JAPAN INTERNATIONAL COOPERATION AGENCY

NEPAL ELECTRICITY AUTHORITY
ENGINEERING SERVICES
PROJECT DEVELOPMENT DEPARTMENT

THE UPGRADING FEASIBILITY STUDY ON THE DEVELOPMENT OF THE KULEKHANI III HYDROPOWER PROJECT IN THE KINGDOM OF NEPAL

FINAL REPORT

EXECUTIVE SUMMARY

FEBRUARY 2003

NIPPON KOEI CO., LTD.
TOKYO, JAPAN

PREFACE

In response to a request of His Majesty's Government of Nepal, the Government of Japan decided to conduct the Upgrading Feasibility Study on the Development of the Kulekhani III Hydropower Project in the Kingdom of Nepal, and entrusted the study of Japan International Cooperation Agency (JICA).

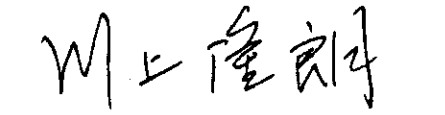
JICA sent a study team, led by Mr. Tsutomu Kodama of Nippon Koei Co., Ltd. to the Kingdom of Nepal five times from September 2001 to February 2003.

The team held discussions with the officials concerned of the Majesty's Government of Nepal, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of His Majesty's Government of Nepal for their close cooperation throughout the study.

February 2003



Takao KAWAKAMI
President
Japan International Cooperation Agency

February 2003

Mr. Takao KAWAKAMI
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit you the Final Report of the Upgrading Feasibility Study on the Development of the Kulekhani III Hydropower Project in the Kingdom of Nepal.

The main objectives of the Upgrading Feasibility Study is to formulate the optimum development plan of the Kulekhani III Hydropower Project which is planned to be built in the Rapti River about 40km southwest of Kathmandu in liner distance. To attain the purpose, the Study Team performed the survey, investigation and studies during the period from September 2001 to February 2003. In conclusion, the Upgrading Feasibility Study proposed to develop a peak power station of regulating pond type with an installed capacity of 45MW from technical, environmental and economic/financial viewpoints. It was also recommended to implement the Project as early as possible by proceeding to the detailed design following this Study in order to supply the reliable peak power in the dry season in the fiscal year of 2007. The implementation of the Project contributes to the development of the national economy in Nepal and the regional development around the Project by effective utilization of the water resources in Nepal.

The Report consists of four Volumes, Main Report, Executive Summary and two Supporting Reports. The Main Report covers all the investigation and study results including field investigation and results, plan formulation, environmental impact assessment and resettlement action plan, cost estimates and project evaluation. The Executive Summary presents main outputs of the Study. The Supporting Reports give additional and supporting information and data to the Main Report.

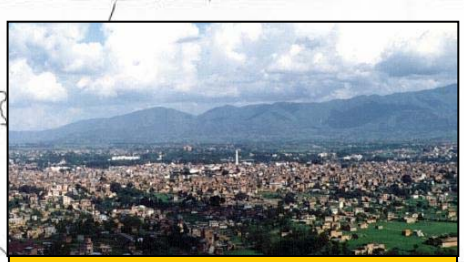
We would like to express our grateful acknowledgement to the personnel of your Agency, your Branch Office in Nepal, and the Embassy of Japan in Nepal, and also to officials and individuals of His Majesty's Government of Nepal and Nepal Electricity Authority for their assistance and advice extended to the Study Team. We sincerely hope that the results of this Study would contribute to the national and regional development of the country.

Yours sincerely,

Tsutomu Kodama
Team Leader
Upgrading Feasibility Study
on
Kulekhani III Hydropower Project

KL-IP/S(Underground)

Kulekhani Reservoir



Kathmandu

KL-II P/S (Above-ground)

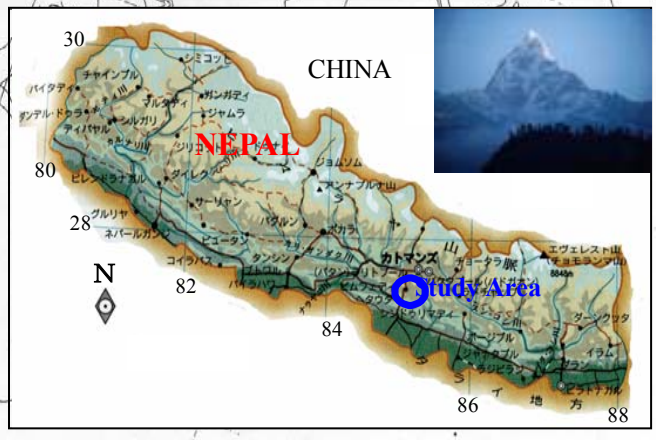
Proposed Site for KL-III P/S Regulating Pond

