

# Rehabilitation of Kidatu Power Plant

## Optimisation of water use for power generation

**The presentation:**

- ❖ Kidatu rehabilitation
- ❖ Efficiency improvements
- ❖ Technical solutions
- ❖ Achievements

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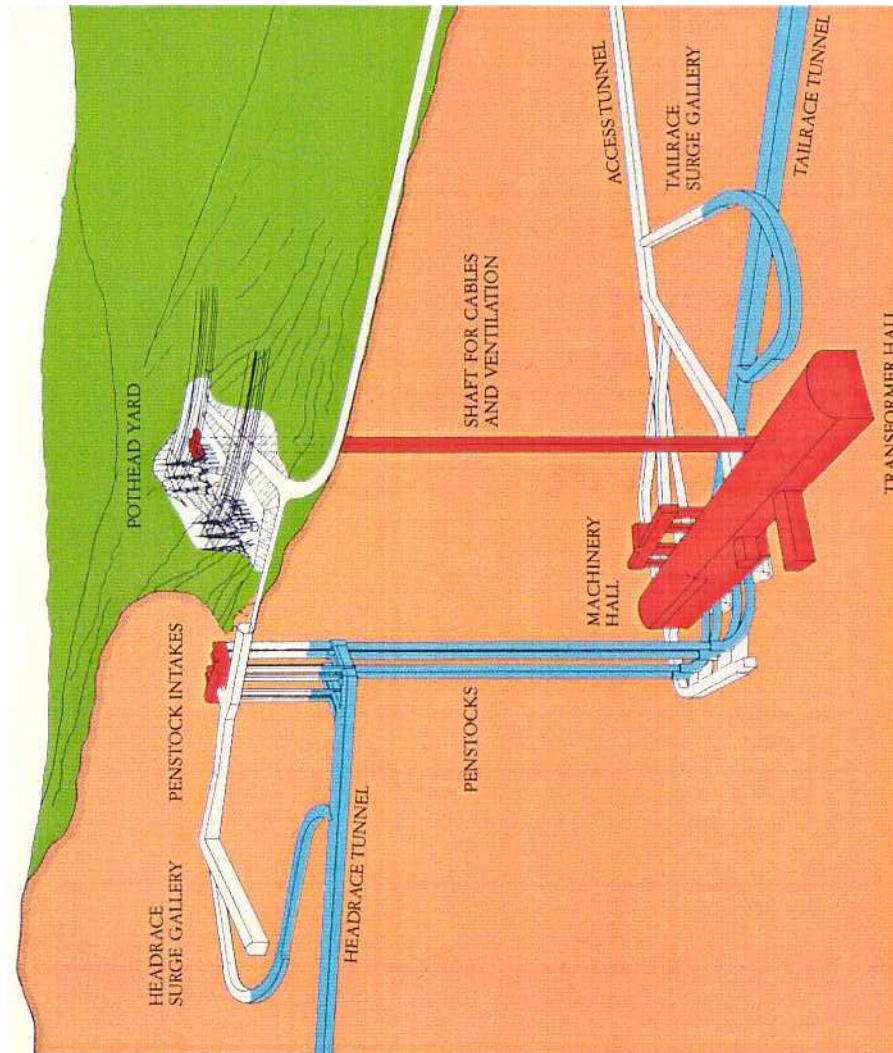


# Rehabilitation of Kidatu Power Plant

Optimisation of water use for power generation

## Major Rehabilitation Contents :

- ◆ Turbines
- ◆ Generators
- ◆ Transformers
- ◆ Control system
- ◆ Communication
- ◆ Maintenance



