



power in control



**POWER & CONTROL TECHNOLOGY: HYDRO CONTROL TECHNOLOGY**

## Varying Control Demands

The different hydro turbine types each come with their own specific demand for controls. Also, the required automation level varies from system to system. To meet these demands, DEIF offers a range of dedicated controllers.

Our multi-functional solution integrates all relevant control functions in just two hardware variants that interact with your PLC using communication protocols such as Modbus. Because the multi-functional units manage comprehensive control functions, you require only limited PLC capability.

DEIF's Delomatic controller is a single unit solution covering all necessary controls for the entire plant. The controller is adapted to the control of various turbine types and their auxiliaries.

Designed for AC generators ranging from a few kW to 20 MW or more, DEIF's solutions match any requirements you have, simple or complex, and stand out for their durability and flexibility.

*DEIF offers quality solutions that match the requirements of all types of applications, from simple single units to complex all-in-one setups.*

*Naturally, our systems are equally suitable for new installations and retrofits.*



Jan M. Jacobsen  
Product Manager  
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## Hydro Applications Include:

### Francis



### Kaplan



### Pelton/Turgo



### Archimedes



### Water Level Control



### Modular and Reliable

- ✓ 3 controller variants cover application range
- ✓ Free choice of automation level
- ✓ Proven for new installations as well as retrofits
- ✓ Remote control via safe internet connection

# Turbine Control

Selection of Controller to Match the Plant

## A Complete Controller Range

From Basic to Complex Quality Solutions

▲ Complexity

GPU-3 Hydro



GPC-3 Hydro



DM 400 Hydro



### Best in Class

- ✓ Adaptable to various turbine types
- ✓ Fully automated for unmanned operation
- ✓ Operator-friendly
- ✓ Remote control from central control room

### Cut Your Cost

- ✓ Water level optimised running
- ✓ Cut in personnel cost
- ✓ Automatic control of auxiliary equipment
- ✓ Free of charge PC programming tool



### **Power in Control**

The following pages feature a selection of case studies for a number of different applications that successfully run DEIF units and solutions.

DEIF has become a preferred control solution supplier to some of the biggest operators in the market, not just because of our innovative, safe and reliable technology but because of our commitment in guiding you through all phases of your project, from specification to installation or configuration. DEIF's flexible product platform covers the full range of application possibilities.

Most customers are able to install and commission our standard products working from data sheets only. But in cases of doubt, DEIF's far-reaching network of sales and competence centres, distributors, customer care teams, and technical support teams is available to assist you and ensure you invest in and implement the best controller for your application.

DEIF realises how space is always in demand. Saving you time and cost, our standard controllers require limited room for mounting and installation in switchboard cabinets.

Basic installation information can be found in the product quick start guide, and application setup is made easy with DEIF's Utility Software.

For greater detail, we refer you to the product installation instructions, just as you are invited to attend training courses on how to install and operate DEIF's standard controllers.

*Integrating a modern control system with a vintage look proved possible at Denmark's National Energy Museum...*

In 2012, DEIF Hydro Control Technology delivered the backbone of a long-overdue upgrade of Denmark's biggest hydro power plant, Gudenaacentralen.

Delivered by ASEA Brown Boveri in the 1980s, the plant's 3 × 1.3 MW Francis turbine generators' control system was operational but there were no spare parts available and no support.

The owner decided on DEIF's DM 400 Hydro solution because of its comprehensive format: One simple-to-operate controller manages all turbine and generator controls and protections.

DM 400 Hydro functionality includes:

- Synchronising and load control
- Generator protection
- Mains failure protection
- Voltage and power factor control
- Turbine start/stop control
- Turbine monitoring
- Hydraulic power pack control and monitoring
- Graphic presentation of data and remote access via internet.

The plant was inaugurated in 1921 and is part of Denmark's National Energy Museum, which made retrofitting the system an aesthetic challenge: The previous control system had been visible but DEIF's new hardware had to be integrated and hidden in the original design features of the plant.

DEIF solved the problem by hiding the majority of the control system behind the existing distribution panel. The remaining visible parts were placed in a console designed to agree with the plant's vintage look.



