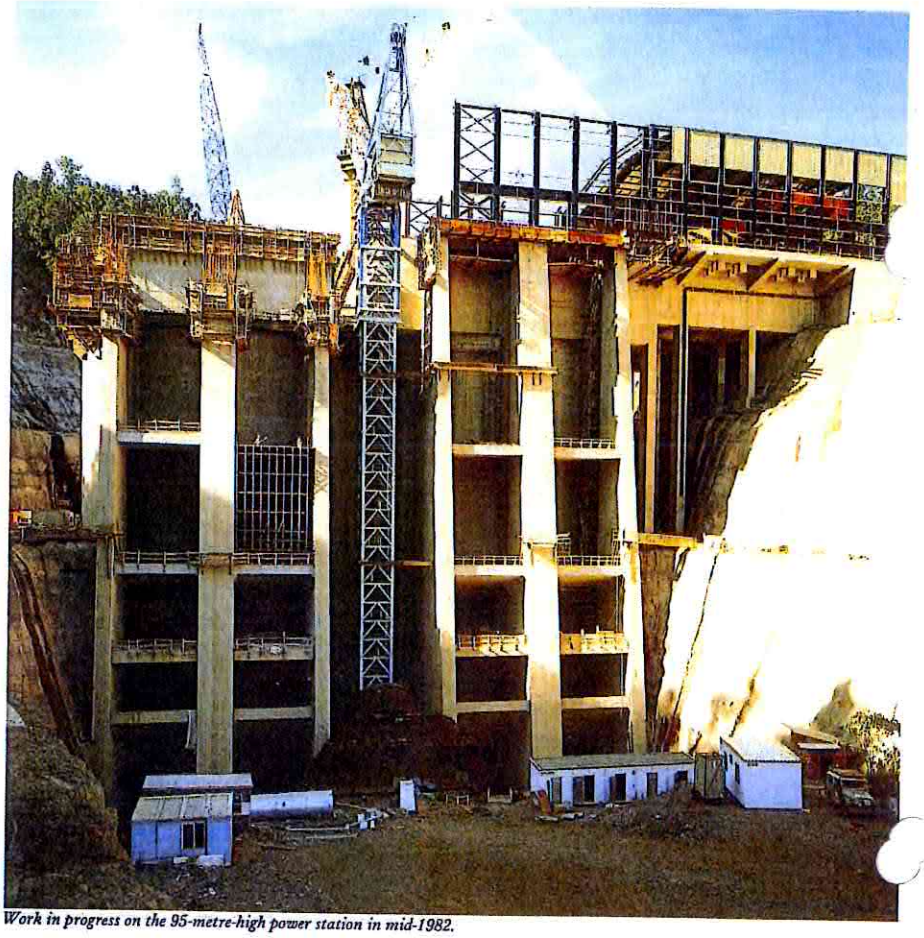
Construction of Split-Yard Creek Dam began in 1976, and in late 1978 the first power station contractor moved on to the site.

In September 1981, construction work was accelerated in order to overcome early construction delays resulting mainly from site geological problems and industrial factors. The aim was to achieve completion of the first generating/pumping unit for the winter of 1984.

This challenge was met successfully. No 1 unit began commercial operation with the Queensland Electricity Generating Board's system on 18 June 1984 and immediately helped to meet the year's peak electricity demand which occurred in July. No 2 unit followed suit on 27 August 1984.



Assembly bay partly constructed.


Work in progress on the 95-metre-high power station in mid-1982.

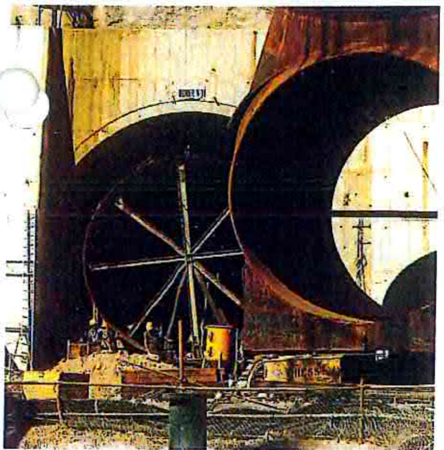
Dam and Tunnels

Split-Yard Creek Dam has an available storage of 23 300 megalitres, twice the annual water consumption of Toowoomba, but about one-fiftieth the size of the 1 150 000 megalitre Wivenhoe Dam.

Built by the Queensland Water Resources Commission, Split-Yard Creek Dam is the highest earth and rock fill dam in Queensland.

The control structure in the dam consists of two concrete silos above intake and diffuser structures. The control structure is equipped with stoplogs, trashracks and gates capable of regulating the flow into the tunnels.