# Kidatu Power Plant

## Key Figures

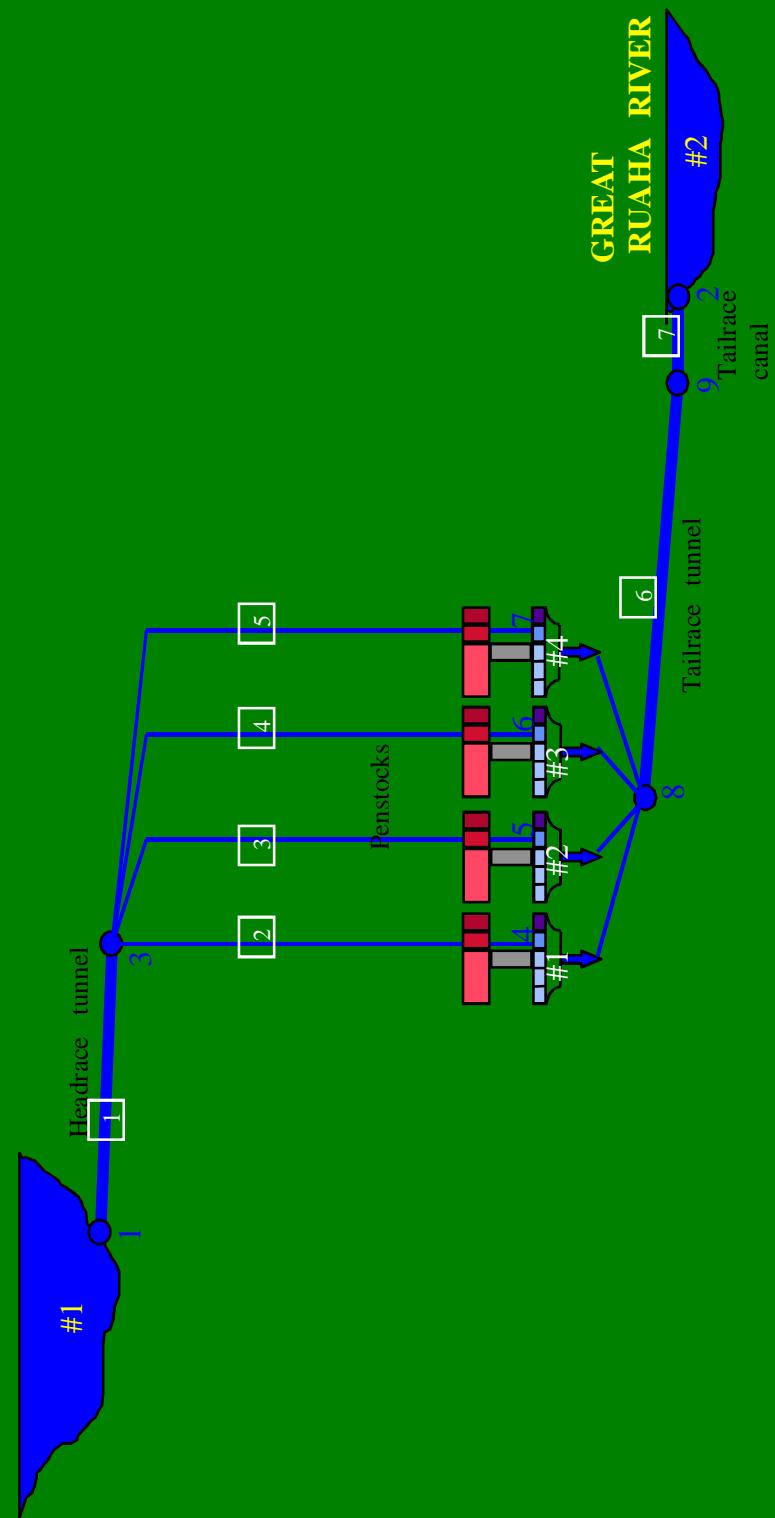
- ❖ Commissioned 1975
- ❖ Storage Mtera 3.2 bm<sup>3</sup> & Intake 125 mm<sup>3</sup>
- ❖ Net head 165 m
- ❖ Installed capacity 210 MW
- ❖ 4 francis units and 35 m<sup>3</sup>/sec each
- ❖ Annual production 1.2 TWh
- ❖ Load factor of about 67%
- ❖ Rehabilitated 1997 - 2003

