Sida Evaluation 2008:41

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Foreword

This document comprises the Final Report on the Evaluation of Swedish Support for Uri Hydro-Electric Project, India.

The report is in two parts:

- Main Report, November 2005, with its Annexes A to H;
- Report on Supplementary Socio-Economic Studies, June 2008.

The original studies were carried out during the second half of 2005, and the Main Report on the evaluation was prepared on completion of these studies. However, the socio-economic field activities were interrupted by the devastating earthquake which struck the area around Uri on 8th October 2005. As a consequence Sida commissioned supplementary socio-economic studies in 2007 in order that further field data could be obtained and a more detailed socio-economic assessment carried out. The report of these supplementary studies is included as an addendum to the Main Report.

Abbreviations and Acronyms

ABSEK	Aktiebolaget Sevensk Exportkredit (Swedish Export Credit Agency)
BITS	Swedish Agency for International Technical Cooperation
BOT	Build, Own and Transfer
CAT	Catchment Area Treatment
CCGT	Combined Cycle Gas Turbine
CEA	Central Electricity Authority (of India)
CERC	Central Electricity Regulatory Commission (of India)
CHF	Swiss Francs
Cumec	Cubic metre per second
D/C	Double Circuit (transmission line)
EIRR	Economic Internal Rate of Return (equalising discount rate)
El.	Elevation (above mean sea level)
EPC	Engineering, Procurement and Construction
GBP	British Pounds
GoI	Government of India
GWh	Gigawatt-hour
HEP	Hydroelectric Project
Hz	Hertz
IDC	Interest During Construction
INR	Indian Rupees
IWT	Indus Water Treaty (1960)
J&K	Jammu and Kashmir
km	Kilometre
kWh	Kilowatt-hour
m	Metre
mm	millimetre
MOU	Memorandum of Understanding
MVA	Megavolt-amp
MW	Megawatt (= 1000 watts)
NATM	New Austrian Tunnelling Method
NEEPCO	North Eastern Electric Power Corporation Ltd
NHPC	National Hydroelectric Power Corporation (of India)
NIB	Nordic Investment Bank
NTPC	National Thermal Power Corporation
OCGT	Open Cycle Gas Turbine
ODA	Overseas Development Administration
OECD	Organisation for Economic Cooperation and Development
p.a.	Per annum
PAP	Project Affected Person
PDD	Power Development Department (of Jammu & Kashmir)
PGCIL	Power Grid Corporation of India Limited
PLC	Power Line Carrier (communications system)
SCADA	System Control and Data Acquisition

SEB	State Electricity Board
Sec, s	Second
SEK	Swedish Kroner
Sida	Swedish International Development Cooperation Agency
UK	United Kingdom
USD	United States Dollars
WCD	World Commission on Dams
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)
yr	Year

Salient Project Features

Hydrology	
Catchment Area	12,750 km^2
Average annual catchment precipitation	660 mm
River flows: average (50% dependable) Minimum flow in 90% dependable year Design flood	266 cumecs 66.5 cumecs 2264 cumecs
Barrage and Head Regulator	
Barrage	93.5 m long, 20 m high, reinforced concrete
Spillway gates	6 hydraulic radial gates 8.0 m wide x 7.5 m high 3 hydraulic radial gates 8.0 m wide x 8.25 m high
Spillway capacity	2760 cumecs
Full supply level	El. 1491 m
Head regulator gates	2 hydraulic radial gates 16.0 m wide x 5.0 m high
Desilting Basin	
Design	2 surface basins, settling particles >0.15 mm for 960 MW operation
Size (each)	300 m long, 66 m (top) to 44 m (bottom) width
Surplus Escape (for load rejection etc)	
Syphon	6 bays 6.0 m deep x 8.0 m wide
Capacity at El. 1941	500 cumecs
Headrace Tunnel, Surge & Pressure Shafts	
Headrace tunnel	10.67 km long, horseshoe shape, 8.4 m internal diameter
Cross sectional area	59.6 m^2
Design discharge	248 cumecs
Velocity at design discharge	4.2 metres/sec
Surge shaft	22.5 m diameter x 93.5 m high
Pressure shaft	2 no. 5.0 m diameter, 254 m long, steel lined
Bifurcation	2 x 5.0 m diameter into 4 x 3.25 m diameter
Powerhouse	
Construction	Underground powerhouse with separate machinery hall, transformer hall and draft tube gate gallery
Machinery hall size	122 m long x 22 m wide x 38 m high
Transformer hall size	127 m long x 17 m wide x 24 m high

Draft tube gate gallery	83 m long x 7.5 m wide x 17 m high
Installed capacity	4 no. 120 MW generating units = 480 MW
Turbine type	Vertical shaft Francis turbines
Head	Gross head = 252 m, design net head = 228 m
Design energy generation	90% dependable year = 2663 GWh/yr 50% dependable year = 3200 GWh/yr
Tailrace	
Tailrace tunnel	2.06 km long, 8.4 m internal diameter, horseshoe
Contract Arrangement	
Type of contract	EPC Contract with single point responsibility and joint-and-several responsibility between consortium members
Client	National Hydroelectric Power Corporation
Contractor	URICO Consortium
Consortium members and responsibilities:	
Uri Civil Supply Co.	Supply of civil construction materials
Uri Civil Contractor (Skanska and NCC)	Construction of civil works
SWECO AB	Design and planning
Kvaerner Boving	Supply of mechanical and hydromechanical equipment
Kvaerner Boving Construction	Erection of mechanical and hydromechanical equipment
ABB Generation	Supply of electrical equipment
ABB Construction	Erection of electrical equipment
Contract award date	22nd November 1989
Original contract period	72 months
Operation of first unit	February 1997
Operation of last unit	April 1997
Funding	
Foreign supply and construction costs	Mixed credits from Sida, BITS, ABSEK, ODA and Commercial Banks
Local supply and construction costs (including escalation on foreign contracts)	Indian Government and NHPC sources including secured loans and corporate bonds
Summary of foreign funds (final drawdown)	
Sida: Grant	SEK 700 million
BITS: Concessionary loan (0% interest)	SEK 765 million CHF 157 million
ABSEK: Export credit at commercial rates	SEK 413 million CHF 190.06 million
NIB: Commercial loan	SEK 414.85 million
ODA: Grant	GBP 17.15 million
West Merchant/Standard Chartered loan	GBP 31.19 million
Project Costs	
Initial Cost Estimate (incl. land, transmission, IDC and environmental measures)	INR 17,207 million (= SEK 6,469 million at 31/10/89 exchange rates)
Final Price (incl land, transmission, IDC etc as per NHPC final report of Sept 2000)	INR 33,880 million (= SEK 6,957 million at 1/9/00 exchange rates)
Percentage project price increase:	97% in INR terms 7.5% in SEK terms –26% in USD terms

Executive Summary

1 Introduction

The 480 MW Uri Hydroelectric Project on the Jhelum River in Jammu and Kashmir, India, was constructed by a Swedish-British consortium between 1989 and 1997. Funding for the offshore component of the project was provided by the governments of Sweden and the United Kingdom, and the local currency component was funded by the National Hydroelectric Power Corporation (NHPC) and the Government of India.

The total Swedish funding for the project amounted to around SEK 3,350 million, with a concessionality level of nearly 36%. The Swedish funding provided some 65% of the original project cost, and concessionary funding from British ODA provided a further 10%. A further 9% of project cost was arranged as a commercial loan through Nordic Investment Bank, leaving NHPC to source around 15% of the contract cost. NHPC also funded the ancillary costs, such as land acquisition, transmission and environmental measures.

As part of its routine procedures Sida has commissioned an independent evaluation of the Swedish Support for the Uri Project, which is being undertaken by the Consultants. This is the Executive Summary of the Final Report of the Consultants.

The objectives, targets and rationale for the Swedish support of the Uri Project have been determined from study of the pre-contract documentation, Sida's Appraisal Report (23 June 1989) and discussions with project stakeholders involved in the project at the time.

The main objectives of the Uri Project were as follows:

- To supply electricity to the Northern Grid of India
- To improve electricity supply in the Kashmir Region of India
- To obtain environmental benefits from displacement of alternative thermal power generation
- To assist with capacity building in the electricity sector in India
- To develop a sustainable hydroelectric resource.
- The investigation of the degree of achievement of these objectives and the derivation of lessons learned from the intervention are the main subjects of the Consultant's Final Report.

2 The Uri Hydroelectric Project, India

The Uri Project is a run-of-river hydroelectric project on the Jhelum River in Kashmir, located downstream of the existing state owned Lower Jhelum HEP. The project comprises a gated barrage, intake, desilting basins, headrace tunnel, pressure shaft, underground powerhouse and tailrace tunnel.
The project commands a gross head of 252 metres, and has an installed capacity of 480 MW. Provision has been included in the headworks for a second stage of 480 MW, which would require replication of the scheme from the headrace onwards.

The transmission line to evacuate power from the project did not form part of the EPC contract, but was constructed concurrently with the project.

The project beneficiary for the Uri Project is the National Hydroelectric Power Corporation of India, a central government owned agency responsible for major hydropower development.

In 1988 NHPC launched a limited competitive tender for the project, inviting three consortia to bid. The Contract was awarded by NHPC to the Swedish-British URICO consortium on 22nd November 1989 with the works to be completed within a fixed time period (72 months) at a fixed off-shore cost.

The main parties involved in the consortium and their responsibilities were as follows:

SWECO AB, Sweden	Planning and design services
Uri Supply Company AB, Sweden	Supply of materials for civil works construction
Uri Civil Contractor (comprising Skanska AB and NCC International AB, both of Sweden)	Leader of the Consortium Execution of the civil works
Kvaerner Boving Ltd, UK	Supply of turbine and hydromechanical equipment
Kvaerner Boving Construction Ltd, UK	Erection of turbine and hydromechanical equipment
ABB Generation AB, Sweden	Supply of electrical equipment
ABB Construction AB Sweden	Erection of electrical equipment

The project cost comprised the individual package costs denominated in four currencies (SEK, CHF, GBP and INR) together with NHPC's own costs. Although some contingencies were provided in the foreign funding for the civil works, the majority of cost increases were covered by the INR finance; this included escalation on the foreign component.

The final project cost (including land acquisition, NHPC's costs and transmission), as reported by NHPC, was INR 33,880.6 million, an increase of 96.6% on the original expected cost of INR 17,207 million. However much of this increase is attributable to the change in the exchange rate between 1989 and 2000. During this period the INR devalued by more than 50% against the USD and by similar amounts against other foreign currencies. Hence in USD terms the final price was lower than the original expected price.

3 Findings

The funding instrument used for the Uri Project by both the Swedish and British Governments was a package of "mixed credits" comprising grants, concessionary loans and commercial loans. This finance package was tied to donor country supply of all goods and services procured under the funding.
This approach to project finance, although not common since the 1992 Helsinki Agreement, was a conventional approach to project finance at the time. A minimum concessionality level for such funding was stipulated under OECD rules at 35%, and both the Swedish and British funds carried this level of concessionality.

The decision to finance the project appears to have been taken since the energy sector in India was a target of Swedish-Indian Development Cooperation, and surplus funds had accrued due to underspend against the energy sector allocation. Although a medium sized hydroelectric project had been sought as an ideal project to fund, the Indian Government identified the Uri Project as a priority scheme, and requested Swedish support for it. The decision to support the project generally appears to be in line with Swedish policy at the time.

The security situation in the project area degenerated very soon after contract award, and led to disruption of construction activities. Without the determination of the Contractor it is likely construction would have been abandoned. It appears that the degeneration of the security situation was not predicted by the Swedish Ministry of Foreign Affairs, who authorised the intervention to proceed.

Apart from an 18-month delay caused by the adverse security situation and by delays to land acquisition and the issue of an explosives licence, the project was completed on time. The quality of the workmanship is very good, and the scheme has proved reliable with only a few residual defects. The availability of the station to generate with the flow available in the Jhelum is typically more than 99%.

The transmission lines which were due to be constructed by NHPC, but were then handed over to Power Grid Corporation, for construction were severely delayed and almost resulted in delays to commissioning the Uri Project. However following pressure by the Swedish Government, the lines were completed on time.

The Monitoring Team acting on behalf of the Funding Agencies, and the Panel of Experts acting for NHPC under funding from Sida made a great contribution to the successful completion of the project.

The project has been largely successful in its main objective of supplying electricity to the Northern Grid. Apart from a few disruptions to the transmission links, badly needed supplies have been injected into the grid since commercial operation started in March 1997. However the eight years since the start of generation appears to have been one of the driest periods on record, and as a result of this project output has only been some 75% of the design production. We believe that this dry period is a hydrological anomaly, and envisage that the production will revert closer to the design levels when the dry cycle ends.

Prior to the construction of Uri the Kashmir power system had very little interconnection capacity with the Northern Grid, and was severely short of capacity. The voltage levels and supply frequency were very erratic. Consumers either had to have their own back-up generators or other forms of lighting and heating. Elaborate voltage regulators were required to operate electrical equipment. The situation has improved very significantly since Uri was constructed, not only because of the additional capacity provided by Uri, but also due to improved interconnection with the Northern Grid and the commissioning of other power stations.

The project has largely achieved its objective in displacing thermal power generation. Although the Northern Grid has been short of capacity for most of the last eight years, and hence none of the existing thermal capacity has been displaced, the energy from the Uri project can be regarded as having displaced either thermal projects which did not have to be built, or less efficient and more polluting forms of primary energy use, such as paraffin or woodfuel.

The project has achieved good capacity building for NHPC, who have benefited financially, and benefited from technology transfer and training as a result of the project. Other parts of the Indian Electricity Sector have benefited less from the project.

The technical sustainability of the Uri Project appears generally to be good. Apart from the current low river flow sequence, there seems to be little to prevent the station from achieving its design level of production for many years to come. The sediment management appears to function well, apart from the high level of maintenance needed on the flushing valves in the desilting basins.

The findings of the social and environmental appraisals of the Uri project are very mixed, ranging between very good (raised incomes and increased skills of locally employed labour during construction, capacity building of utility staff, provision of water supply, health, education and children's parks, increased quality of electricity supplies, site restoration and high quality of aquatic surveys and impact assessment) and poor.

The principal adverse environmental impacts relate to the aquatic ecosystem. The Uri barrage and Buniyar Nallah culvert create barriers to migration of fish and benthic fauna that are only partially mitigated by the fish passes which have been provided. Also, the release of compensation water at Uri barrage of between 6 m^3/s (maximum) and some unknown lower value impoverishes the biological productivity in the 11 km bypassed channel for six to seven dry season months each year, a channel which has historically received average flows in these months of between 236 and 88 m^3/s, with a historical absolute 10-day minimum of 31 m^3/s.

4 Conclusions

We conclude that the funding of the project was in line with the objectives and the bilateral cooperation mechanisms in use at the time, although it remains questionable whether the deterioration of the security situation might not have been foreseen.

The utilisation of the intervention funds appears to have been effective and reasonably efficient. Most of the objectives of the Swedish Support have been met, although there has been an unfortunate period of low river flows resulting in lower than expected electricity production.

The conclusions of the social and environmental appraisals of the Uri project are that many mitigation and enhancement measures have been well executed whilst some others leave a lot to be desired.

5 Lessons Learned

The deteriorating security situation in Kashmir nearly resulted in suspension or abandonment of the Uri Project. The contractors and NHPC are to be commended for their efforts in continuing construction. However one must question whether an adequate appraisal of the security situation was carried out.

The devaluation of the INR could have had an impact on NHPC's ability to service the loans. Fortunately for NHPC the current method of supply tariff setting enables them to recover the full project cost and make a profit, irrespective of the low generation due to low river flows. In other circumstances the borrower might not have this protection, and the impacts of devaluation need to be considered.

Delays to completion of the transmission line for power evacuation nearly delayed commissioning of the Uri Project. The Monitoring Team appears to have been a very effective means of monitoring all peripheral aspects of the project as well as construction of the scheme itself. The active participation of the Swedish Embassy also appears to have contributed to the success of the project.

Land acquisition and ownership issues contributed to the delays of the project and the transmission line. The availability of the site might have been considered in more detail prior to committing funding to the project.

Lessons learned from social and environmental appraisals of the Uri project include ones that need to be replicated in future projects. These are listed in the report. The principal lesson learned concerning adverse impacts is that projects should not now be funded unless they are supported, at the time of Sida appraisal, by comprehensive and completed social and environmental impact assessments and environmental monitoring, mitigation and resettlement plans. In particular, the determination of constant or variable compensation flows should be determined and agreed before giving support to river-related projects.

6 Recommendations

The hydrology of the river is a key factor in the long-term success of a hydroelectric project since it governs the energy production and has impacts on environmental sustainability. It is recommended that analysis of the hydrology should be supported under the intervention for such projects.

Since it is generally considered appropriate that local people should benefit from improved electricity supplies when a major power project is constructed, consideration should be given to additional support to the local electrical infrastructure and institutions.

The Monitoring Team and Panel of Experts played important roles in the success of the project, and we recommend a similar approach be adopted in future.

Principal recommendations regarding social and environmental aspects relate to ensuring social and environmental impact assessments and environmental monitoring, mitigation and resettlement plans (including land acquisition, compensation and livelihood improvement measures) are prepared in advance of donor project funding. Where these are not satisfactory, technical assistance (along the lines of the Asian Development Bank) may be required for some months or years until they are satisfactory, and full mitigation costs have been internalised within project economics and financing. With hydropower projects in particular, it is recommended that consideration be given to provision of an income stream in perpetuity for watershed management and mitigation of residual social and resettlement issues.

The employment of Project Affected Peoples could be given increased priority in the long-term operation of projects as well as during construction.

The Uri Project has generally been successful, and funding of such projects could be repeated. However the tied-aid model is no longer regarded as appropriate.

1 Introduction

In response to Sida's invitation and Terms of Reference dated 23rd March 2005 (Reference no. 2005 00 0400), Scott Wilson ("the Consultants") submitted a proposal and was appointed to carry out the evaluation, starting on 1st August 2005.

This document is the Draft Final Report which has been prepared during the Project Visit and Data Gathering Phase of the study. In this report the findings and data are presented, together with preliminary analysis and evaluation of the intervention. This report provides the basis of the workshop which was held at the Swedish Embassy in New Delhi on 20th October 2005, to which stakeholders including Sida, NHPC, Power Grid Corporation, Skanska, Alstom (now incorporating ABB) and GE (now incorporating Kvaerner Boving) were invited.

1.1 Background

The 480 MW Uri Hydroelectric Project on the Jhelum River in Jammu and Kashmir, India, was constructed by a Swedish-British consortium between 1989 and 1997. Funding for the offshore component of the project was provided by the governments of Sweden and the United Kingdom, and the INR component was funded by NHPC and the Government of India (GoI). The total Swedish funding for the project amounted to around SEK 3,350 million, with a concessionality level of nearly 36%. The Swedish funding provided some 65% of the original project cost.

As part of its routine procedures Sida has commissioned an independent evaluation of the Swedish Support for the Uri Project, which is being undertaken by the Consultants.

1.2 Objectives of the Evaluation

The objective of this independent evaluation for Sida is to ascertain viability and sustainability of the completed project following the Swedish assistance, and to improve the level of understanding and knowledge of the conditions for sustainable development so that lessons learned from the evaluation might be applied in other similar support programmes.

In carrying out this assignment, we have kept in mind the overall objectives of the evaluation which are to:

- assess to what extent the external support has fulfilled the original objectives and led to expected results;
- assess the effectiveness and efficiency of the utilisation of the development assistance funds;
- assess the current operational effectiveness and viability of the plant;
- improve understanding and knowledge of the fundamental conditions for sustainable development.

The Terms of Reference for the evaluation, which are included in Annex A, provide a detailed list of issues to be investigated. During the Inception Stage of the study additional items were identified and approved by Sida for investigation. The combined list of issues is presented in Section 1.5.

1.3 The Evaluation Team

The staff responsible for the evaluation comprises a core team assigned to the study, with support from a number of specialists, all of whom are members of Scott Wilson staff from its UK and Indian companies.

The Core Team comprises of the following members:

Project Manager & Power Market/Economics Specialist – Mike McWilliams
Mike McWilliams is a chartered engineer with 28 years of experience in the engineering, study and review of major power projects. He is the Director of the company's hydropower & water resources unit, and has many years of experience of living and working in Asia. He has travelled and worked widely in India since 1994. He has been project manager and provided key roles in more than 15 relevant hydropower studies undertaken by Scott Wilson and his particular expertise lies in the evaluation of project economics and value within the regional power markets.

Mr McWilliams is responsible for the management and coordination of the project team, for liaison with Sida staff and other stakeholders, for editing the project reports and deliverables, and for technical and financial elements of the study.

Hydropower Engineer – L.V. Kumar
Mr. Kumar is a hydropower and water resources engineer with some 30 years of experience in the power industry of India and South Asia. Formerly Managing Director of WAPCOS, India's foremost hydropower and water consultancy, he was responsible for a wide range of hydropower related studies including sedimentation modelling, environmental impact assessments, catchment treatment, socio-economic bench mark surveys and performance evaluation of hydro projects. In 2002 Mr. Kumar provided specialist inputs on the assessment of the Uri hydropower project on behalf of Haskoning India.

Mr Kumar is responsible for evaluation of the project performance, and the role of the project in the Northern Grid and the J&K electricity system.

Environmentalist – Andrew Wain
Andrew Wain is an environmental specialist in the hydropower sector. Having spent much of the past 25 years working on the environmental aspects of hydropower projects he is very familiar with the environmental requirements of multilateral agencies such as the World Bank and Asian Development Bank. He is also familiar with the environmental conditions of the Himalayan region having been responsible for environmental studies of hydroelectric projects in the Western Himalaya/Hindu Kush region.

Mr Wain is responsible for evaluation of the environmental aspects of the project.

Social & Cultural Expert – Chhaya P. Bhat

Chhaya Bhat has over 15 years of field experience in India as a rehabilitation and resettlement expert, and has undertaken socio-economic field surveys including livelihood issues, social mobilisation, gender issues, preparation of mitigation reports and resettlement action plans. She has extensive experience of working with multi-lateral agencies such as the World Bank, Asian Development Bank, Government departments, and NGO's.

Ms Bhat is responsible for evaluation of the socio-economic and resettlement aspects of the project.

1.4 Evaluation Criteria and Methodology

The evaluation of the results of the Swedish support for the Uri Project is being carried out in the context of the original expectations for the project, which were identified in late 1989.

The primary basis for the evaluation is to establish the original objectives, targets and rationale for the Swedish support for the project, and to determine the degree to which these targets have been achieved. Where specific performance parameters and criteria were not identified at the time of the decision to support the project, assessment has been made against the level of performance which should have been expected from a project of this nature.

For the environmental, socio-economic and resettlement aspects of the project, performance has primarily been assessed in terms of the legislation, guidelines and practices prevailing in the 1980s when the project was conceived and the early 1990s when the environmental and social impact mitigation measures were undertaken. Brief reviews are also being carried out of the environmental and socio-economic performance under current standards.

A wide range of methodologies is adopted for the performance of the evaluation including the following:

- Review of the original correspondence and documentation relating to the decision to provide support for the project;
- Review of studies, reports and other and documentation relating to the design and construction of the project, the additional environmental studies, the enactment of the Catchment Area Treatment Plan and the resettlement of displaced persons;
- Consultation with individuals and organisations involved with the decision for Sweden to support the project;
- Consultation with individuals and organisations responsible for construction, monitoring, operation and maintenance of the project, including the contractors, the owner, NHPC, J&K state agencies and Power Grid Corporation;
- Physical inspections of the project elements and the environment in the project area;
- Data gathering from appropriate agencies in India regarding the performance of the project since completion;
- Meetings and consultations with Project Affected People and other inhabitants in the project vicinity and the wider Kashmir region;
- Review and analysis of the collected data to determine performance against the identified criteria.

The reviews, consultations and inspections have been carried out in Stockholm, New Delhi, the Uri Site and in Srinagar, and by telephone and email with stakeholders in other locations.

1.5 Issues Investigated

1) The objectives, targets and rationale for Swedish support to the Uri Project;
2) The extent to which the objectives and targets have been achieved, and the reasons for any high or low achievements;
3) How the external support includes elements to secure long-term sustainable development of the project;
4) To what extent the long-term sustainability measures have proved successful;
5) The impact of the external support on the supply and availability of electric power in India;
6) The success of the external support on improving the availability and quality of electric power in Kashmir;
7) The impact of the external support in relation to capacity building, liberalisation and restructuring of the energy sector in India;
8) Linkage of the Uri Project with other projects in the region;
9) The environmental considerations and results achieved in the development of the Uri Project;
10) The social and cultural impacts of the Uri Project;
11) Any positive or negative unforeseen impacts and effects resulting from development of the project;
12) Evaluation of Uri under current environmental guidelines;
13) Evaluation of Uri in terms of current Sida poverty alleviation objectives;
14) The efficiency and effectiveness of the Swedish support for the project;
15) Lessons learned from the Swedish support of the Uri Project in the context of general development cooperation and specifically in relation to the energy sector.

1.6 Acknowledgements

The Consultants would like to express their thanks to the following who have greatly assisted with the performance of the evaluation:

- NHPC Uri Site for support to the team during the site visit, and for arranging meetings in Srinagar and the local region;
- NHPC Faridabad (Head Office) – all departments but especially the Contracts Department who coordinated the meetings;
- Swedish Embassy New Delhi for facilitating the meetings and site visit;
- Sida Stockholm, especially Central Archives.

2 The Uri Hydroelectric Project

The intervention evaluated in this study is the 480 MW Uri Hydroelectric Project in the state of Jammu and Kashmir in north-west India. The project was constructed between 1989 and 1997 for the National Hydroelectric Power Corporation of India by a consortium of Swedish and British companies. The offshore component of the project was funded by a package of mixed credits (grants, export credits, concessionary loans and commercial loans) the majority of which were Swedish.

2.1 Background to Project

The Uri Hydroelectric Project was conceived by the Power Development Department (PDD) of the Government of Jammu and Kashmir, who submitted a Detailed Project Report (DPR) to the Central Water and Power Commission in 1974. Following modifications to the project, it was cleared by the Central Electricity Authority (CEA) in March 1980. Responsibility for development of the project was transferred to the National Hydroelectric Power Corporation of India (NHPC) in 1981. NHPC carried out the preliminary design and obtained Forest Department clearance for the project in 1986, and commenced pre-construction work in 1987.

In the early 1980s the Government of India and NHPC began soliciting funds from international agencies with the objective of implementing the project on an Engineering Procurement and Construction (EPC) basis with bilateral support.

The Swedish company, Skanska, promoted the project, seeking support from Swedish Government agencies including Sida. Following an indication of bilateral support in 1988, the Swedish-British URICO consortium led by Skanska participated in a limited tender held by NHPC for finance and construction of the project. NHPC and GoI formally approached Sida for financing in June 1989. The consortium was successful in the tender, and following confirmation of the funding support by the bilateral agencies, URICO was awarded the contract on 18th October 1989. The Order to Commence was given by NHPC on 22nd November 1989, and construction of the project started in early 1990. Generation of electricity from the first unit commenced in February 1997.

2.2 Project Characteristics

The Uri Project is a run-of-river hydroelectric project on the Jhelum River in Kashmir, located downstream of the existing state owned Lower Jhelum HEP. The project comprises a gated barrage, intake, desilting basins, headrace tunnel, pressure shaft, underground powerhouse and tailrace tunnel. The project commands a gross head of 252 metres, and has an installed capacity of 480 MW. Provision has been included in the headworks for a second stage of 480 MW, which would require replication of the scheme from the headrace onwards. Further details are provided in Section 2.4.2.

The transmission line to evacuate power from the project did not form part of the EPC contract, but was constructed concurrently with the project. Details of this system are provided in Section 2.5.2.

Salient features of the project are shown in Preface II at the beginning of this document.

2.3 Implementation Arrangements

2.3.1 The Project Beneficiary – NHPC

The project beneficiary for the Uri Project is the National Hydroelectric Power Corporation of India, a central government owned agency responsible for major hydropower development. At the time of the original appraisal NHPC was one of three main central government organisations responsible for power development in India, the others being the National Thermal Power Corporation (NTPC) and the North Eastern Electric Power Corporation Ltd (NEEPCO).

In 1989 NHPC, NEEPCO and NTPC also owned transmission lines linking their projects to the transmission networks of the State Electricity Boards. However in 1991/92 these transmission lines were handed to Power Grid Corporation India Limited (PGCIL) to form the basis of a nationwide transmission system.

2.3.2 Tender Process and Negotiation

The project was first drawn to the attention of Sida by Skanska in 1983, following meetings between Skanska and NHPC in New Delhi. NHPC had prioritised the Uri Project for development, and was seeking a financed EPC contract for its execution. Skanska submitted a number of unsolicited bids for the project during the mid-1980s, none of which were accepted by NHPC. In 1988 NHPC launched a limited competitive tender for the project, inviting three consortia to bid. In addition to the Swedish-British consortium called URICO, bids were submitted by German and Brazilian consortia. It appears that these rival bids were intended to be used as part of the NHPC/GoI negotiating strategy, rather than as serious contenders for the contracts.

NHPC and GoI were aggressive in their pursuit of improved terms for the funding package, although there seems to have been less pressure on the contract price once it was competitively bid. The funding agencies agreed to fully finance the foreign exchange component of the project, and a separate counter-trade deal was also agreed with the URICO consortium to off-set much of the INR component of the project.

Throughout the negotiation process the Swedish Government, through the Swedish Embassy in New Delhi and the Swedish and British bilateral funding agencies were closely involved, and this participation appears to have played a significant part in securing the contract.

2.3.3 Contractual Arrangements

The Contract was awarded by NHPC to the URICO consortium on 22nd November 1989. The main contract was awarded to URICO whose members took joint-and-several liability to complete the project within a fixed time period (72 months) at a fixed off-shore cost.

Individual sub-contracts under the main umbrella were awarded to the following URICO members in relation to their own particular areas of responsibilities:

SWECO AB, Sweden	Planning and design services
Uri Supply Company AB, Sweden	Supply of materials for civil works construction
Uri Civil Contractor (comprising Skanska AB and NCC International AB, both of Sweden)	Execution of the civil works
Kvaerner Boving Ltd, UK	Supply of turbine and hydromechanical equipment
Kvaerner Boving Construction Ltd, UK	Erection of turbine and hydromechanical equipment
ABB Generation AB, Sweden	Supply of electrical equipment
ABB Construction AB Sweden	Erection of electrical equipment

Table 2.1: Responsibilities of URICO Partners

The consortium was led by the civil contractor, Uri Civil Contractor. NHPC consider that that the strength and organisational ability of Uri Civil was a major factor in the success of the project. They also consider that it was appropriate for such a consortium undertaking construction of a major hydro-power project to be led by the civil, rather than mechanical or electrical contractor.

The civil works contract was re-measurable (i.e. the contractor was paid in accordance with the actual quantities of work) up to a capped limit. Certain items, primarily relating to unforeseen conditions in the underground works and the possible requirement for grouting of the barrage foundation, fell within an additional price cap. The design and electrical and mechanical works packages were to be undertaken for a fixed lump sum price.

The contractual arrangement appears unusual and complex. However NHPC's contract department, including personnel involved with the administration of the contract, advise that it was a well-drafted contract, and worked well. It provided the single point responsibility they desired while incorporating the flexibility needed to accommodate changes and unexpected circumstances.

NHPC responsibilities under the contract included:

- Review and approval of designs and drawings
- Overseeing the construction of the works
- Inspections of the plant at the manufacturing works
- Measurement of work for payment purposes
- Provision of local support and preliminary works
- Environmental aspects

NHPC were assisted in their performance of these responsibilities by the Panel of Experts, as discussed in Section 2.3.7.

2.3.4 Project Cost

The project cost comprised the individual package costs denominated in four currencies (SEK, CHF, GBP and INR) together with NHPC's own costs. The original total cost amounted to INR 17,207 million, using 1989 exchanges rates. This included the cost of the URICO construction contract together with the cost of land acquisition, roads and supporting infrastructure, transmission lines and environmental measures.

Although some contingencies were provided in the foreign funding for the civil works, the majority of cost increases were covered by the INR finance; this included escalation on the foreign component.

The final contract price for the packages, including all settled claims is shown in Table 2.2.