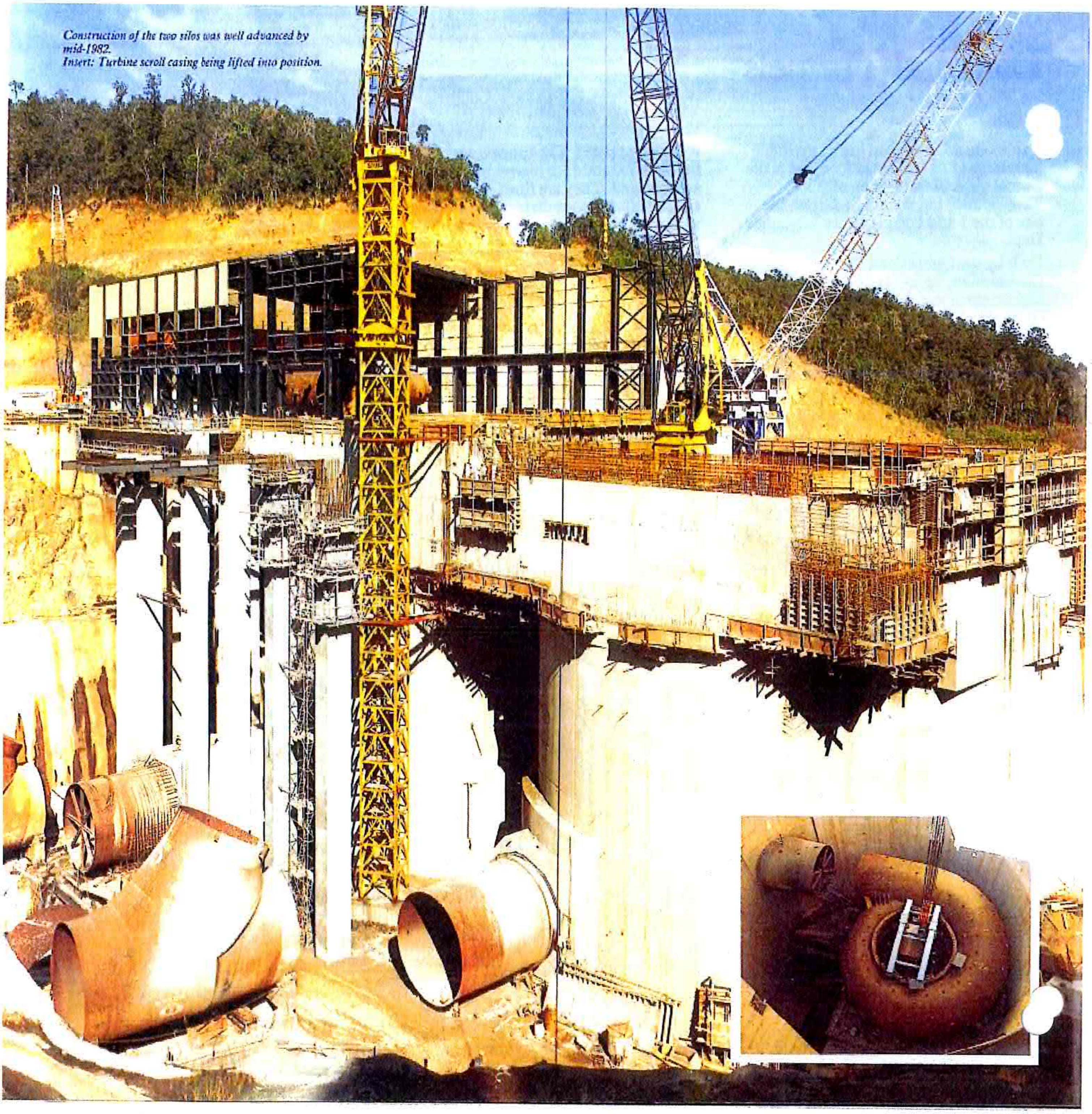
Each of the generator/pumping units is connected to Split-Yard Creek Dam by a 420 metre tunnel. The tunnels vary between 7.6 and 11.5 metres in diameter as excavated. They are lined in part with concrete (8.5 metres diameter) and in part with steel pipes (6.8 metres diameter) which were manufactured on site. Outside the tunnels, the pipes divide into a bifurcate (Y piece) to connect with both the pumps and turbines in the power station.



Tunnel liner being inserted in No 1 tunnel with bifurcate in foreground.

The completed Split-Yard Creek Dam.

Early construction mid-1980 showing foundations and installation of pump branch pipes.



Construction of the two silos was well advanced by mid-1982.
Insert: Turbine scroll casing being lifted into position.

Power Station

Little of the 95-metre-high Wivenhoe Power Station is visible because the structure is mostly underground and below the level of Wivenhoe Dam.

The largest contract in a hydro-electric power station is for the civil engineering work, and at Wivenhoe this was awarded to a joint venture consortium of Thiess, Codelfa-Cogefar, Evans Deakin. The power station structure was designed by engineering consultants, Snowy Mountains Engineering Corporation.

Below the Wivenhoe Dam water level, the power station consists of two 32-metre-diameter concrete silos with walls 1.5 metres thick. A multi-level concrete and steel-framed superstructure is built across the tops of the two silos. Each silo houses an inter-connected machine set consisting of a pump, a turbine and a generator, plus control and ancillary equipment.

Each pump/turbine unit comprises a 312.5 megavolt-ampere unidirectional motor/generator driven by a Francis water turbine tandem-coupled to a centrifugal pump capable of discharging 231 cubic metres per second of water. The nominal generating capacity of each unit is 250 megawatts.

The large size of Wivenhoe's equipment compared with units in the world's biggest hydro-electric stations is due to the relatively small operating head at Wivenhoe ranging from 64 to 117 metres between the upper and lower storages. A large volume of water is therefore needed to drive the turbines and, in consequence, they and the pumps must be of immense size. In fact, the pumps were the largest in the world at the time of installation.

Each of the pumps used to fill Split-Yard Creek Dam from Wivenhoe Dam is capable of pumping, in less than one hour, a volume of water equivalent to the daily water consumption of Brisbane.

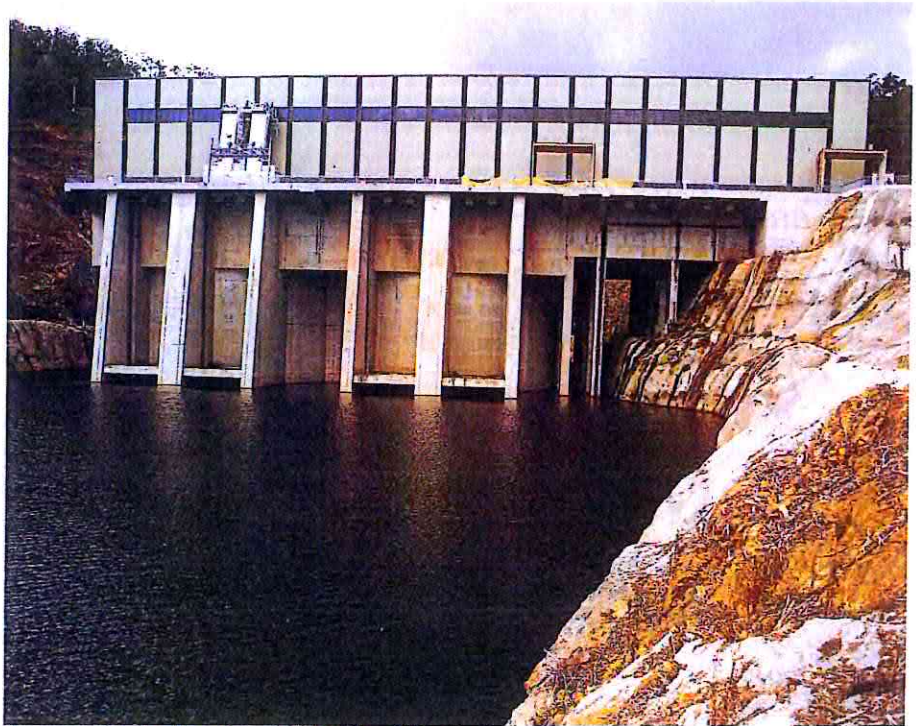
The contracts for the pumps and turbines were awarded to Mitsui and Co. (Australia) Ltd, with major design and construction work sub-contracted to Toshiba International Corporation Pty Ltd in Japan.