# Kidatu Power Plant

## Conceptual layout

### KIDATU DAM

Full supply level : 450.00 m  
Min. storage level : 433.00 m



# Kidatu Power Plant

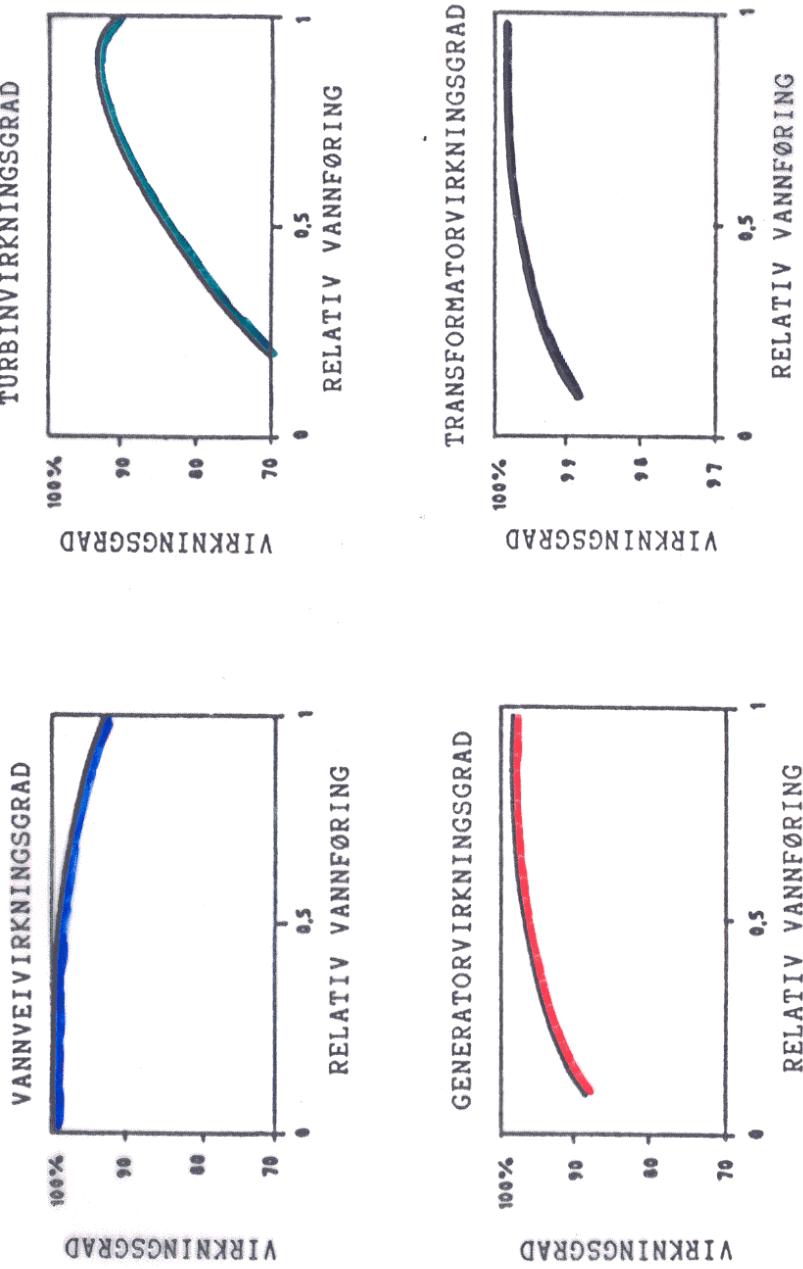
## Improvement opportunities

A feasibility study in 1995 revealed the following situation with regard to improved operation:

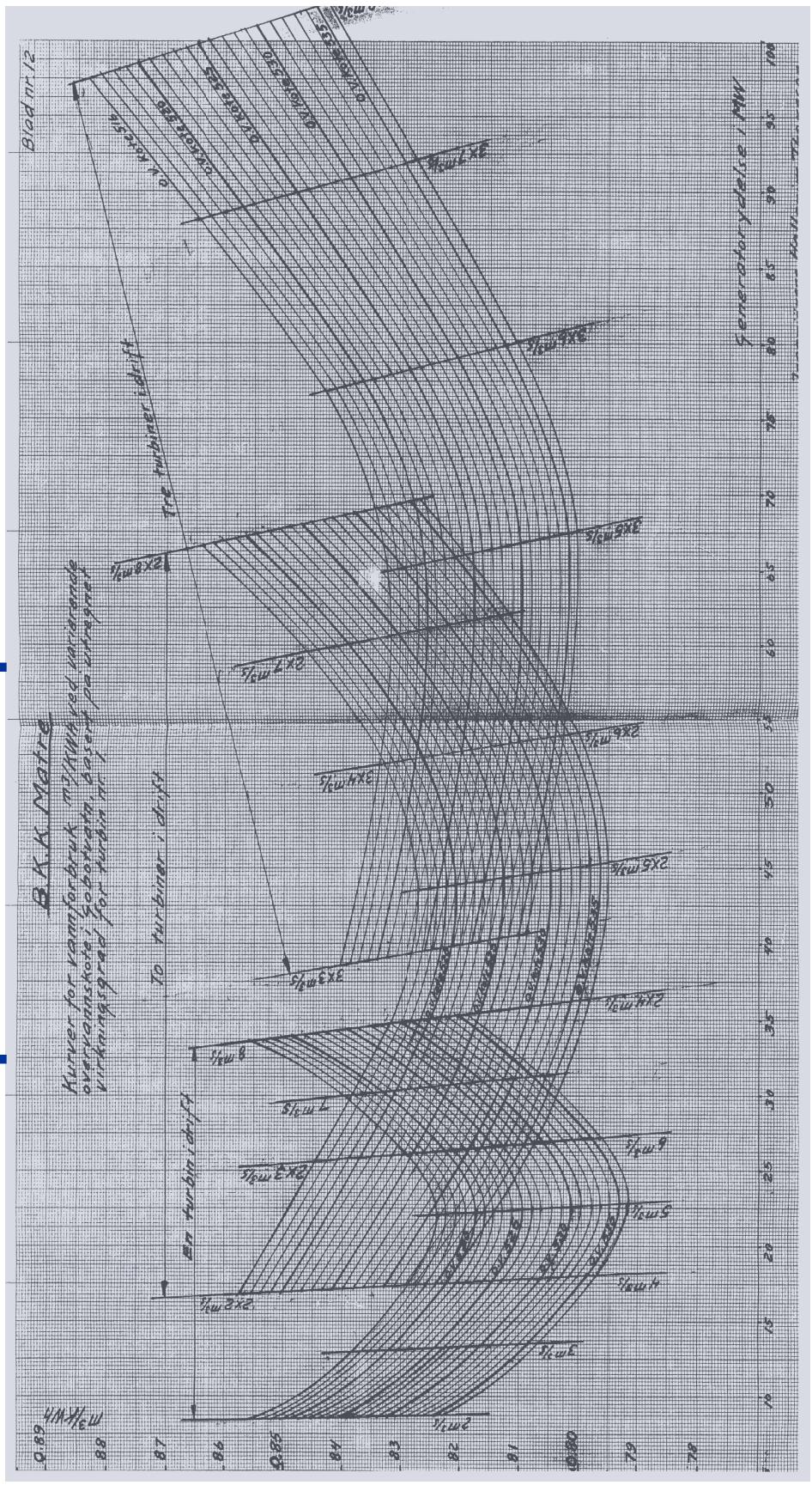
- ❖ low water level in reservoir
- ❖ francis units on low output
- ❖ power distribution between units