Proposed Site for KL-III P/S Headwork

KL-II P/S Headwork

Khulekhani Dam

Proposed Site for KL-III Underground P/S



5.0 KM

THE UPGRADING FEASIBILITY STUDY ON DEVELOPMENT OF
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LOCATION MAP OF
THE KULEKHANI OVERALL DEVELOPMENT SCHEME

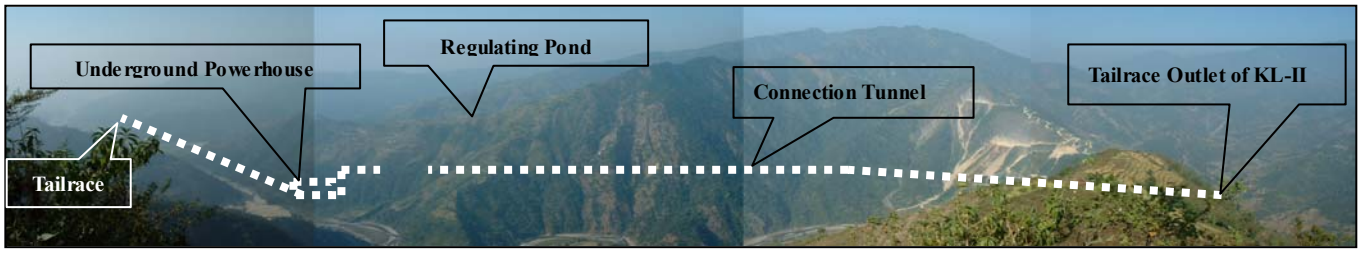

Photo 1 Distant View of the Kulekhani III Project

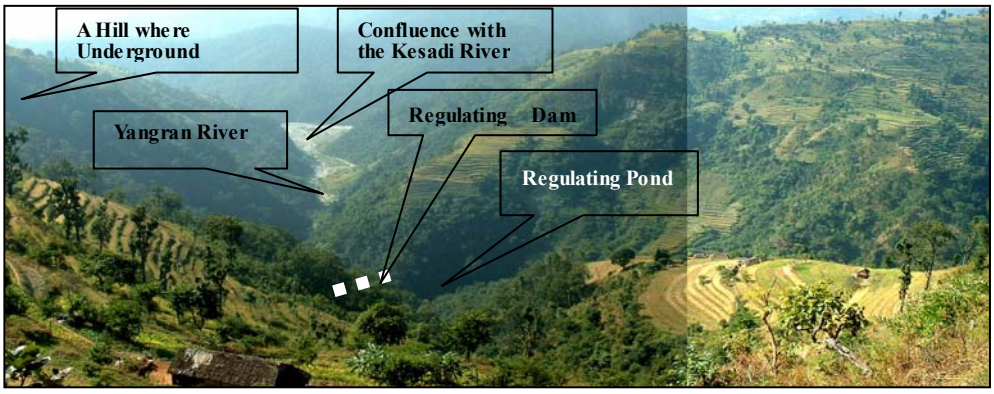

Photo 2 Distant View of the Proposed Regulating Pond Site on the Yangran River

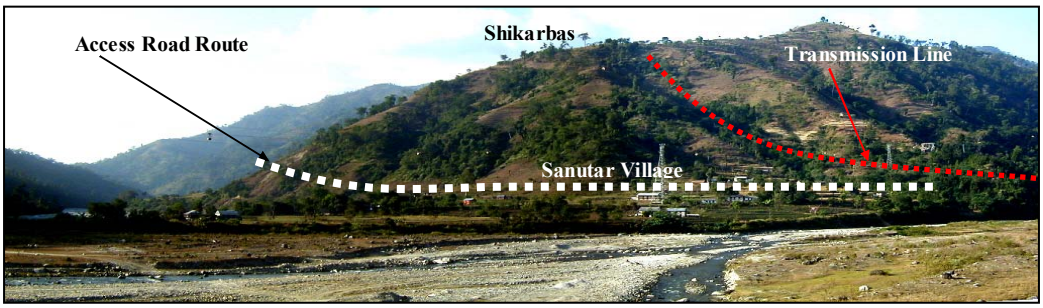

Photo 3 General View of Sanutar Village for Access Road Site

Photo 4 Irrigation Canal in Yangran River

Photo 5 Water Supply Point

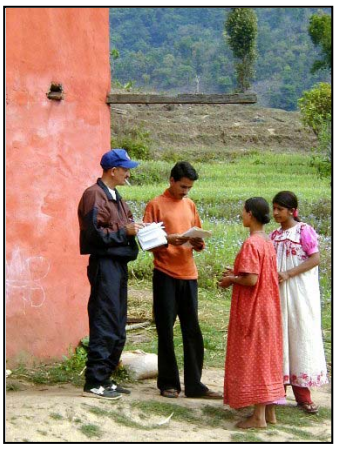

Photo 6 Interviewing Sanutar Women's Savings Group

SUMMARY OF FINAL REPORT

1. Meteorology and Hydrology	● The annual average inflow into the Kulekhani Reservoir is 4.36m^3/sec for 33 years from 1963 to 1995. ● The design floods are 470m^3/sec, 280m^3/sec, and 1,810m^3/sec at the Khani headworks, Yangran regulating dam, and tailrace. ● The annual sediment volume is estimated at 19,000m^3/year equivalent to 2,300m^3/km^2/year at the Yangran river basin.
2. Geology and Landslides/ Sedimentation in Project Area	● The geology of the project area mainly consists of Marble, Dolomite, Schist, Quartzite, Phyllite, and Slate. Major thrust faults of Mahabarata Thrust (MT) and Main Boundary Thrust (MBT) cross in the project area. ● The geology of the powerhouse underground cavern placed in siliceous dolomite layer of 150m is fresh and sound rock. Weathered slate and phyllite layers in both sides of dolomite affect the stability of cavern as a result of stability analysis. ● Careful attention to the design and excavation works of the tunnels will be needed at the boundaries of the MT and MBT. ● Landslide R-1 in the regulating pond will be stable by excavation of head and embankment at toe. Landslide R-2 of 1.5 km upstream from pond has a possibility of large scaled landslide, and to be investigated in the detailed design.
3.Environmental Assessment	● The impacts on the natural environment by the Project would be minimal. ● The impacts on the social environment are resettlement and land acquisition in Sanutar and Gumaune Villages, the Yangran regulating pond area, and the tailrace outlet. Resettlement and land acquisition are estimated at 25 households and 15 ha.