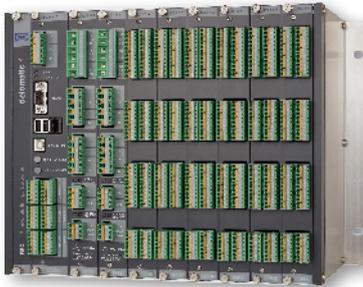
# Gudenaacentralen: Bjerringbro, Denmark

## Aesthetic Retrofit of Vintage Control System

### Data

- ✓ Original Commissioning: 1921
- ✓ Year of Retrofit: 2012
- ✓ Machine Type: 2-chamber Francis
- ✓ Capacity: 3 × 1.3 MW
- ✓ Machine Head: 10 m (33 Feet)

### Products



Integrated Systems, DM 400 Hydro



Multi-Differential Relay, MDR-2



Insulation Monitor, ADL-111Q96



Generator Protection Unit, GPU-3 Hydro



Battery Charger, DBC-1



Advanced Graphical Interface, AGI 100 series

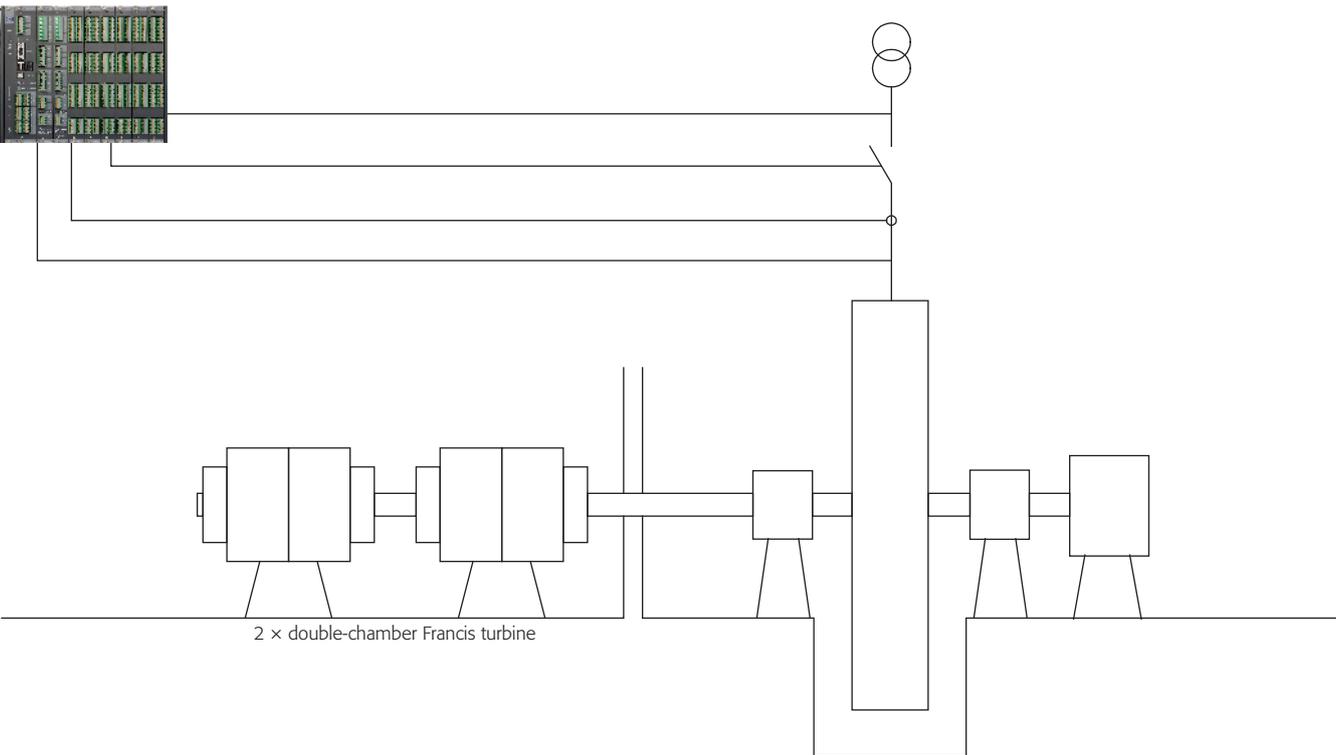


Rudder Angle Transmitter, RT-2



Ground Fault Relay, RMC-142D

### Diagram From Case



*...A cost-effective retrofit increased power output and changed daily operation from manual to automatic.*