# Hydro Power Plant Characteristics

## Efficiency Curves



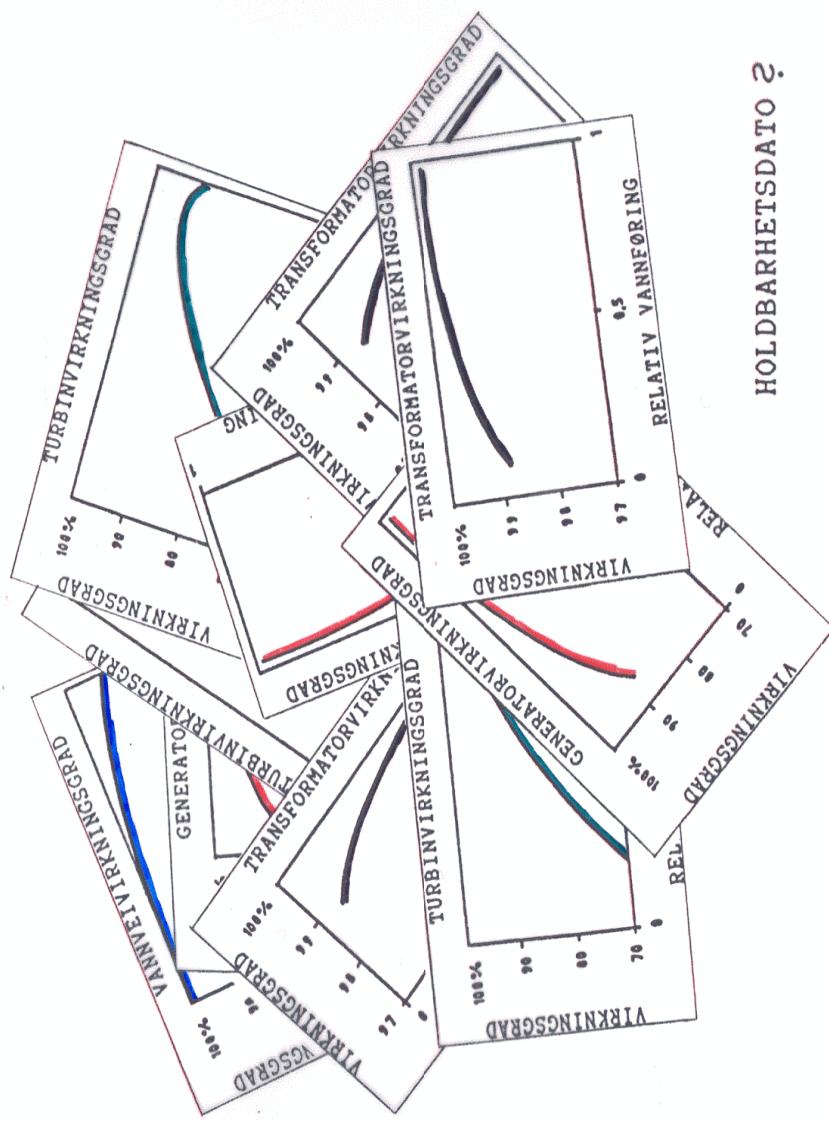
# Production planning with classic production optimisation methods