4. Power Survey	● The energy demand predicted by NEA in August 2002 is adopted as a result of a review of the latest demand forecast of NEA. ● The peak power demand by NEA will be slightly increased by considering the load factor restrained by load shedding.
5. Optimum Power Development	● The Project is needed in the power system for supplying peak power for 4 hours to cope with the power deficit in 2007. ● The underground powerhouse with the regulating pond type is selected as the optimum project layout. ● The optimum reservoir operation is 4 months seasonal operation of the Kulekhani reservoir in the dry season, 8 hours daily peak operation of KL-I and the KL-II, and 4 hours of KL-III. ● The optimum installed capacity is 45MW, generating 47.3GWh/year and input timing of the Project into the system is in 2007.
6. Feasibility Design	● The feasibility design of the Project gives the principal feature below: Khani intake: Headwork with the maximum intake water of 2.0m^3/sec Regulating dam: 52m high RCC dam, 475,000m^3 regulating pond Connection tunnel: Free flow concrete lined tunnel, 3.25m (D) and 3.5km (L) Power tunnels: Pressure flow concrete lined tunnel, 4.1m (D) and 0.4km (L), and penstock Tailrace tunnel: Free flow concrete lined tunnel & culvert, 4.4m (D), 2.1km (L) Power station: Underground Type, 17m (W), 31m (H) and 74m (L) Turbine & Generator: Francis turbine (23MW & 500rpm) and conventional generator (26.4MVA) Installed capacity: 45MW at max. plant discharge of 43.1m^3/sec and rated head of 118m
7. Construction Plan and Project Cost	● The construction period is 3.5 years for main construction works after the detailed design, pre-qualification and tendering. ● The project cost is estimated at US$ 78 Million as a result of feasibility design.
8. Economic and Financial Aspects	● EIRR is 15.3% at alternative gas turbine thermal. ● FIRR is 5.0% at average tariff of NRs.6.81/kWh, being US ¢ 8.9/kWh in 2002.
9. Recommendation	● The Upgrading F/S Study found that the Project to be viable in technical, environmental and economic/financial terms. Therefore, the implementation of the Project is recommended as early as possible by proceeding to the detailed design in 2003.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF DRAWINGS