Work Area	**Contractor**	**Currency** (millions)	**Sum**
Planning & design	SWECO	SEK	244.95
Civil materials supply	Uri Supply Co	SEK	112.29
Civil works construction	Uri Civil Contractor	SEK	2086.82
		CHF	188.03
		INR	2949.79
Mechanical supply	Kvaerner Boving	GBP	34.70
Mechanical erection	Kvaerner Boving Construction	GBP	10.58
		INR	164.58
Electrical supply	ABB Generation	CHF	168.95
Electrical erection	ABB Construction	CHF	2.21
		INR	112.25

Work Area	Contractor	Currency (millions)	Sum
Total Price		SEK	2444.06
		CHF	359.19
		GBP	45.28
		INR	3226.62
Equivalent price in INR (at Sept 2000 exchange rates)		INR	27,618.00
Equivalent price in SEK (at Sept 2000 exchange rates)		SEK	5,671.00

Table 2.2: Final Cost of URICO Contracts

The final project cost (including land acquisition, NHPC's costs and transmission), as reported by NHPC, was INR 33,880.6 million, an increase of 96.6% on the original expected cost of INR 17,207 million. However much of this increase is attributable to the change in the exchange rate between 1989 and 2000 (when the claims were settled and the price finalised). During this period the INR devalued by more than 50% against the USD, from around INR 19 = USD 1.00 in 1989 to INR 45 = USD 1.00 in 2000, and by similar amounts against other foreign currencies. Hence in USD term the final price was lower than the original expected price.

NHPC's evaluation of the reasons for the INR cost increase is shown in Table 2.3.

Reason for Increase	Amount of increase (INR millions)	Percent increase over original
Foreign exchange variation	7,922.2	48.52
Price escalation on contracts and NHPC costs	1,519.5	9.31
Statutory reasons (taxes, duties etc)	1,480.6	9.07
Interest During Construction (IDC)	5,502.3	33.7
Others (including security)	249.2	1.53
Total	16,673.8	96.9

Table 2.3: Project Cost Increases in INR

From examination of the final prices it is apparent that the cost were kept well under control during the contract execution, and the increases were largely due to unavoidable circumstances outside the control of any of the parties to the contract.

The foreign currency costs of the project were kept largely within budget in the respective currencies of the contracts. In SEK terms the foreign currency costs increased, although this was largely due to the 25% devaluation of the SEK against the CHF and GBP, and the fact that some 50% of the foreign cost was denominated in these latter two currencies.

The denomination of most of the project cost and loans in foreign currencies has left NHPC exposed to exchange rate movements.

2.3.5 Project Financing

At the time of the project initiation in the mid-to-late 1980s NHPC was in relatively poor financial health, and was unable to raise adequate funds on the domestic market for project development. The government also had limited resources, and hence sought bilateral funds for construction of the project.

Following extensive negotiation between NHPC/GoI and the bilateral agencies involved in the funding package, the co-financiers signed an internal agreement on 1st December 1989 following which each co-financier signed financing agreements with its Indian counterpart.

Agency	Type of Funds	Currency	Original Amount	Final Drawdown
Sida	Grant	SEK	700 m	700 m
BITS	0% interest concessionary loan	SEK	765 m	765 m
		CHF	157 m	157 m
ABSEK	Loan at commercial rates	SEK	443 m	413 m
		CHF	196 m	190.06 m
NIB	Commercial loan	SEK	420 m	414.85 m
ODA	Grant	GBP	17.15 m	17.15 m
West Merchant/SCB	Commercial loan	GBP	31.84 m	31.19 m
Total in SEK @ 31/10/89 & 1/9/00 exch. rates		**SEK**	**4,213 m**	**4,833 m**

Table 2.4: Financing of Foreign Component (Final Drawdown)

The foreign funding package covered the full amount of the foreign exchange payments to URICO. The interest on the Charge Account (into which the funding was paid according to a pre-agreed schedule, and then disbursed to the contractor according to actual progress) was used to fund the works, including the additional upgrading of National Highway 1A undertaken by Uri Civil Contractor as a variation.

The Swedish Government component of the funding amounted to some SEK 3,331 million at 1989 exchange rates, or 79% of the total foreign financing. A further SEK 420 million was provided by NIB, amounting to 10% of the foreign financing. The original concessionality level for the Swedish Government funds was 36.2%, indicating total concessionality of SEK 1,197 million on the Swedish funds.

Based on the final drawdown assessed in September 2000, and using the current exchange rates at that time, the quantum of Swedish funding had risen to SEK 3,758 million, or 78% of the foreign finance. The concessionality level fell slightly to 34%, indicating total concessionality of SEK 1,278 million on the Swedish Government funds.

The actual funding provided by the Indian Government is indeterminate due to a complex process of on-lending funds to NHPC and the large movement of exchange rates occurring over the funding period. The original total project cost, including land, transmission lines, IDC and environmental measures would have required some INR 5000 million contribution by GoI at October 1989 exchange rates. We estimate that the final contribution by GoI was more than double this figure.

In addition to funding the foreign exchange components of the Uri construction contract, the funding package included finance for the Panel of Experts (to assist NHPC), and the Monitoring Panel (reporting to the financiers), as well a additional environmental studies. These additional costs were covered by an additional grant of SEK 15 million by Sida, which does not appear in the NHPC record of fund drawdown.

At the time of the evaluation in October 2005 the outstanding balance on the foreign loans taken on by NHPC are shown in Table 2.5.

Loan Description	Outstanding Balance USD	Outstanding Balance CHF	Equivalent in SEK	% outstanding
ABSEK (was SEK now in USD)	6 million		47.6 m	11.5
ABSEK CHF component		8 million	48.8 m	4.2
NIB (was SEK now in USD)	30 million		238 m	57.4

Table 2.5: Outstanding Balance on NHPC Forex Loans

The ABSEK loans are due to be fully repaid in December 2005, while the NIB loan will not be fully repaid until January 2011. It is reported that GoI has fully repaid the BITS concessionary loan, which would not have been due to be fully repaid until ten years after commissioning (i.e. mid-2009). As a 0% interest rate loan, this repayment would have reduced the effective level of concessionality.

It is clear that without the bi-lateral funding package neither NHPC nor GoI would have been in a position to finance a foreign EPC contract for the work, and it seems doubtful that the Uri Project would have been implemented at the time.

2.3.6 Construction Programme

The original project construction programme required completion of all the civil, mechanical and electrical works within a 72 month period from the Order to Proceed date of 22nd November 1989. Hence the contractual completion date was 22nd November 1995. Substantial completion of the project was achieved in May 1997, following commissioning of the last unit in April 1997. This represents a delay of 18 months, which was covered by an extension of time awarded by NHPC.

The original 72 month construction period is considered a reasonably conservative timescale for a project of this nature. However the logistical problems presented by the project location meant that it was a realistic period.

For India the concept of construction of a hydroelectric project of this magnitude in such a short period was new. Previous projects of this scale typically took 10 to 12 years, and sometimes longer. The completion of the Uri Project within the contract period (other than the awarded extension of time) has given NHPC and others in the hydropower industry the confidence that projects can be completed in a much shorter period, and a number of recent projects, such as Chamera II (NHPC) and Malana (private) have matched or bettered this timescale.

The extension of time for the Uri project were awarded for three main reasons:

1. The law and order situation in Kashmir, including in the project area, degenerated rapidly almost immediately after the award of the contract. This resulted in disruptions to work, interruptions to material deliveries and generally slow progress. The majority of the disruptions occurred early in the project, and culminated in the kidnapping of two Swedish engineers and the wife and daughter of one of them on 31st March 1991. The wife and daughter were quickly released, but the engineers spent 97 days in captivity before escaping. This resulted in a complete stoppage of construction from April 1991 to December 1991.

2. The process of land acquisition by NHPC was disrupted by the security situation and by the absence of formal land ownership records. The full allocation of land for construction of the project and the temporary works areas was not available until late 1991.

3. The licences necessary for the storage and use of explosives were delayed due to the security situation. Since explosives were necessary for the underground excavation, which was on the critical path for project completion, this delayed the construction programme.

NHPC awarded the 18 month extension of time together with some associated costs, and the claim was reconciled in 2000.

The completion of the Uri Project within 90 months of award in the adverse environment of the project area must be regarded as a credit to all those involved. The prospect of fast completion of the project was one of NHPC's main reasons for adopting the financed EPC concept, and they consider that the schedule achieved justifies this choice.

2.3.7 Project Monitoring

Monitoring of the project was carried out by three main teams:

1. NHPC (Site and Head Office)
2. The Panel of International Experts
3. The Monitoring Team

NHPC maintained project teams on site and in their Head Office who carried out continuous monitoring of the project in terms of progress, compliance and quality and budget. The team also monitored the activities involved with environmental aspects, resettlement aspects, training and other associated activities. As part of their agreement with the financiers, NHPC issued quarterly reports on the project progress and key issues. They also produced semi-annual reports on training of the owner's personnel and annual reports on displaced persons.

The Panel of International Experts was appointed by NHPC in consultation with Sida (who provided the funding) with the particular objective of assisting NHPC in making key design decisions.
The seven-man panel included technical, environment, operation and training specialists who visited and reported twice yearly throughout the construction period.

Sida was responsible for monitoring the project on behalf of the co-financiers, following the physical and financial progress, the contract fulfilment and the fulfilment of conditions stipulated by the Swedish Government and monitoring the utilisation of the Charge Account. This monitoring was undertaken by Sida staff and by their Monitoring Team.

The Monitoring Team was engaged by Sida with the function of monitoring all aspects of the project, and any activities and issues which might impact the success of the project, on behalf of the financiers. The core team comprised a Power Engineer and a Financial Analyst, and was supplemented by other specialists as appropriate. When it became apparent that lack of progress on the 400 kV transmission line to Wagoora might prejudice commissioning of the station, a transmission specialist was included in the Monitoring Team for four years. Similarly when the land acquisition issue delayed the project in the early years of construction, a legal expert joined the team to review the situation. The Monitoring Team visited site twice yearly and submitted reports to the financiers and other involved parties.

It is apparent that the excellent level of monitoring of project implementation, including those aspects relating to the project which did not form part of the construction contract, contributed greatly to the success of the project. In particular the Monitoring Team was able to identify embryonic issues in time for action to be taken to mitigate disruption. The support and active participation of the Swedish Embassy and Sida personnel in New Delhi also played a key role in the success of the project.

2.4 Technical Description

A technical description of the project is provided below and the project characteristics are summarised in the Salient Project Features in Preface II of this document

2.4.1 Location and Access

The Uri Project is located on the Jhelum River in the Kashmir Valley in Jammu and Kashmir, Northern India. The project site is around 90 km west of Srinagar, and around 20 km from the line-of-control which forms the de-facto border between India and Pakistan.

Access to the project area for personnel is most easy by air to Srinagar, and then by road to the project site. However for much of the construction periods helicopters were provided for the contractors expatriate personnel to travel to site from Srinagar, due to the security situation.

Much of the project plant and equipment was imported from Sweden and elsewhere in Europe. The nearest major port was Mumbai (Bombay) some 2500 km distant by road and rail. Road conditions were not suited to large and heavy loads required for a project of this nature. In particular the 300 km road from the nearest railhead at Jammu to Srinagar presented great problems, especially in winter months.

The logistics of transporting materials and equipment to site required exceptional planning and coordination, which appears to have been well managed by the contractor.

2.4.2 Main Scheme Components

The Uri hydroelectric power project in J&K is now renamed as Uri-I Project. This project is located between Lower Jhelum hydro project of J&K state and Uri-II Project of NHPC, on which construction has recently commenced. The layout is shown in Figure 2.1.

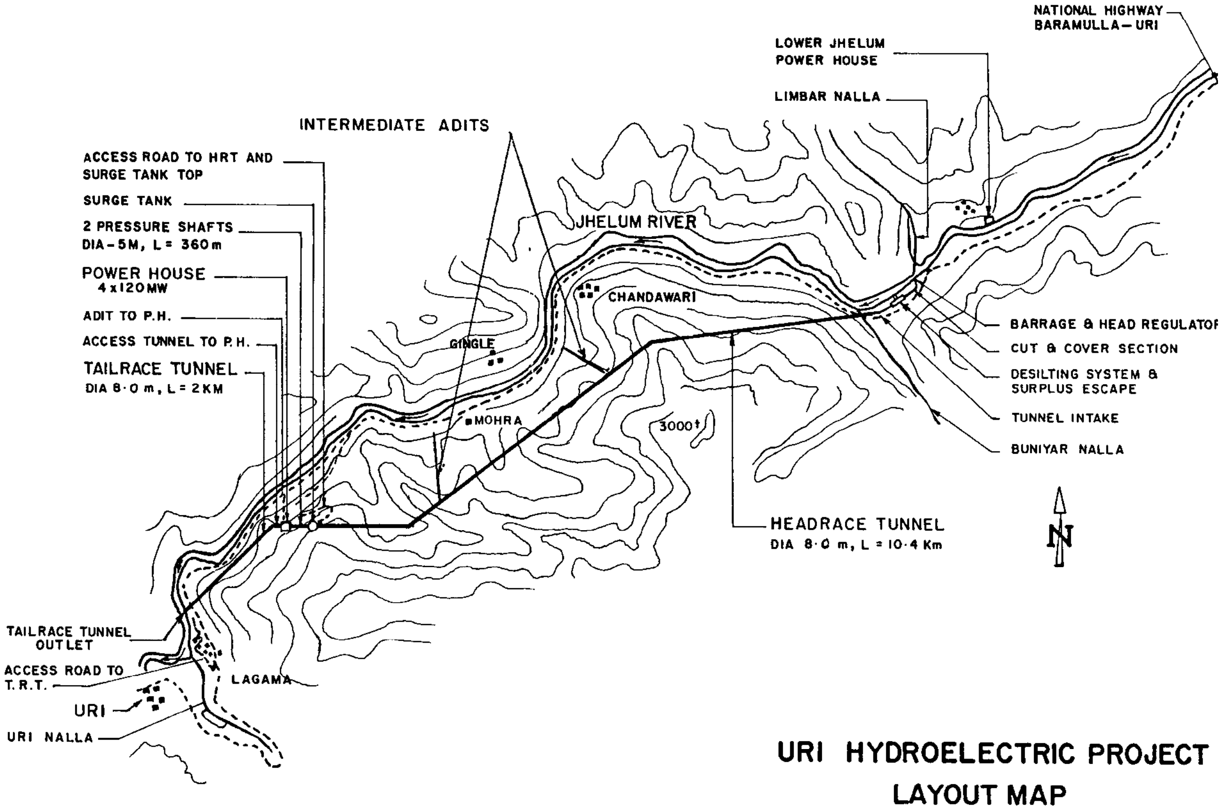


Figure 2.1: Layout of the Uri Project

The main components of the Uri-I hydroelectric power project are:

- Barrage complex
- Cut and cover culverts
- Desilting arrangements
- Surplus escape
- Headrace canal
- Culvert intake and culvert across Buniyar Nallah
- Headrace tunnel
- Power station with penstocks and surge arrangements both upstream and downstream of the power station.

- Tailrace tunnel and outlet works
- Pothead yard (switchyard)

The project is typical of Himalayan hydro projects, having a barrage, intake and de-silting basin to exclude silt from the turbines, at the headworks. The power plant including the headrace and tailrace tunnel are totally underground.

The salient features of the project are described in Annex D and Key Characteristics are presented in Preface II.

2.4.3 Electrical and Mechanical Equipment

The electrical and mechanical equipment supplied for the project comprised the following:

- Spillway radial gates and stoplogs, fishladder gates, head regulator radial gates, screens, stoplogs and trash rake (purchased by NHPC), gantry cranes and flushing gates
- De-silting basin gates and valves
- Intake roller gates at Buniyar Nallah, with crane, screens and trash rake
- Bulkhead doors to adits
- Sliding bulkhead gates to surge shaft
- 283 m long steel penstock and bifurcation
- 4 no. spherical rotary main inlet valves
- 4 no. vertical shaft Francis turbines, 122 MW each, 333.3 rpm, rated flow 59.21 cumecs, with hydraulic governors
- Synchronous generators, 136 MVA output, 13.8 kV voltage, 50 Hz, 0.9 power factor
- Main and auxiliary bus ducts
- Auxiliary, Unit transformer, excitation transformers
- Block transformers, single phase, 50 MVA, 13.8 kV to 400√3
- SF6 Gas Insulated Switchgear, 400 kV (underground)
- 400 kV oil filled cables 2 x 3 no. + 1 spare (GIS to surface)
- Control, protection, SCADA systems
- Cooling Water, turbine shaft seal water, fire-fighting and general water systems
- Dewatering and drainage systems
- Air Conditioning and Ventilation Systems
- Powerhouse and GIS cranes
- Diesel generator (2 x 1125 KVA)

This equipment was supplied by ABB (electrical) and Kvaerner Boving (mechanical and hydromechanical), with the great majority being imported from Sweden and UK.

Further details are provided in Annex D.

2.5 Ancillary Works

In addition to the main scheme components which formed part of the URICO construction contract, there are a number of ancillary components, some of which did not form part of the contract.

2.5.1 Access Roads

There were three main types of access road for the project:

- Public roads, principally between the railhead at Jammu and Srinagar, and between Srinagar and Baramulla which required some upgrading and strengthening of bridges to allow passage of the heavy construction traffic for the project;
- The 33 km single track section of National Highway NH1A between Baramulla and the project site which required substantial upgrading to carry site deliveries and traffic around the site;
- The temporary site access roads developed to provide access between the various project components and temporary works areas such as quarries and access adits. A number of the roads have subsequently become permanent parts of the local infrastructure.

The public roads were generally the responsibility of the State Government, and NHPC provided funding for the upgrade of the structures on the Jammu-Srinagar-Baramulla road. This appears to have been carried out successfully. The road still presented a major challenge to the hauliers, especially in winter months.

The temporary site access roads were the responsibility of the EPC Contractor, and these were contracted and maintained as part of the project, once land acquisition issues had been resolved.

The 33 km of NH1A were the responsibility of the Owner under the contract terms. NHPC attempted to procure the reconstruction of this road. However by mid-1991 its condition was severely hampering construction activities, as well as local traffic movements. After failing to procure a local contractor to undertake construction, NHPC awarded a contract for reconstruction and maintenance of this road to Uri Civil Contractor. Much of the funding for this additional work appears to have come from accrued interest in the Charge Account. The Monitoring Team consider that handing over this responsibility to Uri Civil Contractor significantly contributed to the success of the project.

2.5.2 Transmission Lines

At the time of the Sida appraisal in mid-1989 it was envisaged that NHPC would undertake the construction of the transmission lines required to evacuate power to the northern grid. A 94 km long 400 kV double circuit line would be constructed from Uri to a new substation at Wagoora near Srinagar, and an 11 km long double circuit 220 kV line from Wagoora to the existing substation at Pampore would link Uri to the Kashmir grid. A second 400 kV double circuit line from Wagoora to Kishenpur near Jammu would connect Uri to the Northern Grid. This Wagoora to Kishenpur line was due to be constructed for NHPC by a Russian contractor. Under this arrangement there would have been a reliable and unconstrained connection of Uri to the Northern Grid. The 400 kV Wagoora-Kishenpur line would also have greatly strengthened the link between Kashmir and the Northern Grid, which until then had been served by a 132 kV line operated by the Power Development Department (PDD) of J&K with only 90 MW of capacity.

In 1991 the newly formed Power Grid Corporation India Ltd (PGCIL) took over NHPC's transmission network, together with those of NTPC and NEEPCO. PGCIL also took over responsibility for construction of the 400 kV lines. Around this time the decision to build the 400 kV Wagoora-Kishenpur line was dropped, and PDD decided to construct a new 220 kV double circuit line from Pampore to Kishenpur. This line would have around 300 MW of capacity in summer (when Uri generates at full capacity), but higher capacity in cold winter conditions. The transmission system associated with the

Uri Project is shown in Figure 2.2, which also shows the 400 kV D/C line with is now under construction, and due for completion in 2006.

Construction of the 220 kV line proceeded reasonably quickly despite rugged terrain over high mountains. However the 400 kV line from Uri to Wagoora was delayed by land acquisition problems and other factors. It soon became apparent that there was a danger of the line not being completed in time to commission the Uri Project. The issue was taken up by the Monitoring Team, which was strengthened by addition of a transmission specialist. The Monitoring Team, Sida and the Swedish Embassy pressed GoI to take action to ensure that the transmission line would be completed on time. Eventually the land acquisition issues were resolved (apart from some residual compensation problems), and with enormous effort and manpower the transmission line from Uri to Wagoora was completed, just soon enough to avoid delay of commissioning the Uri Project.

It is apparent that without the efforts of the Monitoring Team, Sida and the Swedish Embassy the transmission line would not have been completed on time, and the start of operation of Uri would have been delayed.

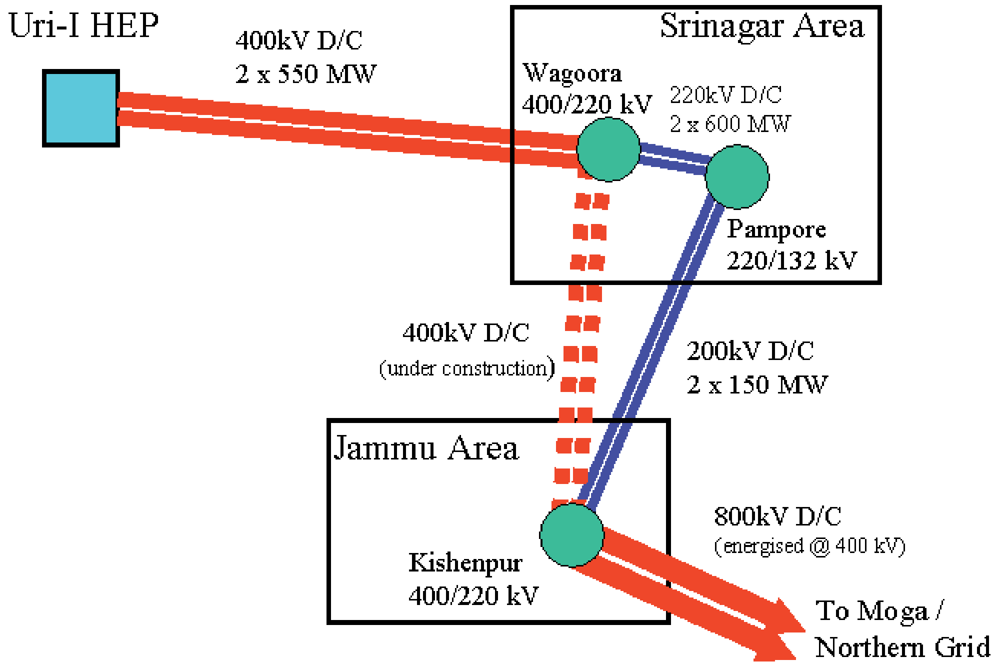


Figure 2.2: Power Evacuation System for Uri HEP

The 220 kV transmission line from Pampore to Kishenpur has been a weak link in the evacuation of power from Uri to the Northern Grid. The line is susceptible to avalanches and other disruption in winter, and its remote location makes it vulnerable to sabotage. When this line is out of action, which can be for several weeks at a time, Uri is not able to supply power to the Northern Grid. Hence the project can only supply the State Grid. Since the other powerstations on the State Grid are fairly old and in poor condition, their operational tolerances are wide, and it has proved difficult to operate Uri with these other stations connected. Hence in these circumstances only Uri supplies the State system. As a result of the poor state of the State electrical network, and because of the reactance requirements of the system, depression of the voltage occurs in these conditions. Typically the voltage at Uri is 315 kV, and the voltage at Wagoora falls to around 300 kV. As a result all supplies on the State grid are at extremely low voltage. Also Uri is not able to achieve full output of its generators without overheating, and hence the output has to be reduced.

NHPC estimate that they have lost at least 100 GWh of generation on average per year due to the problems with the 220 kV Pampore-Kishenpur line.

A solution to this problem is imminent, as PGCIL has started construction of the postponed 400 kV transmission line from Wagoora to Kishenpur. The work is well advanced, and should be completed in April or May 2006. This line is designed to be robust, and route selection has been carried to avoid avalanche problems. There will also be the fall-back of the existing 220 kV line in the event of problems.

2.5.3 Construction Camp

The main construction camp for the project, including accommodation for up to 200 expatriate staff and their families, office and recreational facilities was located at Gingle Village, approximately midway between the headworks and tailrace of the project. This village now provides the operators' accommodation and NHPC offices, as well as providing accommodation for local government officials and others.

The houses are of a permanent nature, and as demonstrated during the 8th October 2005 earthquake, were designed to be resistant to earthquake damage. This village survived intact, when Uri Town, some 10 km distant, was devastated. Other accommodation was provided around the project area for the imported labour force working on the construction of the project.

2.6 Security and Political Issues

A number of political and security issues affected the project during construction, and came close to forcing the termination of the project at one stage. The project is located in the disputed territory of Kashmir close to the Line of Control, which forms the de facto border between India and Pakistan. The political risk was assessed by the Swedish Ministry of Foreign Affairs, who cleared the project for Sida funding.

2.6.1 Security Situation in the Project Area

Up to the time of contract signature in 1989, Kashmir, including the vicinity of the Uri Project, was a popular destination for both domestic and foreign tourists. However within months of contract signature the security situation degenerated, and tourism in western Kashmir virtually ceased.

In April 1990 UriCivil was ordered to remove all expatriate personnel from the site because of civil disturbances. Work started again around a month later.

The security situation became extremely serious in February 1991, when two Swedish engineers from the Contractor's team were kidnapped, together with the wife and daughter of one of them. Although the wife and daughter were soon released, the engineers remained in captivity for 89 days before they escaped. At this time the Contractor withdrew his staff from site, and laid off his Indian labour force. Work did not re-start on the project until 1st December 1991, once adequate security arrangements had been agreed with NHPC. These included provision of a helicopter service for transportation of the expatriates between Srinagar and Uri site, and the requirement that all expatriates working on the project remained within the boundaries of the project, where intensive security was provided.

Following this incident there are few reports of disruption of work due to security problems, and it is believed that the good relations between URICO and their local labour force helped to protect them from being targeted.

In October 1995 two NHPC officials were shot in Srinagar; one of them subsequently died.

Apart from causing the loss of some nine months of construction activity, the adverse security situation resulted in very difficult working and living conditions for all the project personnel and their families, and it is a great tribute to URICO and NHPC that the project was constructed under such circumstances.

2.6.2 Explosives Permits

As a consequence of the terrorism activities in the project region, there was a delay in the provision of a licence for the storage and handling of explosives. Tunnel excavation could only start in May 1992 following the completion of the explosive magazine. This was one of the contributory factors to the 18-month delay for which an 18-month extension of time was awarded.

2.6.3 Indus Water Treaty

Under the terms of the 1960 Indus Water Treaty Pakistan has primary rights to the water of the three Western Rivers (Indus, Jhelum and Chenab) while India has primary rights to the water of the three Eastern Rivers (Sutlej, Beas and Ravi), all of which rise in India and flow into Pakistan.

Under the terms of the treaty there are constraints on the development of the rivers, and notification and approval is required prior to any construction. In 1985 NHPC obtained IWT clearance for the project. However when changes were subsequently made to the layout of the project, Pakistan required that the notification and approval process be repeated. India maintained that it was not required, and a stalemate ensued. In its evaluation of the project Sida concluded that the project essentially complied with the conditions of the IWT, and that the project would either be approved or the Pakistani objections would be dropped.

NHPC advise that the project was subsequently approved under the IWT, although we have not been able to confirm this. However there is no record of any on-going objection.

There are however objections by Pakistan under the IWT to the Kishenganga Project and to Lake Wular Barrage /Tulbul Navigation Project (refer to Section 3.10.1).

2.6.4 Labour Management

Initially when URICO started work on site they suffered labour unrest from the local population over the use of Indian workers from outside the region. A formula was struck under which it was agreed that only qualified skilled labour from outside the region would be used, and that for every skilled worker imported from elsewhere in India three local labourers would be employed. Furthermore training and technology transfer would take place to improve the skill level of the local labour. This agreement appears to have pacified the unrest, and together with the high level of wages paid, resulted in relatively trouble-free labour relations.

URICO reputedly adopted strict performance requirements from their workers, and non-performing workers were laid off. However this strict but fair system was accepted by the workforce, and URICO believes it contributed to the high quality of the work.

2.7 Environmental Aspects

2.7.1 Introduction

In Sida's appraisal of the Uri project in June 1989, it was recognised that the environmental clearance given by the Department of Science and Technology some nine years earlier was not based on a rigorous environmental impact assessment process. This process was (and still is) evolving. Indeed, it was not until the early 1990s that the World Bank published its EIA procedures which then became the basis for other banks and many countries to consider, adopt and adapt.

The Environmental Clearance (1980) was granted subject to three safeguards. These related to fuelwood being provided free of charge to the labour force to avoid indiscriminate felling of trees; land damaged during construction should be restored and landscaped; and soil conservation measures should be implemented during construction of roads.

Additional conditions were later stipulated by various government departments: compensatory afforestation of 64 ha in Tathamulla Block and 8 ha in Uri residential colony and construction work sites; treatment of critically degraded areas; and a number of miscellaneous measures relating to prevention of landslides, design of desilting basins and fish ladder, benign disposal of construction debris and the desirability of an environmental monitoring team within NHPC.

In order to comply with these conditions, NHPC established an environmental team and contracted various agencies, including the principal contractor Uri Civil, to implement environment protection measures accordingly.

In order to provide advice and a monitoring brief on mitigation measures, Sida included an Indian environmental engineer in the Panel of Experts. The Panel met and advised NHPC of its findings on two occasions per year throughout the project construction period.

Progress on environmental studies, and implementing mitigation and enhancement measures, was further reported by a Monitoring Team, also financed by Sida. The Monitoring Team visited the project at about six month intervals, usually one month after the POE's visit. All POE and Monitoring Team reports (16 of each) have been reviewed, with other documentation, for this study.

2.7.2 Aquatic Ecosystem Surveys

During appraisal of the Uri project in June 1989, Sida's principal concerns related to the inadequate consideration given to the aquatic ecosystem. The appraisal report noted that for six to seven months each year the project would convey all of the Jhelum river's dry season flows (flows less than 226 m^3/s) for power generation via the headrace tunnel and thereby leave the seasonally abandoned or "by-passed" 11 km main river channel without its principal source of water during six or seven months.

The appraisal report pointed out that the minimum flow at the Uri barrage site was 36 m^3/s in 1956 and that a release of this magnitude would have made the project unviable, and a release of 10 m^3/s would have significantly reduced the project benefits from the standpoint of power economics. Detrimental impacts on the aquatic ecosystem were foreseen but were not ascribed any value. Indeed, with the limited data available to the appraisal mission in 1989, no robust evaluation could have been made.

As little was known about the aquatic ecology in the project area, and with the agreement of NHPC and others, Sida proposed and financed studies of the aquatic environment. These were carried out during the construction period. Initially, studies over a two-year period were proposed; in practice, these were extended to four periods of survey between 1990 and 1997. Surveys were carried out by the Institute of Freshwater Research (of the Swedish National Board of Fisheries) in conjunction with the Post Graduate Department of Zoology at the University of Kashmir, Srinagar and with additional assistance of NHPC. It appears that the Department of Fisheries of J&K was not involved. Field surveys covered fish, benthic fauna and flora and water quality. These surveys were supported by detailed taxonomic studies in Sweden. They led to a recommendation for minimum compensation flow releases at the Uri barrage of 5–10 m^3/s for the downstream bypassed channel.

Findings of these surveys assisted Uri Civil's engineering consultants (SWECO) with design of the fish pass at Uri barrage. In March 1996, SWECO's draft project operating manual described operation of the fish pass as follows: "The two fishladder gates shall be kept open from April to September. The discharge will be about 5 m^3/s in lure water part and about 1 m^3/s in the fishladder proper with the gates fully open. The flows may be decreased if found favourable for the fish migrating". It is noted that no minimum flow was stipulated. No references to recommended flows have been noted in POE or Monitoring Team reports; these reports were awaiting final results of the aquatic impact study. In the event, no minimum flow rates were stated by the POE.

In the final edition of the manual, dated February 1997, the wording of the requirements remained the same except that the months "from April to September" were omitted. The manual thus reads "The two fishladder gates shall be kept open during the migrating periods. The discharge will be about 5 m^3/s in lure water part and about 1 m^3/s in the fishladder proper with the gates fully open. The flows may be decreased if found favourable for the fish migrating".