The contract for the generator/motors and automatic controls was awarded to Mitsubishi Australia Ltd with major design and construction work by Mitsubishi Corporation Pty Ltd in Japan.

Much of the sub-contract fabrication work was carried out by Queensland contractors.

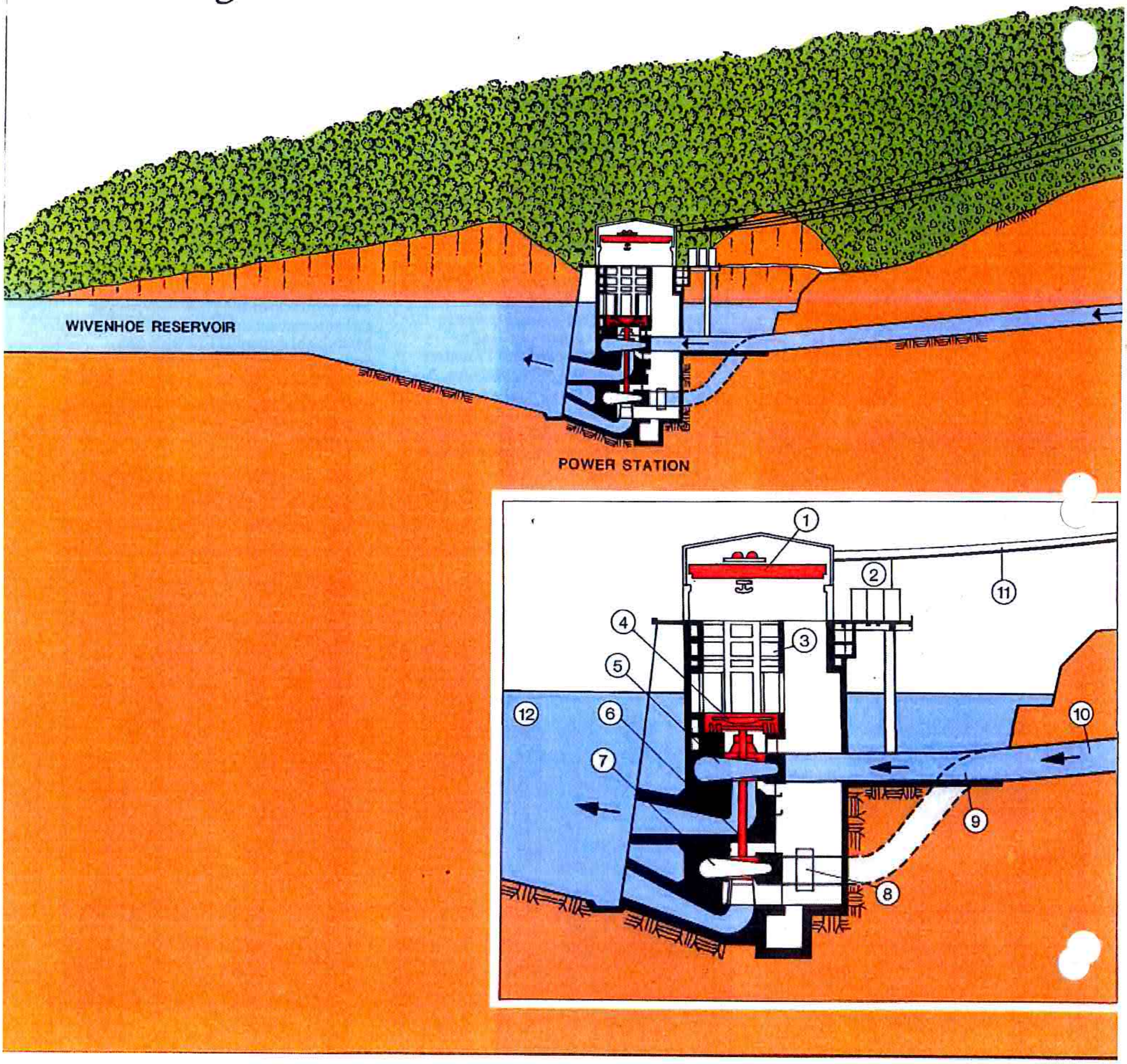
The 350-tonne travelling bridge crane ready for work over the equipment hatchway on the top floor.