In 2011, DEIF India won the job of retrofitting the Mohammadpur Power Plant by the Bhimgoda Barrage. Built at the head works of the Upper Ganga Irrigation Canal, the barrage is 455 m long and sits at the head of a 23,000 km<sup>2</sup> catchment area. The canal system is immense, consisting of 6,450 km of main canal and branches, providing irrigation for up to 2,023,000 ha.

First commissioned in 1952 with 2.0 MW turbines, the power plant, which sits on the main canal, was increasingly in need of an overhaul of its turbines, generators, switch gear and control systems. DEIF India supplied a comprehensive and up-to-date turbine generator controller

solution for a new setup featuring three 3.4 MW Kaplan turbine generators and a 5.79 m design head. The first of the three systems were successfully commissioned in April 2012. Before the retrofit, the Mohammadpur Power Plant was operated with a manual hydraulic governor, meaning all operations were performed in manual mode.

Among other features, DEIF's comprehensively engineered Delomatic 400 Hydro (DM 400 Hydro) solution introduced a simple and user-friendly single push-button start and the following functionality in one single rack unit:

- Sequence & Start-stop Control
- Electrical Protection of Generator & Busbar
- Mechanical Protection of Generator
- OPU Pump & System Control
- Brake & Jack Control
- Power Regulation Control
- Excitation System Control
- Voltage & PF Control
- Water Level Control
- Modbus TCP/IP communication to plant SCADA system
- Data Logging

Replacing PLC models, DM 400 Hydro controls sequencings and governor operation. The solution has generated higher output, making it highly cost-effective compared to alternative solutions.

Other primary benefits include more user-friendly operation and stable and reliable production with a sequence of event system in place that makes troubleshooting very easy.



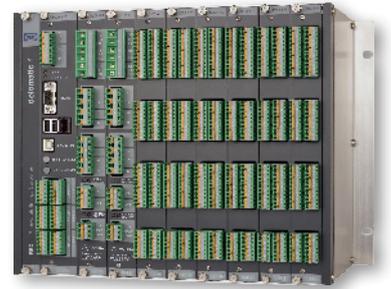
# Mohammadpur: Ganga, India

Moving to Automatic Operations Increased Output

## Data

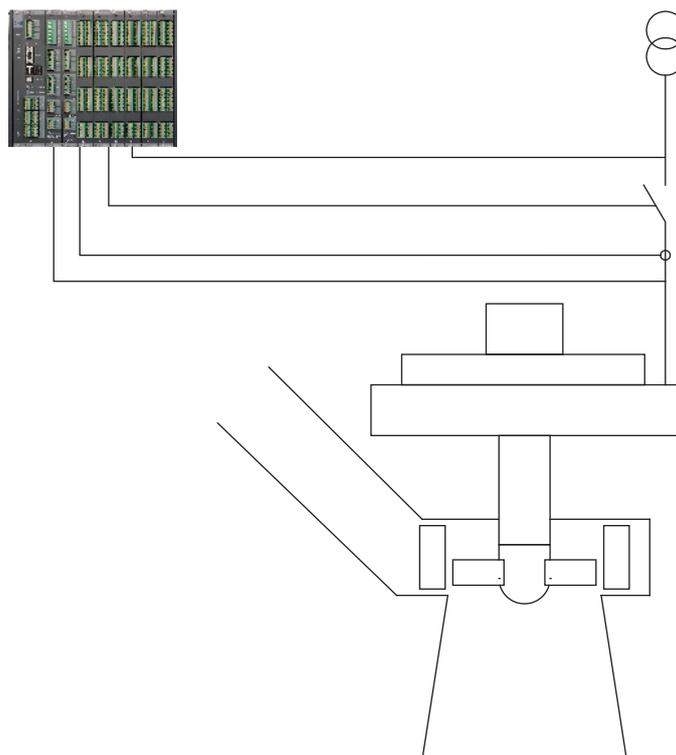
- ✓ Turbine Type: Kaplan
- ✓ Installed Capacity:  $3 \times 3.4$  MW
- ✓ Type of Power Station: Surface Run-of-River
- ✓ Original Commissioning: 1952
- ✓ Year of Retrofit: 2012
- ✓ Design Head: 5.79 m
- ✓ Design Discharge:  $255 \text{ m}^3/\text{s}$