Thus in terms of compensation flow for the Jhelum bypassed channel, from the toe of Uri barrage to the tailwater discharge portal, engineering provision is made for a maximum release of about 6 m^3/s through the fish pass and lure water conduit. Any additional release would require opening a spillway gate. In this 2005 review, no daily records of fish pass and lure water flows have been seen. It remains unclear whether these flows are explicitly included in the Jhelum flow record for 1997–2005 provided by NHPC (Annex E).

2.7.3 Forestry Compensation

Relatively few trees were affected by project construction. This loss is reported to have been more than compensated for by planting trees elsewhere, and replacing losses, by Forest Department of J&K. Furthermore, the loss was made good very early in the project construction period.

2.7.4 Catchment Area Treatment (CAT)

In recognition of the needs to reduce and minimise sediment loads at Uri barrage but also to enhance the environment, NHPC commissioned remote sensing and related studies of relatively small but steep tributary catchments between the Lower Jhelum hydropower project (belonging to PDD J&K) and Uri barrage. These erosion studies were carried out by the Regional Remote Sensing Service Centre at Nagpur and revealed various levels of degradation in these areas.

NHPC then requested and commissioned the Forest Department of J&K to prepare a costed treatment plan for moderate and severely degraded areas and then implement conservation measures in nine catchments – five on the north and four on the south side of Jhelum river, with the treatment area covering approximately 40% of the total area of about 150 km^2.

It may be noted that the total catchment area to Uri barrage is some 12,570 km^2 and the CAT plan was for a small fraction of this area. Fortunately, from a hydropower development point of view, Wular Lake fulfils the role of a natural sediment trap for large and coarse materials and protects Lower Jhelum and Uri from most of the large catchment's sediment load. NHPC therefore concentrated its CAT efforts on the steep-sided nallahs entering the gorge section of the river. (No CAT plan has been prepared or implemented for similarly degraded catchments between Wular Lake and Lower Jhelum HPP).

Progress in implementing these ambitious plans was monitored by NHPC and reported at POE meetings. Progress was reported to be good and satisfactory but some CAT works were outstanding in 1997 when Uri power plant was commissioned. NHPC facilitated the completion and maintenance of this work by Forest Department up until 2002.

2.7.5 Site Restoration

UriCivil was contractually responsible for restoring and landscaping sites and leaving them in safe condition for beneficial use. In particular, areas around the barrage, intake works and sediment basins were of prime concern, together with spoil heaps created by deposits of tunnel muck. All site restorations were reported to be satisfactorily completed in the Project Completion Report (NHPC, 2000).

2.8 Socio-economic Aspects

The socio-economic survey of the affected families was undertaken in 1991 on behalf of NHPC by their Environmental Officer, supported by other NHPC staff working on the development and construction supervision of the Uri Project. During the survey efforts appear to have been made to cover the important socio-economic aspects.

2.8.1 Project Affected Persons due to land required for the Project components

According to survey around 246 family properties were affected in 12 villages due to land acquisition as follows:

Houses	30
Houses and land	47
Land only	169
Total number of family properties affected	**246**

Table 2.6: Properties Affected by Uri Hydroelectric Scheme

Beside the above, a mosque and custodian land were also affected. The villages affected due to land required for the Project were Buniyar, Gingle, Pringal, Nowagran, Rajarwani, Bandi, Lagama, Mohura, Gantamulla, Helad Peernia, Bela Salamabad and Chahal.

2.8.2 Project Affected Persons due to the Parallel Road

A "parallel road" was constructed during the project for the transportation of materials to the work site. This road runs parallel to national highway NH1A, but on the side of the Jhelum River, whereas NH1A is on the south side. The aim was to keep much of the heavy construction traffic off the main highway, which is the traditional route from Muzzafrabad to Srinagar, and to facilitate the movement of construction vehicles. Around 20 hectares of land was acquired for the road construction. The total number of families affected was 225, as follows:

Houses/shops	44
Land	181
Total number of family properties affected	**225**

Table 2.7: Properties Affected by Parallel Road Construction

In addition a mosque was affected. The affected villagers in this area were Dawaran, Gingle, Noorkhan, Kachan, Azadpur, Tathamulla and Iehtishampora.

The affected families were given compensation for the lost houses and land in accordance with the procedures set out in the Rehabilitation Plan.

2.8.3 The Process followed during Land Acquisition

The process of land acquisition was largely in line with local legislation applicable to the State of Jammu and Kashmir at the time. After the socio-economic survey was carried out, a retired person from the State Revenue Department was appointed, who helped with preparation of land related documents.

The "Rehabilitation Plan of Uri HE Project" was prepared by NHPC in 1992 after completion of the socio-economic survey; the document was prepared by the ex-Revenue Department appointee. The plan was prepared while the land acquisition process was already in progress.

The circumstances during which the land acquisition and rehabilitation process took place were very difficult, characterized by acts of war, kidnapping, pressure from militant groups and other disrupting influences.

The rehabilitation approach was based largely on cash compensation. The Rehabilitation Plan also included educational facilities, medical facilities, employment, and vocational training.

2.8.4 Monitoring

As with the technical, financial and environmental aspects of the project, monitoring of the rehabilitation process was carried out on three levels:

1. By NHPC
2. By Sida Monitoring Team
3. Panel of International Experts.

The inspection and reporting process for the rehabilitation plan was similar to that of the other aspects, except that NHPC produced a semi-annual report on displaced persons, detailing the progress of the rehabilitation plan.

Neither the Monitoring Team nor the Panel of International Experts included a specialist in sociology or rehabilitation.

2.8.5 Employment

During construction many people from the local region, including "project affected persons" were given opportunities of employment. At the peak of construction activities URICO employed in excess of 4700 Indian nationals, of whom the majority were recruited locally. During the seven-year construction period URICO estimates that up to 9000 people were trained and worked on the project. Following initial unrest among the locally recruited labour it was agreed that only skilled Indian nationals would be employed from outside the Kashmir region, and three locals would be employed for every Indian national employed from elsewhere.

During construction URICO undertook to employ at least one member from each of the project affected families. While it seems likely that this was carried out, the employment provided was only for the duration of construction.

The rates of pay by URICO were high compared with those paid by NHPC, and both were high compared with local wage levels.

3 Findings and Evaluative Conclusions

3.1 Objectives, Targets and Rationale for Swedish Support

The objectives, targets and rationale for the Swedish support of the Uri Project have been determined from study of the pre-contract documentation, Sida's Appraisal Report (23 June 1989) and discussions with project stakeholders involved in the project at the time.

The evaluation has been carried out in the context of the situation and conditions prevailing at the time (1989), although some consideration has been given to evaluation under current environmental guidelines.

The primary objective of the project was to develop a sustainable hydroelectric resource to provide electricity to the Northern Grid. The specified installed capacity of the project was 480 MW, and an average annual energy production of 3080 GWh was envisaged.

Secondary objectives of the project were to improve the electrical supply in the Kashmir region, to assist with capacity building in the Indian electricity sector, and to gain environmental benefits through the displacement of thermal energy by clean renewable hydropower.

3.1.1. Objectives of Sweden-India Cooperation

The background to the Swedish funding of the Uri Project dates from the 1960s and 1970s, when much of Swedish aid to India was in the form of import support. This aid was partly tied and partly untied, and goods covered included paper, fertilizers and industrial equipment. Up until 1975 the aid consisted of grants and loans. From 1975 to the mid-1980s support consisted entirely of grants, and approximately half was tied to Swedish origin products.

From the mid-1980s Swedish support to India primarily consisted of Mixed Credits – project loans with a concessional element, usually tied to the procurement of Swedish goods and services.

The primary sectors for Swedish support in the period leading up to the Uri Project were:

- Water and sanitation
- Forestry and natural resources
- Health
- Education
- Energy
- Environment

During the 1990s the health and energy sectors received the majority of Swedish support. If compared solely in terms of Sida grant funding, these sectors shared the Sida support almost equally. However when concessionary loans, such as that provided by BITS for the Uri Project, are taken into account, the Swedish support was heavily weighted towards the energy sector.

From 1996 onwards Poverty Alleviation objectives tended to dominate the aid policy, with the specific objectives for development cooperation with India being:

- Fighting poverty and improving living conditions, especially for women and children;
- Sustainable utilisation of natural resources and reduction of pollution.

However these new policies were introduced well after the commitment to funding Uri was made (in 1989), and hence did not influence the decision to support the Uri Project.

In approving the project in July 1989 Sida stated that the Uri Project met with the requirements for development cooperation on the following grounds:

- During the previous five years some 30% of the development cooperation had been in the energy sector, and the energy sector was a target of the programme;
- Utilisation of India's hydroelectric potential and reduction of India's dependence on fossil fuels was a specific target of the programme;
- Attempts had been made to identify a suitable medium sized hydroelectric project to support, but without success;
- The Uri Project, although larger than it would ideally have selected, met with the development objectives of Sida.

3.1.2 Accrual of Sida Development Aid Funds

During the 1980s around SEK 400 million per annum of funding was allocated by Sida for the development cooperation programme for India, of which some SEK 100 million per annum was allocated to the energy sector. Due to a number of factors it proved difficult to fully utilise this allocation, and by 1989 a surplus had accrued. In 1989 the Ministry of Finance in New Delhi wrote to the Swedish

Government to request that the unspent balance of funds allocated to the energy sector, which at the end of 1988/89 amounted to around SEK 400 million, should be utilised in support of the Uri Project.

It would appear that support for the Uri Project was a convenient way of spending the funding which had been committed to the energy sector in India in a single project which met with the objectives of development cooperation programme.

3.1.3 Use of Mixed Credit Funds for Infrastructure Projects

The use of "Mixed Credits", which comprise funding consisting of grants, concessional loans and commercial loans, usually tied to donor country supply, was a conventional means of project implementation in the 1980s and 1990s. This approach was adopted for a number of projects in the power sector in India, including development packages from Russia, France, United Kingdom, Japan and Germany. In the hydropower sector projects were supported by Russia, Canada, France, United Kingdom and Japan, and there was competition to secure such projects for bilateral funding.

Elsewhere in the world many major hydroelectric projects were developed using "Mixed Credits" around this time including Turkwel Gorge in Kenya, Samanalawewa in Sri Lanka, Mrica in Indonesia, Pergau in Malaysia and Song Hinh in Vietnam.

The use of Mixed Credits has reduced since 1992 when the Helsinki Agreement became effective. Under this agreement OECD countries agreed not to offer tied-aid funding to countries which had per capita income sufficient to be ineligible for 17- or 20-year World Bank loans, and for projects (other than in Least Developed Countries) which were commercially viable.

Prior to the Helsinki Agreement the guidelines for bilateral aid supported projects were set by OECD, and included a minimum concessionality level of 35%. In configuring the Swedish funding package for the Uri Project, the Swedish Government appears to have complied with the OECD guidelines.

3.1.4 Conclusions on Reasons for Swedish Support for the Uri Project

From our evaluation we conclude that the use of Swedish funds for support of the Uri Project met with the objectives of Swedish-India cooperation at the time, and the use of bilateral mixed credits with the funding tied to donor country supply was a conventional approach at the time.

3.2 Impact on Supply and Availability of Electricity in India

3.2.1 Power Sector in India

Hydroelectric projects currently constitute about 30% of the installed capacity in India, with the balance coming from thermal sources (coal, lignite and gas). Hydroelectric schemes are predominantly located in the Himalayan Region, although there are also schemes in the Western Ghats in Southern India and in the Eastern Ghats in Orrisa. The Government has set a target of 10% of generation to come from small renewable projects.

The country is divided into five regions for purposes of analysis, and for transmission and distribution networks. These are Northern, Western, Southern, Eastern and Northeastern regions. The Uri Project falls in the Northern Region. Other existing hydroelectric project in the Northern Region are listed in Table 3.1 and Table 3.2.

Northern Region	Installed Capacity at March 2005 (MW)
Central & Private	
1. Giri Bata	60
2. Bassi	60
3. Binwa	6
4. Andhra	17
5. Sanjay	120
6. Gaj	11
7. Baner	12
8. Thirot	4.5
9. Ghanvi	23
10. Malana (Pvt.)	86
11. Baspa-II (Pvt.)	300
Bhakra Beas Management Board	
1. Bhakra L& R	1,325
2. Ganguwal	78
3. Kotla	78
4. Dehar	990
5. Pong	396
National Hydroelectric Power Corporation	
1. Baira Siul (Himachal Pradesh)	198
2. Salal-I (J & K)	345
3. Salal-II (J & K)	345
4. Tanakpur (Uttaranchal.)	94
5. Chamera-I (Himachal Pradesh)	540
6. Chamera-II (Himachal Pradesh)	300
7. Uri (J& K)	480
Satluj Jal Vidyut Nigam Limited	
1. Naptha Jhakri (Himachal Pradesh)	1,500
HARYANA	
1. W.Y.C.Phs	63
Total (Non State)	**7,429**

Table 3.1: Central Government and Private Hydroelectric Stations on Northern Grid

State Government Stations	Installed Capacity at March 2005 (MW)
Jammu & Kashmir Power Development Corp.	304.
Himachal Pradesh State Electricity Board	312
Haryana Power Generation Corporation	62
Rajasthan Rajya Vidyut Utpadan Nigam Ltd	430
Punjab State Electricity Board	1,142
Uttar Pradesh Jal Vidyut Nigam Ltd	507
Uttaranchal Jal Vidyut Nigam Ltd	978
Total	**3,736**

Table 3.2: State Government Hydroelectric Capacity on the Northern Grid

The Uri Project is a Central Government Project, owned, operated and maintained by the National Hydroelectric Power Corporation Ltd (NHPC). NHPC is fully owned by Government of India. Uri Project lies in J&K and as such allocates 12% of its generation to the J&K Government as a free power component, which forms part of royalty fees. The Uri Project contributes significantly to the income and revenues of NHPC.

Northern Region Electricity Board of GoI, in consultation with Central Electricity Authority and Ministry of Power allocates the power generation from the Central Government Projects (such as Uri) to each state. In order to meet the electricity demand in each state, the state's own generation stations along with the royalty component of central government projects are taken into consideration in order to determine the allocation of energy from central government projects. This system applies to J&K state where the Uri Project is located. The Systems Directorate of Power Grid Corporation of India administers the day-to-day power allocation, while the operation unit of Power Grid Corporation transmits, wheels and evacuates power on its grid.

3.2.2 Supply of Electricity to the Northern Grid

The prime role of the Uri Project is to provide electricity to the Northern Grid. The project was designed with an installed capacity of 480 MW. It was expected to generate at full output almost continuously for five months of the year (April to August) with production falling to lower levels in the winter months. The "Firm" (exceeded in 90% of years) output was estimated at 2663 GWh/yr, and the average (50% reliable) output was estimated at 3080 GWh/yr. Out of this production 12% of the energy is provided free to the J&K Government as a royalty for the project, and J&K has an option to purchase additional energy when needed.

Financial Yea	Uri HEP Actual	Northern Grid			Uri Output
		Target	Actual	% achieved	% of N. Grid
	GWh	GWh	GWh		
2000/01	1,781	32,634	29,126	89.3	6.1
2001/02	2,087	31,598	29,233	92.5	7.1
2002/03	2,463	31,248	30,221	96.7	8.1
2003/04	2,872	35,108	37,288	106.2	7.7
2004/05	2,207	40,174	36,105	89.9	6.1

Table 3.3: Uri Contribution to Northern Grid Generation

The contribution of the Uri Project to the total northern grid generation (including Jammu & Kashmir) over the last five years is shown in Table 3.3. From this table it can be seen that the generation available to the Northern Grid is consistently below the required target, other than in the very wet year of 2003/04. The shortfall has varied between 1000 and 4000 GWh/yr. The contribution of Uri to the Northern Grid generation has varied between 6% and 8% over this period. As the supply and demand increases, the percentage contribution from Uri will decrease.

3.2.3 Power and Estimated Energy Production

The full 480 MW output from the scheme is achieved when there is adequate flow in the Jhelum River, and there is nothing to indicate that this maximum output will decrease, providing the current levels of operation and maintenance are continued.

The energy simulation studies carried out prior to construction determined the design average generation to be 3080 GWh/yr, and the 90% dependable generation to be 2663 GWh/yr.

Since the start of commercial operation NHPC has recorded the generation from the project as follows:

Financial Year	Generation (GWh/yr)	% of Design Average Energy
1997–98	2178.5	71
1998–99	2575.3	84
1999–2000	1948.9	63
2000–01	1780.6	58
2001–02	2088.3	68
2002–03	2453.7	80
2003–04	2873.5	93
2004–05	2206.7	72
Average	**2263.2**	**73**

Table 3.4: Uri Generation since Commissioning

As shown in Table 3.4, the energy production from the scheme has not matched the anticipated levels; the average generation in the eight years since commissioning has been 2263 GWh/yr. In only one year (2003/04) has the 90% reliable level (representing a 1 in 10 year drought) been achieved. The production is around 74% of the design average production, and around 85% of the design firm (90% dependable) production.

Although there has been some loss of production due to problems with the 220 kV transmission link from Pampore to Kishenpur, as discussed in Section 3.2.6, and other technical issues may also have reduced production, we conclude that the low output is primarily due to low flows in the Jhelum River. We initially considered it likely that the long-term average flow had been overestimated. However we have now concluded that it is more likely that the last eight years constitute an unusual dry period, and that the long-term energy production will be close to the design estimates. The hydrological issues are discussed further in Section 3.11.1.

Problems with the lack of availability of the 220 kV line between Pampore and Kishenpur are estimated by NHPC to have reduced generation by at least 100 GWh/yr. These problems will be largely resolved in 2006 with the commissioning of the new 400 kV line from Wagoora to Kishenpur.

Some loss of production will have been caused by failure of equipment at the powerstation, such as the oil-filled cables and the main transformers. However according to the current measure by which such losses are judged – the Capacity Index – such loss of energy should be around 1%, or less than 30 GWh/yr.

It appears that the energy production estimates have not been revised to take account of the flow in the fish pass and compensation releases. If the fish pass and compensation flow results in the loss of 5 cumecs of usable water for six months per year, this could represent a loss of generation of some 50 GWh/yr. However since the main use of the fish pass is in the Spring months, when there is a surplus of flow over the generation capacity, it is believed the generation loss will be less than this figure.

Although the output of the Uri Project over the last eight years since commissioning has been below the expected level for hydrological reasons, and there has been some disruption to transmission due to problems with the 220 kV transmission line, we consider that the project has largely achieved its prime objective of supplying power to the Northern Grid. Furthermore, with the completion of the new 400 kV transmission link in 2006, and providing that the last eight years proves to be the result of a meteorological anomaly, the project appears likely to achieve this objective for the foreseeable future.

3.2.4 Cost of Power and Economic Justification

A financial and economic evaluation of the project was carried out on behalf of Sida in 1989, as presented in the Appraisal Report of June 1989. In this appraisal it was concluded that the expected tariff of 1.14 INR/kWh in 1995/96 would be adequate to provide NHPC with a "fairly comfortable net income", after covering its costs. However concern was expressed that at this tariff level NHPC might find it difficult to find a buyer for the electricity.

Since 1989 devaluation of the Indian Rupee and project cost increases have occurred, together with rapid price escalation. The price of electricity is now regulated by the Central Electricity Regulatory Commission (CERC), and set for each powerstation on a cost recovery basis. The formula takes into account interest on loans, accelerated depreciation, the cost of operation and maintenance and other defined costs, and provides a return on equity of 14% to the owner. The aggregate sum per annum required to meet these costs is divided by the actual energy generation, to set the basic sales tariff.

The sale rate for electricity from Uri HEP in selected years is shown in Table 3.5.

Financial Year	Regulated Sale Price of Electricity from Uri HEP (INR/kWh)
1999–2000	2.46
2000–2001	2.01
2003–2004	2.4377
2005–2006	2.5091

Table 3.5: Regulated Sale Tariff for Uri HEP

At these price levels NHPC has been able to sell the electricity produced to consumers on the Northern Grid. Only J&K has shown a reluctance to purchase more than its free 12% allocation, unless forced to do so by high winter demand. Hence the financial justification for the project still holds, and the project provides a significant income for NHPC.

Comparison of the Uri-I 2005/06 tariff with the tariff for other NHPC hydroelectric schemes is shown in Table 3.6.

Project Name	Installed Capacity	Year of Completion	Tariff (INR/kWh)
Uri-I (Stage 1)	**480 MW**	**1997**	**2.5091**
Baira Siul	198 MW	1981	0.420
Lotak	105 MW	1983	0.570
Tanakpur	120 MW	1992	1.2022
Chamera-I	540 MW	1994	2.1120
Sallal-II	345 MW	1993–5	0.4156
Rangit	60 MW	1999	2.11
Parbati (forecast)	*800 MW*	*2009*	*2.47*

Source: NHPC Project Details
Table 3.6: Comparison of Tariff between Uri and other NHPC Projects

The comparison between Uri and the other NHPC projects in inconclusive in respect of cost-effectiveness. The table shows a wide range of tariffs varying between INR 0.420 and INR 2.5091 per kWh. These approved tariffs vary according to project cost, and according to the stage of drawdown of the project loans. The rate for Uri, although at the top of the range, is not far above the next highest projects.

The original economic justification for the project was more equivocal, although it concluded that on the basis of a least cost thermal alternative analysis, the Uri project provided an economic internal rate of return (EIRR) of 13.65%, and a benefit-cost ratio of 1.27 at 10% discount rate.

3.2.5 Electricity Despatch Arrangements for Uri Project

For communication purposes, the Uri Project is linked to Northern Grid substation at Kishenpur with a satellite link (VSAT and LDST1 satellite phone), and it is also linked to Wagoora. In addition both landline and PLC (Power Line Communication) are also available. There is a connection between Uri and the Lower Jhelum hydroelectric station by a wireless system.

Generation at Uri is governed by the flow releases of the Lower Jhelum hydroelectric station, since there is virtually no storage available at the Uri headworks. Hence the flow released at the Lower Jhelum tailrace, together with the flow accruals between the Lower Jhelum headworks and the Uri barrage, comprise the flow available for generation. In the wet season spillage from the Lower Jhelum headworks is also available to Uri for generation.

Under the Indian Grid Code NHPC must declare the power level envisaged to be available from Uri for each block of 15 minutes in the day, and this power level must be confirmed six blocks (i.e. 1 ½ hours) in advance. This allows the Northern Regional Load Despatch Centre to plan the load despatch, which is then notified to the operating staff at Uri.

The issue is complicated by the fact that Lower Jhelum HEP is a state project, and is not subject to the Grid Code. Hence the operators of Lower Jhelum are at liberty to vary the output of the station to suit their own requirements, without taking into account the need for planned output at Uri. If the output of Lower Jhelum is varied unexpectedly, NHPC can become liable to liquidated damages for failure to meet their contracted supply. To overcome this problem NHPC have stationed an engineer at Lower Jhelum powerstation to ensure that they know in advance of any changes in output at this station.

3.2.6 Issues Affecting Output of the Uri Project

During the course of the last eight years there have been many occasions when the State operated 220 kV line between Pampore and Kishenpur has been disrupted. This disruption has generally been due to landslides and avalanches affecting transmission towers; incidents of sabotage have also been recorded. The longest of these disruptions has lasted several weeks, as access to the line is very difficult after heavy snow.

The consequence of disruption of this line under the current transmission arrangement is as follows:

- The ability to transfer electricity from Uri to the Northern Grid is interrupted;
- The Kashmir system operates in "island mode", in isolation from the remainder of the Northern Grid;
- Since Uri cannot synchronise with the older sets on the state system, and since Uri is the largest generator, all the other generators supplying the Kashmir State Grid are shut down;
- The inadequacies of the state grid mean that voltage levels drop, typically to 315 kV at the Uri end of the 400 kV Uri-Wagoora line, and to 300 kV at the Wagoora end;
- Depending on the time of year the impact on Uri output varies; in summer, when Uri has the ability to generate at full output due to high river flows, the output at Uri sometimes has to be reduced due to the low operating voltage to prevent the generators overheating; in winter (when the majority of these disruptions occur) the output from Uri is often inadequate to meet the high winter demand in the Kashmir Valley.

NHPC estimates that it has on average lost around 100 GWh per year of production as a result of problems with the 220 kV line. This issue should be resolved when the new 400 kV Wagoora-Kishenpur transmission line is completed in 2006. This line is being designed to be resistant to avalanches and landslides, and there will be redundant capacity so that is the 220 kV line is affected, the 400 kV line should still be operational.

3.3 Improvements to Availability and Quality of Electricity in Kashmir

3.3.1 Regional Power Network

The north-west part of the northern region power evacuation network is shown in Figure 3.1. In J & K, the network has been planned to transfer power supply to the various demand centres. The two key sub-stations are Kishenpur near Jammu and Wagoora near Srinagar.

The Uri Project is linked to Wagoora by a 94km long 400kV double circuit line. Wagoora substation in turn is linked to other demand centres within the Kashmir Valley and to Kishenpur via Pampore. Until the new 400kV line from Wagoora to Kishenpur is completed the existing arrangements for evacuation of power is based on following linkages, which are shown in more detail in Figure 2.2.

a) 11km, 220kV D/C with series compensation line connecting Wagoora with Pampore (towards east)

b) 220kV line connecting Pampore with Kishenpur (towards south).

c) A 220kV line of PDD links Wagoora to Zainkot (towards the north).

All the 220kV and 132 kV lines in J&K belong to and are operated by PDD.

Currently the carrying capacity of the 220V line between Pampore and Kishenpur is restricted to 300 MW (although in winter conditions it can handle up to 400 MW) and is proving to be a limitation for the evacuation of power from Uri to the Northern Grid.

A new 400kV link from Uri-I to the prposed Uri-II project is planned and subsequently a line from Uri-II to Wagoora substation will be built.

In general electricity demand in the Kashmir Valley in the peak winter months is met by importing energy from the Northern Grid. This is on account of low energy generation within the state due the lower river flows in the Jhelum and other rivers in winter. The low flows affect the Lower Jhelum and other hydro plants of J&K State as well as the Uri-I power project.

3.3.2 Improvement of Electricity Supply in the Kashmir Region

Prior to the construction of the Uri Project the availability of electricity in Kashmir was extremely restricted. The Kashmir Valley was supplied by a number of hydroelectric projects, the largest of which was the Lower Jhelum project immediately upstream from the Uri Project, with 105 MW of installed capacity. Other hydros in the state included Upper Sindh, with 23 MW of capacity and Ganderbal with 15 MW. The other significant supply was the 132 kV transmission interconnection to the Northern Grid through Udhampur, with a capacity of around 90 MW. Hence maximum supply to the Kashmir Valley through the public electricity network amounted to around 233 MW. However during the peak winter demand period, when river flows are at their lowest, the energy available from the hydro projects was severely restricted, even though they could generate at maximum capacity for short periods.

It is not possible to determine the electricity demand in the Kashmir Valley in the years before construction of Uri, since the system was so severely supply constrained that the true demand was never met. Most businesses had back-up generators if they could afford to, and everyone had alternative means of lighting, heating and cooking. Load shedding and extremely low and fluctuating voltage supplies were normal; consumers used “voltage lamps” (lamps designed to give acceptable light output over a wide range of voltages) if they could afford them, and voltage stabilisers were required for any other electrical equipment.

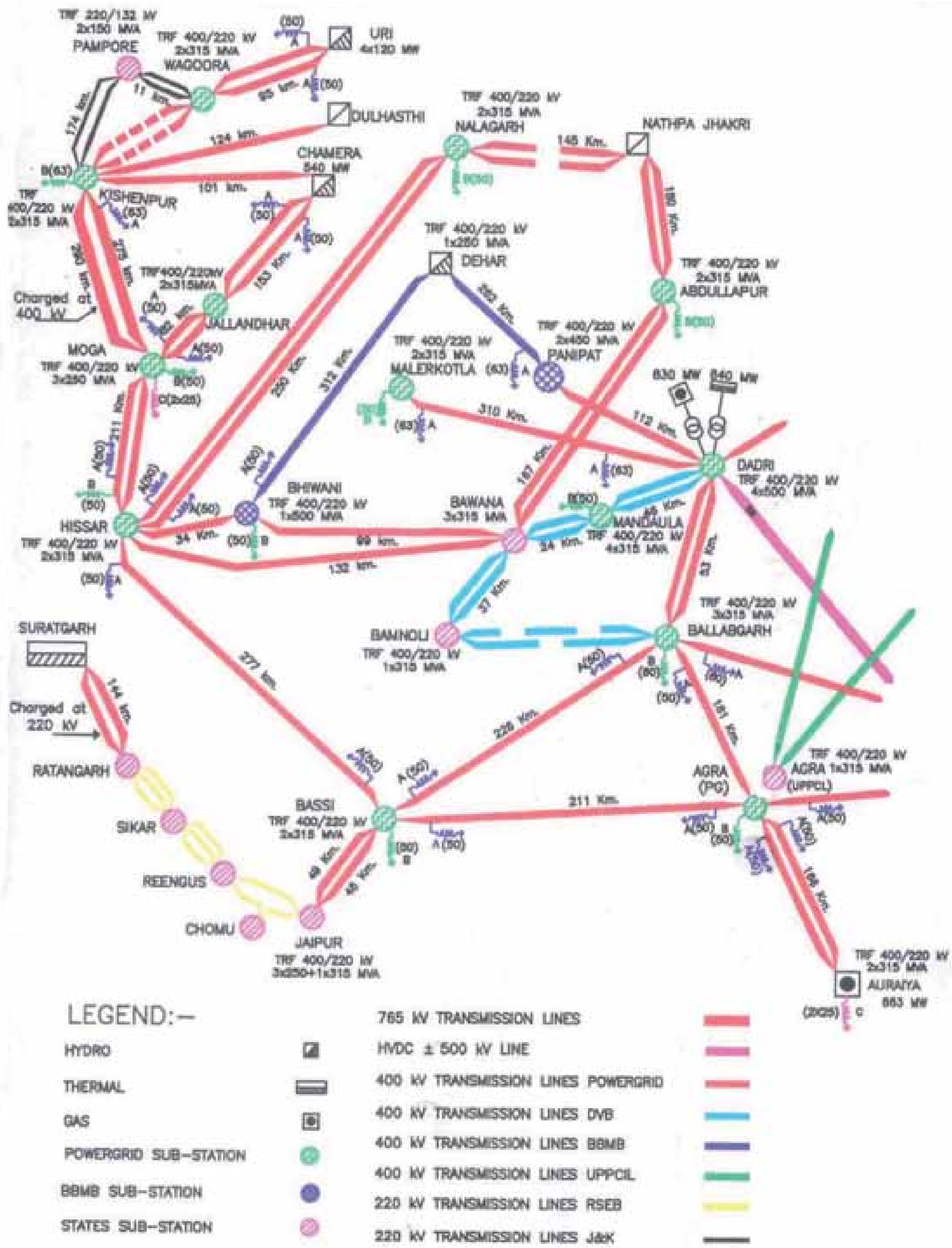


Figure 3.1: High Voltage Transmission Network of the NW part of Northern Grid

Since the mid-1990s a number of factors have improved the availability of electricity in the Kashmir Valley:

- The Uri Project was commissioned in April 1997, providing up to 480 MW of capacity, some 275 GWh/yr of free energy and first option on further energy;
- The Upper Sindh HEP has been expanded with a further 105 MW of capacity;
- 175 MW of open cycle gas turbines (OCGT) generation has been installed at Pampore, close to the major demand centre of Srinagar. This provides an important back-up and emergency supply, although the cost of generation from this plant is high;

- The 220 kV transmission line between Pampore and Kishenpur was completed in around 1997, providing some 300 MW of capacity either to export from Uri to the Northern Grid, or to import from the Northern Grid to Kashmir. The operation of this line varies from year-to-year, but typically the net flow in the months of November, December and January is from the Northern Grid to Kashmir, indicating that virtually all the output from Uri in these months is being consumed in Kashmir.

As a consequence of the above factors the quality of supply of electricity in Kashmir has improved dramatically, although as can be seen from Table 3.7, the J&K power system is still unable to meet its energy and power demand, in common with many other state electricity systems in India. However from a consumer's perspective the quality of supply in Kashmir has improved significantly, and the Uri Project has played a key role in this improvement.