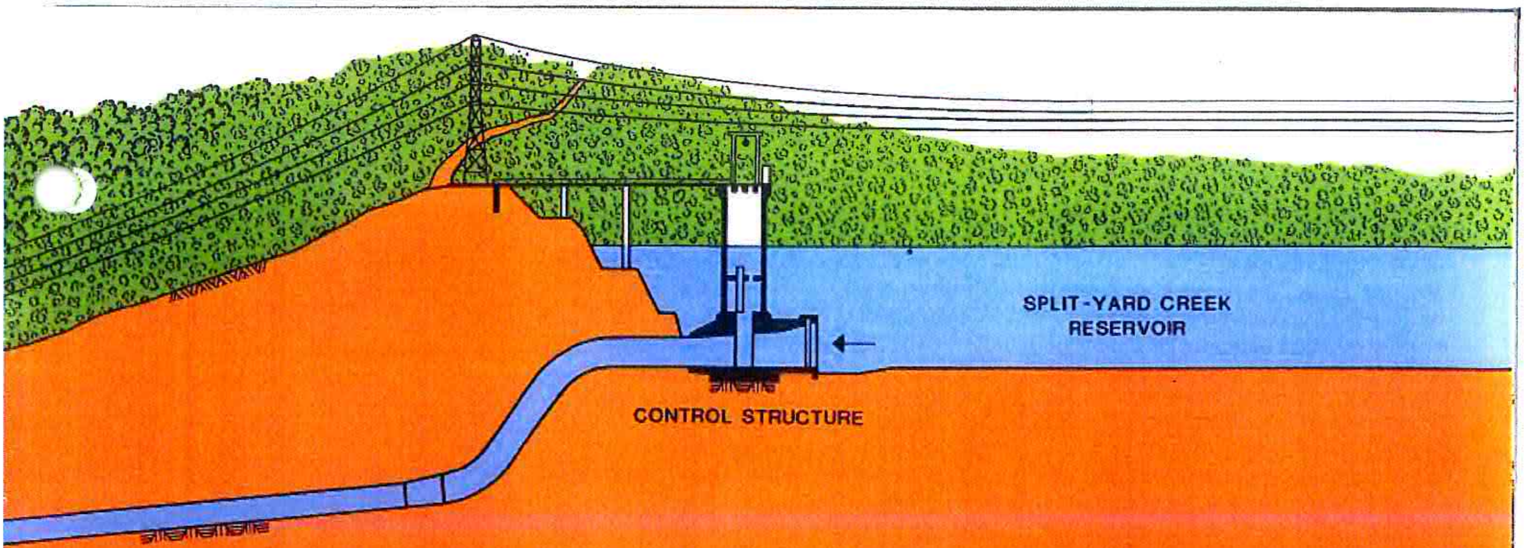
Assembly bay building almost completed late in 1983.



The power station viewed from the bank of the tail bay off Wivenhoe Dam.

Flow Diagram





Generating Mode

In the generating mode, water flows down through the tunnel from the high level Split-Yard Creek Dam to the low level Wivenhoe Dam.

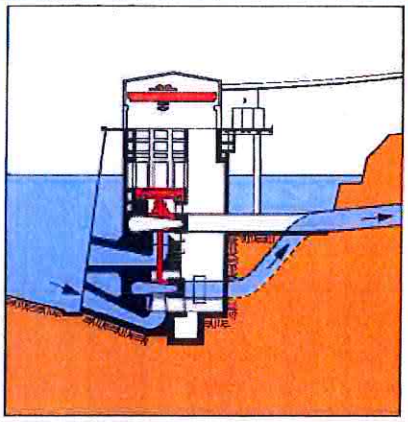
As the water passes through the turbine, guide vanes control the rate of flow and the spinning turbine drives the generator to produce electricity.

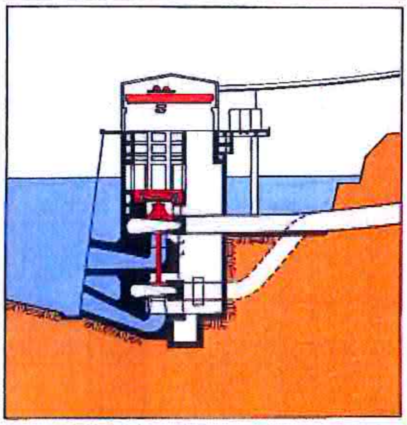
A vertical shaft assembly permanently joins the rotor of the generator/motor to the turbine runner and pump impeller; all three always rotate as one.

When the generator is being driven, damage to the pump is avoided by draining the water out of the pump chamber so the impeller can spin freely in air.

The discharge valve on the output side of the pump is closed and the pump chamber filled with compressed air to stop water from flowing into it from the lower reservoir.

1. *Bridge crane*
2. *Transformer*
3. *Control levels*
4. *Generator/motor*
5. *Turbine*
6. *Vertical connecting shaft*
7. *Pump*
8. *Discharge valve*
9. *Tunnel division*
10. *Tunnel to upper reservoir*
11. *Transmission line*
12. *Lower reservoir*





Pumping Mode

During pumping, water is drawn from the lower reservoir as the pump forces it to flow through the open discharge valve, along the tunnel to the upper reservoir.

Electricity is taken from the State's power grid to drive the generator/motor and turn the pump.

To avoid damaging the turbine, its chamber is drained of water, the guide vanes are closed and compressed air keeps water from flowing back in from the lower reservoir as the turbine runner spins in an empty chamber.

Synchronous Condenser Mode

When operating as a synchronous condenser, both the tubine and pump chambers are drained, the turbine guide vanes are closed and the pump discharge valve is shut. Compressed air keeps both clear of water.

Electricity is connected from the State grid and the shaft turns at its rated speed.

In this mode, the generator/motor can be quickly switched to either pumping or generating modes by allowing water to flow into the appropriate chamber.

Work Plan

Earthworks for the power station began in 1978, two years after work began on Split-Yard Creek Dam.

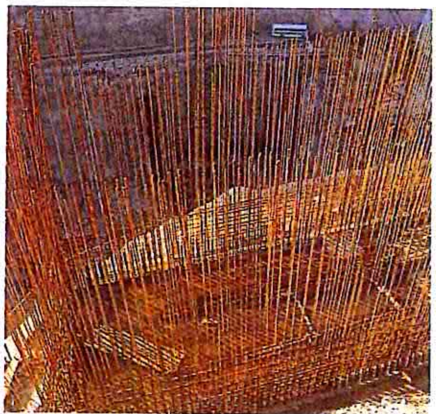
When it became evident that rock quality of the station and tunnel area did not reach the standard indicated by geological investigations, batter and tunnel support measures, together with concrete and reinforcing steel in the power station silos, were significantly increased.

These extra measures created a 15 month delay in the construction programme.

In early 1981, the Co-ordinator-General, in consultation with the State Electricity Commission, decided to accelerate the programme to compensate for the delay. The revised programme aimed at having No 1 unit available for the winter of 1984, with No 2 unit to be completed by late August 1984.

Further delays resulted from on site industrial action, and from tail bay flooding in April and June 1983.

To achieve the target completion dates, a work programme involving double shifts by the civil engineering and major plant contractors was necessary. A vital concern was integrating the major concrete placements at high levels in the station's structure with the installation of major plant items (up to 360 tonnes) at lower levels.