This is: Cumbbersome, time consuming & inaccurate

# Computerised optimisation software

With all factors included:



❖ Efficiency curves for all major elements

❖ Operational constraints etc

# RunAid software

## Contents and facilities

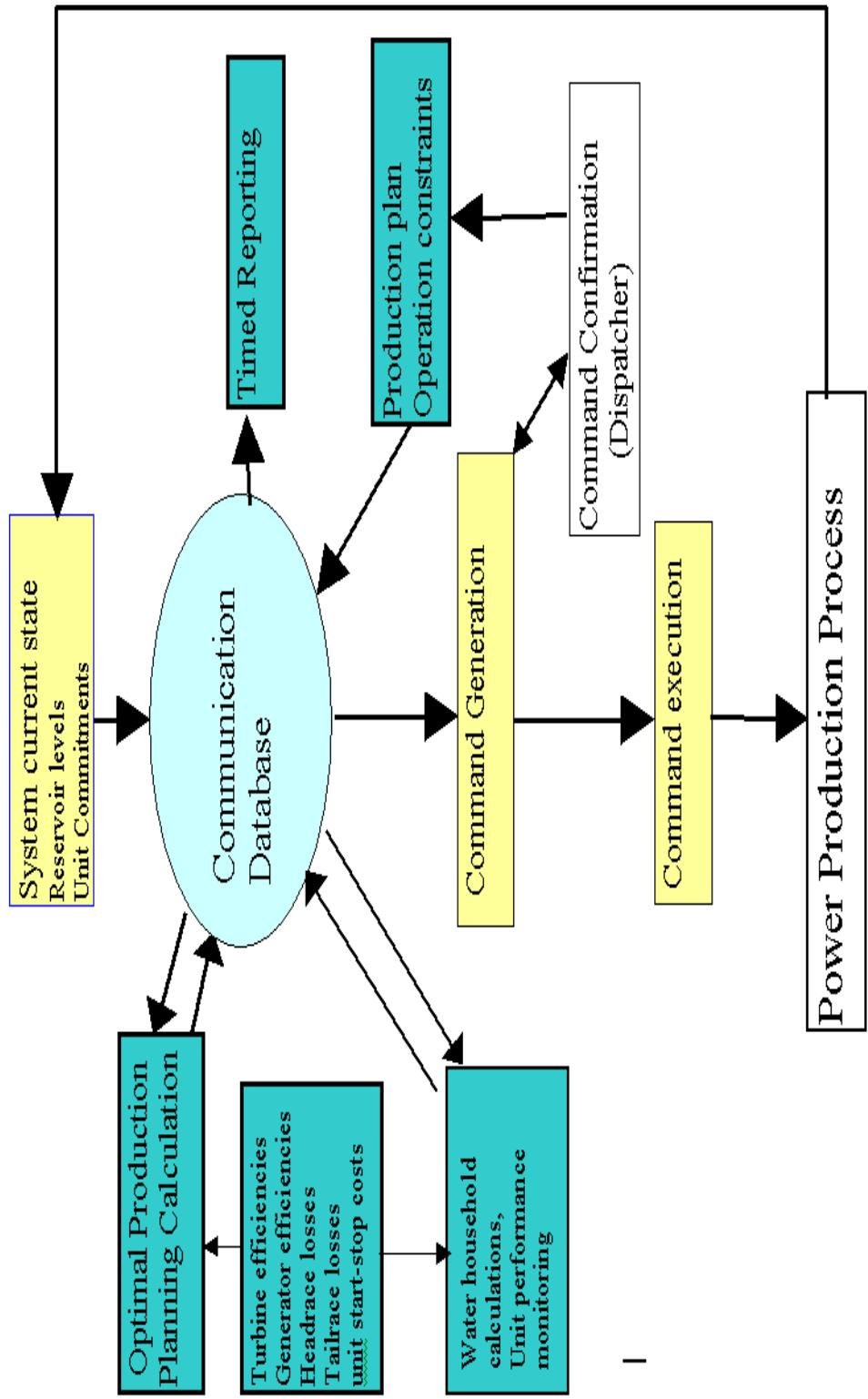
- ❖ Fixed plant data  
(reservoir, waterways & machinery)
- ❖ Operational limitations (fixed and/or temporarily restricted operational intervals w/vibrations or cavitations, residual water requirements, units out of operation etc.)
- ❖ Operational data (variable)  
water levels, inflow, water values, energy unit price, spinning reserve etc.
- ❖ Optimisation algorithms  
on costs (water consumption) or benefits
- ❖ Off-line simulation possibilities