Indicator	2000–01	2001–02	2002–03	2003–04	2004–05
Installed Capacity (including share of NHPC projects) (MW)	1,126	1,234	1,234	1,234	1,234
Energy Demand (GWh)	6,410	6,635	7,243	7,105	8,138
Energy Supplied (GWh)	5,361	5,899	6,327	6,780	7,387
Shortfall in Energy Supply	16.4%	11.1%	12.6%	4.6%	9.2%
Peak Power Demand (MW)	1,170	1,209	1,250	1,268	1,316
Peak Power Supplied (MW)	974	999	1,060	1,218	1,166
Shortfall in Power Supply	16.8%	17.4%	15.2%	3.9%	11.4%

Table 3.7: Electricity Supply and Demand Indicators for J&K State

3.3.3 Access to Electricity in Kashmir

An objective of the support for the Uri Project was also to improve access to electricity within Kashmir, although no indicators were identified at the time of the 1989 appraisal. The project area has had good access to electricity for many years; indeed one of the oldest hydroelectric schemes in India, the now defunct Mohra Station, was constructed there in 1907. The intake for this project lies at the end of the stilling basin of the Uri barrage, and the powerstation, which was fed by a timber channel, is located opposite Gingle village, mid-way between the headworks and tailrace of the Uri Project. Until the mid-1990s this project supplied electricity to the towns of Baramulla and Sopore, and other villages in the vicinity. In addition Lower Jhelum HEP has provided up to 105 MW of electricity to the State Grid and the region since 1974. The Project area has therefore been a net exporter of power for many years.

We were unable to obtain data to make meaningful comparisons of availability of electricity connections before and after commissioning of the Uri Project. However it is apparent that all villages near to the main roads in the project area have electricity, and in discussion with Project Affected Persons all confirmed that they had electrical connections. The Jhelum Valley between Uri and Srinagar has many parallel sets of power lines supplying and transmitting electricity at different voltages. Any problems seem likely to relate to the poor quality of the distribution infrastructure.

We conclude that most of the accessible villages of the Jhelum Valley all have reasonable access to electricity, and that the main benefit of the Uri Project for these villages is to reinforce the supply to the state power system, and therefore improve the reliability and quality of the electricity supply.

3.3.4 Affordability of Electricity for Regional Supply

It appears that the problem experienced in J&K in meeting the electricity demand is related more to the affordability of electricity than to the actual supply available from the Northern Grid. Large financial deficits are incurred by the state in providing electricity. In 2001–02 the cost of supplying electricity in J&K was INR 4.124/kWh, compared with the average revenue of INR 1.370/kWh.

Much of this deficit must be attributed to the high level of losses on the J&K system. In 2001–02 the level of losses was 2964 GWh/yr compared with recorded sales of 3375 GWh/yr (i.e. losses accounted for 47% of the generated energy).

Although J&K receives 12% free electricity from the Uri Project worth around USD 15 million per annum, the high cost of purchasing additional electricity from Uri is a disincentive to use more of this electricity locally. However once the commercial loans for Uri have been paid off it is envisaged that the tariff level will reduce, which may encourage J&K to purchase more electricity.

3.3.5 Outlook Following Completion of 400kV Connection to Northern Grid

Following the completion of the 400 kV Wagoora-Kishenpur transmission line by PGCIL in 2006, it seems likely that the operation of the Kashmir system in isolated "island mode" will be a rare event, and that generally full interconnection with the Northern Grid will be maintained. This should finally alleviate the low voltage problems which are occasionally still present. However supplies to Kashmir will only become fully dependable when the national supply-demand imbalance has been addressed, and the state electricity institutions and infrastructure are improved.

It was reported by PGCIL that even at times when there is a supply shortage on the Northern Grid, supplies to J&K are maintained at the contracted levels as a matter of policy.

3.4 Environmental Benefits from Displaced Thermal Generation

Approximately 70% of the installed capacity in India currently comprises thermal power stations, as shown in Table 3.8. Some 80% of energy is generated by thermal plant, although the proportion varies depending on the season.

Type of Plant	Installed Capacity (MW) (at August 2005)	Percentage of Total
Coal Fired	62,544	54.0
Multi-fuelled	1,744	1.5
Lignite Fired	3,330	2.9
Gas Turbines (gas and liquid) fuel	12,113	10.5
Diesel Generators	1,075	0.9
Nuclear	3,310	2.9
Hydro	31,737	27.4
Total	15,853	100

Table 3.8: Installed Capacity in India (Aug 2005)

The great majority of thermal generation (more than 85%) is from coal or lignite fired plant.

It is reasonable to assume that in the absence of the Uri Project, a coal-fired station would have been constructed, and hence one can assume that the energy generated by Uri displaces coal-fired generation. In practice in India, since demand exceeds supply, hydro energy does not actually displace thermal energy, since both are required, and energy not supplied from the grid tends to be provided by low efficiency self-generation.

The average generation of the Uri Project since commission has been 2263 GWh/yr. If it is assumed that this quantum of coal-fired energy has been displaced, it can be calculated that the quantities of environmental emissions shown in Table 3.9 are displaced by the Uri Project each year.

Environmental Emission Displaced by Uri HEP	Quantity (tonnes)
Carbon Dioxide (CO2)	2,000,000
Sulphur Dioxide (SO2)	20,000
Nitrogen Oxide (NOx)	10,000

Table 3.9: Environmental Emission Displaced by Uri HEP

Although not quantified at the appraisal stage, and subject to the lower than expected energy production of the project, it is clear that the Uri Project achieves its environmental objective of displacing thermal power generation (or possibly even less efficient and more polluting forms of energy use).

3.5 Impact on Capacity Building, Liberalisation and Restructuring of the Energy Sector in India

The Uri Project has assisted the capacity building of NHPC by two main means:

- Financial performance
- Operational performance

The project has had a direct impact in both of these areas on NHPC, as described in the following sections. In addition the project has had an indirect effect on other organisations by a number of methods including:

- Movement of trained and experienced staff from NHPC into other organisations;
- NHPC's joint-venturing with other agencies;
- Overall contribution to the availability of electricity to states on the northern grid including J&K, Punjab, Uttar Pradesh, Haryana, Delhi, Himachal Pradesh, Rajasthan and Chandigarh, all of whom have had allocations of energy from Uri HEP;
- Setting an example to other participants in the power sector in respect of the engineering and project management of power projects;
- The 400 kV transmission line from Uri to Pampore was one of the first undertakings of the newly formed Power Grid Corporation of India Limited (PGCIL) under the electricity sector restructuring programme, and the interaction between PGCIL and the project teams (especially the Monitoring Team) will have benefited their knowledge of project development.

It appears that the Uri Project has had positive benefit in respect of capacity building in the energy sector in India, but less of an impact on liberalisation and restructuring.

3.5.1 Impact on Financial and Organisational Strengths of NHPC

The financial performance of NHPC in the period before Uri was relatively weak, and its ability to borrow funds commercially to finance projects was limited. When Uri started commercial operation it increased the generation output of NHPC by 35% to 40%. In the early years of generation sales from Uri accounted for some 50% of NHPC's total revenues.

Operating Performance	2003–04	2002–03	2001–02	2000–01	1999–00	1998–99	1997–98	1996–97
Generation (GWh)	11,046	9,863	8,912	8,774	8,691	9,917	8,816	5,614
Machine availability (%)	96.82	96.62	96.86	92.09	91.05	88.39	83.00	83.25
Sales (INR million)	12,761	11,723	12,210	11,799	10,757	11,944	9,930	5,344
Man power (Nos.)	13,648	13,017	13,054	11,850	12,150	11,860	11,799	12,119

Source: NHPC

Table 3.10: Operating Performance of NHPC since 1996–97

Financial Performance	2003–04	2002–03	2001–02	2000–01	1999–00	1998–99	1997–98	1996–97
Sales (INR million)	12,761	11,723	12,210	11,799	10,757	11,944	9,930	5,344
Profit after interest & depreciation and tax	6,214	5,105	4,709	4,434	4012	3,053	2,994	1,067
Dividend	1,200	750	500	300	150	150	150	150
Reserves & surplus (cumulative)	33,385	28,524	25,985	21,391	16,906	12,721	9,486	6,345
Net Fixed Assets	84,598	66,087	65,868	66,126	67,237	62,793	63,050	32,710
Net Current Assets	1,078	17,675	15,500	18,642	21,009	14,718	12,525	4,868
Net Worth								
– Share Capital	86,290	72,406	63,457	51,882	44,462	38,250	33,930	29,174
– Reserves	33,385	28,524	25,985	21,391	16,906	12,721	9,486	6,345
Borrowings	68,478	75,078	62,172	56,431	55,837	53,077	54,922	52,233

Source: NHPC

Table 3.11: Financial Performance of NHPC since 1996–97

As can be seen from Table 3.10 the operating performance of NHPC has progressively improved since the commissioning of the Uri Project in terms of sales revenues and units of electricity generated and also in respect of average machine availably.

From Table 3.11 it can be seen that the financial performance of NHPC has also improved significantly since 1997, and NHPC advises that it is now able to borrow commercial funds on the domestic market with a 15-year term at 6.9% interest rate. This reflects the liquidity improvement in the domestic financial markets as much as NHPC's own performance.

The financial support provided to NHPC and the Government of India came at a time when it was urgently needed, and has helped with the development of the electricity sector in India.

3.5.2 Benefits to J&K Power Development Department

The main benefits to the J&K state government and its power department arise from the 12% free energy issued to J&K as a royalty payment for the project, and the back-up support provided by Uri to the state power grid to improve the quality and reliability of supply.

The value of the free electricity to the J&K government based on the average generation from Uri to date is between USD15 and 20 million per annum, varying with the alternative cost of supply and exchange rate variations. The free supply meets around 5% of J&K's electricity demand. This benefit should subsidise the cost of electricity sales in the state, but in practice only reduces the losses which J&K makes on electricity sales. For example in 2001–02 the J&K's cost of electricity sales (including generation, transmission and administration) averaged INR 4.123 per kWh, whereas the revenue from sales averaged INR 1.379 per kWh.

The benefit of backing up the state power grid, and therefore providing a much improved quality of supply, although less tangible, will have had a major impact on the ability of the J&K PDD to serve its customers, and hence is likely to have had a significant capacity building benefit.

However the Uri Project has not significantly assisted with the infrastructure aspects of the J&K state grid, which is in very poor shape, or with the technical and non-technical grid losses, which still amount to nearly 50% of total generation.

3.5.3 Benefits to Other Power Agencies

The other power agencies in India have benefited from the Uri Project to a lesser degree, although the following have received some benefit:

- The state electricity utilities of J&K, Punjab, Uttar Pradesh, Haryana, Delhi, Himachal Pradesh, Rajasthan and Chandigarh have been beneficiaries of the energy from Uri through their purchases from NHPC;
- Other hydropower developers in both the public and private sector have learned from the engineering, construction and project management of the Uri Project, and have gained confidence to employ some of the techniques used on Uri;
- Contractors have been taken to Uri to see examples of work and workmanship which NHPC has wanted replicated on other projects.

3.5.4 Training and Technology Transfer

Training provided as part of the EPC contract assisted with the development of NHPC's staff capabilities in project design, construction planning, quality control, contract procedures, construction techniques and the specification and selection of mechanical and electrical equipment. Some training was also provided on works inspections, environmental control and operation and maintenance. A total of some 250 man-months of training was provided, much of this overseas.

The recipients of the training did not all remain at Uri, but where still actively working for NHPC, are located in Head Office and at other NHPC facilities. This training and the experience gained by NHPC staff working on the Uri Project appears to have been highly beneficial in helping NHPC develop their own design and project management capabilities. Some personnel who were trained or gained experience on the Uri Project have now moved to other public and private organisations around India, and have promulgated their knowledge.

We consider that the training and acquisition of technical and management skills resulting from NHPC's participation in the Uri Project has played a significant role in its development. Some of this knowledge has also passed on to other organisations.

3.5.5. Lessons Learned and Replication of Project Components

In discussions with NHPC staff a number of lessons were learned from the construction of the Uri Project including:

Engineering

- The tunnelling techniques used were innovative for India, especially the NATM rock support methods, the use of shotcreting, the use of forward probing to ascertain geological conditions in advance and the use of timer-delayed blasting and pre-splitting to reduce overbreak;
- The use of hydraulic lift radial gates (previously crane-lift vertical gates were the norm);
- The use of vacuum treatment for improved durability of concrete surfaces exposed to high water velocities was new;

- The use of fibre reinforcement in concrete exposed to potential abrasion was new;
- The placement of concrete in high lifts was not common practice in India at the time;
- Innovative techniques were adopted for placement of concrete at low temperatures, down to –10°C;
- The use of continuous slip-forming for the surge shaft was a new technique in India;
- The use of the innovative pinch valves in the de-silting basins has not proved entirely successful, and has demonstrated the need to use proven technology in critical areas.

Project Management

Many of the project management techniques adopted on the Uri Project were innovative in India at the time, particularly the management of the design, physical and programme interfaces by the contractor under his single point EPC responsibility.

Other new aspects of project management included the contractor taking full responsibility for quality assurance under a Quality Plan; the use of a Safety Plan by the contractor to manage Health and Safety and the use of advanced computerised program and resource management software to control the construction schedule.

Contractual Aspects

The innovative EPC contract arrangement, whereby the design and the electrical and mechanical works were undertaken for fixed lump sums, but the civil works were carried out under a re-measurable contract, with payment based on actual quantities (up to a cap), was regarded by NHPC as a great success. It provided the flexibility to cope with unexpected physical conditions, especially in the underground works, while keeping the total price under control. Aspects of this contract were apparently used on subsequent NHPC contracts.

3.6 Elements for Long-Term Sustainability of the Project

The life of a hydroelectric project is typically regarded as being 50 to 60 years, but in practice may extend to 100 yeas or more with appropriate refurbishment and rehabilitation measures. In order to achieve this longevity the project needs to be well engineered, and the project, the surrounding environment and the upstream catchment need to be managed in a manner which will ensure long-term sustainability.

3.6.1 Quality of Construction and Equipment

A very high quality of construction was adopted for the project, and the quality of the equipment provided appears generally to be very good.

Although the project has now been operating for eight years, and many of the structures will date from well before commissioning, the structures are showing no signs of deterioration. Typical problems encountered elsewhere in India, such as lack of cover to reinforcement, inadequate compaction, leakage from and distortion of shutters and poor surface finish are nowhere to be seen. Generally the quality of the civil engineering workmanship is excellent.

The hydromechanical equipment, particularly the gates at the headworks look to be of very high quality and show little sign of deterioration. The main problem area is the durability of the pinch valves (see Section 3.7.2).

The electro-mechanical equipment is generally of high quality, although the turbines suffer from vibrations at certain outputs (see Section 3.7.2).

The electrical equipment appears to be generally of high standard and likely to give trouble-free operation over their expected life-spans, with the exception of the oil-filled cables, the transformers and the PLC system (see Section 3.7.2).

3.6.2 °De-silting, Sediment Management and Protection of Generating Equipment

The functioning of the de-silting arrangement appears to be very good, and little or no sediment damage to the turbine runners has been observed. This is partly the result of a well designed and effective de-silting facility, but can also be partly attributed to the de-silting facility being designed for double the capacity for the existing scheme. In common with the other headworks, the de-silting basins are sized for both Stage 1 and Stage 2 of Uri-I HEP, and hence have the ability to drop out much smaller particles with only Stage 1 in operation.

The excellent operation of the de-silting basins is compromised by the problems with the pinch valves (see Section 3.7.2), and by the need to dewater the basins completely when maintaining or replacing these valves.

The Jhelum River appears to have much less of a silt problem than most other Himalayan rivers, which is partly attributable to Lake Wular and Lake Dal upstream, which drop out a large proportion of the silt load. Hence it seems likely that the scheme can continue to operate indefinitely, providing that the local catchment is well managed.

3.6.3 Catchment Management

There are three principal components of catchment management which relate to the long-term sustainability of the Uri project: water availability, sediment transport and water quality relating to algae and weed growth. These are considered further in Section 3.11.

3.6.4 Ecological Sustainability

The principal ecological sustainability issues of the project relate to the efficacy of the Uri barrage fish pass, compensation water in the seasonally bypassed Jhelum channel and the efficacy of the Buniyar Nallah fish pass. These are considered further in Section 3.11.

3.6.5 Socio-economic Sustainability

During the project implementation stage the main focus was on providing compensation to the people whose houses and land were acquired. Some training programmes were planned and implemented to improve the financial status of the families. Around 80 families were given vocational training in Backyard Poultry Farming; however it appears that few or none of these have taken up this occupation.

A certain number of Project Affected Persons (PAPs) attempted to invest their compensation payments in commercial ventures, such as shops, but several of these have failed; hence these people have lost the potential for improved livelihood.

It appears that some of the PAPs are worse off compared with their standard of living before they were relocated: some of them are now without assured employment and others are not able to continue their businesses due to lack of demand.

During the construction period the URICO payroll for Indian national staff reached a peak level of around INR 20 million per month in 1994 (around SEK 5 million at the time). Much of this will have found its way into the regional economy. In addition Kashmir based hauliers, many of whom were based in Baramulla, received substantial revenue from transportation contracts. Following completion of the project the quantum of funds entering the local economy dropped dramatically, and many businesses established to service the project and its labour force were no longer sustainable.

The loss of income to the local community will have been partly compensated by the money entering the local community as a result of the great Army presence in the region.

These issues are discussed further in Section 3.12.

3.7 Success of Long-Term sustainability Measures

The fact that the Uri Project has been in operation for more than eight years enables a good assessment of the long-term sustainability to be carried out. The main technical and operational issues relating to long-term sustainability are presented below, and those issues concerning environmental and socio-economic sustainability are presented in Sections 3.11 and 3.12 respectively.

3.7.1 Availability of Powerstation to Generate

The ability of the station to deliver electricity to the grid is governed by a combination of issues including:

- The availability of the scheme to operate;
- The efficiency of operation;
- The availability of river flow;
- The availability of the transmission lines to evacuate the load;
- The availability of the power grid to receive the load.

In the case of the Uri Project, being a run-of-river scheme with multiple units, and the Jhelum River flow being highly seasonal, there are periods in the year when the flow diminishes to levels where not all the turbine-generator units are required for generation. Hence maintenance can be carried out without any loss of generation. Making use of these low-flow months for maintenance, NHPC has been able to achieve a very high level of Capacity Index (percentage of capacity available ÷ percentage of capacity which can be generated, taking account of water availability), typically in excess of 99%. From the quality of the equipment and the quality of the operation and maintenance, it would appear that this high level of availability is likely to be sustained.

The selected turbine-generator equipment has a high level of efficiency, and was proven in the commissioning tests to achieve the performances levels specified in the contract. Efficiency can reduce with time, often as a result of turbine runner erosion and wear. In the case of Uri there is little evidence of runner erosion. The cavitation damage observed during maintenance on the back of the turbine blades is not serious. NHPC has now established a 6-year refurbishment cycle for the runners (one per year for four years, then a two year gap), and the runners are repaired in India by welding. A spare runner is substituted for the one under repair, so that no loss of generation occurs.

The river flow over the last eight years has been substantially below expectations. Our assessment is that this is likely to be a cyclical reduction in flow affecting other rivers in the region, and should not affect the long-term performance of the project. It is possible that global and regional climatic changes may affect the flow of the Jhelum River, but these are unlikely to be responsible for the recent dry period.

The 400 kV transmission line connecting the Uri Project to the State Grid near Srinagar has proved very reliable. Minor disruptions have occurred, in particular due to faulty relays and malfunctioning PLC equipment; these are being rectified by NHPC. However there is full redundancy in the system since each of the two circuits has adequate capacity to carry the full station output, and it is unlikely that significant loss of production will occur due to problems on this line. The entire length of this line is in an area with a very significant military presence, and it is much less vulnerable to sabotage than other transmission lines in the region.

Failure of the 220 kV line connecting Pampore (Srinagar) to Kishenpur (Jammu) has been responsible for some loss of production. Failures have been due to avalanches and sabotage. In view of the access difficulties it can take many weeks to rectify the problems. In such circumstances the Uri project cannot supply significant energy to the Northern Grid, and the output is restricted to the demand on the Kashmir Grid. This is less of a problem in winter when local demand is high and the river flow (and hence power output) is low. However in spring and summer it can result in significant loss of generation. NHPC estimate that more than 100 GWh per annum of production has been lost as a result of problems with this 220 kV line. However this problem should disappear with the commissioning of the new 400 kV PGCIL line in 2006.

3.7.2 Residual Technical Problems

Following completion of the Uri Project there are a few residual technical problems which affect the performance of the project, although they have little impact on the quantum of energy produced.

ID	Equipment	Problem	Action
1	Head regulator intake	Accumulation of trash	NHPC procured and installed a trash raking machine.
2	De-silting basin valves	Valve sleeves failed early in use; all replaced by Kvaerner Boving; subsequently sleeves have short life – typically two years.	NHPC replace sleeves when leakage becomes excessive; trials underway of Indian manufactured sleeves using different compounds. Hope to find a more durable material.
3	Francis turbines	Turbines vibrate when operate between 100 MW and 40 MW.	NHPC in discussion with Kvaerner Boving (now GEC). Meanwhile try to operate outside this range.
4	Francis Turbines	Problems with excessive runner clearance excessive uplift and high thrust bearing temperature.	Replacement of seals during maintenance appears to solve problem.
6	Transformers	5 of 12 single phase transformers have failed (1 in 1999, 2 in 2002, 2 in 2004.)	NHPC procured 2nd spare transformer from BHEL; consider problem due to accumulation of copper sulphate in oil – additive used to retard. Could also be due to voltage transients.
7	Oil-filled cables	Leakage from 400 kV oil-filled cables from underground GIS to pothead yard.	There are two circuits of three cables each plus one spare. Reductions in the oil pressure were observed within one year of commissioning, and leakage was observed within two years of commissioning. Repairs were carried out initially by ABB (1999) and subsequently by TATA. The problems have persisted, and have caused intermittent disruption of one or other of the circuits. However it is understood that little disruption to station output has occurred. NHPC has initiated procurement of one solid insulation (XLPE) cable, and may have to replace all the cables.
8	RALZB Protection Relay	Problems have occurred with the RALZB relay, and spares are no-longer available. Also the test kits are no longer available.	These relays are located at both ends of the Uri-Wagoora transmission line. The relays at Wagoora were supplied to NHPC under the contract, and issued to PGCIL by NHPC. There are suggestions that this analogue technology was nearing obsolescence at the time of supply. NHPC intend to procure modern digital relays and test kits, and will issue replacement equipment to PGCIL.
9	PLC Equipment	As with RALZB relays, the PLC equipment was issued by NHPC to PGCIL. The cards have been failing, and PGCIL have not been able to find spare parts.	As with the RALZB relays there is a suggestion that the equipment may have been old technology. Further it is suggested that it would have been preferable if equipment for which parts are available in India had been supplied. NHPC are looking into replacing the PLC equipment.

Table 3.12: Residual Technical Problems

The problems described in Table 3.12 are relatively minor, and generally do not result in loss of production. However some of them, such as the failures of the pinch valve, the transformers and the oil-filled cables have high nuisance value. They detract from the otherwise exceptional quality of the project.

In the majority of cases the failures occurred outside of the warranty period of the equipment. It is also observed that the electrical conditions under which the plant has been operating are not always in accordance with the design assumptions. For example very low voltages occur when Kashmir is in "island mode" (315 kV), and high electrical transients occur when Uri is black-started and the 400 kV transmission line is charged from the Wagoora end. These conditions could be contributing to some of the electrical failures.

3.7.3 Sediment Management

The physical management of the sediment arriving at the Uri project headworks is being successfully handled, and there is little evidence of sediment damage to the generating equipment, or of accumulation of sediment at locations where it could interfere with the operation of the scheme. The problems relating to the pinch valves in the de-silting basins, and the inability to work on these valves without dewatering the basin spoil what would otherwise be an exemplary sediment management scheme.

The issue of catchment management to provide long-term protection against erosion and sediment rates is discussed in Section 3.11.2.

3.7.4 Obsolescence of Equipment

During the discussions with NHPC and PGCIL operating staff concerns were expressed that some of the equipment, in particular the RALZB relays and the PLC equipment were old technology at the time they were installed and that they have become obsolete much more quickly than might have been expected.

It appears that the equipment in question was of an old analogue design, which was being replaced by digital technology. We consider that this obsolescence results from unfortunate timing, with the equipment being specified at the time of the transition from analogue to digital technology. We do not consider this reflects badly on the supplier, although better efforts could have been made to support the customer.

3.7.5 Issues Concerning Procurement of Spares

The electrical and mechanical equipment supplied for the Uri project was almost exclusively of European origin. NHPC and PGCIL staff have expressed some concern about the difficulty of procuring spares and support for this equipment. Part of the problem appears to lie with the internal procurement processes of the organisations and with the exchange control regulations in India. There has also been some difficulty in sending support personnel to site due to security considerations.

The spare part procurement issue is not one of major concern at the Uri Project, but it does raise the question whether more efforts should be made on such projects to supply equipment which can be supported locally.

3.7.6 Design for Local Conditions

During discussions with the operating staff it was noted that in a few cases the design carried out by URICO was not entirely suitable to local conditions. Two specific examples were given as follows:

- The powerhouse control room accommodation is suitable for 6 to 8 staff who would normally be employed on a similar European powerstation, but was inadequate for the 20 or so staff employed by NHPC;
- The toilet facilities are suited to western use, but not suited to Indian, and particularly Kashmir use.

3.7.7 Performance During Earthquake of 8th October 2005

During the Consultant's visit to the project to carry out this evaluation, the project area was rocked by a major earthquake at 09:25 on Saturday 8th October 2005. The epicentre of the quake was located around 10 km north-east of Muzaffarabad and some 60 km from the Uri Project. The magnitude of the main event was 7.6 on the Richter scale, and more than 30 aftershocks exceeding magnitude 5.0 have been recorded.

The earthquake caused devastation throughout Kashmir. Estimates of the fatalities now exceed 80,000 (early November 2005), and nearly three million people were made homeless. The town of Uri, some 10 km from the Uri Project powerhouse, was completely destroyed and several hundred people were killed.

The Uri Project survived the earthquake virtually unscathed; the only reported damage was a surface crack in the control building in the underground powerhouse. The powerstation stopped generating when the 400 kV lines to Wagoora tripped, apparently due to loss of load in the Srinagar region. However after inspections for damage the powerstation was brought back on line after around two hours.

The NHPC operators' village at Gingle, which had been constructed by URICO as their senior staff construction camp, also escaped virtually undamaged. It was subsequently learnt that the camp had been designed specifically to resist major earthquake loadings.

The accelerometers installed at the Uri Project were reported to have recorded the earthquake. However the computer which was provided to download and analyse the output is no longer operational, and NHPC do not have a master copy of the software to install on another computer. Hence at the time of writing the magnitude of the earthquake loading at the Uri Project had not been determined.

3.8 Extent to which Objectives have been Achieved

In general terms the Uri Project must be considered a significant success, with the main objectives of the project having been substantially achieved. Comments on the particular objectives are provided in Table 3.13.

Objective	Degree of Achievement	Comment
Supply of electricity to the Northern Grid	High	Rapid completion of project; generally good quality and performance of plant; some constraints due to unreliable 220 kV link will be resolved in 2006; low water flows apparently due to hydrological anomaly.
Improved access to electricity in Kashmir	Medium/Low	Project area already had reasonable access to electricity; project has not really contributed to expanding or improving state grid.
Improved quality of electricity supply in Kashmir	High	Substantial benefit to quality of supply in Kashmir; currently only problems when 220 kV link to Northern Grid severed – this issue will be resolved next year. Without Uri severing of 220 kV link would lead to massive load shedding.
Capacity building in electricity sector	Medium	Major contribution to financial and management capacity of NHPC, which is a major part of the electricity sector in India. Minor contributions to other electricity agencies. Little contribution towards capacity building in J&K state electricity agencies.
Environmental benefits from displaced thermal generation.	Medium	Electricity production from Uri has displaced thermal generation, or other less efficient generation with consequent emission benefits; lower than expected generation out over first 8 years reduces magnitude of this benefit, but appears to be a hydrological anomaly.
Sustainable development of hydropower resource.	High	Development appears to be technically sustainable, with generation output expected to continue undiminished for many years to come.

Table 3.13: Degree To Which Objectives Have Been Achieved

3.9 Reasons for any High or Low Achievements

The high level of achievement in the main objective of the project – to provide electricity to the Northern Grid, must be attributed in a large part to the personnel involved in construction, and subsequently operation of the project.

- URICO, the Contractor, must receive great credit for the efforts in overcoming adversities due to the remote and difficult location, and especially the unexpected problems caused by the adverse security situation;
- NHPC demonstrated good abilities as the owner in managing the project, and in administering the contract in a way which allowed construction to continue in the adverse conditions;
- The establishment the Panel of Experts and the Monitoring Team had a significant impact on the project, enabling incipient problems to be identified early and solutions to be developed, in the absence of which commissioning would almost certainly have been delayed;
- The NHPC operating team are maintaining the project in good order, which should enable the project to continue operating for its design life;
- PGCIL will play a major role in securing the evacuation of electricity to the northern grid when the new 400 kV transmission line is completed in 2006.

Another area of high achievement is in the improvement of quality of supply to the Kashmir region. The main reason for this is the low starting point, since the isolated nature of the Kashmir Grid resulted in very low quality of supply before Uri was completed. An even higher level of achievement would have been attained if the 400 kV line from Wagoora to Kishenpur had been constructed at the same time as Uri, as originally intended. However by next year (2006) when this line is complete, there will be two completely separate double circuit lines, and there will be sufficient redundancy in the system to ensure that the Kashmir grid rarely, if ever, has to operate in "island mode" with the consequent depression of voltage.

We consider that the sustainability of the project has achieved a reasonably high level. It seems likely that the long-term electricity output of the project will match the expected levels. There are few, if any signs of factors likely to diminish the electricity production; sediment appears to be generally under control, although some improvements in catchment management are possible. One area where sustainability appears to have been less well achieved is in the socio-economic aspects, where some of the Project Affected People appear to have been negatively affected, and since completion the project has not significantly enhanced the standard of living of the local population. However the negative aspects are offset by the economic benefits accrued during construction, and the training provided to Kashmiri workers on the project which has enabled them to get work elsewhere.

An area of low achievement is on the impact of the project on the Kashmir electricity network and the State electricity agencies. Due to the separation of responsibilities of the Central Government agencies (NHPC and PGCIL) involved in building and running the project and transmitting the power to the northern grid, from the local state agencies, there appears to have been little improvement in the state electricity infrastructure. It would have been difficult to link improvement of the state infrastructure directly with the Uri Project, but a separate project supporting the state electricity agencies could have brought additional benefits to the region.

3.10 Linkage of the Uri Project with other Projects in the Region

The Uri Project forms part of a planned integrated development on the Jhelum River, together with a transfer from the adjacent Kishenganga River.

3.10.1 Uri I Stage 2, Kishenganga and Tulbul Barrage

The headworks of the Uri Project have been constructed with provision for a second stage of the project, which would double its installed capacity from 480 MW to 960 MW. All components of the project from the head regulator, through the de-silting basins to the intake to the headrace tunnel have been sized for this second stage. The second stage would therefore consist of a parallel headrace tunnel, pressure shaft, surge shaft, new powerstation cavern and tailrace tunnel. The existing powerhouse has been arranged so that the new cavern can be constructed without disrupting generation at the existing scheme.

The economics of the first stage (known as Uri-I Stage 1) was not dependent on the eventual construction of Stage 2. The additional cost of sizing the headworks for the second stage was included in the cost of the Stage 1 when the economic analysis was carried out, but no benefit from the second stage was included.

The second stage of Uri would provide very little additional energy under the existing river flow regime, only capturing large floods during the high flow months. In the past the economic viability of the second 480 MW stage depended on the transfer of additional flow to the Jhelum River by means of the Kishenganga Hydroelectric Project and the construction of regulatory storage at Lake Wular with the Tulbul Barrage. Construction of the Tulbul Barrage as part of the Tulbul Navigation Project started 30 years ago. However partly as a result of environmental concerns, partly due to objections by Pakistan under the Indus Water Treaty and possibly also for economic reasons, construction stopped after little physical activity and has not recommenced. There have been eight rounds of talks under the IWT to discuss the Tulbul Navigation Project (or Tulbul Barrage as it is known in Pakistan). It is reported that agreement was almost reached in 1991, but discussions broke down over the construction of the Kishenganga project. There are doubts that the Tulbul project will ever be resuscitated.