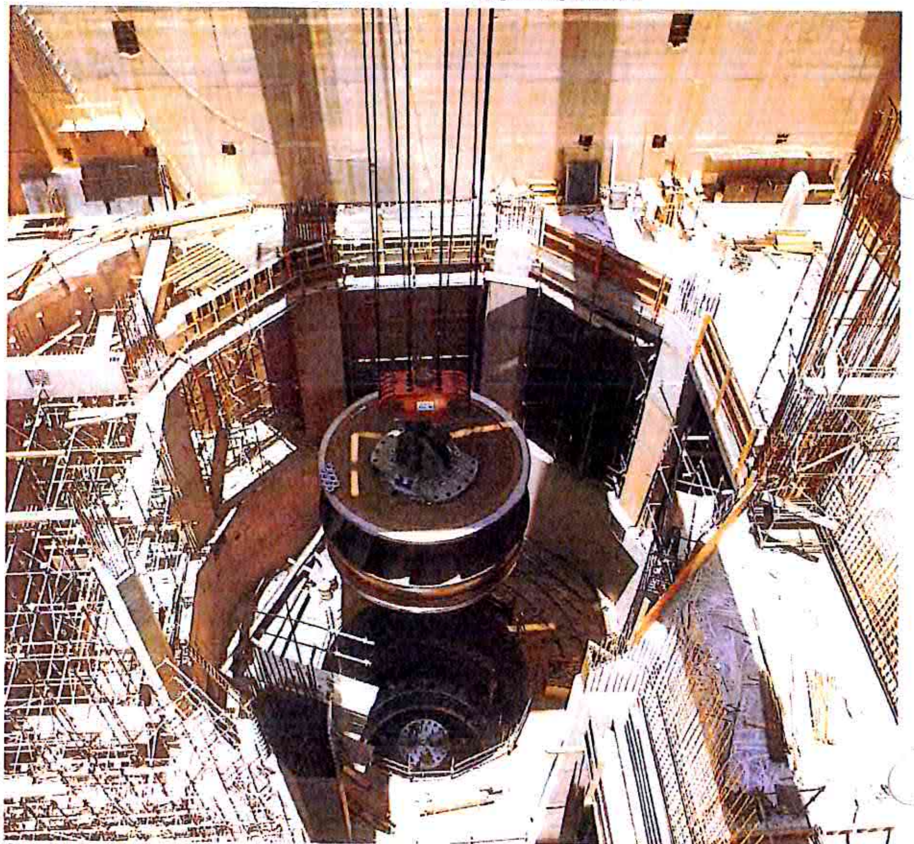
Striking pattern created by reinforcing.

Space in the assembly bay for pre-erection of large plant items was another critical factor, and integration of the operation of the overhead crane with the five tower cranes working in the confined space was vital to the success of the programme.

When construction of major works is accelerated, there is always concern that quality might be sacrificed for expediency. That this was not the case was shown during commissioning of plant beginning mid-March 1984.

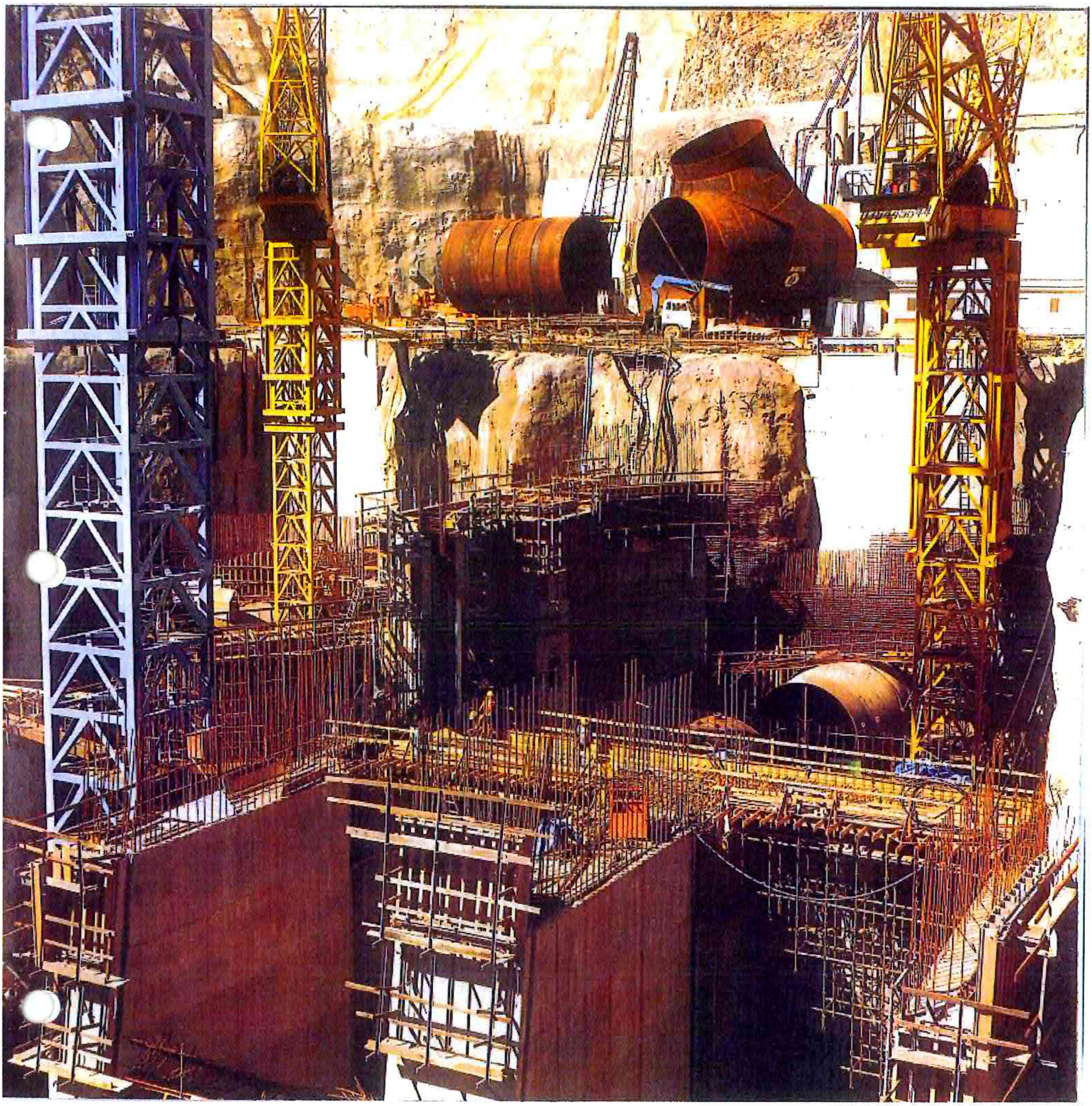
No significant problems were encountered and commissioning of both Wivenhoe units was completed on schedule in the very good time of five months.