## Product



*Integrated Systems, DM 400 Hydro*

## Diagram From Case





## **Complete Controller Packages, Retrofits and Market-leading Support**

DEIF Hydro Control Technology's market-leading hydro controller solutions form a complete package in mains/generator/engine control and protection, suitable for integrated, customised solutions for all plant types and sizes.

Award-winning and innovative, the controllers are some of the most comprehensive on the market today, ranging from cost-effective single and advanced multi-function controller platforms to units suitable for engineered Power Management Solutions. The controllers are suitable for synchronous/asynchronous single or 3-phase AC generators and provide control and protection of auxiliary equipment.

## **User-friendly, No External Controllers Required**

As a rule, DEIF's control concepts eliminate the need for external controllers and are user-friendly alternatives to standard controllers. Working with DEIF, you also benefit from the advantages of collaborating with one qualified supplier.

Ideal for retrofits, DEIF Hydro Control Technology's control concept is a cost-efficient and easy-to-implement all-in-one solution. The concept integrates functionalities such as synchronisation, regulation (primary and secondary), protection, power management, auxiliary management and circuit management.

We also offer outstanding product quality, expert support engineers for standard support, consultant application engineers to check specifications, and project managers ready to assume responsibility for turnkey power management solutions.

# Generator Protection Unit, GPU-3 Hydro

## Full Generator Protection Package



Easy to operate and configure, DEIF's Generator Protection Unit (GPU-3 Hydro) is an ideal controller for PLC-based hydro power systems.

The GPU-3 Hydro offers comprehensive generator protection and synchronisation. Serial communication enables easy interfacing with PLCs, SCADA-systems and more, and the unit features all necessary 3-phase measuring circuits and displays all values and alarms on a quality LCD screen.

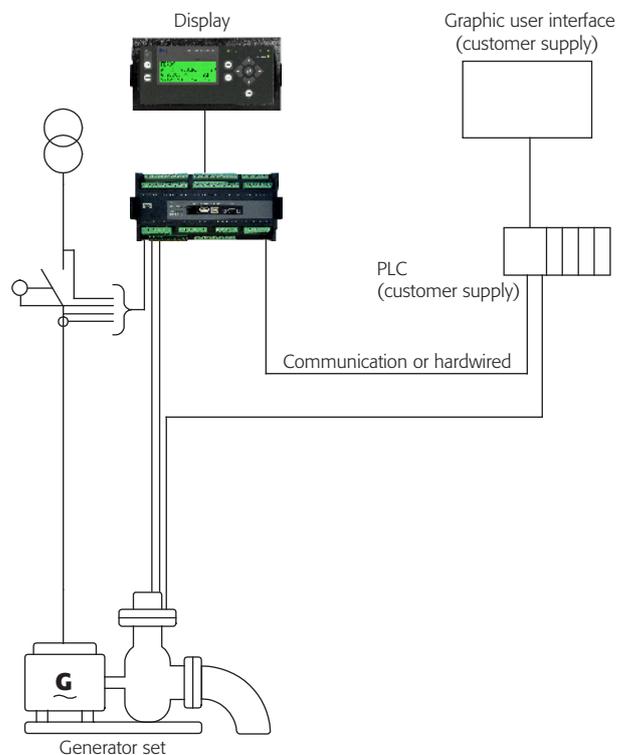
For start/stop and protection functionalities, add the GPU-3 Hydro turbine control option, a turbine interface card with separate power supply and independent microprocessor. In cases of GPU-3 Hydro main processor failure, the engine interface card will activate its back-up mode to ensure uninterrupted turbine supervision and automatic turbine shutdown in case of shutdown alarm.