# Assistance from RunAid

- ❖ Optimal number of units in operation
- ❖ Optimal load distribution between units
- ❖ Optimal start & stop of units during planned period
- ❖ Optimal strategy for expected price profile
- ❖ Calculation of optimal bids to the Pool
- ❖ Water flow (instantaneous and accumulated)
- ❖ Trends in efficiency curve changes
- ❖ Simulations for different operation strategies

# RunAid technology

## Implemented as an online application

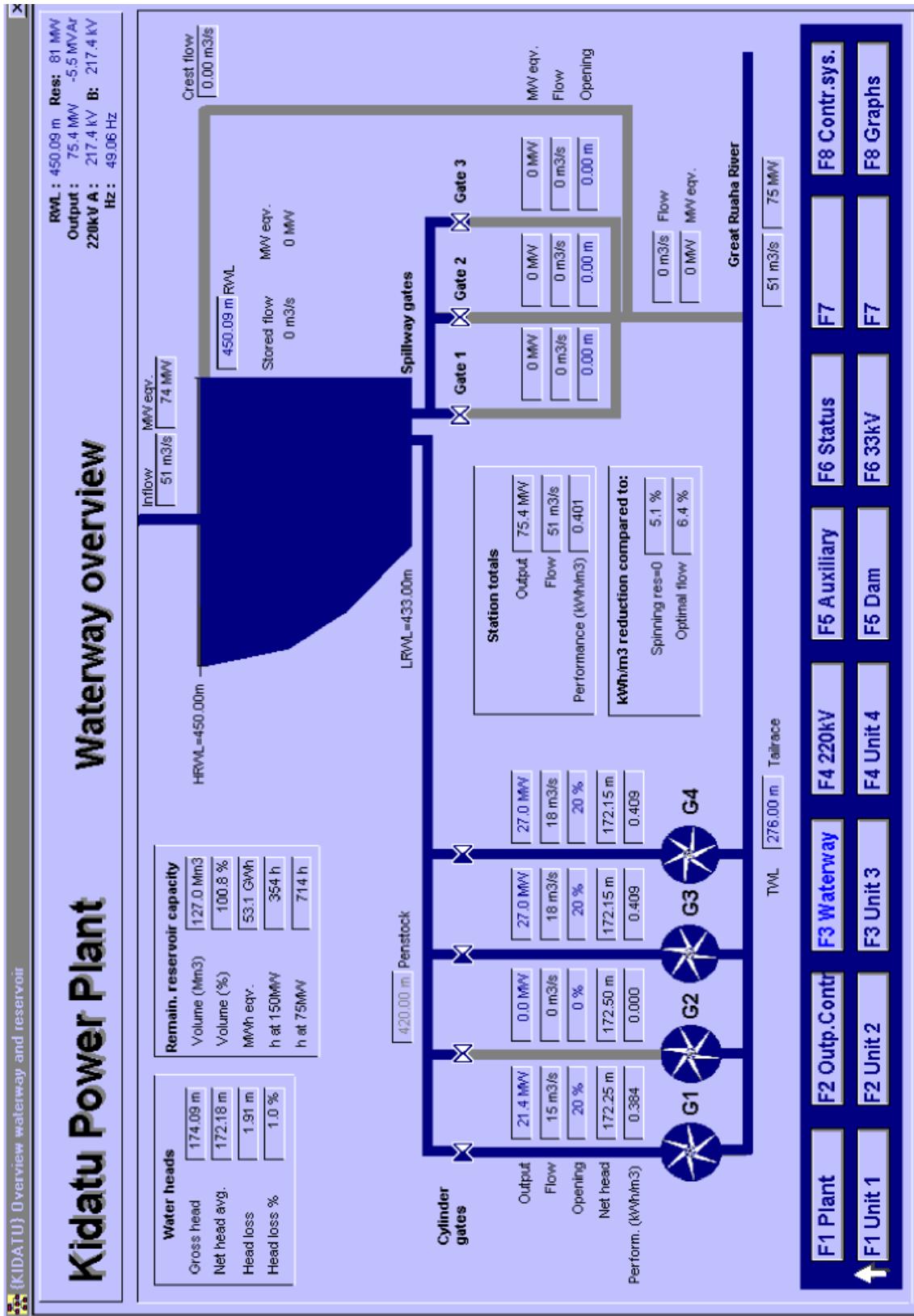


# RunAid at Kidatu

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- **Online production optimising with two options :**
  - Online Joint Control:** Optimal load distribution between the units
  - Online Optimal Operation:** Fully optimised, including automatic start & stop
- **Operation plans**
  - (incl. regards to start & stop costs)
- **Online calculation of water flow & volumes**
- **Comparison of 3 operational scenario (advises)**
- **Set point regulation of voltage on 220-kV bus-bars**
- **Off-line production simulation**