Construction work was accelerated to achieve completion by mid-1984.



Lowering of turbine runner onto the pump shaft.

Power station progress by mid-1981. ▶



Operation

Mechanical energy to drive Wivenhoe's turbines comes from the kinetic energy of water flowing downhill between Split-Yard Creek Dam and Wivenhoe Dam through the power station. The water causes the turbine runners to rotate, which causes the generators to spin and produce electricity at the generators' terminals.

Electrical output of the generators is controlled by regulating the flow of water through the turbines by means of adjustable guide vanes.

When water in Split-Yard Creek Dam has fallen to the level where it must be replaced, the generators automatically become motors drawing up to 245 megawatts from the State's electricity system and driving the centrifugal pumps which pump water from Wivenhoe Dam back up to Split-Yard Creek Dam.

Apart from certain hydraulic considerations, the arrangement of tandem-mounted pumps and turbines, was chosen to permit running mode changes, that is, changeovers from generator to pump operation and back again without the need to bring the common shaft assembly to rest. This arrangement provides the means of fast start-up and mode changes in times of emergency.

Generator transformers are located between the generators and the 275 000 volt transmission system to step up the generated voltage of 13 800 volts to 275 000 volts when generating, and to step down the generator/motor supply voltage when pumping.

The generator transformers are connected by a 275 000 volt transmission line to the electricity grid at Mt England substation, two kilometres from the power station.

Besides pumping and generating, the power station has a third mode of operation in which its generating/pumping units run as synchronous condensers.

In short, a synchronous condenser is a motor carrying no load, but rotating at the same frequency as other base load power station generators.

Wivenhoe's ability to run in this synchronous condenser mode of operation provides it with extra functions, namely, system voltage control and spinning reserve.

In synchronous condenser mode the unit is available for immediate duty either as a pump (by letting water into the pump chamber) or as a generator (by letting water into the turbine chamber).

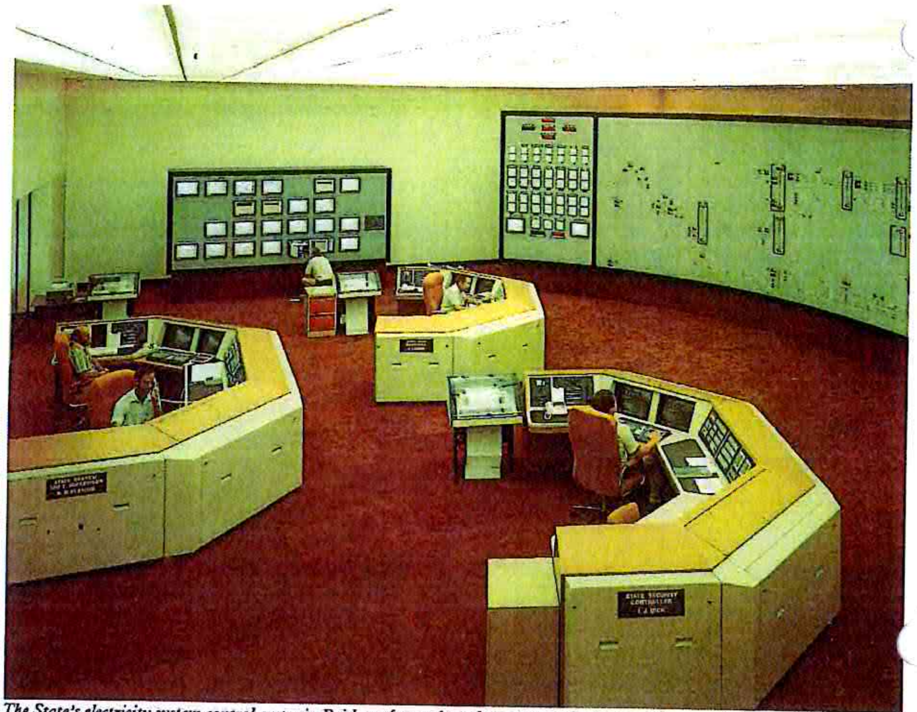
Plant control equipment has been designed to provide 17 programmes for starting, stopping and mode changing between the basic generating, pumping and synchronous condenser functions.

There are three programmes for protection-initiated main plant shut-downs in case of equipment failure.

In addition, special control actions, including four under-frequency actions, initiate an automatic power station response to system failures elsewhere. This ability makes Wivenhoe Power Station unique in the world of power generation.

Wivenhoe's two units can be locally operated from the power station control room, but are usually remotely controlled from the State's electricity system control centre in Brisbane where complex control technology automatically monitors the performance of the units.

Normally, the power station is unmanned and staff required for maintenance or emergency operation come from neighbouring Swanbank Power Station near Ipswich.



The State's electricity system control centre in Brisbane from where the power station is remotely controlled.

View of the power station showing its two generator transformers.

Insert: Generator transformer, located between the generator and the 275 000 volt transmission system.

Model Studies

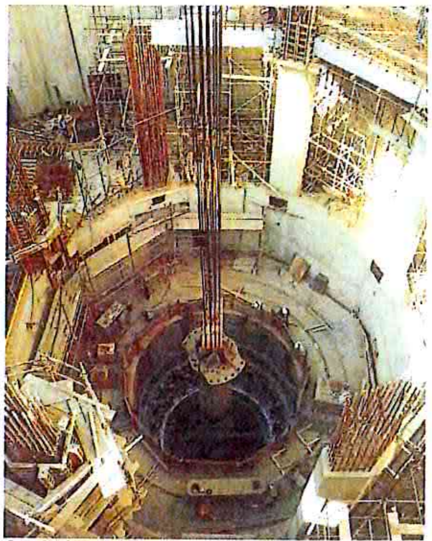
Because of the wide variation which could occur between the water levels of Split-Yard Creek Dam and Wivenhoe Dam (64 metres to 117.5 metres), it was necessary to undertake model studies to determine the most efficient use of the available water energy.