With free software download and upgrade at [www.deif.com](http://www.deif.com), it is possible to customise the application to suit your needs exactly: dedicate specific functions or logic conditions to different inputs and outputs and tune all sequences according to your requirements.

### GPU-3 Hydro Features

- ✓ Generator/busbar protection
- ✓ Synchronisation
- ✓ Multiple display units and operator panels possible
- ✓ Turbine protection with back-up on shut-down channels
- ✓ Turbine control and communication

### GPU-3 Hydro Application Example



### GPU-3 Hydro Type Approvals



# Generator Paralleling Controller, GPC-3 Hydro

Designed for Stand-alone or PLC Solutions



The GPC-3 Hydro is a flexible and compact generator paralleling controller designed to be either the only controller in the system or to operate in conjunction with a PLC.

Especially suited as a single controller solution for micro and mini hydro plants, the GPC-3 Hydro also serves as a generator controller working as a slave for a power station PLC on hydro plants using digital communication.

The GPC-3 Hydro is a multifunction component and offers all functions needed for a modern hydro turbine generator controller. GPC-3 Hydro contains complete protections, measurements and turbine control and protection and can communicate with all PLC and SCADA systems. The GPC-3 Hydro displays values and alarms on a LCD screen.

DEIF's M-Logic configuration tool supports easy application customisation and enables you to dedicate specific functions or logic conditions to different inputs and outputs.

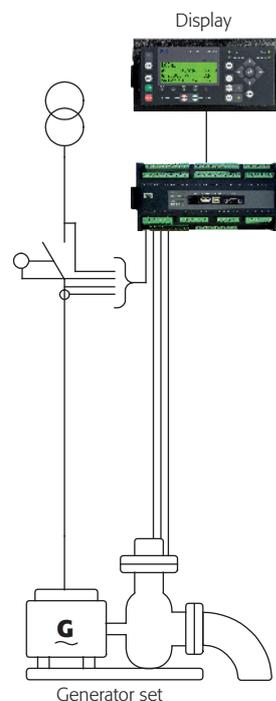
If you require remote control, supervision and status indication, additional display units and additional operator panels (AOPs) as well as graphical displays are easily installed.

## GPC-3 Hydro Features

- ✓ Mains/Generator/Motor protection
- ✓ The unique M-Logic, a simple configuration tool
- ✓ Turbine protection with back-up on shut-down channels
- ✓ Turbine speed and AVR control
- ✓ Multiple display units and operator panels possible
- ✓ Additional Operator Panel (AOP)

## GPC-3 Hydro Application Example

### Stand-alone



## GPC-3 Hydro Type Approvals



# Integrated Systems, DM 400 Hydro

*Simplifies your control solution while cutting installation and operational costs.*

A customised solution, DEIF's integrated Delomatic 400 Hydro (DM 400 Hydro) system cuts installation costs significantly compared to systems that require multiple units to provide synchronisation, protection and PLC functionality.

DM 400 Hydro-controlled plants offer fully automated control for stable optimised operation and require less maintenance and fewer man hours.

The DM 400 Hydro is compatible with all types of turbines and flexible and easy to adapt with simple parameter settings.

Critical functions such as speed governing, generator protections and synchronising are fully integrated with password-protected features for maximum security.

Apart from valve control (main valve, drain valve, fill valve), turbine adaptation options include the following:

## **Francis & Similar**

Control of wicket gate, UP/DOWN digital commands or analogue for hydraulic proportional valves.

## **Kaplan**

As Francis, plus control of runner pitch. The relation between wicket gate opening and runner pitch is a configurable curve laid into the DM 400 Hydro.

## **Pelton/Turgo**

Configurable sequential control of multiple nozzle/spear valves. Control can be UP/DOWN digital commands or analogue. Control of deflector/bypass.

