

# Mini Hydro Power Plant-Dewata Tea Estate



Project Stakeholder: PT. Chakra



## Diesel Substitution in Indonesian Tea Estates An Opportunity for Small Scale Hydropower

Until 2003 the Dewata tea estate was representative of many of the estates in West Java relying on captive diesel power to supply their factories and other energy requirements. The majority of the tea estates in West Java are typically located in remote highland areas. When first built, positioning of the factories was largely influenced by the availability of a reliable energy source, in most cases small-scale hydropower. By 1925 approximately 400 mini hydro-schemes were operating in Java providing more than 12,000 kW of power to the tea industry. As a result of decades of highly subsidized diesel fuel, however, most of these schemes were abandoned in the 60's and 70's and replaced by diesel generators. Of the few which remain operational, most are outdated and in desperate need of refurbishment.

The PT. Chakra owned Dewata Estate is located approximately 65km south of Bandung. The 600 hectare estate produces over 1,200 tons of tea per year. Prior to the completion of the Mini Hydro Power scheme in December 2002, the estate relied exclusively on diesel powered generators to supply power for running the factory and supplying estate workers houses with evening lighting.

### Background

In 1999 ENTEC AG, MHPP and PT. Chakra jointly carried out a feasibility study to assess the viability of a site identified on an earlier visit made to the estate. On the basis of the study's findings and the projected fuel price increases, PT. Chakra decided to go ahead with the building of a 250 kW mini hydro power plant. Construction was started in early 2001 and completed in December 2002. This decision was fully vindicated when in the same year the Indonesian Government began its policy of fuel subsidy removal. Prices have since increased considerably and it is their intention to eventually bring prices fully in line with international levels and remove subsidies entirely. The main technical features of the scheme are shown on the following page.

The scheme will provide the estate with a sustainable clean source of energy – a valuable “plus” for the company's image in the now highly competitive tea export business where customers are becoming more and more environmentally conscious.

### Financial

Investment costs of the scheme are approximately US\$1300 / kilowatt installed capacity. Financing was 50% loan – 50% equity. With a loan repayment period of 5 years (2 year grace period) and project lifespan of 20 years the scheme's Financial Internal Rate of Return (FIRR) is >35%. Yayasan Bina Usaha Lingkungan (YBUL), a local NGO active in the support of environmentally friendly enterprises in Indonesia arranged for the loan component of the scheme.

### Technical Assistance

The project claims an overall local content exceeding 80%. With the exception of imported generators and control electronics, all other components of the scheme have been produced locally adopting designs developed and introduced to local manufacturers through MHPP. Dewata's dependence on diesel fuel for energy generation is representative of the estate sector in Indonesia. The Dewata example could therefore be repeated in many tea estates in Indonesia provided suitable technical assistance and funding programmes pragmatically designed to meet the specific requirements of mini hydro were available. It is hoped that the exposure of the Dewata experience to relevant policy makers, financing institutions and potential project stakeholders will encourage similar initiatives in the future.

The 572m long stone masonry headrace channel connects the intake with the storage tank. It runs alongside the estate road and features a number of aqueducts and pipe bridges.



Pressure testing of the penstock pipe. The net head of the scheme is 62m and the penstock has a total length of 194m.



The electro-mechanical equipment features 2 x 125kW units. Turbines and all associated mechanical equipment was manufactured locally. The digital control system (DTC) was manufactured jointly by ENTEC AG and PT Heksa Prakarsa Teknik.



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## Environmental

The Dewata Estate is located within the Gunung Tilu conservation area of West Java. The awareness of the importance of catchment area protection for the long term sustainability of projects such as the Dewata mini hydro power project convinced PT. Chakra to cooperate with the local forestry department in a scheme supporting reforestation of areas adversely effected as a result of illegal logging. It is hoped these efforts will contribute to the long term sustainability of the scheme's catchment area.

The presence of the Dewata project will reduce diesel consumption of approximately 320,000 liters/year, and avoid annual CO2 emissions of approximately 1000 tons. Additionally the project will reduce noise pollution and other negative effects on the immediate environment caused through the transport, spillage and disposal of oil and diesel products.



## Technical Specifications

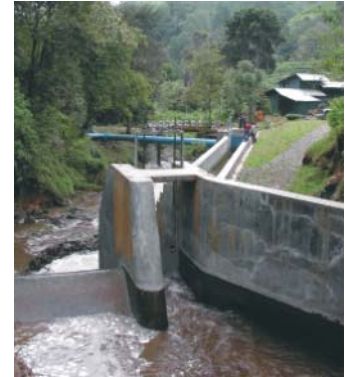
Power Output (P)	2 × 125 kW
Design Flow (Q)	600 liters/second
Net Head (Hn)	62 meters
Intake	Conventional diversion weir and side intake
Headrace Channel	572 meters long stone masonry open channel
Storage Tank Capacity	2275 cubic meters
Penstock Pipe	ø 600 mm / thickness 6 mm / length 194 m
Electrical Transmission	1 km long 20 kV line
Turbines	2 × X-Flow T15 bo 160 mm / ø 300 mm
Generators	2 × Hitzinger 185 kVA/1000 rpm
Governor/Control System	Entec AG-Digital Turbine Controller 14 (DTC 14)
Mechanical Transmission	Direct drive couplings

MHPP is a Indonesian - German cooperation project. The Directorate General for Electricity and Energy Utilization is responsible for Indonesian contributions and the *Deutsche Gesellschaft für Technische Zusammenarbeit* is responsible for German contributions. ENTEC AG is a Swiss engineering and consulting company specialized in mini hydro power technology and development.

*The Cikahuripan river flowing through the estate has relatively stable flow characteristics over the year, favorable for the requirements of a mini hydro power scheme*



*A conventional side intake with submerged orifice diverts the design flow of 600 liters / sec. into a sandtrap before entering the headrace via a pipe bridge*



*The 2,275 m³ capacity storage tank provides back-up capacity allowing the scheme to supply peak load demands for limited periods even when streamflow is below design flow.*



*A cascade type spillway conveys any excess flow from the storage tank back to the river.*



*The middle and lower sections of the penstock pipe, power house and tailrace viewed from the upper anchor block.*



*Commissioning of the turbine and flow control devices. ENTEC AG designed T14 cross flow turbines were manufactured by PT. Heksa Prakarsa Teknik, Bandung, Indonesia.*



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