# RunAid at Kidatu



# RunAid at Kidatu

## Achievements

Operational observations with & without online operation indicates a performance improvement varying between 1 and 3%

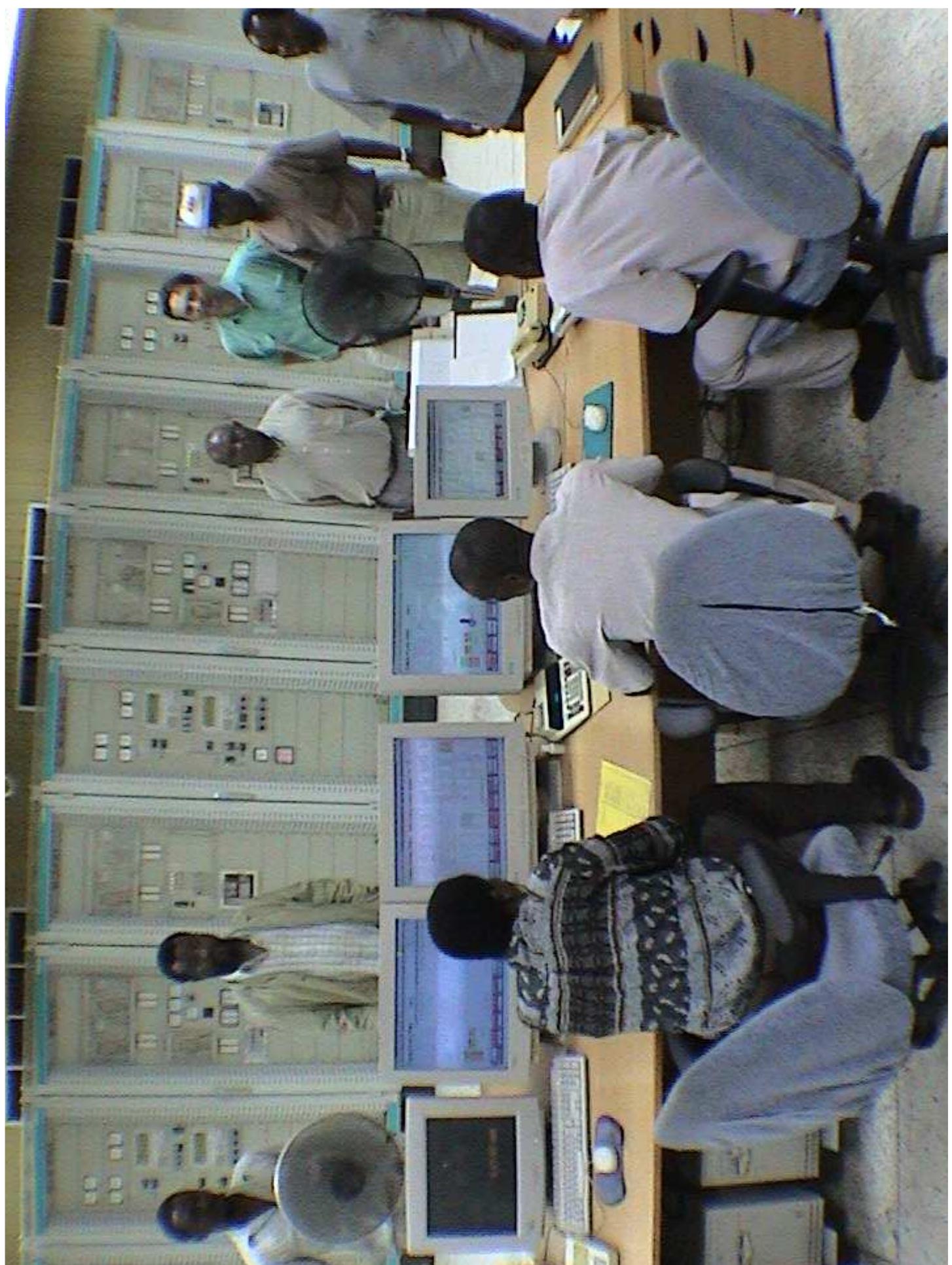
- ❖ 2% of annual prod 1.2 TWh gives 24 GWh, similar to a new extra mini hydro plant !!