The first studies resulted in the selection of Francis turbines and centrifugal pumps tandem-mounted on the one shaft assembly.

To ensure a non-turbulent water flow in the pipes between the two reservoirs, in two directions according to whether pumping or generating, the water flow paths were modelled in Snowy Mountains Engineering Corporation's hydraulic laboratory in Cooma.

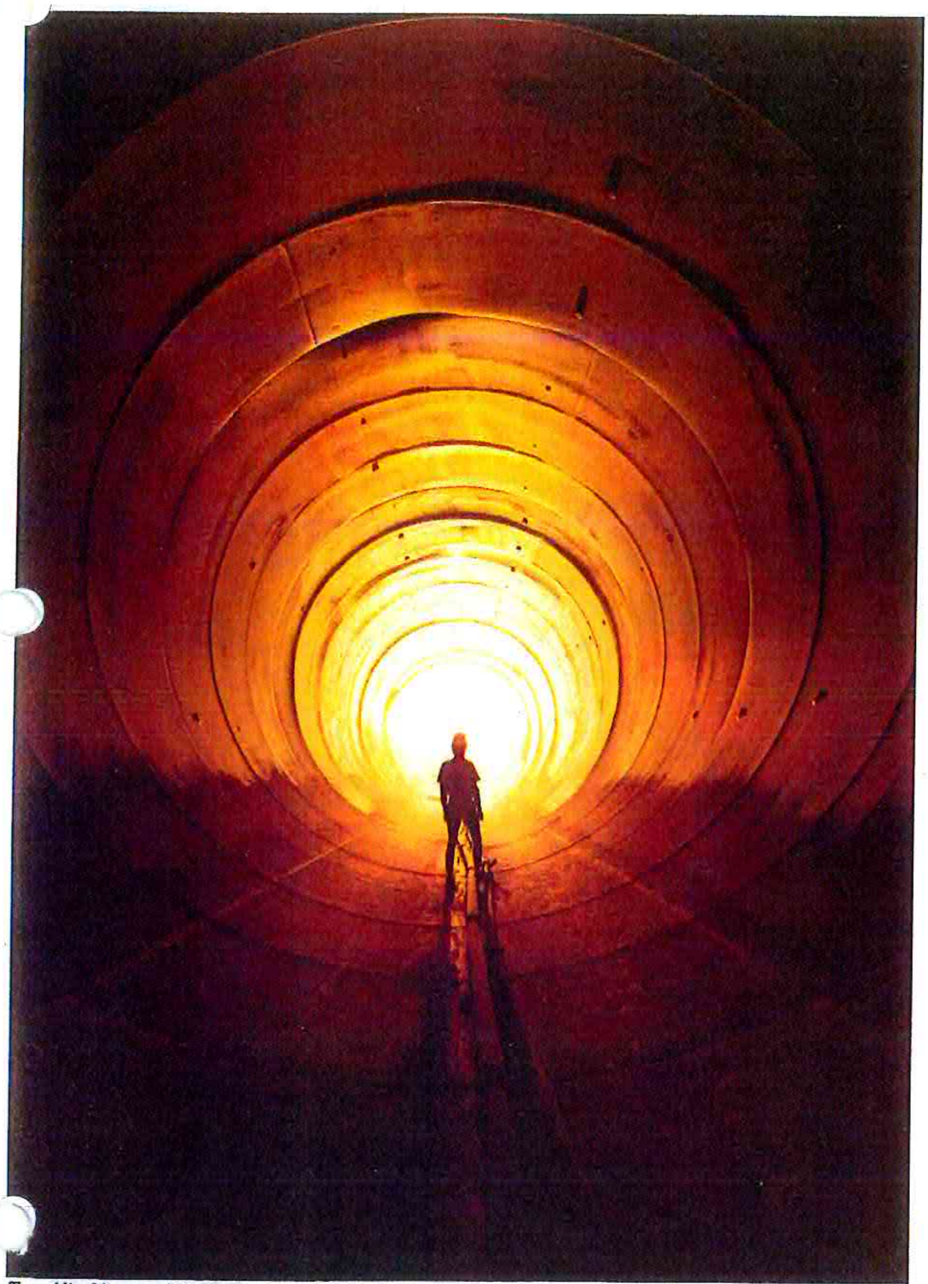
The pump and turbine contracts required the contractor to model test the major pump and turbine component to prove compliance of his designs with the performance specification and to produce compatible hydraulic characteristics.

The pump and turbine model tests were carried out by Toshiba International Corporation Pty Ltd at its Tokyo hydraulic test laboratory.



Installation of a pump shaft in April 1983.

The pump shaft being lowered by crane into the silo.



Tunnel lined in part with steel pipes.

Functions

Wivenhoe is a multi-purpose power generation and water pumping facility. It has four main operations — peak load generation, off-peak pumping, spinning reserve and automatic start-up.

Peak Load Generation: As a peak load power station, Wivenhoe can generate up to 500 megawatts over morning and evening peaks, thus assisting the coal-fired power stations to meet the electricity demands of consumers. Split-Yard Creek Dam provides five hours of full load generation, a normal day's operation.

Off-Peak Pumping: As an off-peak pumping station, Wivenhoe can assist the base load coal-fired power stations cope with the after-midnight light load situation. This is when Wivenhoe's water is returned to the upper reservoir. The pumps take seven hours to pump back the water used in a normal day's generation.

Spinning Reserve: When operating in the synchronous condenser mode, with the units already synchronised with the State's grid, Wivenhoe can provide an immediate back-up to the coal-fired power stations, ready to come into service when a power system failure occurs elsewhere in the State. The generation/pumping units are converted to spinning reserve synchronous condenser operation when not generating or pumping.

Automatic Start-Up: When a power system failure occurs elsewhere without warning, resulting in insufficient generating or transmission capacity to match the system load, Wivenhoe Power Station will detect the falling system frequency that follows and will start-up or mode-change automatically to replace the lost system capacity and restore the frequency to its normal value.

