ESI HYDROPOWER AFRICA

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Sustainable hydropower as a feasible solution to Africa's generation needs

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MAINTENANCE & REFURBISHMENT OF MTERA HYDRO POWER PLANT

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Introduction

Location of Mtera

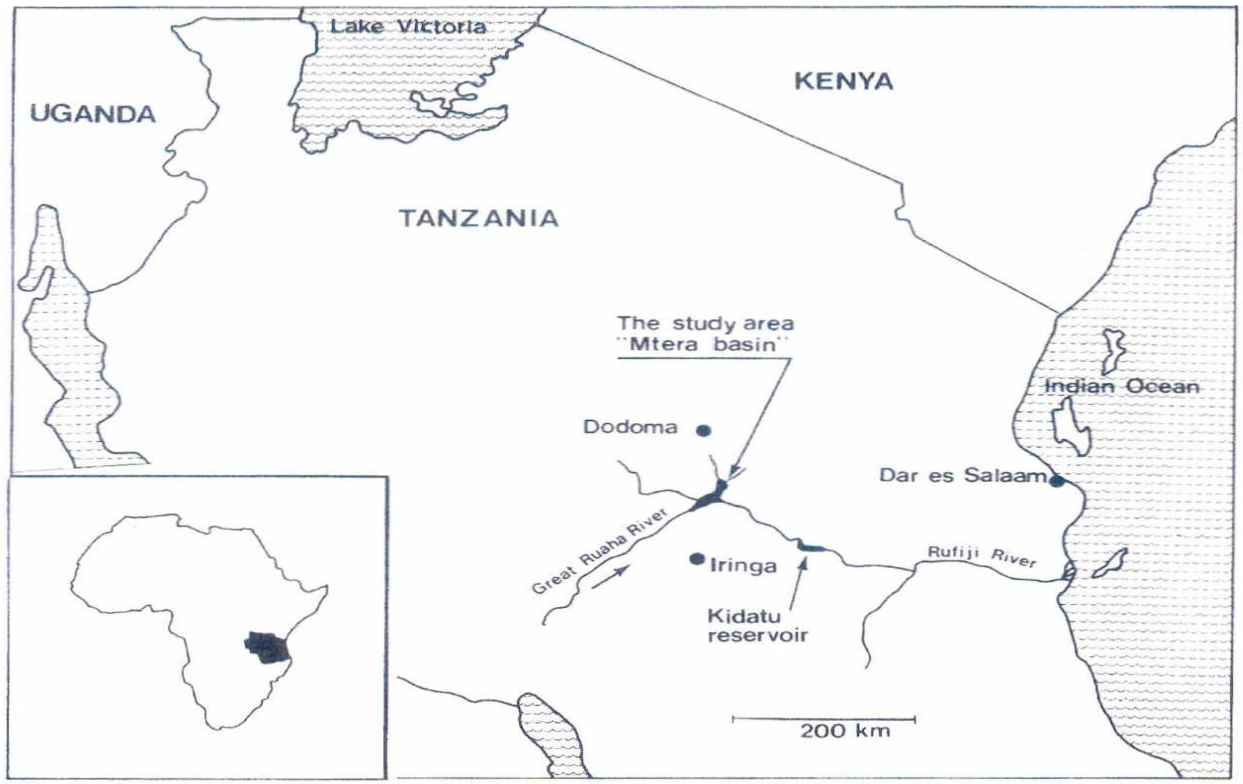

Fig. 2. Location of Tanzania (insert map of Africa) and the Mtera Basin and Reservoir.

INTRODUCTION

- Plant Location - along the Great Ruaha River on the Iringa – Dodoma borders
- The Plant comprises a reservoir and an underground powerhouse.
- Mtera dam is the largest dam in Tanzania, and is the road bridge between Iringa and Dodoma Regions and is part of the Great North Road(Cape Town to Cairo)

INTRODUCTION -DAM FEATURES

MTERA RESERVOIR AT FULL (F.S.L.) ANDMINIMUM(M.S.L.)		
PARAMETERS	**F.S.L**	**M.S.L.**
Water level (m.a.s.l)	698.5	690.0
Reservoir Volume (million m^3)	3800	600
Reservoir area (km^2)	660	200
Mean depth (m)	6.2	3.2

Technical data of Mtera Hydro Power Plant-Dam

- Dam Type – Concrete buttress dam
- Dam height – 45m
- Crest Length – 260m
- Spillway capacity – 4000 m^3/s
- Catchment area 68,000 km^2
- Dam capacity – Live storage 3,200Mm^3
- Dam-Built 1975-1981 and cater for Mtera and downstream Kidatu power plants

Technical data of Mtera Hydro Power Plant

- Construction of Power Plant 1984 -1988
- Plant capacity -2 x 40MW, Francis Turbines
- Generation voltage 11kv, transmission voltage 220kV
- Rated discharge 2 x 47.5m^3/s
- Head (m) 105
- Length of headrace & tailrace (km) 0.1 & 10.5 respectively
- Average Energy 429GWh,Firm Energy 195GWh

Maintenance practice

- Preventive maintenance – As recommended by manufacturer
- Corrective maintenance – based on equipment condition
- Breakdown maintenance
- Manual maintenance management system

Maintenance Challenges

- Deferred Maintenance - Failure in maintenance schedules optimization

- Lack of adequate funds for maintenance and repair - uncertainty in funding cause delay in repair and maintenance resulting into frequent outages and inconsistent plant performance

Maintenance Challenges cont..