The Kishenganga Hydroelectric Project comprises a 21 km long tunnelled transfer from the Kishenganga River (which becomes the Neelum River in Pakistan) to Lake Wular, and includes a 330 MW hydroelectric powerstation. The additional flow from this transfer will benefit all the projects downstream on the Jhelum River, including the existing Lower Jhelum scheme, Uri-I and the future Uri-II projects. However the transfer will reduce the generation of the proposed Neelum-Jhelum project in Pakistan by around one-third, since this project is dependent on the flow of the Kishenganga (Neelum) River. Construction of the Kishenganga Project has started, although Pakistan has objected that this project conflicts with the Indus Water Treaty.

In view of the doubts over whether the Tulbul project will be completed, it seems unlikely that the second stage of Uri-I will be constructed in the near future.

3.10.2 Uri II Project

A separate hydroelectric scheme is under construction immediately downstream of the tailrace of the Uri Project, and is known as Uri-II. This project will have 240 MW installed capacity, and will comprise a 52-metre high concrete gravity dam, 4.3 km of headrace tunnel, 3.8 km tailrace tunnel and an underground powerhouse with four units of 60 MW each. The civil works contract for this project was awarded in mid-2005, and preliminary construction works have commenced.

The Uri-II project will have minimal impact on the existing Uri Project; it will have its own 400 kV transmission link to Wagoora and the two projects will be operated in conjunction so that the power flows in Uri-II approximately match the flows released from Uri-I. The new 400 kV link from Uri-II to Wagoora will provide a second independent circuit, and provide some additional redundancy to evacuate power from both Uri-I and Uri-II.

The project cost approved by CEA is INR 17,310 in January 2004 prices, or approximately USD 385 million. This means that the specific cost is just over USD 1600 per kW installed.

3.11 Environmental Considerations and Results Achieved

3.11.1 Catchment Management – water availability

3.11.1.1 General

The Uri project generates power from unregulated Jhelum flows. The run-of-river water availability is dependent on surface and groundwater runoff from precipitation in the form of snowfall/snowmelt and rainfall, and reductions in flow caused by consumptive use abstractions for irrigation, industry, public water supply and domestic water use.

With regard to precipitation and river flows, persons consulted in the project area have remarked that snowfall has decreased in the last 10 or more years, excepting a good snowfall in 2004/05. Whether this is a transient feature of the variable climate, or indicative of genuine climatic change, is open to debate.

The custodian of water resources in the Jhelum catchment area is the Irrigation and Flood Control Department of J&K. Under the Indus Water Treaty, total consumptive use of the Jhelum in India is limited. The extent to which the allocation is currently utilised has not been ascertained. However, the general point is made that as the population grows, standards of living rise and industries and irrigation expand in the Kashmir Valley, run-of-river water availability and power generation at Uri may be expected to decrease.

When NHPC commissions the Kishenganga and Uri-II power projects, which will involve a water transfer to Wular Lake, water availability at Lower Jhelum, Uri and Uri-II will increase throughout each year, subject only to any temporary interruptions to the transfer taking place (Figure 3.2). In most spring and summer months, these transfers will not increase power generation at Lower Jhelum and Uri because of their capacity constraints; at such times, these transfers will increase the discharges through the Lower Jhelum and Uri barrage spillway gates into respective downstream channels. This may have insignificant impact on the approach conditions to the fish pass at Lower Jhelum but could have cumulative adverse impacts on the approach conditions and efficacy of the Uri barrage fish pass in the main fish migration season. It is not known if this point has been addressed in the EIA studies of Kishenganga and Uri-II projects. At other times, generally in autumn and winter, when Lower Jhelum and Uri power plants are not capacity or system constrained, these transfers will supplement power generation at Lower Jhelum and Uri and not provide any additional water in their "bypassed" downstream channels.

Thus, without precise planning numbers to hand, it may be expected that Kishenganga transfers will much more than compensate for increasing consumptive use in the Kashmir Valley catchment area of Uri and it appears that the long-term sustainability of the Uri project will be assured from the point of view of water availability. However, it is noted that the amount of augmentation of Jhelum flows from Kishenganga water transfers is also subject to weather variability, in particular the amount of snowfall/snowmelt in the Kishenganga catchment area.

There are two further considerations which may affect water availability at Uri to various degrees. Storage capacity in natural lakes which overflow and feed Jhelum river at Uri is subject to increasing siltation. These lakes, particularly Wular Lake, provide some attenuation of flood season discharges and augment dry season flows. As their siltation increases, the regulation benefits of these lakes will diminish. The second feature relates to flood control measures – flood relief channels (e.g. at Srinagar) and channel dredging (e.g. at Baramulla). These are designed to drain land and evacuate flood discharges faster and thereby reduce flood levels. In turn, these may tend to reduce flows at the beginning of the dry season. Their impacts at Uri are likely to exist but be very small, even insignificant.

In view of the major investments at Lower Jhelum and Uri power projects, and the proposed future investments at Kishenganga and Uri-II project, it will be imperative that the hydrological monitoring network on Jhelum river is maintained and produces high quality records, particularly at Baramulla. Also, it will be important that the water resources apportionment and management in the Jhelum catchment area is supported by up-dated databases of water abstractions and return flows.

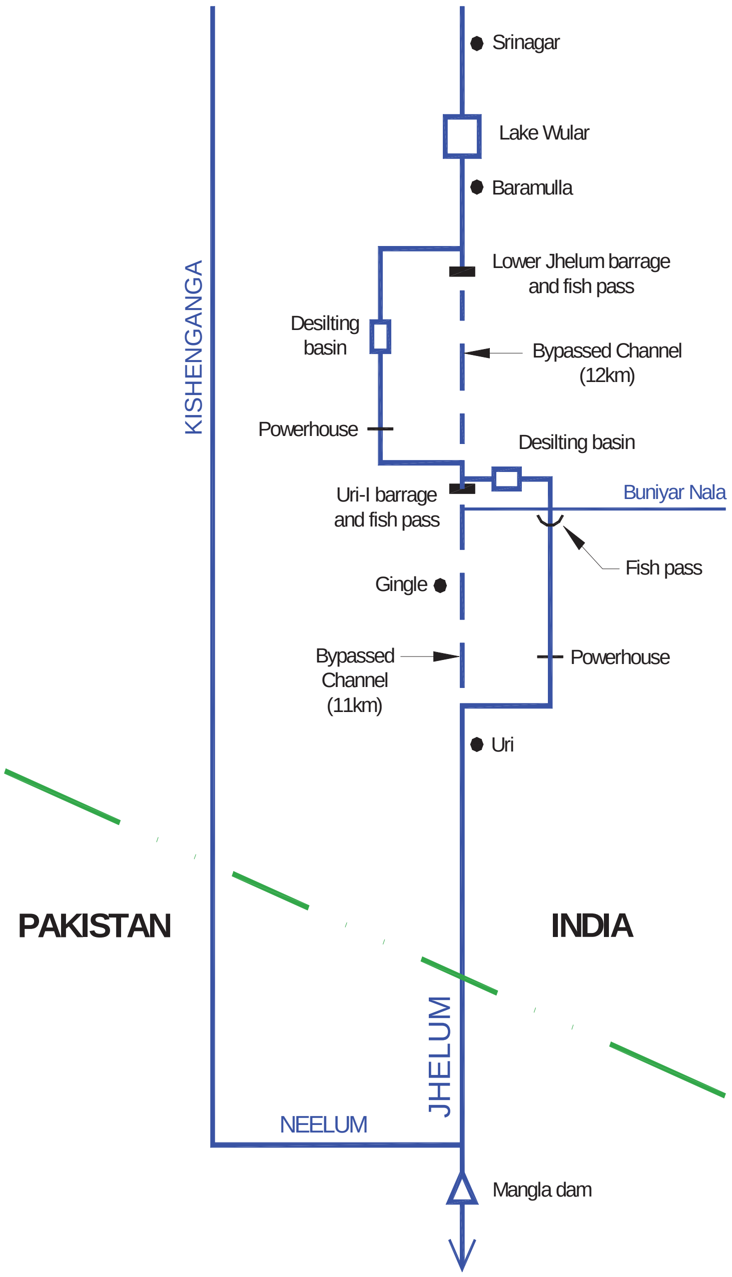


Figure 3.2: Bypassed Jhelum River Channels

3.11.1.2 Jhelum Flow Records and Power Generation at Uri

Examination and comparison of river flow records should permit an assessment to be made of the apparent shortfall in power generation at Uri in the years since commissioning in 1997. It is reported that annual generation has been less than the design generation (90% dependable year) in seven years out of eight.

To assist this assessment, NHPC has provided a composite Jhelum flow record (10-day means) for the period January 1976 to September 2005 (Annex E). NHPC compiled the record from four sources, as described in Table 3.14.

River Gauging Station	Period	Remarks on Station Location
Baramulla	1976 to 1987	15 km upstream of Uri Barrage site
Lower Jhelum Hydropower Plant	Jan 1988 to July 1991	Just upstream of Uri
Buniyar	August 1991 to 1996	500 m Upstream of Uri Barrage axis
Uri Barrage	1997 to Sep 2005	After commissioning of Uri project

Source: NHPC Faridabad, 2005

Table 3.14: River Gauging Sites for Compiling Jhelum Flow Record

The Baramulla records (12 years) are understood to be derived from daily level records, cross section surveys and weekly float velocity measurements, with adoption of one or more float coefficients. It is known that a coefficient of 0.85 is commonly adopted by Irrigation and Flood Control Department but this has not been confirmed for Baramulla. This 12-year record is understood to be a part of the longer Baramulla record which was originally used to establish the Uri project design. The location of the station is stated by NHPC as being 15 km upstream of Uri barrage. It would therefore appear to be located a short distance upstream of Lower Jhelum barrage.

Lower Jhelum Hydropower Plant flow records (3 years 7 months) are understood to be compiled from operational data for the barrage spillway gates and Denil fish pass (some 13 km upstream of Uri) plus

- either canal intake flows measured at or near the Lower Jhelum barrage
- or generation flows at the power house some 12 km downstream of the Lower Jhelum barrage and 1 km upstream of Uri barrage. In this case, it is expected that discharges from the sedimentation basins along the canal and headrace canal overflows should be included.

The Buniyar records (5 years 5 months) are understood to be derived from daily level records, cross section surveys and float velocity measurements, with adoption of a float coefficient, for an Uri project gauging station (one of four) operated by NHPC during Uri construction.

The Uri barrage records (8 years and 9 months) are compiled by NHPC from operational data and are reported to include turbine flows, spillway gate flows, sediment flux discharges and fish pass discharges. It has not been confirmed whether the fish pass flows include the lure water discharge, alongside the fish pass, which at times is potentially 5 m^3/s.

The composite Jhelum 10-day records (Annex E) provide flow information on exceptional wet and dry periods that, later in this report, are seen to support and be compared with statements in the Sida appraisal report, Monitoring Team reports and observations made about fish use of the Lower Jhelum and Uri fish passes.

Monthly flows and annual statistics (Table 3.15) have been compiled from the 10-day records for this study. The records clearly show that the eight years of power generation at Uri have been generally drier than average years and some of these have been exceptionally dry[1].

[1] Unfortunately, the precise degree to which annual flows have deviated from the mean annual flow appears to be dubious. It is rare for annual flows in very dry years to be less than 60% of mean annual flow. In the composite Uri record, several years after 1997 are seen to be well below 60%. Whilst the absolute values of flows in the 1997 to 2005 record are considered to be reasonable, we believe their values expressed as % of mean annual flow may be exaggerated because the mean annual flow (308.1 m^3/s) appears to be high. The high flows recorded at the Buniyar project gauging in 1991–1996 are those that heavily influence the mean in this record. Records have been checked (and found correct) by NHPC and have been adopted accordingly.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Full Year	Year
	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mv/s	m^3/s	m^3/s	m^3/s	%ave.
1976	58.1	149.0	253.0	374.6	503.6	422.1	357.9	673.2	431.2	115.8	76.1	59.7	289.5	99.3
1977	69.1	102.7	129.7	269.7	404.7	331.9	339.9	209.1	167.1	95.0	93.9	72.6	190.4	65.3
1978	72.4	77.6	224.9	402.1	537.4	377.4	339.5	245.8	131.3	79.3	80.9	57.1	218.8	75.1
1979	45.7	67.9	229.4	373.7	475.5	382.2	302.2	150.9	103.8	93.5	81.2	96.7	200.2	68.7
1980	102.6	210.9	380.4	453.4	501.7	485.6	464.7	314.2	255.2	121.0	90.7	89.4	289.2	99.2
1981	91.2	239.3	426.9	760.4	737.2	476.8	398.5	349.9	134.0	102.0	87.5	69.2	322.8	110.7
1982	64.2	105.5	272.8	494.5	533.7	487.9	369.3	293.7	124.6	116.3	156.1	161.3	265.0	90.9
1983	128.2	134.2	465.2	638.7	809.2	690.1	689.0	619.8	387.8	157.0	109.6	89.7	409.9	140.6
1984	82.5	102.2	218.6	420.0	518.8	457.6	252.1	272.8	337.1	67.5	49.4	56.5	236.3	81.0
1985	66.1	71.6	99.6	274.3	501.8	446.0	336.6	319.6	82.8	129.2	94.2	77.0	208.2	71.4
1986	81.4	124.1	262.2	739.6	830.9	539.5	600.1	482.9	156.1	135.1	163.4	256.9	364.4	125.0
1987	161.3	258.4	472.5	674.0	502.8	451.3	394.1	319.6	228.8	129.9	94.8	82.3	314.1	107.8
1988	74.3	147.9	505.1	609.6	562.1	327.4	456.7	428.2	171.4	279.2	73.1	62.3	308.1	105.7
1989	78.8	77.4	223.1	433.0	650.3	611.6	347.5	412.3	144.9	115.9	115.4	85.2	274.6	94.2
1990	91.9	215.7	481.3	620.8	766.3	434.0	358.8	229.3	181.4	90.9	64.3	64.7	299.9	102.9
1991	161.2	281.7	533.8	1138.8	901.0	954.3	649.9	376.2	302.4	177.9	72.2	67.7	468.1	160.6
1992	86.5	222.4	459.5	810.4	968.3	781.4	596.3	457.2	921.4	262.6	137.6	124.4	485.7	166.6
1993	183.8	248.6	587.7	640.9	990.2	667.8	1006.2	328.8	183.0	156.5	129.6	103.9	435.6	149.4
1994	106.3	183.7	416.3	595.9	819.7	673.6	581.3	482.4	448.9	354.5	72.1	107.3	403.5	138.4
1995	115.6	225.5	400.5	654.4	810.5	607.7	586.3	1008.5	250.5	162.1	130.8	83.1	419.6	144.0
1996	112.5	220.9	638.8	622.7	777.4	1112.7	971.7	598.4	482.1	182.4	96.8	80.4	491.4	168.6
1997	68.9	63.1	191.2	378.4	520.2	444.5	302.5	248.0	425.8	122.5	114.4	116.7	249.7	85.7
1998	104.7	168.7	355.6	770.3	722.2	470.5	383.3	150.4	134.4	107.8	60.8	50.1	289.9	99.4
1999	57.5	115.6	203.1	296.5	335.3	120.5	89.6	138.4	91.9	60.8	68.1	62.4	136.6	46.9
2000	51.9	75.3	118.3	243.3	313.9	126.7	296.9	122.0	201.4	93.9	40.1	44.3	144.0	49.4
2001	38.1	38.1	62.7	161.6	286.9	130.3	111.7	124.5	78.7	50.9	69.6	50.2	100.3	34.4
2002	64.7	111.6	245.3	495.8	492.2	273.1	150.0	120.4	154.9	79.8	47.1	43.8	189.9	65.1
2003	37.7	109.1	381.1	587.8	800.5	506.8	242.7	151.8	160.4	129.4	58.5	75.6	270.1	92.7
2004	87.8	148.2	329.9	265.3	531.1	221.7	152.9	99.1	82.7	86.7	56.9	53.2	176.3	60.5
2005	86.4	143.8	334.4	493.0	531.1	472.1	557.4	219.7	120.2	n/a	n/a	n/a	n/a	
max	183.8	281.7	638.8	1138.8	990.2	1112.7	1006.2	1008.5	921.4	354.5	163.4	256.9	491.4	
mean	87.7	148.0	330.1	523.1	621.2	482.8	422.8	331.6	235.9	133.0	89.1	84.3	291.5	
min	37.7	38.1	62.7	161.6	286.9	120.5	89.6	99.1	78.7	50.9	40.1	43.8	100.3	

Source: NHPC 10-day records presented in Annex E

Table 3.15: Jhelum Monthly Flow Records – composite record at Uri

In order to consider the flow record for Uri barrage in a wider regional context, the Uri record may be compared with the annual flows published for the Chenab river at Salal hydropower station (Table 3.16). Chenab river runs broadly parallel to Jhelum, has some similar physiographic features and experiences broadly similar seasonal weather. In making this comparison, it is recognised that Chenab is a higher yielding river than Jhelum where mean flows and catchments areas at Chenab at Salal and Jhelum at Uri[2] are 881 and 308 m^3/s and 21,500 and 12,750 km^2 respectively. These indicate that average flows and catchment area at Salal are 2.9 and 1.7 times greater than at Uri.

[2] A mean annual flow at Uri (266 m^3/s) is given in River Jhelum, Kashmir Valley (Nyman, 1999); the mean flow at Uri has not been quoted in other reports reviewed in this study).

	Chenab Annual River Flows at Salal		Jhelum Annual River Flows at Uri	
Year	m³/s	% of mean flow	m³/s	% of mean flow
1985	794.6	90	208.2	68
1986	953.9	108	364.4	118
1987	937.4	106	314.1	102
1988	1097.9	125	308.1	100
1989	834.4	95	274.6	89
1990	1025.6	116	299.9	97
1991	1047.6	119	468.1	152
1992	929.4	106	485.7	158
1993	821.3	93	435.6	141
1994	887.3	101	403.5	131
1995	1022.5	116	419.6	136
1996	996.6	113	491.4	159
1997	757.4	86	249.7	81
1998	961.1	109	289.9	94
1999	753.1	86	136.6	44
2000	710.8	81	144.0	47
2001	606.8	69	100.3	33
2002	769.9	87	189.9	62
2003	833.7	95	270.1	88
mean	881.1	100	308.1	100

Source: Chenab flows from Strivastava and Gupta, 2004; Jhelum flows from Table 3.15.

Table 3.16: Annual Chenab & Jhelum Flows Prior to and During Years of Uri Generation

The published Chenab flow records includes seven of the eight years of generation at Uri. In six of these years, Chenab flows were below average but not as severely below average as Uri.

Another line of enquiry has been to examine a Jhelum flow record at Mangla in Pakistan. This includes Jhelum flows at Uri, Kishenganga to the north and additional catchment areas downstream. This examination has also confirmed the dryness of recent years. The record is not presented here because of uncertainties about its original source.

Thus three hydrological records support the commonly expressed views of NHPC staff at Gingle and foresters at Baramulla that snowfall and hence snowmelt has been minimal in most years since 1997. Coupled with some transmission line and system constraints which have been experienced, the flow records definitely explain why Uri power generation has underperformed and been less than expected at the time of Sida's appraisal. However, in order to attempt to establish further quantification of this, a detailed power system study and hydrological study would be required.

3.11.2 Catchment Management – sediment transport

NHPC has incorporated three mitigation measures with regard to erosion and sediment transport.

Desilting Basins

Engineering measures at the barrage intake and desilting basins have been provided to protect the headrace canal, tunnel flows and turbines from damaging effects of abrasion. The performance of these measures is described in Section 3.6.2.

Inspection of the Jhelum channel where silt is discharged (near the siphons for surplus escape in the headrace canal) revealed no build up of sediment deposits, inferring that barrage spillway flows transport the sediment downstream as intended.

Catchment Area Treatment

NHPC commissioned Forest Department to plan and implement Catchment Area Treatment (CAT) measures in nine micro-watersheds upstream of the Uri barrage. In its 16th and final report (May 1997), the POE was satisfied with the works carried out, noting the good quality of engineering works and plantations. The POE commended NHPC and the Forest Department for motivating villagers in all watersheds to form grass roots committees to protect the CAT works. At the time of this 1997 report, it was noted that CAT works were expected to be completed by March 1999 and maintenance was committed for a further two years by Forest Department.

In addition to the POE monitoring progress, the NHPC Environmental Team and a Monitoring Committee reviewed CAT progress regularly. The Monitoring Committee comprised staff from NHPC, Ministry of Environment and Forests, Pollution Control Board and Forest Department. In the minutes of the Monitoring Committee's final meeting (July 2002), it is recorded that the Committee had visited and was satisfied with restoration of spoil tips, Nowshera quarry, CAT plantations and other works, and confirmed that NHPC funds had been made available for maintenance of the sites until 2002. Good survival rates of plants were observed. Thus it may be noted that for some five years after project commissioning in 1997, the NHPC Environmental Team and the Monitoring Committee were still very active and NHPC continued to fund Forest Department for some maintenance works.

Subsequently it is understood that NHPC handed over maintenance of CAT works to Forest Department and that NHPC is not involved in maintaining soil conservation measures in the nine micro-catchments. From investigations during this study, it is also understood that Forest Department has had no internal budget allocation for Uri CAT maintenance work since 2002 and that staff of Forest Department believe that some of the good works performed by the project are now degenerating. Without this vigilance and maintenance, it may be concluded that erosion and sediment transport may be expected to increase from some parts of the nine micro-watersheds upstream of the Uri barrage.

Physical access inside the nine micro-catchments continues to be restricted for security reasons. The only ways of independently assessing the status of these areas is by viewing what can be seen from the main Jhelum valley and by obtaining an overall impression from images provided by internet services such as Google Earth. Observations and photographs in October 2005 revealed that in the limited areas that could be seen – along 12 km of the north and south sides of the main Jhelum valley – vegetation cover was generally continuous and obvious erosion areas were limited to poorly constructed terraces on south facing slopes and footpaths and cattle tracks leading to forests and high elevation grazing areas, also on south facing slopes. North facing slopes appear to be mainly under forestry. Google Earth images (dated "within last three years") confirm this description along the main Jhelum valley sides, and indicate this is repeated higher up these nallahs for land which cannot be seen from the main Jhelum valley but is "seen" by satellite.

The phenomenon of post-project conflict relating to financing and managing soil conservation measures is common to many hydropower developments worldwide. With modern "joint forest management" and "integrated watershed management" policies, and programs with similar labels, the common source of the post-project problem is non-availability of finance. As soon as hydropower project financing of soil conservation works ends and forest protection staff (forest guards) return to routine departmental work, any earlier motivation of villagers in the nallah watersheds (with their grass roots committees to protect the CAT measures) typically ends abruptly. Thus some, or many, of the soil conservation efforts previously made to improve infiltration and soil water storage (tree cover, terracing) and to reduce the speed of surface runoff (tree cover, check dams) become unsustainable.

With a run-of-river scheme like Uri, with provision of generously sized sediment basins, some increase in sediment loads may be handled satisfactorily by the silt exclusion measures provided. But when we take a broader and global view, and consider Uri-II and Mangla downstream, the need to sustain CAT measures is very apparent.

The present sediment transport situation is that Wular Lake continues to protect both Lower Jhelum and Uri projects by absorbing most of the large and medium sized sediment loads entering the lake. The valleys that are contributing most of the larger sizes of sediment load to the two power station intakes are those in the gorge reach of the Jhelum downstream of Wular Lake. Some of these tributary valleys have excellent natural or planted tree cover and yield very little sediment. This is particularly true of north facing hillsides. Others have been exploited for their timber and have not been replanted with trees; they are either grazed by villagers' livestock, beyond their carrying capacity in some areas, or cultivated. This grazing land on hillsides provides little detention storage and maximises surface runoff when snow is melting and during severe storms. Where there is cultivation on pronounced slopes, attempts at terracing have been made; some appear to be well constructed and maintained but many terraces appear to be poorly constructed and sources of erosion. Typically, there is no forested land upslope of these terraces and storm surface runoff from higher areas passes through such terraces and also contributes to their erosion.

Extreme erosion and very high sediment loads were observed in 1992 during Uri construction. A damaging storm of 110 mm was reported in August; it caused washouts and landslides. Shortly afterwards, on 8 and 9th September, 438 mm was recorded in 24 hours. This storm caused more erosion and damage; 368 people in Jammu and Kashmir were reported to have died as a result of it (Monitoring Team Report No. 6, November 1992). The Jhelum mean flow (1,428 m^3/s) for the 10 days which followed this storm event (11–20 September 1992) is included in the NHPC records (Annex E). This flow is the greatest of the 1,080 10-day flows in the 30-year record (1976–2005). This serves to illustrate that it is not routine spring and summer wet weather conditions which deliver most sediment into the nallahs and Jhelum river but the less frequent events which occur on only one or two days per year and the much rarer events such as in September 1992. It is for these infrequent storms, and following these storm events, that maintenance of forestry and CAT measures are required to minimise erosion.

The pressure on exploiting trees for house construction, fuelwood and non-timber forest products continues to grow as the valley population increases and standards of living rise. Grazing pressure continues to increase and the need for more cultivated land increases. Thus when financed soil conservation programmes come to an end, as with recent CAT programmes, there is no monitoring or incentive to encourage villagers to tend, nurture and protect newly planted trees and prevent livestock from browsing them. Similarly, there is no specific programme to replace or maintain terraces, check dams and other physical measures.

A community or social component is essential in CAT programmes, and it does not cease when a programme of works are completed. The importance of this component was clearly recognised in statements made by the POE when it commended NHPC and the Forest Department for motivating villagers in all watersheds to form grass roots committees to contribute to and protect the CAT measures. However, it is noted that in practice there was no social expert in the POE (to monitor and advise on this and on resettlement and rehabilitation) and that a social facilitator was not included in the nine categories of job specifications for the forestry team fielded by the Forest Department for the CAT works under NHPC funding (Uri Catchment Development Plan (1993–98). J & K Forest Department, April 1993).

Furthermore, it appears that no-one is currently assigned to working with villagers on developing livelihood strategies which both increase standards of living and conserve the environment.

This is believed to require attention in the nine CATs upstream of Uri. As stated before, this problem is common to numerous hydropower projects worldwide. It is clearly an existing major problem at Salal on Chenab river where average costs of sediment-related annual maintenance are reported to be USD 5.2 million/year (Strivastava and Gupta, 2004).

A model solution, based on many years of hydropower utilities and World Bank environmentalists studying past failures, is currently being followed at the Nam Theun 2 hydropower project in Laos. There the solution is to dedicate and contractually guarantee a portion (in this case approximately 0.8%) of the hydropower project's revenue each year throughout the concession period (25 years) to protecting the watershed, supporting resettlement communities and funding monitoring and mitigation programmes (Manolom and Grant, 2005). This is now considered the principal and sustainable way in which erosion, sediment transport and excessive adverse effects on fish ecology, reservoir sedimentation and wear and tear on machines may be avoided or minimised.

Site restoration

As noted earlier, in the minutes of the Monitoring Committee's final meeting (July 2002), it is recorded that the Committee had visited and was satisfied with restoration of spoil tips, Nowshera quarry and other construction areas.

During our visit in October 2005, Forest Department staff indicated that they had used bio-fertilisers when planting on spoil heaps and in construction areas. VAM – Vascicular Arbuscular Mycorrhiza and nitrogen fixing bacteria were used. Seedlings of plants were inoculated with VAM and/or nitrogen fixing bacteria before planting. These fungi and bacteria form partnership with plant roots. The VAM are known for providing water and nutrition especially phosphorus, to the plants. Many trees had been planted on spoil tips and construction areas, and slopes were stabilized with turf. Two children's parks, one at Buniyar for locals/tourist and the other at the Uri barrage site, have also been developed on spoil tips.

Forest Department staff confirmed that the results of this use of biotechnology were excellent in many areas, particularly in the first few years of growth. The typical dimensions of treated soils placed around roots of seedlings were 45 x 45 x 45 cm. However, the Forest Department believes these dimensions to be inadequate for encouraging sustained growth in tunnel muck in some areas, now preferring a more generous application.

During our visit in October 2005, the spoil tip areas appeared to be stable. Their vegetation cover remains good in most areas but vegetation on the riverside slopes of some spoil tips appears sparse. This is particularly true of the sides of the flat-topped spoil heaps which have now been occupied by the Indian Army. This gives the impression that high security may have made access for inspection and maintenance (watering, replanting trees and turf) impracticable.

From the presentation of Jhelum river flow records (Table 3.15), it is apparent that there has been an unusually prolonged series of years with below average river flows, inferring that precipitation has been regularly and at times exceptionally below average. This may help to explain why there are reported differences in views on the success and survival rates of planting on spoil areas. In the first years, the amount of treated soil around plant roots was sufficient in nutrients and water holding capacity. But as plants developed and roots entered tunnel muck, a succession of dry years occurred. With responsibility for maintenance transferred to Forest Department, with no budget allocation since 2002, it is reasonable to assume that essential watering of plants in these dry spells has ceased, leading to mortalities.

It is recorded that NHPC's website accords the Uri project with high marks for its landscaping and protection of environment. NHPC staff regularly comment that Uri is their environmental showpiece. With regard to landscaping and site restoration, including public amenity features (children's parks), this acclamation is well deserved. It reflects well on NHPC's commitment to protect the environment which is proclaimed on various notice boards at Gingle and elsewhere.

3.11.3 Catchment Management – water quality

Water quality of Jhelum river at the Uri barrage intake site caused continuing concern to the Panel of Experts. Recent reports indicate that water quality is deteriorating at Srinagar and Wular Lake (Kundangar and Abubakr, 2004; Wani and Pandit, 2004; Wani, 2004). Various algae and water weeds are present indicating high nutrient supplies. Weeds and consumer plastic rubbish are seen at Lower Jhelum intake boom and at Uri barrage. Some of the river banks in Baramulla are seen to be covered in rubbish, including plastic bags, ready to be transported to Lower Jhelum and Uri in future flood seasons.

NHPC have not reported unmanageable problems with water quality and trash. However, the increasing raw sewage and other untreated waste discharges at Srinagar and elsewhere are considered to be cause for concern at Uri in future. High costs can be involved in maintaining/replacing cooling systems in power stations when algae and water plant debris pass through gates into power system conduits.

The operation of Uri hydropower project has little impact on the water quality of flows which pass from the Uri barrage intake to the powerhouse and tailrace. The small impact of the engineering project itself is that flows in the headrace and tailrace tunnels are not subject to the water quality improvement or "cleaning capacity" of the turbulent river reach which they bypass. This is not considered significant.

Project related housing has some small but adverse impact on water quality in the 11 km bypassed Jhelum river channel, between the Uri barrage intake and the tailrace. New project colonies (e.g. Uranbau and Gingle) discharge untreated polluting loads from septic tank drainage into this reach. These effluent quantities are unmeasured but are seen to be very small. They add cumulatively to other small untreated domestic waste effluents from villages and the Indian Army camps, which discharge into this reach.

In spring and summer, Uri barrage spillway flows through this reach provide great dilution for these small effluent discharges.

In autumn months (typically from September) and winter months (to February/March) almost all Jhelum flow is normally diverted for power generation. In these seasons, the bypassed Jhelum channel receives natural flows from local tributaries and springs and whatever flow is released from the Uri barrage fish pass and lure water conduit (Figure 3.3). During this time, the wide and stony Jhelum river bed is exposed with the reduced stream flow appearing as a small watercourse within the main river bed. This small watercourse reduces in size to a trickle as tributary discharges recede in the dry season. No records of tributary or Jhelum flows are available for this reach since Uri power generation began in 1997.

Attention was given to the project-related domestic effluent discharges, especially at Gingle, during the construction period. Responsibility for determining compensation flow rates at Uri barrage for the 11 km bypassed channel – usually the principal issue in any barrage or dam project environmental management plan – was divided. Reading of POE and Monitoring Team reports indicates that neither NHPC nor the POE would accept releases of minimum flows recommended by the Institute of Freshwater Research (IFR) which had been commissioned by Sida to carry out an aquatic impact assessment study. IFR recommended releases of 5–10 m^3/s in its report dated September 1995. The POE, which had no specialist in aquatic ecology, then looked to NHPC to continue water quality monitoring in low and high flow conditions and "prepare and implement water pollution control measures, if necessary". A brief history of the water quality deliberations is given in Annex F.