Depending on its operating mode at the time of system failure, this start-up/ mode-change time can be achieved in less than 20 seconds.

This amazingly fast automatic response to a system power loss is a special feature of Wivenhoe Power Station.

General Information

WIVENHOE POWER STATION

General

Station generating capacity	
— rated	500 MW
— maximum	625 MW
Transmission voltage	275 000 V
Number of units	2
Pump capacity	207 m³/s
Pump impeller diameter	7.95 m
Length of pump drive shaft	22 m
Turbine rating	260 MW
Turbine runner diameter	6.6 m
Generator/motor rating	312.5 MVA
Diameter of generator rotor	12.5 m
Mass of rotating parts per unit	1 450 t
Operating head range	64 m – 117.5 m
Minimum operating level (M.O.L.) (for power station)	EL 49.0 m
Volume of concrete used in structures	110 000 m³

Power Station

Lowest foundation level	EL 2.0 m
Total height of structure (to roof)	95 m
Length of main floor (EL 78 m)	110 m
Width of main floor (excluding transformer decks)	40.25 m

Tunnels

Length	420 m
Diameter as excavated	11.5 m – 7.6 m
Diameter after lining	8.5 m – 6.8 m

Split-Yard Control Structure

Diameter of silos	15 m
Height of structure	40 m

SPLIT-YARD CREEK DAM

Catchment area	360 ha
Full supply level (FSL)	EL 166.5 m
Storage capacity at FSL	28 700 Ml
Inundated area at FSL	105 ha
Embankment crest level	EL 168.0 m
Embankment length	1 150 m
Volume of embankment fill	3 500 000 m³
Original bed level	EL 98.0 m
Lowest foundation level	EL 91.5 m
Height (foundation to crest)	76.5 m
Width of crest	10 m

Ml (megalitres) and m³ (cubic metres) are metric measures of water volume. 1 Ml = 1 000 m³.
m³/sec (cubic metres per second) is a measure of discharge, i.e. volume of water per second.

Wivenhoe Power Station at sunset.

Team

PROJECT MANAGEMENT

Co-ordinator-General

Co-ordinator-General	: S. Schubert
Director, Technical Division	: J. J. Mulheron
Director, Engineering Branch	: P. M. Phillips

State Electricity Commission

Commissioner	: N. A. Galwey
Deputy Commissioner (Engineering)	: J. R. Hamilton
Chief Engineer (Services)	: J. F. Carter
Wivenhoe Project Engineer	: N. K. Davies

Snowy Mountains Engineering Corporation

Director	: D. G. Price
Project Manager	: F. H. Tucker
Senior Resident Engineer	: P. G. Goldston

Queensland Water Resources Commission — Split-Yard Creek Dam

Commissioner	: D. W. Beattie
Deputy Commissioner	: A. E. Wickham
Chief Construction Engineer	: M. M. Pegg
Project Engineer	: J. F. Mienert

PRINCIPAL CONTRACTORS

STATE ELECTRICITY COMMISSION:

Thiess, Codelfa-Cogefar, Evans Deakin Joint Venture

• Main power station civil works including concrete silos, second stage excavation, tunnels and upper intake works.

Mitsubishi Australia Ltd

• Generators, switchgear, instrumentation and controls, phase isolated busbar (part) and accessories.

(Automatic controls by Brown Boveri (Australia) Pty Ltd, data logger by Leeds and Northrup Australia Pty Ltd)

Mitsui and Co. (Australia) Ltd

• Francis turbines and accessories.

• Centrifugal pumps and accessories including pump discharge valves.

(Pump and turbine manufacture by Toshiba International Corporation Pty Ltd, pump discharge valves by Mitsubishi Corporation Pty Ltd)

GEC Australia Ltd (Heavy Engineering Division)

• Generator transformers, station transformers and phase isolated busbar (part).

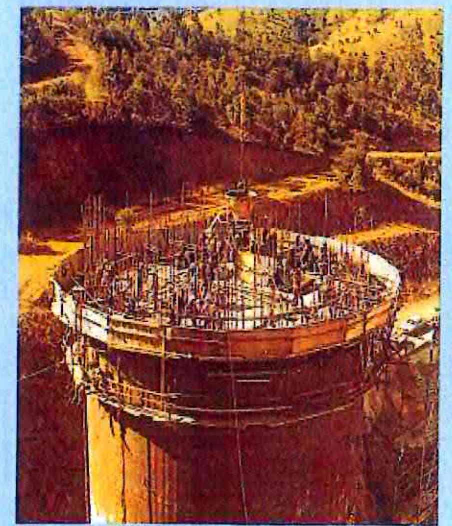
• Draft tube and suction conduit (lower level) gates.

Newsteel Pty Ltd

• Tunnel liners, branch pipes and bifurcates.

John Holland (Constructions) Pty Ltd

• Mechanical auxiliaries including air compressors and receivers, drainage pumps and pipework.



Construction of a Split-Yard Creek Dam intake tower.

• Electrical auxiliaries including cabling and diesel generator.

(Major erection sub-contractor to Mitsubishi Australia Ltd)

PHB-Weserhutte Pty Ltd

• Station cranes including 350 tonne assembly bay crane.

Samsung Heavy Industries Co. Ltd

• Coaster gates, bulkheads (upper level) and hoists.

Johns Perry-Johns and Waygood Lift Division

• Power station lifts.

Environ Mechanical Services Pty Ltd

• Ventilation and air conditioning equipment.

Evans Deakin Industries Ltd

• General light and power.

(Major fabrication and erection sub-contractor to Mitsui and Co. (Australia) Ltd/Toshiba International Corporation Pty Ltd)

Leighton Contractors Pty Ltd

• Power station access road.

QUEENSLAND WATER RESOURCES COMMISSION:

John Holland (Constructions) Pty Ltd

• Split-Yard Creek Dam and first stage power station excavation.

PRINCIPAL CONSULTANTS

Snowy Mountains Engineering Corporation

• Consulting engineer for overall power station project.

Queensland Electricity Generating Board

• Consulting engineer for generator transformers.

Cameron McNamara and Partners

• Consulting engineer for access road.