# RunAid at Kidatu

## Benefit

In monetary terms we outline the following scenario:

- ❖ With a consumer sales tariff of 0.09 USD/kWh the additional value is 2 mUSD per annum.
- ❖ The total installation price for RunAid integrated into the control system was about 0.2 mUSD.
- ❖ Repaid within approximately 2 months !!!



# RunAid at Kidatu

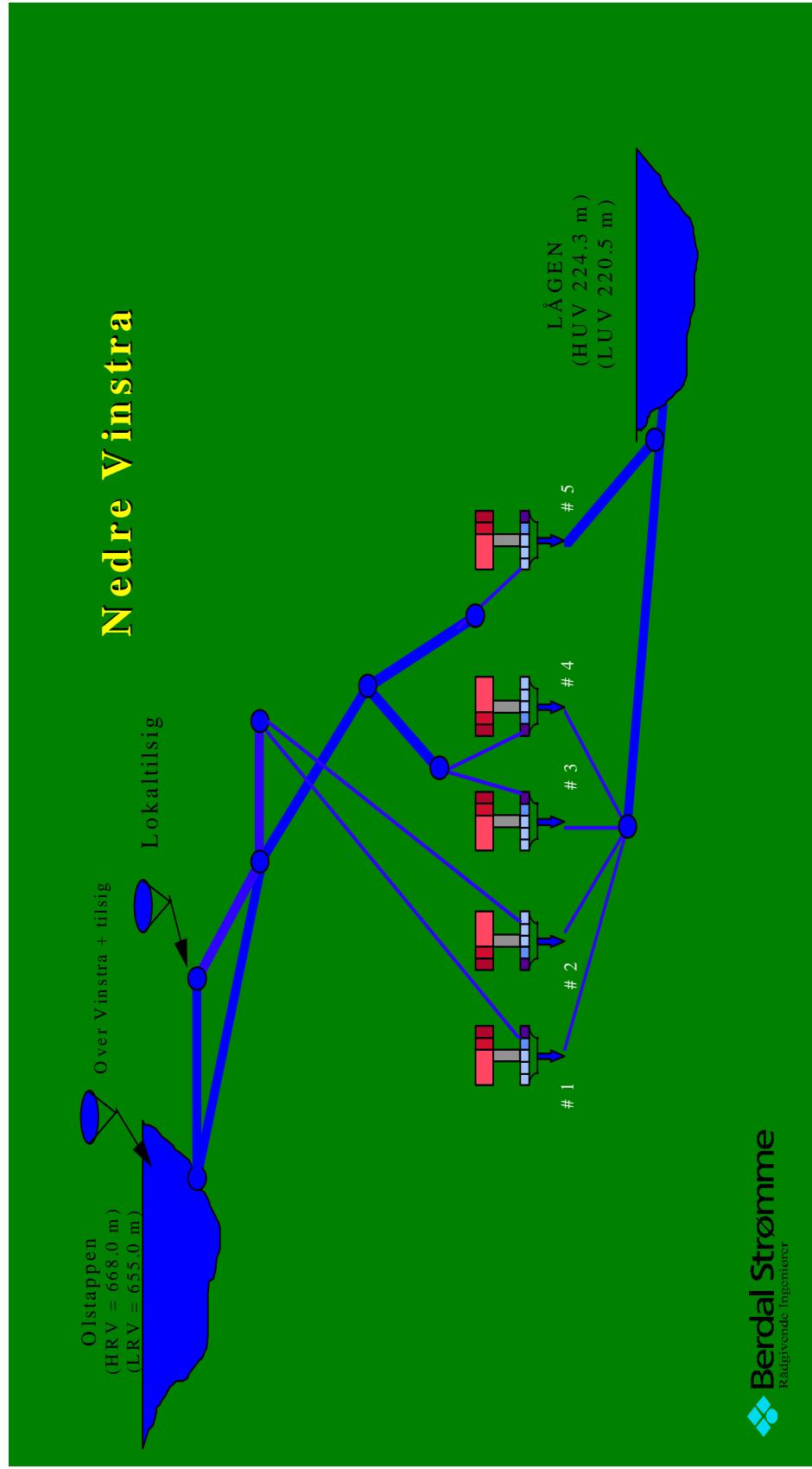
## Retro perspective

3<sup>rd</sup> world war is predicted to be the fight for water rights and we can note:

- ❖ These sessions clearly shows the need for water for various purposes being a reason conflict. (drinking water, irrigation, power, animals, etc)

# RunAid for one power plant

## Nedre Vinstra



# RunAid for several power plants

## Saudafaldene