## **Other Turbine Types**

The DM 400 Hydro can be adapted to all turbine types



## **DM 400 Hydro Type Approval**



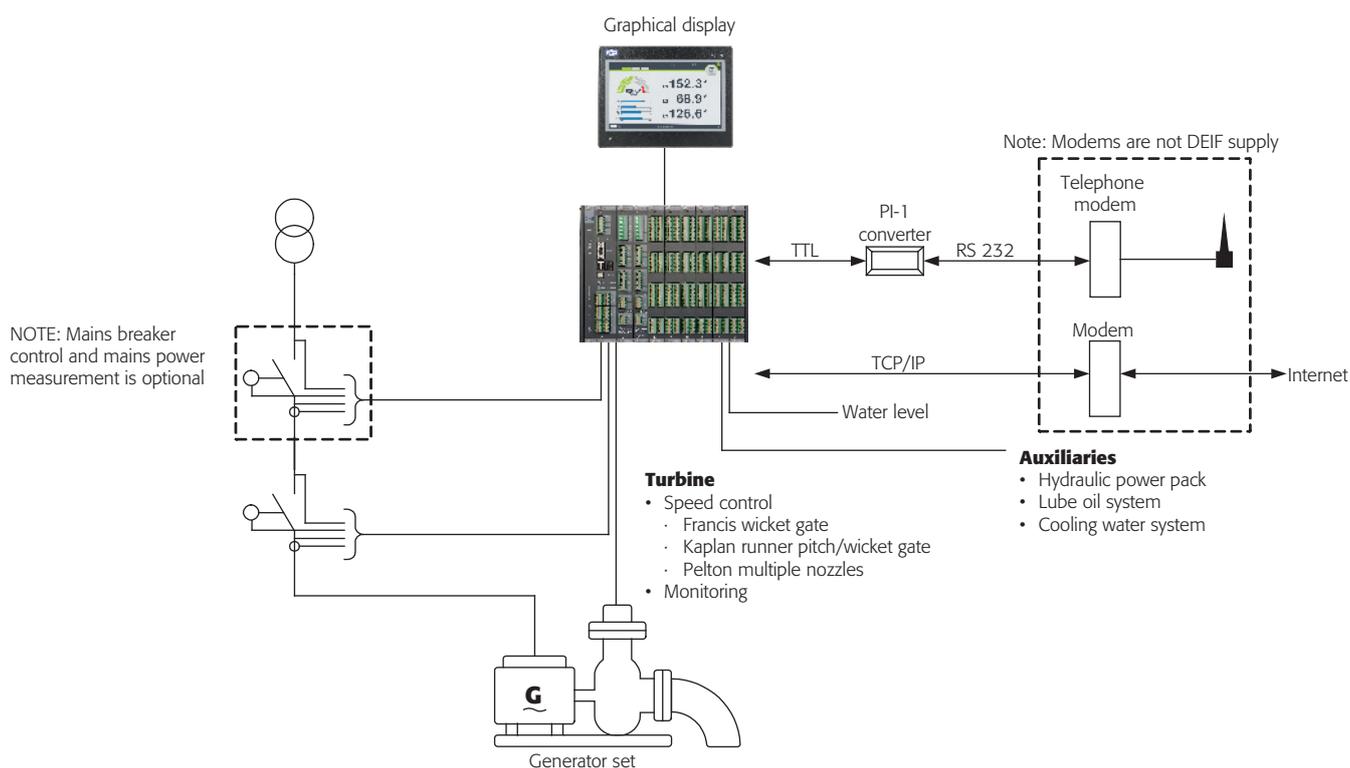
# Integrated Systems, DM 400 Hydro

Fully Automated Operation for all Turbine Types

## DM 400 Hydro Features

- ✓ Hydro Turbine Controller for Parallel with Mains or Stand-alone Generator
- ✓ Valve Controls (main/drain/fill)
- ✓ Water Level Control
- ✓ Relay or Analogue Output for Speed/power Control
- ✓ Turbine control, protection and supervision
- ✓ Generator control, protection and supervision

## DM 400 Hydro Application Example



DEIF is a market leader with a proven record of more than 80 years of technological achievement and innovation in engine & genset controls, marine bridge instrumentation, switchboard instrumentation and renewable energy controls.

Our goal is to always bring a competitive edge to our customers' businesses by providing green, safe and reliable product lines with flexible features and first class service and support.

The DEIF Group is committed to maintaining and expanding its position as a trusted global supplier of quality solutions.



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