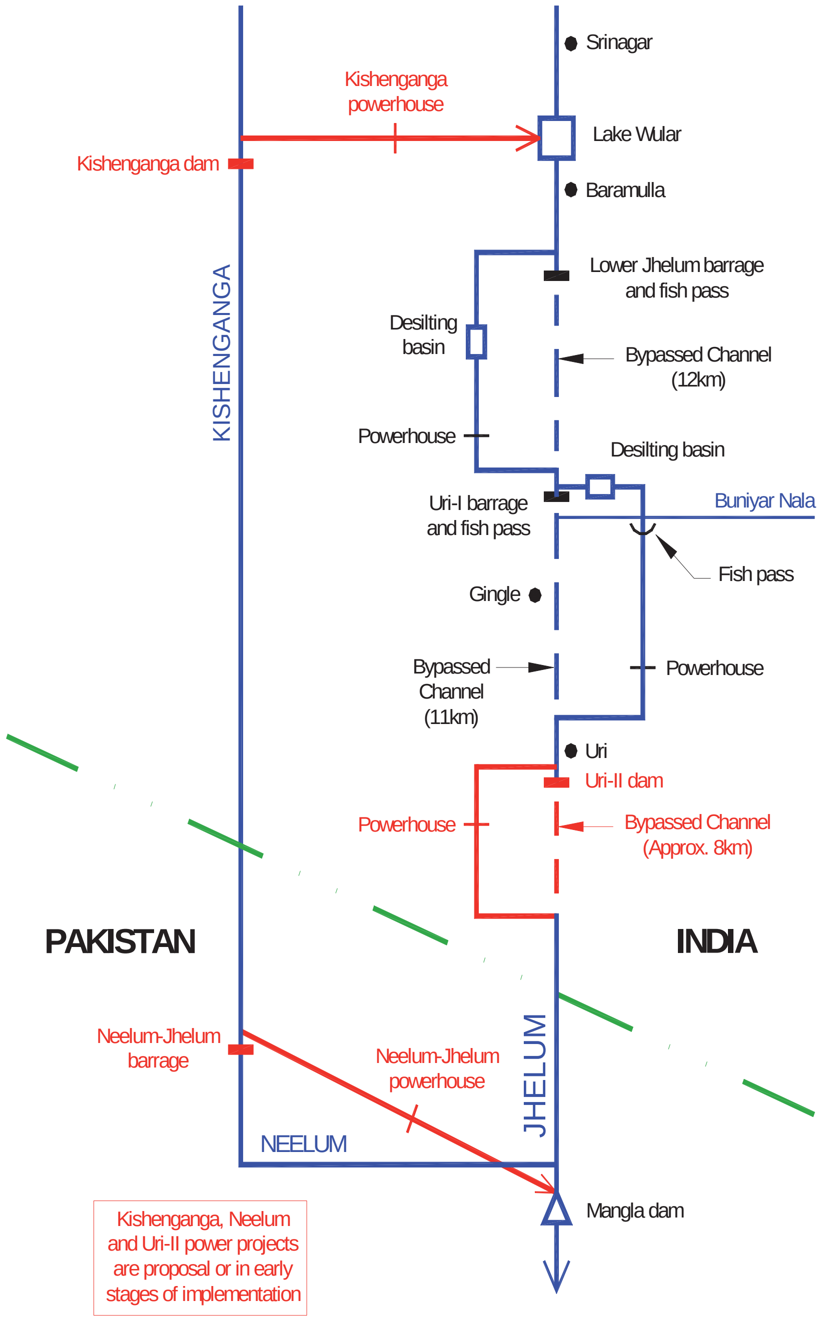


Figure 3.3: Proposed/On-going Hydropower Developments

In October 2005, eight years after project commissioning, water quality monitoring was reported to be carried out periodically by NHPC. Compensation water releases (fish pass and lure water discharges combined) are reported to be reduced in September or October each year and remain small until the following spring. During inspections on October 7th 2005, substantial flows were seen in the fish pass and lure water conduit but these were significantly reduced two days later. On 9th October 2005, almost all of the released water was being diverted to the left bank furrow (formerly supplying Mohra power station) located about 100 m downstream of the fish pass structure. When this water is not required for irrigation further along the furrow (which becomes a flume), it continues to be diverted below Uri barrage but is later discharged to Buniyar Nallah near the Mohra flume bridge crossing of Buniyar Nallah. Thus, on these occasions, almost no flow occurs in the stony bed of the Jhelum between the Uri barrage and Buniyar Nallah confluence. There are no known pollution sources in this reach. The diverted (fish pass and lure) water that is returned to Jhelum via Buniyar Nallah does therefore form a part of the flow which receives and dilutes Uranbau, Gingle and other small quantities of untreated effluents.

There are no known reports of adverse public health impacts with regard to water pollution in the bypassed Jhelum channel. No reports of fish kills in this bypassed reach have been received. Villagers along the valley sides use spring, well and nallah tributary sources for domestic purposes. Surveys to assess villagers' views on water quality in the Jhelum, especially in autumn and winter months, were perforce abandoned because of the earthquake tragedy on 8th October 2005.

3.11.4 Ecological Sustainability – Uri barrage fish pass

The principal ecological sustainability issue of the Uri hydropower project relates to fish migration, principally Schizothorax species (snow trout). For mitigation, a fish pass (fish ladder) has been incorporated in the barrage structure. The fish pass is of the pool type with orifices and notched overflows connecting the pools. It is sited in almost the centre of the barrage. Looking downstream, the fish pass is sandwiched between six spillway gates on its right bank side and three spillway gates and the power scheme intake on the left bank.

Research Results – fish tagging

Since commissioning of the project in 1997, manual observation and fish tagging surveys (1997,1998,1999), commissioned by NHPC and conducted by Professor Yousuf (University of Srinagar) have confirmed that fish enter and pass through the Uri fish pass in the principal meltwater and upstream spawning migration months of April, May and June. There is little information for other months.

In total, some 1,185 snow trout have been tagged and released in various sections of the river. 122 of these (10%) were re-captured by September 1999, as reported by fishermen who provided the tag numbers of caught fish (NHPC Research Project, 1999). Records of more recaptured fish, since September 1999, have become available from fishermen and the total number of recaptured fish is now 164, some 14% of tagged fish which were released (Yousuf, pers. com). Summary details are given in Table 3.17.

Information gained from recaptured tagged fish (of 1,185 tagged and released)	No. of fish
Recaptured without crossing any of the two barrages	63
Recaptured which had crossed Uri Barrage Fish Pass	33
Recaptured which had crossed Lower Jhelum Fish Pass	46
Recaptured which had crossed both Uri and Lower Jhelum Fish Passes	22
Total	164

Table 3.17: Fish Use of Fish Pass at Uri and Lower Jhelum Barrages

Use of the two fish passes is thus proven. However, a number a factors indicate the overall use of the Uri fish pass is at times, perhaps most of the time, poor in relation to the numbers of fish attempting to move upstream.

Observations of turbulent spillway flows having high velocities at and near to the entrance to the fish pass and simultaneous observations of numbers of fish in the fish pass (seen when flows into the pass are stopped for inspection) on 4th and 5th May and 6th and 7th June 1998 indicated very few fish could find their way into the fish pass (NHPC Research Project, 1999). The report does not indicate what flows were occurring in the fish pass and lure water conduit or through the spillway gates, nor does it state which of the nine spillway gates were open. However, from the 30-year record (Annex E) of average 10-day Jhelum flows occurring at these times (within which these early May and early June dates are embedded), the flows upstream of the Uri barrage are found to have been 883 and 583 m^3/s respectively.

Observations made in the high flow season in 1999, when flows were much lower, indicated much better conditions; many more fish were utilising the fish pass. The dates of observations were 1st and 11th May and 19th June 1999. Again the report does not indicate what flows were occurring. From the 30-year record of average 10-day Jhelum flows occurring at these times, the flows are found to have been 363, 364 and 99 m^3/s respectively. (In all cases, these 10-day flows are believed to be sufficiently indicative but not precise).

Checks have not been made on generation flows at these times of fish studies. If the assumption is made that the power station was working at maximum capacity for the flows available (up to a nominal rated flow of 226 m^3/s) and 6 m^3/s were being released through the fish pass and lure water, the spillway flows surrounding the fish pass entrance may be roughly assessed as given in Table 3.18.

Date of observations on fish in Uri fish pass	Period of 10-day flow	Total average 10-day Jhelum flow m^3/s	Indicative Spillway flow m^3/s	Summary of Observations made in Research Report (1999)
4th and 5th May 1998	I-May 98	883	651	Few fish in ladder
20th May 1998	II-May 98	652	420	No observations made of fish in the ladder. Many fish seen downstream of barrage. (39 caught in a single cast of a net). Fish seen jumping "but carried back by gushing water".
6th and 7th June 1998	I-Jun 98	583	351	Few fish in ladder
1st May 1999	I-May 99	363	131	Many fish in ladder. 103 caught, tagged and released in ladder. More than half fish in ladder remained untagged.
11th May 1999	II-May 99	364	132	Good number of fish in ladder
19th June 1999	II-June 99	99	0	Less fish in ladder than on 1st and 11th May 1999 but more than in May and June 1998.

Note: Estimated spillway flows assume 6 m^3/s discharges through fish pass and lure water conduit, and 226 m^3/s (or available balance) is diverted to headrace tunnel for generation.

Table 3.18: Observations of fish in Uri fish pass and Assessment of Flow Conditions

Professor Yousuf also reported his observations on the Denil fish pass at the Lower Jhelum barrage (Figure 3.3). To these we may add respective average 10-day Jhelum river flows but without estimation of Lower Jhelum fish pass and spillway flows (both undetermined for this report). Observations are given in Table 3.19.

Date of observations on fish in Lower Jhelum fish pass	Period of 10-day flow	Total average 10-day Jhelum flow m^3/s	Summary of Observations in Research Report
24th June 1998	III-Jun 98	387	22 fish caught in Lower Jhelum ladder
1st May 1999	I-May 99	363	53 fish caught in Lower Jhelum ladder. (N.B. On same day, 103 caught, tagged and released in Uri ladder. More than half fish in Uri ladder remained untagged, indicating more than 200 in Uri ladder).
11th May 1999	II-May 99	364	66 fish caught in Lower Jhelum ladder. (N.B. On same day, good number of fish in Uri ladder)

Table 3.19: Observations of Fish in Lower Jhelum Fish Pass

Noting the poor performance of the fish pass at Uri on occasions when inspected in 1998, and better use of it in 1999 when flows were lower, and the better use of the fish pass at Lower Jhelum where fish enter the ladder from a pool at the toe of the barrage, Professor Yousuf has concluded that it is not the differences in design of the fish passes themselves but the approach conditions at the entrance to the fishes passes, including hydraulic conditions at the toe of the barrage, which are relevant. Every fish pass design manual emphasises the importance of creating good approach conditions to fish passes. Although a fish pass itself may be excellent once fish have entered it, it can be useless or almost useless if most fish cannot find and enter it. Because the approach conditions at Uri barrage appear poor in high flows, Professor Yousuf has advocated creation of pool type conditions, similar to conditions observed at Lower Jhelum (NHPC Research Project, 1999).

From the above observations, and for illustrative purposes, we might tentatively conclude that Jhelum flows greater than 400 m^3/s (when spillway flows are typically about 180 m^3/s, after diversions of flows to the Uri headrace tunnel) do not provide conducive approach conditions to the Uri fish pass and that flows less than this are more favourable – though not as favourable as they might be with pool conditions at the toe of the barrage. Examination of the 270 10-day periods in April, May and June in the 30-year record (Annex E) indicates that 400 m^3/s is exceeded for three quarters of the time in these months (Table 3.20).

Condition	Number of 10-day periods in 30 years (1976 to 2005)				% of all 10-day periods
	April	May	June	April/May & June	April/May & June
10-day flows > 400 m^3/s (with inhibiting hydraulic conditions at Uri barrage fish pass entrance)	63	79	58	200	74
10-day flows < 400 m^3/s (with more conducive hydraulic conditions at Uri barrage fish pass entrance)	27	11	32	70	26
All 10-day periods	90	90	90	270	100

Table 3.20: Estimated Time in Main Migration Season when Approach Conditions should be Conducive to Fish Entry into Uri Fish Pass

The threshold flood flow adopted (400 m^3/s) is speculative. The data series from which the table is derived is of average 10-day flows for periods embracing the dates of Professor Yousuf's observations. Flows at the time of his observations might have varied considerably from the mean flow values given. Two further points may be noted.

i. the benefits of fish pass fish surveys and observations (as in the NHPC report, 1999) may be improved considerably if records of flows in the fish pass, lure water conduit and each and every spillway gate are made available to fish researchers.

ii. the 30-year 10-day river flow data base is available to consider other threshold values in the main migration months, and indeed for all months, as may be required.

Implications of fish mortalities

Apart from the important findings in the NHPC Research Project, other observations have a bearing on the efficiency of the Uri fish pass. When snowmelt and wet season flows recede to approximately 232 m^3/s each year (the power station design flow – nominally 226 m^3/s plus 6 m^3/s for the fish pass and lure water conduit), all spillway gates are then closed. This is normally in August or September. From this time until flows recover in the following spring, all river flow (except the release through the fish pass and lure water conduit) is directed to the left bank intake upstream of the barrage for power generation. When the spillway gates are closed on these occasions, NHPC staff working at the barrage report that many fish become stranded in the river channel immediately downstream of the barrage.

These fish are taken away for the table (beneficially) by local people or die. These occasions may occur more than once in this season because gates may be closed, opened and closed again according to variation in Jhelum flows.

These reported observations appear to suggest that some fish (many, but numbers unknown) have been attempting to move upstream in this season but entrance conditions to the fish pass have inhibited access. On these occasions, it must be concluded that is not the hydraulic approach conditions with high velocities at the toe of the barrage which inhibit fish movement through the fish pass but that these fish failed to find the fish pass entrance. There are no reported observations of fish numbers in the fish pass at these times.

Examination of NHPC's Uri barrage records of spillway gate operations would provide a precise assessment of the number of times each year that gates are fully closed. Without analyses of these records, examination of the 10-day flow records over 30 years (Table 3.21) provides some indication of the variability of flows in this "spillway gate closing" season which appears to confirm that gates may be closed, opened and closed on several occasions in some autumns.

Condition	**Number of 10-day periods in 30 years (1976 to 2005)**		
	August	**September**	**October**
Mean flow in month	332 m^3/s	236 m^3/s	133 m^3/s
10-day flows > 232 m^3/s (implying some spillway flows occurring and at least one spillway gate open)	55 (61%)	27 (30%)	8 (9%)
10-day flows < 232 m^3/s (implying all spillway gates closed)	35 (39%)	63 (70%)	81 (91%)
All months	90 (100%)	90 (100%)	89 (100%)

Note: Available record ceases in September 2005; hence 89 No. 10-day periods for October.

Table 3.21: Estimated Time in Autumn Months when Spillway Gates are Open and Closed

This single (or multiple) annual event of "spillway gate closing" appears to present an opportunity for research on stranded fish – species, numbers, lengths, weights and, importantly, determining whether fish are ripe with eggs, or not, for spawning at this time of year – which is not considered to be the main spawning season. If every occasion of stranded fish was thoroughly monitored for some years, the seriousness (or irrelevance) of these fish mortalities might be assessed. This might have possible implications for developing a programme for recovering and "trucking" stranded fish for release upstream of the Uri barrage (a mitigation measure employed at some dams) and for improving design of approach conditions of proposed new fish passes to be constructed at barrages elsewhere.

Development of pool conditions in the approach to Uri fish pass

As Uri-II project (involving a dam too high for a fish pass) is expected to be constructed downstream of Uri and will obstruct upstream fish migration, there will be another cumulative adverse impact on fish migration in Jhelum river and therefore at Uri. It therefore appears most unlikely that NHPC will now consider additional engineering works to improve approach conditions for the fish pass at Uri barrage, as advocated by Professor Yousuf. Also, the Uri site is now very complex. Some kind of weir across the river would be required to create a good pool approach condition. The weir itself might present an additional obstacle to fish movement (and itself require a short fish pass) and the left bank irrigation channel intake (formerly for the flume to the 7 MW Mohra power station) would need to be re-engineered. Then there is a sedimentation issue of the created pool; this arises because there are arrangements at and near the project intake on the left bank to pass bed load into this reach. The opportunity for creating optimum approach conditions at the toe of the fish pass and barrage structure (similar to Lower Jhelum) appears not to have been foreseen at the time of design and construction (or considered but found infeasible) and, realistically, it appears that creation of good approach conditions now cannot be expected to occur.

Management of Uri barrage spillway gates and fish counters

Whilst nothing can be done to change the instantaneous flood flows which require to pass through the gated spillways – flood flows must spill – it appears it would be helpful to investigate whether flows through certain spillway gates, and certain combinations of spillway gates, cause flow conditions at or near the fish pass entrance to be more hostile or more conducive to fish use of the fish pass. (For example, it may be assumed that a spillway flow in the order of 420 m^3/s may be released via several gates with different openings. Such a flow occurred on 20th May 1998 when many fish were seen jumping but "carried back by gushing water" downstream of the barrage and 39 were caught in a single cast of a net – Table 3.18). The only way to throw light on this is to monitor fish numbers moving through the fish pass during the migration season and then examine such fish count records in relation to operational records of the configuration of spillway gates operating and their discharges.

This investigation might lead to NHPC managing use of spillway gates at the Uri barrage in sequences which improve hydraulic conditions for migrating fish at the fish pass entrance at the toe of the barrage. There would be expected to be times when spillway flow conditions are hostile to fish migration, regardless of which combination of gates are used to pass flood flows. At these times, nothing can be done. At other times, informed management of the gates may transform use of the fish pass from one of little or no use in certain flow conditions to a situation where fish move upstream in modest or high numbers.

This requires investigating the feasibility of installing fish counters in the Uri fish pass. If fish counters can now successfully count upstream moving fish in Uri fish pass' particular geometry and hydraulic conditions (fishes having lengths typically between 7 and 35 cm) and enter the counts into a data logger with an instantaneous/event triggered time base, we should expect to learn more about fish migration itself and about engineering solutions to mitigating adverse approach conditions. The following information might become available:

- Is there a preferred time of day when fish move? (One local observer reported most movements at sunrise).
- Is there a preferred flow rate in the fish pass (N.B. 1 m^3/s is understood to be the design maximum) which facilitates movement?
- Is there a preferred "lure" flow rate, in the other component of the fish pass, which attracts fish movement? (N.B. 5 m^3/s is understood to be the design maximum).
- Which are the spillway gate combinations, and what are their opening positions (with flow rates), which a) encourage and b) inhibit fish movement in the fish pass?

If fish counting is feasible in Uri fish pass conditions, and carried out for a number of years with full information on flow rates (fish pass, lure water, spillway gates, power intake), it may be possible to make the best of the situation at Uri and operate combinations of gates which give more optimal approach conditions for migration through the fish pass. This research might improve management of spillway gate combinations to the benefit of fish migration, without any loss in power generation.

Enquiries about fish counters made for this study (Annex B) revealed that many are in use in Sweden, Iceland, Scotland and elsewhere and some appear to be very capable of counting fish where fish lengths exceed 24 cm. The fish length range of Schizorathax species in Uri tagging investigations is in the order of 7 to 35 cm (NHPC, 1999), suggesting that the larger snow trout (24–35 cm +) might be counted.

Even if Uri-II is constructed in due course and then adversely affects migration, benefits may still be expected from this research. On the one hand, Uri barrage spillway gates might be managed in better sympathy with fish migration. On the other hand, this research may assist future fish pass approach designs in Kashmir and in other Himalayan regions, within and outside of India.

Thus a recommendation for Sida to consider supporting this investigation, as a follow up to excellent work done by the Swedish Institute of Freshwater Research, by making arrangements to consider the feasibility of installing one or more fish counters at Uri, Lower Jhelum and Buniyar Nallah fish passes, as a first step, is carried forward.

Prevention of poaching at fish passes

Poaching of fish in fish passes is a common problem in many countries. Poachers merely have to stop the inflow for a short time and remove the fish. On the Jhelum river, Fisheries Department continue to express their concern that poaching takes place at Lower Jhelum and Uri fish passes for sale in Srinagar market (at INR 80/kg). Poachers have been apprehended and given the choice of paying a fine or going before a magistrate; they choose to pay the fine. Recommendations made to cover the fish passes with metal grids (as now seen at the new Buniyar Nallah fish pass) have not been implemented. It has been argued by barrage owners that security is tight at both barrages and expenditure on covers is not required. The impasse remains.

Fish mortalities in Uri power system waterways and turbines

Yousuf (NHPC, 1999) postulated that fish moving downstream at Uri barrage would be entrained in the canal and power tunnel system and that significant fish mortality could therefore be expected to occur. There appears to be no hard evidence for or against this in practice. It appears that no serious investigation has been made. We had hoped to receive local fishermen's observations on this and to learn if dead fish, pieces of fish or fish-eating animals occurred in the Jhelum below the tailrace portal. Our attempt to discuss this in a meeting with expert local fishermen at Uri town, arranged for us by the Uri District Magistrate, was thwarted by the earthquake on 8th October 2005. We are not therefore able to contribute any new information on this.

Fish Hatchery

The IFR report (Nyman, 1999) and Yousuf (NHPC, 1999) recommended that a fish hatchery for Schizothorax species be developed as a mitigation measure for the Uri project. It was therefore considered that the construction of fish passes, though potentially helpful, would not mitigate effectively and compensate for the barriers to fish movements and the loss of flows in two long reaches of bypassed channels (a 12 km reach below Lower Jhelum and 11 km below Uri). A hatchery has not been constructed.

However, it is understood that a fish hatchery has been proposed in a recent EIA study of the Uri-II dam and hydropower project as a mitigation measure for the dam where the dam is too high to provide a fish pass.

We have not traced reports on fish catch surveys in Jhelum river which compare catches before and after construction of Lower Jhelum barrage and/or Uri barrage. However, Fisheries Department at Baramulla indicated that catches have declined markedly. Before the construction of Lower Jhelum, catches of 15 kg per day were normal, and catches have now reduced to 1, 2 or 3 kg/day. It is not known whether these values are based on proper surveys and refer to catches per unit effort (CPUE), often expressed as kg/net/day. The implication of this limited statement is that the fishery has declined by a factor of between 5 and 15. It may be noted that this apparent decline is with fish passes in place at both structures.

Closed season for fishing

Recommendations have been made for prohibiting fishing in tributary nallahs during the snow trout spawning season in order to increase survival of spawners and provide a greater abundance of fish in the open season (Nyman, 1999). Such recommendations have not been implemented in J&K.

3.11.5 Ecological Sustainability – Uri barrage compensation water

The Uri barrage compensation flow issue appears to have been unresolved before and long into the project construction period. No compensation water rate of flow has been officially declared. Some of the normal reasons for requiring compensation flow are to meet abstraction demands, riparian demands and to dilute effluent discharges in downstream reaches. These have been mentioned in Section 3.11.3. In situ ecological reasons for requiring compensation flows relate to maintaining aquatic biodiversity. The Institute of Freshwater Research (IFR) gave a lot of detailed attention to benthic fauna and fish in the 1990s (Lennart, 1999). In its mid term report dated September 1995, IFR recommended all year round minimum compensation flow releases of between 5 and 10 m^3/s to cover all requirements. This therefore included substantial releases in the dry season.

At a general level, some maintain that the minimum flow release into the 11 km long bypassed channel should not be less than the minimum recorded flow in the record (36 m^3/s, in 1956). It was reported before construction took place that constant release of this flow rate would make the project unviable (Sida, 1989).

According to the 10-day flow record (Annex E), flows have been less than 36 m^3/s on two more occasions, in February 2001 and January 2003. (Another occasion appears in the record – December 1995 – but this appears dubious and has not been double-checked).

As noted in Section 2.7.2, the final edition of the Uri project operating manual gives the fishladder flow rates as follows. "The two fishladder gates shall be kept open during the migrating periods. The discharge will be about 5 m^3/s in lure water part and about 1 m^3/s in the fishladder proper with the gates fully open. The flows may be decreased if found favourable for the fish migrating". According to this, no compensation flow is stipulated; only advisory flows in relation to the fish pass are given.

Observations in October 2005, during this assignment, indicated that fish pass and lure water discharges were much less than 6 m^3/s and, in the absence of any spillway flows, these were inadequate to assist fish migration, if indeed fish attempt to migrate in October. This is because the combined fish pass and lure water flows spread out across the wide concrete apron at the base of the barrage and flow as a thin film of water over a one metre vertical drop off the apron. There is no way fish can ascend this one metre high vertical step in this film of water. This discharge then spreads our across the boulder bed. Some 100 m downstream, most of this flow feeds the irrigation furrow intake on the left bank and the rest falls over two more barriers to fish movement (i.e. barriers at very low flows) – the first is a low concrete weir, the second a natural fall over rocks located downstream and within a metre or so of the weir. The flows being released on 9th October 2005 had no practical value for fish. On the other hand, the Buniyar Nallah was discharging a substantial flow and creating a minor river within the stony Jhelum riverbed through the bypassed channel. Flow records of Buniyar Nallah have not been seen during the current assignment; if they exist, they are likely to indicate that October flows normally reduce significantly through the dry season in autumn to a trickle in winter months.

Thus, when spillway flows do not occur, the bypassed Jhelum channel only receives natural flows from local tributaries and springs and whatever flow is released from the Uri barrage fish pass and lure water conduit. During this time, the wide and stony Jhelum riverbed is exposed with the reduced stream flow appearing as a small watercourse within the main riverbed. This small watercourse reduces in size to a trickle as tributary discharges recede in the dry season. No records of tributary or Jhelum flows are available for this reach. In these circumstances of reduced wetted perimeter and flow, biological productivity is severely reduced compared to its potential under normal circumstances.

It should be pointed out that a similar position exists in the 12 km bypassed channel downstream of Lower Jhelum barrage to the point at which the Lower Jhelum power station tailrace returns water to the river, about 1 km upstream of Uri barrage. Thus, biological productivity is severely reduced in

23 km of the 24 km reach of the Jhelum river in autumn and winter months. In many other months, when some spillway flows are occurring, productivity is reduced.

There is no apparent evidence of any water abstractions taking place in the reach of the Uri bypassed channel, apart from the irrigation supply to Rampur; if there are any, there is no apparent evidence of them failing to obtain sufficient water. Nor is there any apparent evidence of dead fish or persons becoming sick as a result of the discharge of foul effluents from septic tanks at NHPC colonies at Uranbau and Gingle. However, because of sensitivities of local persons and relief duties related to the severe earthquake on October 8th, our programme of inspections and interviewing of villagers was necessarily curtailed and a thorough survey and assessment was not possible.

As inferred in the earlier discussion on water quality, NHPC took over the full responsibility for water quality monitoring during the project construction period once suitable equipment was procured in 1996. In April 1996, the Monitoring Team noted that NHPC's response to IFR's mid-term recommendation for a guaranteed minimum flow was that only the first kilometre below Uri barrage needed a certain minimum flow to maintain aquatic biodiversity and "this matter will be taken care of". Subsequently, environmental monitoring of the Jhelum has been conducted by NHPC and water quality has been declared satisfactory. In a NHPC summary of post-construction environmental impact assessment, the statement is made that there is "no impact on water quality of the river and as such no adverse impact on fish species and bottom fauna" (Bhatt and Khan, 2003). No statement is made about reduced flows and wetted perimeters and their impacts on fish and bottom fauna, implying that reductions in biological productivity, including benthic fauna, are acceptable to NHPC.

Thus, without any formal prescription of a minimum acceptable downstream flow release, the Uri project is somewhat unusual for a recently constructed project. Consultations with wetland specialists at WWF-India, currently becoming more involved with studying "environmental flows" in India, suggests that a body of opinion is developing which will challenge developers more rigorously on this issue in future, particularly as the World Commission on Dams report in 2000 and recent Indian EIA regulations present greater opportunities for consultations than were present in the 1990s.

3.11.6 Ecological Sustainability – Buniyar Nallah fish pass

Whereas the possible need for a fish pass at the Uri barrage was foreseen as a mitigation measure when Environmental Clearance was given to the project in 1980, the need for a similar measure on the Buniyar Nallah was unforeseen. This is because the original project design proposed a siphon crossing under the Buniyar Nallah which would not have interfered with the Buniyar Nallah channel. (This siphon in included in the physical model currently displayed in the Uri powerhouse). During project construction, various features in the original design were changed. The environmental implications of the change in design appear to have only become apparent when the construction of the culvert crossing of Buniyar Nallah (in place of a siphon) was completed. This is revealed in a photograph during construction (Monitoring Report No. 9, dated April 1994) and in another photograph showing the river running over the culvert where the culvert creates a barrier to upstream fish movements (Monitoring Report No. 13, dated April 1996).

POE and Monitoring Reports made no mention of the change in design from the siphon concept originally adopted by NHPC and present no reasons given by the contractor or NHPC for the change. POE and Monitoring Reports only mention the new barrier to upstream fish movement when construction of the culvert was completed and the obstacle created for upstream fish movement in Buniyar Nallah became visible. From an environmental point of view, this appears to be an illustration of a casualty which can occur when projects, particularly turnkey projects, are implemented within tight time-frames, and implemented under difficult security circumstances which are not conducive to taking on board environmental concerns.

The twice yearly POE and Monitoring Reports relate the various considerations of the POE, NHPC and SWECO given to the design of mitigation measures. In the event, no mitigation was carried out for ten years. A fish pass was finally constructed by NHPC during the second half of 2004. The fish pass is a form of the pool and traverse type with notches, sited on the left bank. It has a trash and boulder protection rack at the upstream end and is covered throughout its length by wire mesh. The structure appears robust. Being sited in a reach of high velocities and on the outer bend of the river, the concrete structure appears nevertheless vulnerable to flood and debris damage, particularly rocks and trees. However, it has survived its first flood season (2005) unscathed which is a credit to NHPC's design and construction.

Staff of Fisheries Department at Baramulla visited the new fish pass for the first time in October 2005. They are concerned that there is no known management plan for its protection (against poaching) and maintenance (removal of gravel, trash, repairs) so far as the Fisheries Department is concerned. Awareness of Fisheries Department's concerns is now known to NHPC at Gingle.

Buniyar Nallah's integrity as a natural riverine wetland was impaired for ten years by the artificial barrier to fish movement. With the recent construction of the fish pass, the integrity of the nallah may in part be restored. The true effectiveness of the fish pass, as with others, may never be known. Aquatic survey work in future, building on baseline data provided by IFR (Nyman, 1999), and the possibility of counting fish through the pass, may contribute to an assessment of the fish pass' value. However, given the fish pass now exists, conditions appear to have been met for the river and its catchment area to be designated an aquatic diversity management area (ADMA). This concept has been suggested for water bodies including the surrounding countryside where maintenance of local aquatic biodiversity is the top priority. This concept was advocated ten years ago and found support of government of J&K and environmental NGOs such as WWF-India (Nyman, 1999). The Uri POE rejected any participation of the Uri project in promoting this, stating it was beyond the terms of reference of the project and for others to consider.

With the integrity of the watercourse now partially restored by construction of the fish pass, it appears timely to pursue the aquatic diversity management area designation again. This is something Sida may wish to consider in partnership with WWF-India and the Ministry of Environment and Forests.

3.12 Social and Cultural Impacts of the Uri Project

3.12.1 Socio-Economic Impact

The Rehabilitation Plan produced in 1992 was designed only for the needs of families who were directly affected by the project; those indirectly affected did not receive compensation.

In undertaking our review we have classified the project affected families/persons in the following categories:

1. Those who lost their houses only,
2. Those who lost their house and land,
3. Those who lost their land only, further categorised as:
   a) Those who lost the majority of their land
   b) Those who lost part of the land but retained the majority of it.
4. Those who lost their employment because they were working as employed labourers on land which was acquired for the project.

In the first case, the people received compensation for their houses and often have constructed new good quality houses on land purchased in the same village or in a nearby village. In most of the cases the house was previously in the grandfather's name and the family was living as a joint families with relatives; now they have tended to change to single family (nuclear family) occupation.

In the second case, where they lost their houses and land, people preferred to move to nearby villages where land was available. In discussion with such people it appears that they paid higher prices for the land they purchased, compared with the compensation they received for the loss of land.