- Unavailability of spares
  - Financial difficulties
  - Outdated design
  - Untraceable manufacturers
- Old maintenance practice- manual mode, the technology has changed the maintenance practice should change too.

Strategies for Maintenance Improvement

- Formulation of company maintenance strategy
- Computerization of the maintenance system
- Frame work contracts for supply of spares
- Enhancement of training to operation and maintenance personnel

Major maintenance works performed

- Replacement of Runners due to excessive cavitations effect – 1991 before cavitation guarantee period (8,000 Hrs)
- Main reason due to inadequate submergence of the runners which caused increased water outlet velocity and consequently cavitation. (Tail race head decreased from 3.2m-2.8m)
- Both runners were corrected by modification of hydraulic shape.

Major maintenance works performed cont…

Replacement of burnt single –phase 11/220kV, 15MVA transformer

- Yellow phase transformer of generator set 1 was gutted by fire on 08/09/2000
- Cause ; the monkey short circuited the 11kV terminals to earth- transformer bushings, and other parts were completely burnt
- Action- burnt transformer replace by spare one. And a spare transformer winding was supplied by M/s Pauwels in May 2007 at Euro 281,740.00

Major maintenance works performed cont…

Replacement of Unit 2 draft tube gate

- In 2005 unit 2 draft tube gate had its chain broken and dropped about 42m and sunk into the draft tube pit.
- Lifting of the submerged gate, fabrication and installation of the new gate, replacement of the operating mechanism and control system was done in 2009, costs Euro 1,206,800 +Tsh. 330,591,301

Essence of undertaking refurbishment

- Ageing, wear and tear of Plant equipment
- Change in technology –continuous design improvements are taking place, be feasible to get higher output & efficiency by making some major or minor changes
- Plant safety improvement
- Improving plant availability and reliability

Essence of undertaking refurbishment cont….

- Unavailability of spare parts due to obsolescence-Manufactures inexistence
- The cost of new hydro plants or their complete replacement is very high.
- Refurbishment of only parts that have out-lived their lives or give frequent trouble, costs only about 30-35% of total replacement cost to achieve full/enhanced capacity & life.

Scope of refurbishment

- Control system- manual operating system need Modernization
- Governors - very erratic and shows malfunction of speed detection, need upgrade
- Drainage and dewatering system affected by corrosion need replacement
- Chiller plants have defects on compressors, water condensers and leaking gas, need replacement

Scope of refurbishment cont….

- Indoor 11kV switch gears- with minimum oil CB - to be replaced with SF6 breakers
- Auxiliary (LV) power supply system-old outdated system, spares is difficult to get – to be upgraded
- 220kV switchgears- repair or replacement of bus coupler and isolator switch
- Dam Safety issues and monitoring equipment -to be upgraded as per today safety requirement.

Scope of refurbishment cont….

- Repair of unit 1 draft tube gate-change of seals, chains, operating and control system
- Repair of bulk head gate crane
- Replacement of stress- strain gauges
- Cylinder gate leakage and controls - inspection and rectification
- Replacement of floating boom-washed away by el-nino rains in 1997/98.

Scope of refurbishment cont….

- Increase in leakage from the turbine runner labyrinth seals- inspection and correction
- Readjustment of clearance between guide vanes
- Plant chlorination system-Replacement
- Power house lift-modernization
- Fire alarm system –replacement
- Braking system repair
- Generator coolers- Cleaning

Project constraints

- Availability of funds
- Generation constraints due to increasing demand may lead to prolonged project duration.
- Original equipment manufactures may no longer be available pertaining to unavailability of parts and may lead to opt for reengineering

Proposed plan

- Feasibility study & project document preparation - NORPLAN contracted (2010)
- Tendering of Works, negotiations and contracting (2011)
- Project Implementation(2011 -2013)- estimated cost US$30m
- Draft report submitted, waiting for final report

Project outcome

- Reduce failures and improve Plant efficiency, reliability & availability
- Increased production and revenue

- Reduced maintenance cost and prolonged equipment life span

- Improved Plant operation and control
- Improvement in plant safety

Conclusion

- Assessment of the plant condition as a first step
- Maintenance strategy as key input for improved condition of the plants after assessment
- Resources for carrying maintenance
- Execution of the maintenance plan
- Monitoring of the result of the plan for continuous improvement

Thank you!

Very Much!