In the third case where people lost their majority of their land and were marginal farmers, they were often left without employment. As a result of the inheritance traditions in the region, land was often owned jointly by siblings of the family, although it might only be farmed and supporting one of the siblings. In such cases the compensation payment was divided among the brothers and married sisters, who were not staying with the family but had property rights on the forefather's lands. Whatever share remained was insufficient to purchase replacement land. A further limitation was lack of land suitable for agriculture remaining in the project area. In such cases the compensation money was used either for construction of a pacca house (pacca houses are strong and durable structures), or for one-off expenditure such as family functions and weddings. The lack of investment for sustainable income appears to have been conditioned by the expectation that NHPC would provide future long-term employment opportunities on the Uri project. This has not always been possible in view of the relatively small numbers now employed on the project.

Prior to the project the agricultural land provided fodder for cattle; the number of cattle owned by the family was dependant on the size of the land and the availability of fodder. Since the loss of the land fodder is no longer available and must be purchased. Since most families cannot afford to purchase fodder they either have a reduced number of cattle or none at all. Hence milk which was previously available for children is less accessible for such families.

Where only a minor portion of a family's land was lost the compensation payment was often regarded as a bonus, and the people were not as badly affected. The money was invested in various businesses such as transportation (mini-buses, jeeps) or in shops. Some of these have proved viable, including some transportation services provided under contract to NHPC.

The fourth case, where employment was lost due to an employer's land being acquired, was not considered or compensated under the Rehabilitation Plan.

3.12.2 Employment

During the peak period of construction activity on the project some 4700 Indian nationals were employed on the project, and in total URICO estimate that around 9000 people were trained and employed during the seven-year construction period.

The number of people employed at different periods of construction was as follows:

Period	Number of Indian Workers Employed at Uri Project
Nov 1989 to Dec 1993	0 to 2500
Jan 1993 to Sep 95	2500 to 4700
Oct 95 to Oct 96	1000 to 2500
Nov 96 to March 97	500 to 1000
April 97 to Oct 97 and onwards	less than 500

Table 3.22: Indian Workers Employed at Uri Project

On commencement of employment all staff were provided with appropriate training, and staff also received training on the job through technology transfer. This enabled labourers to progress to more skilled employment. On termination of employment all URICO staff received a certificate of competence, which has enabled some of them to find work elsewhere, such as in the Middle East. Skanska, which is currently building Delhi Metro, has recruited some of its former employees from the Uri project to work in Delhi.

The employment given by URICO has improved the knowledge and skill levels of local people as well as their economic status during the construction period.

At present 216 people are employed on a permanent basis at the Uri Project by NHPC, and around 200 through contractors.

Some of the PAPs are claiming that they should be employed by "the government" as they claim they were told that they would be given employment as part of the compensation for their land. This could be due to confusion of the promise for employment with the contractor during construction (URICO undertook to employ at least one person from each project affected family) with a promise of long-term employment.

3.12.3 Gender issues

The tradition of the area with its Islamic culture is that the women are not allowed to work as labourers, other than on their own agricultural land. Families who lost the majority of their land were often left with unemployed females, who had previously been working on their own farms, but who could not, by tradition, be employed to work for others. This has indirectly affected the economic status of these families.

No specific efforts appear to have been taken in the rehabilitation process to provide employment opportunities specifically for women.

NHPC has made efforts to employ local women, for example for the post of Staff Nurse. More then 100 candidates applied for the posts out of which four were finally selected. One of the reasons for the response was the presence of a Nursing College in the project area.

There are very few opportunities for employment of women in the project area. Women are prepared to work in Centres where craft and commercial activities such as stitching, embroidery and knitting are carried out. However by tradition women are less likely to seek employment outside the confines of such Centres.

3.12.4 Health Impact

Some primary medical facilities provided by the J&K government were already available in the area prior to the project, and these have been further enhanced. In addition Army medical facilities are also available. Some additional facilities were provided for the project employees, and a medical centre run by NHPC in Gingle is available for local residents. The improvement in road conditions in the project area, including construction of the "parallel road" on the north side of the Jhelum River, has improved access and reduced travel time to the health facilities.

There has been little study of the health benefits of the project, although there is no evidence of adverse impacts on health resulting from the project. It seems likely that the boost to the local economy provided by the project, together with the improvement in medical facilities and access has resulted in some benefits.

The major transportation exercise bringing construction materials to site, which required a truck-load of material every half hour, seems likely to have resulted in exposure of local women to sexually transmitted diseases and HIV/AIDS from drivers and other migrant workers. URICO have suggested that the Islamic culture, together with the strict security imposed by the Army in the region, made this less of a problem than on other comparable construction sites. However there is no evidence of any awareness campaign or of preventative measures, and no study or data appears to be available on this issue.

3.12.5 Educational Facilities

A primary school was started in Gantamulla colony (the main accommodation centre for project workers) for the children of the project workers and was also open for the villagers.

Another school was also started in the Gingle colony especially for the children of NHPC employees and Central Government staff. This school is also open to children from the local villages, although the uptake has not been good. One reason is apparently that the school fees have been set in accordance with central government norms, which are higher than those of the local primary school. Secondly people prefer their children to read and write Urdu, which is not taught as a language in the Gingle colony school. Some local children attend the Gingle colony school up to 4th Standard and are then sent for further education to other local schools.

3.12.6 Cultural Impacts

As part of the compensation package, an alternate resettlement site was offered at a nearby village called Sheeri. However land was only available for construction of houses, and agricultural/pastureland was not offered. Many families declined this offer, partly because they wanted to remain in their existing communities close to their relatives, and partly due to the lack of agriculture/ pastureland.

A mosque at Buniyar was affected by the acquisition of land for the Uri Project. Compensation for this mosque was paid to the Mosque Committee, and the funds were used for the renovation of the existing village mosque. A new mosque was also constructed in Kanchan village.

3.12.7 Infrastructure Development

The "parallel road" to highway NH1A which was constructed on the north side of the Jhelum River for the purposes of construction has helped access to several villages. Prior to the project there was only a kaccha narrow road (poor quality unpaved), trafficable only by cycles or two wheelers. For local villagers this road presented problems for access, especially when transport to clinics or hospitals was required. Now the "parallel road" provides access for most vehicles, and there is a bus service and local jeeps for transportation.

Access to power has improved. Although we have no records from before the project, full access to power is now available in the villages where the PAPs live.

The water supply scheme constructed for Gingle colony has also included provision of stand posts for the Gingle villagers. Another scheme has been executed by Public Health Engineering Department of Baramulla to provide water for Buniyar village.

3.13 Unforeseen Impacts and Effects of the Project

Apart from the 18 month delay in the early stages of construction, the Uri Project was completed essentially as planned, with few surprises or unforeseen events. The few minor unforeseen impacts are described below.

3.13.1 Technical Aspects

The 400 kV transmission line from Uri to Wagoora and the 220 kV line from Wagoora to Pampore, together with the associated switchyard extensions were due to have been constructed by NHPC. However as part of the restructuring of the Indian electricity sector the transmission assets of NHPC were transferred to the newly formed PCGIL in 1991, as were new transmission construction projects. This transfer with its potential for confusion and delay could have resulted in completion of the project without a transmission link to evacuate the power. However the potential for this problem was identified in time, in particular by the Monitoring Team, and steps were taken to ensure that the line was completed in time for commissioning of the Uri Project.

3.13.2 Financial and Economic Impacts

The exceptional devaluation which took place during the course of construction had the impact of increasing the INR price of the project, even though the foreign exchange cost of the projects was largely fixed, and remained under control. In addition the high level of inflation contributed to the INR cost of the project doubling from the initial INR cost estimate. As a consequence the INR cost of the project appeared high relative to projects completed prior to the devaluation. This has resulted in a higher than expected electricity tariff expressed in INR. However the tariff is comparable to that of other recently constructed projects, and the specific cost of USD1500 per kW installed is comparable with the cost of new project (eg Uri-II at USD 1600 per kW at current exchange rates).

3.13.3 Funding Impacts

The delay during the early stages of construction resulted in the accrual in the Charge Account of funds from the project financiers; for a period until the funding schedule was adjusted to match the delayed payments to URICO, there was a significant positive balance in this Charge Account.
This resulted in substantial interest accrual, making additional funds available for the project. It was agreed by the financiers that this accrued interest could be used for the upgrading of highway NH1A.

The concessionary Swedish funding for the Uri Project comprised part grant and part zero interest rate loan. The loan had a 16-year term with repayment starting after eight years. It is understood that following the 18-month delay in completing the project the repayments were deferred by two years. However the Indian Government has elected to repay the loan almost in accordance with the original schedule (repayment completed by late 2005). As the drawdown was slightly behind schedule, this pre-payment has slightly reduced the subsidy to the zero interest rate loan, and hence the overall concessionality level of the Swedish funding package.

3.13.4 Environmental Impacts

As discussed in Section 3.11.6, the deletion of the siphon in the headrace at Buniyar Nallah has provided an impediment to fish movement. As recommended in the environmental studies a fish ladder has now been installed.

The construction of the dam for the Uri-II project downstream of the tailrace of the Uri-I will result in a barrier to fish movement, since the dam is too high for provision of a fish ladder. It is understood that this issue is addressed in the EIA for Uri-II by recommending construction of a fish hatchery.

3.13.5 Socio-economic Impacts

The rapid deterioration of the security situation in 1989 resulted in a virtual cessation of tourism revenue in the project area. Although some local income has resulted from the presence of the Army, in the absence of the Uri Project there would have been very little external income in the project area. Hence the income from the construction workers and the local subcontracts, such as for transport, have had a much more substantial impact than would otherwise have been the case.

It is also likely that the difficulties caused by the security situation have impeded the development of local businesses using the funds received as compensation payments for acquired land and the income received by the project workers.

3.14 Evaluation of Uri under Current Environmental Guidelines

The performance of the project under current environmental guidelines, including those of World Commission on Dams, is presented under lessons learned in Section 4.4.2.

3.15 Evaluation in Terms of Current Sida Poverty Alleviation Objectives

The current development cooperation programme between Sweden and India focuses on:

- Democracy and human rights (including empowerment of women);
- Environment;
- Scientific cooperation.

It seems unlikely that major project finance would be considered under this policy, although the programme has reverted from budgetary support to funded programmes over which Sida has more control.

Aspects of the Uri Project could be construed as falling under the second and third of the above focus areas:

- The development of renewable hydropower resources in Kashmir, and the displacement of thermal generation is a significant environmental benefit;
- The work on the fisheries in the project area has undoubtedly contributed to the knowledge and understanding of the aquatic environment of the Jhelum River, and the understanding gained is applicable to other Himalayan rivers;
- The transfer of technology through the project training programme and through the contractor's staff training has contributed to scientific cooperation, and to poverty alleviation.

However overall the funding of the Uri Project could not form part of the Sweden-India Cooperation Programme in its current form.

3.16 Efficiency and Effectiveness of the Swedish Support for the Project

The Swedish support for the Uri Project is one of the largest ever Swedish bilateral funding interventions. The total funding drawdown including the export credit component (at 2000 exchange rates) was SEK 3,758 million, of which the grant element was SEK 1,278 million. However this grant element represents only some 1.7% of the total Swedish international aid programme during the eight years of construction. Hence the Uri Project did not dominate Swedish aid expenditure during that period to the exclusion of other projects.

3.16.1 Cost effectiveness of construction contract

The cost effectiveness of the construction contract can be judged in two ways:

- By economic analysis (usually compared with least cost thermal alternative)
- By specific cost (cost per kW installed)

Neither of these methods is definitive, since much depends on the nature of the site, the characteristics of the scheme, the selected installed capacity and the cost of alternative thermal fuels.

In the case of Uri both types of assessment were carried out before the commitment of Swedish funds. The economic assessment compared the cost of the Uri Project at the URICO bid price with the cost of generation from an alternative coal-fired powerstation. The Uri Project demonstrated a 13.6% economic internal rate of return (or equalising discount rate), and a benefit-cost ratio of 1.27 at 10% discount rate.

The project costs was also compared with the estimated cost of other hydroelectric schemes in the Northern Region of India. By comparison with the three comparable schemes then under construction

(Chamera – 540 MW, Tanakpur – 120 MW and Dulhasti – 390 MW), it was on average 12.4% more expensive. Similarly by comparison with the Salal-I project completed in 1987 it was 9% more expensive. However it is noted that the INR 15,519 (de-escalated to give a 1989 specific cost of USD1744 per kW installed) construction cost for Uri used in this evaluation included a number of NHPC non-project costs, and it is not clear that the other project costs were on the same basis. Also most of the other plants have a much lower design load factor than that for the Uri Project (73.2% average–63.3% firm), and hence would tend to have lower specific costs. It is also observed that the Uri Project includes some provisions for the future Stage 2, which would tend to inflate the cost.

Our own assessment of the 1989 price of the Uri Project without transmission lines, land acquisition and NHPC costs indicates a specific cost of USD 1500 per kW installed. We have not deducted the Stage 2 provisions, which might represent some 5% of the total cost. This compares with a typical international range for this type of project of USD 1000 to USD 1500. A few larger projects are constructed for less than USD 1000 per kW, and some smaller, or more complex project cost more than USD 2000 per kW, especially if optimised against expensive (e.g. oil-fired) thermal generation. The Uri project has a number of features which would tend to place it at the top end of the USD 1000–1500 range: the location is extremely remote, with exceptional transportation distances; lack of skilled labour force locally; provision of works for Stage 2 incorporated; EPC contract with many risks carried by the contractor; and high load factor. Although the scheme does not include a substantial dam, it has extensive headworks including those associated with the de-silting basins. In conclusion we consider the specific cost to be reasonable for a project of this nature, and that the construction contract was reasonably cost-effective.

3.16.2 Effectiveness of Swedish support

The Swedish support for the project, including the export credit component covered 67.8% of the original contract cost. If the commercial NIB loan is added, this took the support up to 76.4% of the original cost. The British mixed credit package covered nearly 10% of the project cost, leaving less than 14% of the cost to be covered by the Indian Government and NHPC. The funding package at the time of contract award was commensurate with the tied conditions of the funding, which required most of the project components to be procured from Europe. It was also appropriate for the economic conditions in India at the time, where the government was struggling to provide funds for development of the power sector, and for the financial status and creditworthiness of NHPC.

The effectiveness of the Swedish support was compromised to some extent by the adverse exchange rate movement, and the high level of domestic inflation in India. The additional costs arising due to inflation, and due as a consequence of the 18-month extension of the construction period, were carried by NHPC. NHPC estimates that the total project cost including land, transmission and other NHPC costs at March 2000 (refer NHPC Completion Report) is INR 33,881 million. Our calculation of the foreign funding at March 2000 exchange rates is INR 23,537 million. Hence NHPC and the Indian Government had to carry INR 10, 344 million, or 30% of the project cost. This analysis is too simplistic, as the exchange rates were varying during loan drawdown and repayment, but indicate that the NHPC and the Indian Government also made a very substantial contribution to the project funding.

The denomination of much of the project costs and loans in foreign exchange resulted in NHPC being heavily exposed to exchange rate movement.

However it is quite clear that the project would not have gone ahead without the Swedish support, and hence the support was adequate to ensure the project could be constructed.

3.16.3 Completeness of intervention

The intervention was restricted to that part of the project which was within the URICO contract. Hence it did not cover associated components of the project such as the transmission lines, and also did not include any component to reinforce the J&K State Grid.

The delay in constructing the 400 kV transmission lines (refer Section 2.5.2) nearly resulted in a delay to commissioning of the Uri Project. It is worth considering whether the transmission line should also have been included in the scope of the URICO contract and the foreign funding package. This would have improved the chances of the transmission line being completed on time.

The project and the support package did not include any component to improve the quality of the local distribution system. We consider that support to the J&K electricity agencies to improve their distribution infrastructure would have increased the electricity access benefits to the population in the Kashmir Valley. However since the project was constructed for NHPC, a Central Government Agency, and distribution is the responsibility of the State Government, the incorporation of local distribution in the Uri Project would not have been practical.

3.16.4 Issues concerning tied aid with 100% foreign supply

During our meetings with the operators of the Uri Project and the associated transmission lines, frequent comments were made about the difficulty in procuring replacement parts and obtaining service support for the foreign supplied scheme components. It appears that some of these problems are due to restrictions in obtaining foreign currency in India, and other problems are due to the remote location of the project and the adverse security situation, which have discouraged visits.

However it appears that in a few cases the tied nature of the intervention may have prevented equipment being supplied which would have been compatible with other equipment used on the power system in India, and which might have allowed easier support and procurement from domestic suppliers.

4 Lessons Learned

The following lessons have been learned from the Swedish support and implementation of the Uri Project:

4.1 Lessons Learned about Project Support and Funding

4.1.1 Evaluation of Security Situation

It is observed that the security situation in Kashmir deteriorated very soon after the decision to provide Swedish Support for the project had been taken. Although easy with hindsight, it must be questioned whether adequate consideration had been given to the potential for security problems in the project area. This is an issue which could receive better consideration before future interventions in areas where security problems might rise.

4.1.2 Impacts of Devaluation

The INR cost of the project was affected dramatically by devaluation of the Rupee against international currencies. The cost of the project was effectively fixed on foreign currency terms, and hence devaluation increased the INR cost by almost 100%. Since the owner's revenues are denominated in INR, this could have had detrimental consequences for NHPC. Fortunately for NHPC the tariff fixed by CERC takes into account the actual INR cost of the project, and hence the revenue is increased to match the INR cost increase. In other tariff environments this devaluation could have resulted in the owner not being able to service the foreign loans. On future projects consideration should be given to mechanisms which would protect borrowers against exchange rate movements.

4.1.3 Power Evacuation

The 400 kV transmission line from Uri to Wagoora together with the shorter length of 220 kV line on to Pampore and the works at the substations did not form part of the URICO contract. The delays to construction of this line, which was the responsibility of NHPC and subsequently PGCIL, nearly caused a delay in commissioning the Uri Project. It would perhaps have been better if the power evacuation line had been included within the scope of the URICO contract in order to ensure timely completion.

The interconnection with the Northern Grid did not occur as originally planned. The 400 kV line from Wagoora to Kishenpur, which was to be constructed as a Russian project, was not carried out (it is now under construction by PGCIL). The 220 kV Pampore-Kishenpur line has provided a link to the Northern Grid, albeit one with limited capacity and susceptible to disruption. Better investigation of this aspect could have been carried out prior to the decision to support the project. However it should be noted that this aspect has only caused minor interference with the ability of the Uri Project to supply the Northern Grid, and that the new 400 kV line to be completed in 2006 will alleviate this problem.

4.1.4 Assessment of Land Ownership and Access Issues

Delays to the start of construction were caused by the inability of NHPC and the State Government to acquire the land. Better investigation of this issue prior to Contract Award might have avoided the disruption and increased cost associated with this delay.

4.1.5 Funding of Local Electrical Infrastructure

One of the objectives of the Uri Project was to improve local electricity supplies. The quality of supply has been substantially improved as a result of the Uri Project. However for greater improvement of the electricity supply in the Kashmir Valley support would have to be provided additionally to the State electricity agencies.

4.2 Lessons Learned about Project Execution

4.2.1 Use of a Monitoring Team and Panel of Experts

The use by the financiers of a Monitoring Team and the appointment of the Panel of Experts to assist NHPC provided an excellent means of monitoring all aspects of the project. Incipient problems,such as the delays to the 400 kV transmission line, were identified early enough to allow remedial action to be taken. This model is regarded as an excellent example to follow.

4.2.2 Support from Sida and the Swedish Embassy

The pro-active approach by Sida and the Swedish Embassy undoubtedly contributed to the success of the project. In addition to helping when security problems occurred, such as the kidnapping of the contractor's staff, the Embassy were able to apply pressure on Indian Government Agencies to facilitate the resolution of issues likely to disrupt the project. Examples of this were the delay to the transmission line and the delay to land acquisition for the project.

4.2.3 Selection of a Highly Competent and Dedicated Contracting Group

It is apparent that the URICO consortium had ample opportunity to withdraw from the project when the security situation deteriorated, as happened on other projects in the region. The fact that this did not happen is due in a large part to the dedication and determination of the contractor.

4.3 Lessons Learned about Technical Issues

4.3.1 Design for local Conditions and Customs

There are a few instances of the project design being more appropriate to European conditions than to the local conditions in Kashmir. These issues can be avoided by incorporation of local personnel in the design team, particularly in relation to architectural aspects.

4.3.2 Supply of European Sourced Equipment

There are a few items for which NHPC is apparently finding it difficult to get support and spare parts. This highlights the difficulties which can be caused through the provision of European equipment which cannot be serviced and supported locally. In the case of the Uri Project it appears that this problem is restricted to a small number of items.

4.3.3 Use of Innovative Technology

The question of whether to use innovative solutions or well-proven technology is always a fine balance. In the case of the Uri Project this balance has generally been struck well. However in the case of the pinch-valves for the desilting basins the innovative technology has not proved entirely successful. The limited durability of the pinch valve membranes seems likely to cause an on-going problem. Although it does not disrupt the output of the project it has significant nuisance value.

4.4 Lessons Learned about Environmental Matters

This section briefly describes the perceived good features of the planning, implementation and operation of the Uri project – features which should be repeated in any similar projects in future. It then considers features that would now, in 2005, be considered poor or unacceptable practice under Swedish, Indian and/or World Commission on Dams guidelines on best practice.

4.4.1 Good achievements – to be replicated in future

Baseline surveys

Sida's Appraisal Report (1989) was very strong on identifying the potential adverse impacts of the project on aquatic life as being serious and in need of expert attention. Sida's pursuit of this cause, through the engagement of specialists at the Institute of Freshwater Research and Swedish Museum of Natural History, was exemplary. Earlier proposals for baseline surveys developed into a full-scale programme of scientific fieldwork and assessment, the quality of which has probably not been matched in any country surrounding the Himalaya.

Publishing scientific survey results

Sida's decision to publish the findings of the aquatic surveys in book form was very commendable. This has ensured that the methodology and findings of excellent work are not only available to researchers and practitioners in Jammu and Kashmir State but to the rest of India, countries surrounding the Himalaya and in other mountainous regions of the world. This is important because pressure on development of rivers for hydropower is growing and the need for well planned and high quality aquatic surveys, taxonomy and impact assessment is becoming very important. In the Himalayan region alone, there are considered to be several countries where government research institutions, development agencies and NGOs will benefit from the work described in this publication.

Ensuring collaboration with partner agencies

Sida ensured aquatic surveys and impact assessment by a Swedish Institute were conducted in collaboration with the University of Srinagar. The beneficial spin-offs of this are apparent and continue, as demonstrated by an important fish tagging research programme which was conducted by the university (with equipment provided from Sweden) and commissioned by NHPC. This has yielded important results, albeit some negative, about fish migration and design of fish passes which should be of immense benefit to J&K State, India and other Himalayan regions where more barrages are proposed.

Technology transfer and training

Sida made provision for very substantial technology transfer and training. This was principally for engineers but included support for four environmentalists to visit projects in Sweden and attend courses in Holland. Comments received from participants in October 2005 demonstrated that this assistance for their continuing professional development was worthwhile and greatly appreciated.

Panel of Experts

Sida made provision for a Panel of Experts to advise NHPC. The Panel included an Indian specialist in environmental engineering. The POE met and reported on 16 occasions. This concentration of effort, coupled with the Monitoring Team advising Sida, helped to ensure that all parties were aware of the importance of environmental mitigation measures. As a result of these efforts, not least by Uri Civil Contractor AB, NHPC and Forestry Department of J&K, site renovation and landscaping was achieved to a very high standard.

Employment of local people

Uri Civil's policy of employing local Kashmiris in the ratio of 3:1 outsiders showed great wisdom. It helped to ensure training and much improved incomes of several thousand local families. Those remaining resident in the area feel a sense of personal achievement, goodwill towards Sweden and some personal on-going partnership with the Uri project, whether they now have employment with NHPC or not. Also, it is understood that over 100 Kashmiris trained by Uri Civil are now employed in construction of the expanding Delhi Metro. The origin of their skills, and those of many others, is traced to their training and employment at Uri.

4.4.2 Modern Practice – Lessons learned from Uri

Support projects which are comprehensively studied

Indian EIA practice was skeletal when clearance was given to the Uri project in 1980. It has subsequently become more rigorous. In view of Sida's own developing emphasis on sustainability of projects and adequate consultations with communities affected by infrastructure projects, it appears very unlikely that Sida could now support a project like Uri without the host government agency providing an adequate EIA report, an Environmental Management Plan and a Resettlement and Rehabilitation Plan at the time of Swedish government appraisal of the project. Consideration of the following features highlight this:-

- Baseline surveys are integral parts of the EIA process. It is now not acceptable to be implementing fundamentally important baseline surveys during project construction. In the Uri case, important issues such as compensation flows and fish pass design and approach conditions, should be based on detailed scientific and technical considerations in previous years and be fully resolved in the EIA process.
- Land acquisition, and resettlement and rehabilitation plans, and the environmental impacts of these (all host government responsibilities), should be based on adequate surveys and consultations in advance of construction. In Uri's case, the contractor's progress was frustrated by land acquisition being delayed and socio-economic surveys of the status of the project affected people were far too late (three years after project commencement) for proper consultations about compensation and rehabilitation to be made. From the perspective of the project-affected peoples, this appears to have been classical top-down planning and development, carried out under considerable pressure (e.g. the contractor and equipment were already on site and permanent access to nine pieces of land was absolutely essential). In the event, it seems probable that resistance to compulsory acquisition of land and property, without very serious consequences in practice, was achieved by generous compensation terms and employment of many project-affected persons by the contractor.

Ensure arrangements made for awareness of impacts of changes in engineering design

With "design and construct" turnkey projects, project owners are under great pressure to approve design drawings submitted by the contractor. More than 2,000 or 3,000 engineering drawings are often involved in large projects. Typically, only the owner's engineering staff are involved in examining the contractor's drawings for approval. Where fundamental changes in design are involved, environmental implications may be missed. In these circumstances, from Sida's point of view, safeguards are in place by virtue of its support for appointment of a Panel of Experts which regularly meets and advises on the acceptability of changes in construction design and related matters.

In the case of Uri, a number of design changes were made from the concept previously developed by NHPC. Almost all changes made had no adverse environmental significance whatsoever and some were beneficial. However, the change from NHPC's concept of a siphon crossing of the Buniyar Nallah to a culvert which presented a barrier to upstream fish and invertebrate movements does not appear to have received any environmental attention. There appears to be no Panel of Experts or Monitoring Team records of any discussion about the environmental impacts of the change in design before construction of the culvert took place, only afterwards when the problem became visible and obvious. The culvert crossing is now a permanent feature and, although potentially mitigated to some unknown extent by construction of a fish pass ten years later, a degree of integrity of the Buniyar Nallah's wetland functions has been permanently damaged. This appears to be an example of creation of a serious environmental impact which was completely avoidable. It appears that the Panel of Experts missed this point, or considered it but did not report it.

Design of fish pass approach conditions

When supporting any projects involving fish passes, special consideration needs to be given to not only the design of the fish pass but to the hydraulic approach conditions to the fish pass at the toe of the barrage. Secondly, impacts of any future water resources development plans need to be fully appraised so that sensible provision may be made for these.

In the case of Uri, it is reported that the contractor's design consultants finalised the fish pass design after inputs from the IFR fish experts involved in the aquatic baseline surveys. It is not known to what extent the approach conditions to the fish pass were or could be modified at the stage when this advice was given. As stated earlier, although a fish pass itself may be excellent once fish have entered it, it can be useless or almost useless if most fish cannot find and enter it. There will almost always be a range of flows for which any fish pass will not be suitable for fish passage. However, it is somewhat disturbing to provisionally conclude that spillways flows greater than about 180 m^3/s (which is not a very large flow) do not provide conducive approach conditions to the Uri fish pass and that only flows less than this are more favourable. No POE or other discussion has been seen to suggest that consideration was given to creating pool conditions at or below the toe of the barrage, as is the case at Lower Jhelum.

Regarding future developments, the Uri project made sensible engineering provision for utilising increased river flows for power generation in future. This was recognised by Sida in its Appraisal Report. Thus the intake, waterways (but not tunnels) and desilting basins have been sized for a 960 MW power station, with additional costs of these provisions. But under current proposals for the Kishenganga power project and transfer of Kishenganga flows to Jhelum river for additional power generation at Lower Jhelum, Uri (without an increase in installed capacity from 480 MW to 960 MW) and Uri-II, it appears that there will be adverse impacts on the hydraulic approach conditions to the Uri fish pass. This is because in most spring and summer months, these transfers will not increase power generation at Lower Jhelum and Uri because of their installed capacity constraints; at such times, these transfers will increase the discharges through the Lower Jhelum and Uri barrage spillway gates into respective downstream channels. This may have insignificant impact on the approach conditions to the Denil fish pass at Lower Jhelum because of the pool conditions which exist but appears likely to have cumulative adverse impacts on the approach conditions and efficiency of the Uri barrage fish pass in the main fish migration season. In these circumstances, the duration of time when flows exceed the provisional threshold spillway flow of about 180 m^3/s (when Jhelum flows are greater than 400 m^3/s) will increase, causing fish migration through the fish pass to be inhibited for longer periods.

The point is therefore made that when supporting any projects involving fish passes, special consideration needs to be given to not only the design of the fish pass but to the hydraulic approach conditions to the fish pass at the toe of the barrage, taking account of observations of good features at other fish passes and recognising the full impacts of all future water resources development proposals.

Preparation for fish pass monitoring

When supporting any projects involving fish passes, special consideration needs to be given to making provision in the design of the fish pass for creating flow conditions conducive to counting fish and measuring flows and for training staff in fish counter technology.

Where fish passes are provided, opportunities are created for counting fish which are not normally available in natural freshwater bodies. In the case of fish passes, records of numbers of fish movements (often including fish length) are essential for evaluating the benefits of the structure. Technologies for counting fish continue to develop and improve but it appears that most if not all of these prefer laminar flow conditions and certain geometries for successful counting. Hence the design of resting pools part way up fish passes and/or the design of the conduit leading from the upstream water intake to the first step or baffle at the top of the ladder need to provide hydraulic conditions and construction materials favourable for fish counters to operate, whether using acoustic, resistivity, infrared, video or other technologies.

In the cases of fish passes at Uri (operating for eight years), Lower Jhelum (operating for 26 years) and now Buniyar Nallah (operating for one year), there are no quantitative records of fish movements and no evaluation of their benefits. Opportunities for installing fish counters may exist at one or more of the three sites. Given that the density of fish passes on the Jhelum river is probably now among the highest in the world, and evaluation of their benefits is impeded by lack of records, opportunities to assess their suitability for fish counting should be sought.

Tunnel muck spoil heaps and vegetation

When supporting any projects involving landscaping of spoil heaps created from infertile tunnel muck, special consideration needs to be given to the amount of the treated planting medium in which tree planting takes place and ensuring arrangements for maintenance of plants on rehabilitated land.

In the case of Uri, results of using biotechnology for planting were excellent in many areas, particularly in the first few years of growth. The typical dimensions of improved soils around roots of tree seedlings was 45 x 45 x 45 cm. The Forest Department believes these dimensions to be inadequate for encouraging sustained growth in tunnel muck in some areas, preferring a more generous application. Also, regular watering of new plants can be a fundamental requirement for a considerable period, especially when successive years of below average rainfall occur. Responsibility for this requires to be declared.

Income stream for watershed management functions and resettlement

When supporting any hydropower projects, special consideration needs to be given to institutional arrangements and sources of finance for sustaining watershed management and host and resettled communities throughout the life of the project. This issue has been the subject of anguished debate for many years and has most recently been articulated in the World Commission on Dams report in 2000.

In the case of rivers in Kashmir, and Jhelum and Chenab in particular, sedimentation is a major issue for aquatic ecology, water users and especially developers of barrages and dams. In the case of Uri, the project attended to environmental protection measures in medium and high erosion hazard areas amounting to approximately 60 km^2; this catchment area treatment (CAT) was within nine catchment areas having a total area close to 150 km^2. Very good work was done but, as earlier text explains, responsibility for maintaining these works now rests with the Forest Department solely and the department has had no budget allocation for maintenance since 2003. This situation may continue indefinitely.

In the case of the run-of-river Uri project, with generously sized desilting basins and relatively small resettlement, the need for a guaranteed income stream to support watershed management and developing community livelihoods exists but is not so apparent as in many hydropower developments. The on-going "model" hydropower development, satisfying World Commission on Dams requirements as far as is practicable, is now taking place at Nam Theun 2 in Laos; here an income stream for watershed management and support of environmentally friendly livelihoods for both host and resettled populations is contractually agreed for 25 years after power generation begins. This need for such an income stream is founded on detailed project preparation with multiple stakeholders. The environmental protection that is expected to occur is seen as being in the interests of all parties, including the developer whereby the reservoir storage capacity, and hence power generation and sales, is protected. The Nam Theun 2 development concept is considered to be the forerunner and model for sustainable hydropower developments.

Institutional arrangements for hydropower development vary between and within countries and are subject to change. Precise arrangements at Nam Theun 2 cannot be expected to suit many future developments but the principles apply. In particular, all catchment stakeholders physically see that hydropower generation will finance management of the catchment that provides the water for power generation. This direct linkage is considered superior to historical models where remote central and/or state government treasuries provide, or fail to provide, funds through ministries.

Thus, an important point is made about support for any hydropower projects in future. Special consideration needs to be given to institutional arrangements and sources of finance for sustaining watershed management and host and resettled communities throughout the life of the project.

Transmission lines

When supporting any hydropower projects, special consideration needs to be given to the adequacy of EIA procedures for related transmission lines.

In the case of Uri, two new transmission lines, one new substation and some extensions of two existing substations were required. These developments were arranged separately from NHPC and were not a part of Swedish support. Nevertheless, transmission lines are an essential component of power generation schemes and this became very evident when Sida expanded the Monitoring Team to include a transmission line specialist. Completion of the transmission lines and substation works necessarily had to be synchronised with completion of the Uri project. Support for the Uri project therefore necessarily implied support for the transmission lines, though the latter were not financially supported by Sweden.

The construction programme for Uri project-related power lines was regularly behind schedule. One of the causes related to delayed land acquisition, similar to delays experienced by Uri Civil. Pressure to acquire land intensified in order to meet target dates for completion. This is regularly cited in the Monitoring Team reports. This pressure resulted in land being acquired and payments of compensation being made in less time than would normally be available for resolving conflicts with landowners and other stakeholders. It appears that some compensation claims remain sources of conflict and unresolved as late as October 2005.

Indian environmental impact assessment practices did not, and do not now, require EIAs for transmission line projects; there are special procedures for transmission lines, typically invoking rules related to the Forest Department. A survey has not been conducted but it is felt that most countries now require new transmission lines to have EIA study reports and social and environmental management plans for them. Thus, it is felt that appraisal missions for power generation projects should pay attention to identifying land acquisition and EIA procedures for related power lines, in addition to the power generation project, and report on the adequacy of these.

Composition of Panel of Experts

When making appointments to a Panel of Experts for water resources development projects, special consideration needs to be given to covering key environmental issues.

In the case of Uri, a single team member, an environmental engineer, covered all environmental and social aspects. Consequently, catchment area treatment works and erosion protection and land reclamation works appear to have received much attention.

Aquatic studies were well handled by Swedish scientists and Professor Yousuf. When it came to considering compensation flows and design of mitigation measures for the fish barrier created by the project at Buniyar Nallah, POE reports imply disputes arose between the fish experts and the POE. Whereas disagreements are not necessarily unusual, it does appear in this case that expertise available in the POE did not cover aquatic ecosystem matters as competently as it might have done. This is not a reflection on the POE environmental expert himself but on the composition of the panel appointed by Sida. Environment embraces many subject areas and it most unusual to expect that one person can necessarily cover all areas authoritatively. If we take the case of Nam Theun 2, three Panels were appointed – a panel for dam safety, a panel of international environmental and social experts (3 No.), and an "International Advisory Group on the World Bank's handling of social and environmental issues" (7 No.). Such an arrangement would definitely not have been appropriate for Uri but this does illustrate that more than one environmentalist may be required for projects which involve land acquisition, resettlement, land restoration, catchment area treatment, compensation water for bypassed channels and fish passes. This is particularly true where host country EIA procedures have been skeletal.

With better developed EIA practices, major land acquisition and socio-environmental issues should be resolved before project construction begins. In this case, one environmentalist on a POE may suffice for relatively small projects. However, for some years to come, it may be expected that a POE may need to draw on the expertise of an additional environmental or social specialist as the need arises. A good precedent for this was established by the timely appointment of a transmission line specialist to Sida's Monitoring Team.

4.5 Lessons Learned about Socio-economic Issues

As with the environmental aspects of the Uri Project there are a number of socio-economic aspects which were not handled in a manner which would be expected under current international guidelines.

4.5.1 Cash Compensation

The use of cash compensation appears not to have been entirely successful. In a few cases it has resulted in compensation to the joint landowners, but the primary land user has not received adequate compensation to purchase replacement land. This has led to a loss of livelihood and reduced standard of living. The system more commonly adopted now in India and elsewhere is "land-for-land", where an equivalent land holding is provided to replace the acquired land. This is generally considered more likely to lead to sustainability of the displaced people's livelihood.

4.5.2 Long-term Employment

It is apparent that in at least a few cases the Project Affected People had an expectation of long-term employment on the project which was not fulfilled. The Contractor undertook to employ at least one member from each of the Project Affected Families. However the actual employment provided by URICO only lasted for a maximum of seven years. This is partly mitigated by the training and certification provided URICO, and it is understood that many of the trained local personnel have been able to find employment elsewhere (including Delhi Metro) on the strength of this certification.

It is possible that more efforts could be made to employ local personnel on the operation of the Uri powerstation. However only a relatively small number of people are required for this work.

4.5.3 Local Cultural and Gender Issues

There are specific issues relating to the Muslim/Kashmir traditions of the project area which were apparently not taken into account in the Resettlement Plan. The main issue is the reluctance of the local women to work outside the home environment, or to work as labourers on land owned by others. Identification of this issue may have enabled different forms of training to be provided, and possibly the establishment of craft centres for women.

5 Recommendations

The following recommendations are made on the basis of our evaluation:

ID	Issue	Recommendation
1	Hydrology	Sida to give greater consideration, in the case of supporting hydropower or other projects involving barrages or dams, to the veracity of historical hydrological records, including preliminary results of river gauging during project construction (via POE and Monitoring Team reports). Sida to give consideration to snow-pack monitoring to help predict following season's power generation.
2	Support by Suppliers	Sida could assist NHPC by encouraging the equipment suppliers within URICO to be responsive to NHPC requests for support.
3	Employment of Local Personnel	NHPC could help mitigate some of the loss of livelihood by deliberately recruiting more Project Affected People for the operating staff.
4	Social and environmental impact assessments	Sida to ensure social and environmental impact assessments and environmental monitoring, mitigation and resettlement plans (including land acquisition, compensation and livelihood improvement measures) are prepared in advance of Sida funding. Where these are not satisfactory, technical assistance by Sida (along the lines of the Asian Development Bank) may be required for some months or years until they are satisfactory, and full mitigation costs have been internalised within project economics and financing.
5	Income stream for watershed management and residual social and resettlement issues	Sida to give consideration, in the case of supporting hydropower or other projects involving barrages or dams, to the supported project making provision for an income stream, in perpetuity, for watershed management and mitigation of residual social and resettlement issues.
6	Fisheries	Sida to consider, in cases of projects involving barriers to fish migration, making provisions for evaluating the efficiency of fish passes by installing fish counters and/or carrying out more fish and fisheries surveys. In the case of Uri, this would appear to be a relevant and valuable technical assistance measure which would benefit NHPC, Fisheries Department and the University of Kashmir, with results being relevant to other similar Himalayan projects.
7	Local Electricity Supplies	The improvement of electricity supplies in the Kashmir Valley has only partly been achieved. Further Swedish support to the state electricity institutions and infrastructure would be beneficial.
8	Support for Hydroelectric Project	Sida to consider, in the case of supporting hydroelectric and water resources schemes in future, adopting similar approaches to financing or co-financing projects as occurred for Uri. This can occur without the tied-aid model which is no-longer appropriate.

Table 5.1: Recommendations

Annex A Terms of Reference

1. Background

1.1 General

The Uri Hydroelectric Power Plant is situated on the River Jhelum in the Kashmir Valley, Northern India, about 90 km from Srinagar.

The first proposal for the construction of a hydropower plant at this location was prepared by the local authorities already in 1974. In 1982, the National Hydroelectric Power Corporation Ltd (NHPC), a Government of India Enterprise, was directed by the Indian Government to review the proposal. In June 1986, after revisions of the project layout, receiving State clearance, reaching an agreement with the Government of Jammu & Kashmir on power sharing, forestry clearance and upon Indus Water Treaty clearance, NHPC invited international tenders for a turn-key project from three groups of contractors. In addition to a Swedish/UK group (URICO), tenders were received from groups from Brazil and Germany/Switzerland. URICO headed by Skanska of Sweden presented the most favourable tender, and negotiations with them continued. In October 1989 an agreement was signed on the construction of the Project between NHPC and URICO.

As the Swedish tender was based on the availability of finance from BITS and Sida for a considerable portion of the foreign cost of the Project, the consortium kept Sida, BITS and the Swedish Government continuously informed on the development of the negotiations. In December 1988 the Swedish Government instructed Sida and BITS to appraise the project and to prepare a proposal for the financing.

A Project Appraisal was made in May 1989 by international experts with extensive experience from similar World Bank assignments. The Appraisal Team concluded that the Project was suitable for the proposed external financing.

A formal request for financing was forwarded by the Indian Government to Sida in June 1989, and an agreement on the provision of financial resources for the project was signed between the Indian and Swedish Governments in October 1989. In a Memorandum of Understanding it was agreed that the external financiers should cooperate closely in the monitoring of the Project, and that Sida should be the representative of the financiers and carry out the monitoring on their behalf.

1.2 The Project

The Uri Project is a run-of-the-river scheme, located down stream of the existing Lower Jhelum Power Station. The Project includes a barrage, above ground desilting basins, a 10,67 km head race tunnel, pressure shafts, an underground power house and a 2,06 km long tail race tunnel. The utilised head is 252 m, and the plant has an installed capacity of 480 MW in 4 units of each 120 MW. The estimated yearly energy generation at the Plant is 2 663 GWh.

If additional regulated water becomes available with the construction of the Wular Barrage and the Kishenganga Hydroelectric Power Project, more units with another capacity of 480 MW could be installed in the Uri Plant in a second stage. Required preparations for the construction of a second stage have been made.

1.3 Contractual Arrangements

The contract between NHPC and URICO was a turn-key contract in which URICO carried full responsibility for successful completion of the Project covering all aspects of design, civil works, mechanical and electrical equipment supply and installation necessary to develop the 480 MW project within 72 months from the date of authorisation to proceed. Order to Commence was given on November 22, 1989.

The leader of the URICO group, Uri Civil Contractor AB, was a joint venture for civil works consisting of Skanska AB (60%) and Nordic Construction Company International AB (NCC) (40%).
This joint venture also established the Uri Supply Company AB. Other partners in the group were SWECO AB for planning and design, ABB Generation AB for the supply and ABB Construction AB for the installation of electrical equipment, and Kvaerner Boving Ltd for the supply and Kvaerner Boving Construction Ltd for installation of the mechanical equipment including turbines, gates and penstocks. Each of the members of URICO undertook joint and several responsibility for the fulfilment of the contractual obligations.

For the implementation of the Project, eight contracts dated October 27, 1989 were made between NHPC and the members of the URICO group.

1.4 Project Cost

The estimated total project cost and currency requirements in million was:

SEK	2 328.00
CHF	353,00
GBP	48,99
INR	1 791,00
SEK (equiv.)	4 990,30

The following costs were not included in the estimate:

- Interest and other financial costs during the construction period;
- Costs for the Panel of International Experts;
- Costs for the Aquatic Life study;
- Costs for the monitoring of the Project.

1.5 Financial Arrangements

Finance for the foreign portion of the Project was provided by Sida, BITS, the Swedish Export Credit Corporation, the Nordic Investment Bank (NIB), the UK Overseas Development Administration (ODA) and the Standard Chartered Bank Ltd. Local funds were provided by the Government of India.

Financing Plan

		Currency (Million)			Total
	SEK	**CHF**	**GBP**	**INR**	**SEK**
Sida	700,0				700,0
BITS	765,0	157,0			1 393,0
AB SEK	443,0	196,0			1 227,0
NIB	420,0				420,0
ODA Grant			17,15		187,1
Export Credit			31,84		347,4
GoI				1 791,0	716,4
Total Financing	2 328,0	353,0	48,99	1 791,0	4 990,3

A number of documents on the financing were agreed upon between the financiers and between the financiers and the Indian beneficiaries.

1.6 Detailed information on the project

Further details of the project, its implementation and the first years of operation are given in *"Monitoring Summary Report, February 1998,"Project Completion Report, September 2000"* and *"Independent Evaluation Report of Uri by Haskoning 2001"*.

2. Purpose and Scope of the Evaluation

The need for improved understanding and knowledge of the more fundamental conditions for sustainable development, makes it important to study how viable projects and programmes are after Swedish assistance has been completed.

The four units of the URI Hydroelectric Power Plant were taken into operation successively during the period February to May 1997. As the Plant now has been in operation during a number of years Sida has decided to employ an external consultant to undertake an evaluation of the support to the Indian Government for the implementation of the Uri Hydroelectric Power Project.

The purpose of the evaluation of the Uri Project is:

- to assess to what extent the external support has fulfilled the objectives set out and led to expected results;
- to assess the effectiveness and efficiency of the utilisation of development assistance funds;
- to assess the current operational efficiency and viability of the plant;
- to improve understanding and knowledge of the more fundamental conditions for sustainable development.

The lessons learned from the evaluation should be possible to apply in other similar support programmes.

3. The Assignment

The evaluation shall address the following issues:

1 Which have been the objectives, targets and rationale set out for the Swedish support to the Uri Project?

2 To what extent have objectives and results been achieved? What have been the causes of high or low achievements?

3 To what extent and in what ways has the external support included elements to secure a long-term sustainable development of the project?

4 To what extent have these elements proved adequate?

5 What results and impact has the financial support had on the supply and availability of electric power in India?

6 What are the results and benefits of the support in terms of local availability of electric Power in Kashmir?

7 What are the results and benefits of the support in relation to capacity building, liberalisation and restructuring within the energy sector in India?

8 What environmental considerations have been taken and results achieved in the development of the Uri Project?

9 What social and cultural effects could be identified as a consequence of the project? The review will, for example, address such questions as if, and how the project has affected the lives of women, man and children in the project area through changes in social services and infrastructure, standard of living (health, education, income and income distribution) and livelihood strategies.

10 Have any unforeseen effects from the development occurred, positive or negative?

11 Have the resources made available through the Swedish support been utilised efficiently? Could the same or better results have been achieved with less resources? Could the allocated resources have been utilised more effectively?

12 What are the important lessons to be learned from the Swedish involvement – both general experiences in terms of development cooperation and sustainability, and specifically, with regard to energy sector support?

4. Methodology, Evaluation Team and Time Schedule

4.1 Methodology

It is envisaged that the evaluation shall commence with the studying of background documents and the interviewing of representatives from different authorities and firms involved in the implementation of the Uri Project, as well as relevant Sida officials. The Team responsible for the monitoring of the project should also be approached. The major fact-finding shall take place in India, if possible for security reasons at the project site in Kashmir, and by interviewing key officials at relevant authorities in New Delhi, as well as Sida's representatives in India.

Relevant publications and reports will be made available from the Swedish Embassy in New Delhi and from Sida/INEC in Stockholm. Selected official data and statistics will also need to be collected in India.

The evaluation should be carried out by the application of internationally recognised evaluation methods. The intended approach and methodology for the evaluation shall be specified in the tender, and will form part of the Contract between Sida and the selected Consultant.

4.2 Evaluation Team

The evaluation shall be carried out by an Evaluation Team headed by a Team Leader. The Team Leader is to have documented experience of evaluation in a team leader position. The Evaluation Team, preferably with evaluation experience, shall be composed of professionals within necessary disciplines, including the power sector. Sufficient knowledge and experience of Swedish and/or international development assistance is also required within the Team.

The Team should be capable of making independent and unbiased assessments.

The Team members should neither have been assigned by a company or as an individual within the Sida financed support to the Uri Project. However, experience from India or other development countries is beneficial.

Proficiency in the English language is a requirement.

4.3 Time Schedule

The evaluation will be divided into three phases:

- Planning and preparatory phase

- Main phase including fieldwork and
- Report writing

The evaluation is expected to commence during the fourth quarter of 2005, and be fully completed according to the agreed time schedule.

5. Reporting

The Preparatory Phase will lead to the presentation of an Inception Report with details of the methodological approach and an outline for the collection and analysis of the field data. The Inception Report shall be presented to Sida within three weeks from the signing of the contract.

It is recommended that a preliminary draft evaluation report be produced while in India. The Evaluation Team shall present at least a draft summary of the evaluation, covering the preliminary findings and conclusions, to relevant recipient representatives and to Sida officials before leaving India.

A Draft Final Evaluation report shall be presented to Sida within four weeks after the completion of the visit to India. The consultant should be prepared to present the Draft Evaluation Report at a seminar. Further discussions on the form of such presentation will be held between the evaluators and Sida.

The Consultant shall present a Final Evaluation Report to Sida within two weeks after receipt of Sida's comments.

The Evaluation Report shall follow Sida's standardised format, Annex 1, and should be written in the English language. Word for Windows or a compatible programme shall be used and the Evaluation Report should be presented in a way that enables publication without further editing. Sida shall be provided with ten copies of the Evaluation Report and on diskette. Subject to decision by Sida, the report will be published within the Sida Evaluation Series.

The evaluation assignment includes the production of an abstract in English and the completion of a Data Work Sheet.

Annex B Individuals and Organisations Consulted

Name	Organisation	Subject Area
Anders Hagwall, Johan Brisman, Jan Essnar, Johnny Andersson and others	Sida	Rationale and background to the project; issues affecting the decision to fund the project; issues during implementation.
Stig Holqvist, Ragnar Udo	Project Manager, Skanska International	Issues during bidding and construction of the project; issues regarding labour force and labour management; security situation; technical aspects of the project.
Mikael Kullman	SWECO	Technical and design issues.
Curt Voxby	Monitoring Team	Issues during construction including technical, commercial, environmental, socioeconomic and political aspects.
Björn Andersson	Aieka AB	Issues relating to the evaluation.
Gareth Jones	GE Energy (formerly Kvaerner Boving)	Issues relating to the mechanical equipment supply, support to NHPC and residual defects.
Carl G Svensson	Sida New Delhi	Liaison with NHPC, workshop in New Delhi, current Sida policy
Various	Power Grid Corporation	Operation of transmission lines, despatch arrangements, quality and condition of equipment supplied by URICO
Various	PDD of J&K	Details of J&K Grid, issues affecting despatch and operation of Uri and impact on J&K grid
Various	NHPC Contracts Department, Faridabad	Details of Uri contract, success of contractual arrangement, issues replicated on subsequent contracts
Various	NHPC Financial Department, Faridabad	Financial performance of NHPC, contribution of Uri to NHPC performance, improvement in NHPC borrowing ability, status of Uri loans
Various	NHPC Design Department, Faridabad	Good and bad features of the Uri design, innovative features and methodology replicated elsewhere, residual problems and measures being taken
Various	NHPC Operations Department, Faridabad	Availability, performance and operational issues at Uri; procurement of parts and support.
Mr A K Sakar and station operating staff	NHPC Uri	Performance of project, residual problems, energy production, station availability, maintenance cycles, quality of construction and equipment, despatch arrangements, issues affecting operation and availability of station; construction of Uri-II and Kishenganga
Olov Enderlein	Institute of Freshwater Research, Sweden	Four Uri fish surveys and concepts of further fish research in Kashmir.
Professor Yousuf	Centre for Research for Development, University of Kashmir, Srinagar	Aquatic impacts of Uri barrage, fish tagging and migration studies, other research findings.
G. Vara Prasad	NHPC, Uri	EIAs of Kishenganga and Uri-II projects. Site visits at Uri.
Khalid Umar	NHPC, Uri	Kishenganga and Uri-II projects. Experiences during Uri construction, including design change at crossing of Buniyar Nallah and rejection of siphon.
A.K. Sarkar	NHPC, Uri	Water releases through Uri fish ladder and lure water channel. Fish counter. Use of former Mohra power station flume for irrigation.
A.K. Grover and Anurag Srivatsava	NHPC, Uri	River gauging and float coefficients; Chenab sediment loads at Salal.
Vitas Kausihik	NHPC, Uri	Septic tank discharge and solids disposal at Gingle and Uranbau.
H.A. Badtal	Sub-District Magistrate, Uri	Socio-economic and cultural impacts, R&R process.

Name	Organisation	Subject Area
Nissar Hussain Hakim	Conservator of Forests, met at Uri	Planting on infertile tunnel muck in spoil heaps – successes and failures; CAT works and unsustained protection by locals after project ended; poor implementation and progress with check dams.
Mr T. Rabikumar	District Forest Officer, Baramulla	Cessation of CAT works since Uri project funding stopped; many environmental protection measures in CATs not maintained. Some existing terraces had been improved, but no new ones constructed. Discussion on need for an income stream for CAT works, in perpetuity. Elsewhere, now better organised with Forest Associations but not at Uri.
Abdul Rahaman Ganai, Mohamad Abdula Meer, Abdula Gani Meer, Mohamad Sultan, Mustar Ahamad, Mustak Ahahmad Mir (along with their families)	Project affected families	R&R process and current socio-economic status.
Ms Gulshan and other Staff Nurses	Staff Nurses	Women's employment, issues related HIV AIDS
Mr. Mishra, Mr Ganeva, other teaching and non-teaching staff	Gingle colony school	Educational facilities for local children
Dr. Narash Kanwal	Medical Officer, NHPC	Regarding water borne diseases and HIV AIDS
Bashir Ahmed Akhoon, and Manzoor Ahmad Lone	Fisheries Office, Baramulla	Concerns about fish ladders injuring fish; wish for NHPC to permit FD to enter and see Uri fish ladder, and make FD presence known; poachers have closed Uri fish ladder flow at night and sold fish in Srinagar market; FD are involved in Uri-II – much better cooperation than during Uri planning and construction; need for hatchery; assumption made that many fish die in power station waterways and turbines but no evidence revealed at tailrace; surveys indicate significant decrease in CPUE since Lower Jhelum and Uri projects commissioned.
Bashir Ahmed Akhoon	Fisheries Office, Baramulla	Visit to Buniyar Nallah to see new fish pass (completed December 2004) for first time. Concerns about its vulnerability to flood damage and responsibility for management of the fish pass. Concern expressed about the most downstream weir in the pass appearing to be too high and an obstacle to ascending fish.
Mr Goplani and Nissar Ahmed	PowerGrid, Wagoora substation, Srinagar	A new substation constructed for the Uri project. Transmission line ROW issues are few; substation domestic waste disposal from septic tanks – effluent to soakaways in compound, solids taken away by municipal contractor. Good quality water supply from tubewell in compound but some unease about a second abstraction (for more housing units) and contamination from septic tank soakaways..
Manzoor Wani, Zahoor Bakshi	PDD J&K Pampore substation, Srinagar	An existing substation, slightly expanded for Uri works. Transmission line ROW issues relate to some unresolved compensation claims and to snow avalanches.
A. R. Baig	Irrigation and Flood Control Department, Srinagar	Discussion on field procedures for obtaining and calibrating river flow records at Baramulla.
Ramesh Misra	NHPC, Faridabad	EIA regulations. Fish passes and fish counters. R&R Plan and its implementation
Dr. Usha Bhatt Dr. Shahid Ali Khan	NHPC, Faridabad	Early environmental clearance for Uri and evolving EIA regulations. CAT maintenance work and project nurseries – handed over to Forest Department. No ongoing permanent requirement at Uri is foreseen for an environmentalist, as CAT and rehabilitation works are now Forest Department's responsibility. R&R Plan – preparation process and implementation. Socio-economic Study

Name	Organisation	Subject Area
Shankracharya	NHPC, Faridabad	Uri's lower than expected power generation. Availability of Jhelum river flow records at Baramulla and Uri. Provision of a composite 10-day record.
Dr. S. Kaul	Ministry of Environment and Forests, New Delhi	Old and most recent EIA regulations. Transmission lines are excluded from EIA process. Fish passes and fish counters.
Archna Chatterjee Dr. Sandeep Behera	WWF-India	WWF's problems with dams; working on environmental flows for NE India where many hydropower projects being considered; following World Commission on Dams procedures on dams. Earlier unsatisfactory EIAs when prepared by government departments and some private companies. Sida giving helpful support to WWF's Dolphin project. Discussion of potential for Sida to consider NGOs for partnerships in R&R work and CATs (e.g. community mobilisation, alternative livelihoods) and for increasing awareness of special wildlife mitigation works (e.g. fish ladders).
Dr. C.L. Trisal	Wetlands International, New Delhi	Fish passes and counters; involvement of NGOs in projects like Uri; programmes for erosion and sedimentation control in Jhelum catchment area; water quality deterioration in Lake Wular; weed growth (Email communications).
Professor Ian Cowx	University of Hull International Fisheries Institute, UK	Fish counters for small size fish (Schizothorax) in fish ladders. His fisheries experience of Jhelum river in Pakistan. (Email communications).
Jim Gregory	Fish Pass Counter Research and Development project, Environment Agency, UK.	On-going research programme on fish counters for fish passes: resistivity, acoustics and other counters. Suitability for small fish. (Telephone and Email communications).
Benedikt Hálfdanarson	Vaki, Sweden	Riverwatcher fish counters in Sweden. (Email communications).
Dr. R Campbell	Tweed Foundation, Scotland	Fish counter experiences and observations on counting small fish. (Email communications).
Dr. Håkan Wickström	Institute of Freshwater Research, Swedish Board of Fisheries.	Uri fish pass flows; fish counters. (Email communications).
Damien Nixon	Environment Agency, UK	Visit installations of two Vaki counters for sea trout on Stour river, Canterbury, Kent
Mike G. Sawkins	Product Manager MACARTNEY A/S Esbjerg, Denmark	Suitability of Sound Metrics' DIDSON fish counters in fish ladders for small fish. No examples provided. (Email communications).
Greg Armstrong	National Fish Pass Officer, Environment Agency, UK	Provision of Environment Agency's Fish Pass Manual. (Email communications).
David Jarron	Vaki – Area Marketing Manager, Iceland	Suitability of Vaki counters for small fish. Recommends a minimum height setting of 40mm which correlates to around 24 cm length for salmon and trout. It is possible to set the scanner to a lower minimum but the infrared scans are 5mm apart and the smaller the height of a fish the less resolution of the silhouette image and the greater the chances of debris and turbulence being recorded. In a good installation and good site conditions it may be feasible to reduce the minimum height setting and the camera providing digital images for any silhouettes that may not be clear enough to identify as fish. However, if there is a lot of debris and turbulence a high volume of "rubbish" data could also be recorded. As with most environmental projects it would be a case of setting up and tuning the site, installation and equipment to achieve the optimum results. (Email communications).

Annex C Documents and Publications Reviewed

Author	Date	Title
Anderson, P	1999	Description of the Jhelum drainage in the Kashmir valley. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Anderson, P	1999	Physical and chemical recordings during biological studies at the Uri dam and power station sites during the period 1990–97. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Beach, M.H.	1984	Fish pass design. Fisheries Research Technical Report No.78. Ministry of Agriculture, Fisheries and Food, UK.
Bhatt U. & Khan S.A.	2003	Environmental & social concerns and their management at Uri power station (480 MW), J&K- A case of sustainable development. In Proceedings of international conference on "Water and Environment" at Bhopal (India) 15–18 December 2003.
Centre for Development Research, Copenhagen	1998	Swedish Development Cooperaion with India in a Poverty Reduction Perspective.
Construction Journal	1997	The Uri Hydroelectric Project (Special Supplement)
Enderlein, O & Yousuf, A.R.	1999	The environmental impact of the Uri hydropower project on the fish community in the river Jhelum. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Engblom, E & Lingdell P.E.	1999	Analyses of benthic invertebrates. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Gazette of India	1994	Ministry of Environment and Forests Notification. Extraordinary; Part II, Section 3, sub-section (ii). January 27, 1994.
Gazette of India	1997	Ministry of Environment and Forests Notification. Extraordinary; Part II, Section 3, sub-section (ii). April 10, 1997.
Government of India	2001	External Assistance Manual
Haskoning	2001	Independent Evaluation of Uri Hydro-Power Project, India (for Skanska)
Indus Commission	1960	Indus Water Treaty
J&K Forest Dept	1993	Uri Catchment Development Plan (1993–1998)
Kullander, S.O., Fang Fang, Delling B. & Ahlander, E.	1999	The fishes of the Kashmir valley. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Kundangar MRD & Abubakr A.	2004	Thirty years of ecological research on Dal Lake, Kashmir. Journal of Research & Development, Vol.4.
Lingdell P.E. & Engblom, E.	1999	Assessing water quality and effects of impoundments in the river Jhelum using benthic invertebrates. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Manohharan T.R. & Behera S.K.	2005	Ganges River Dolphin conservation and livelihood assessment. Farida village: a case study. Report. WWF-India.
Manolom S. & Grant C.	2005	The Nam Theun 2 project: a partnership for development. Hydropower & Dams; Issue 4.
Ministry of Environment and Forests	2005	Draft (EIA) notification which the Central Government proposes in exercise of the powers conferred by sub-section (1) and clause (v) of subsection (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) for imposing certain restrictions …..
Ministry of Foreign Affairs.	2005	Country Strategy. India. January 2005–December 2009. Government of Sweden.
NHPC	1990–2004	Annual Reports
NHPC	1990–1997	Panel of Experts reports, 16 No.
NHPC	1992	Rehabilitation Plan of Uri Hydropower Project, November 1992.

Author	Date	Title
NHPC	1995	Special Panel of Experts Report on Training and Technology Transfer
NHPC	1997	O & M Manual, Civil Works. SWECO. February 1997
NHPC	1999	Effect of Uri and Lower Jhelum barrages on the spawning migration of fish *Schizothorax* Heckel. Final Technical Report of Research Project by Yousuf, A.R.
NHPC	2000	Project completion report, Uri hydroelectric project.
Nyman, L.	1999	Man, water and the Uri project: from globally assessed methods to practical application.. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
Nyman, L. (editor)	1999	River Jhelum, Kashmir Valley. Impacts on the aquatic environment. SWEDMAR, The International Consultancy Group of the National Board of Fisheries.
OECD	1996	Swedish Development Cooperation Review, Summary
Sida	1990–1997	Monitoring Team reports, 16 No.
Sida	1989	Appraisal Report
Sida	2002	Sustainable development. Guidelines for the review of environmental impact assessments
Sida	2004	Integrating the environment. Knowledge for environmentally sustainable development.
Sida	2004	A favourable climate for development. An introduction to Sida's position on climate change and development.
Sida	2005	Sida's environmental management system. Policy and action for environmentally sustainable and management.
Sida et al.	1984 onwards	Correspondence relating to the Uri Project held in Sida's Central Archives, Stockholm.
Srivastav, A. & Gupta R.K.	2004	Sediment removal from reservoir through mechanized means. Proceedings of the 9th international conference on river sedimentation, 18–21 October 2004, Yichang, China
The Scottish Office.	1995	Notes for guidance on the provision of fish passes and screens for the safe passage of salmon. Agriculture and Fisheries Department, UK.
Wani S.A.	2004	Environmentalism and Dal Lake. Journal of Research & Development, Vol.4.
Wani S.A. & Pandit A.K.	2004	Urban impacts on the water quality of river Jhelum. Journal of Research & Development, Vol.4.
Wickstrom, H.	1999	Fish migration and the use of fish ways. In Nyman "River Jhelum, Kashmir Valley. Impacts on the aquatic environment".
World Commission on Dams	2000	Dams and development: a new framework for decision making.
WWF-India	2005	WWF-India's Freshwater and wetlands programme. Strategy Document 2005–2010.

Annex D Technical Characteristics of the Uri Project

The Uri project components can be divided into open air and covered components. The barrage complex is situated downstream of the confluence of River Jhelum with Limbar or Warrikah Nallah. Another Nallah at Buniyar meets the River on the left bank, and required a cross over structure.

1. Open Air Structures

The open-air complex consists of three major parts, viz. a spillway with six bays with a sill level at El 1483.75 m, and under sluice spillway with three bays with a sill level at El 1483.00 mm and a head regulator with two bays with a sill level at El 1485.40 m. The spillway bays are 8m wide and the head regulator bays are 16 m wide. All bays are provided with hydraulically operated radial gates and with stop log grooves in front of the gates. One set of stoplogs is supplied for the spillway bays and one for the head regulator bays. A separated travelling gantry is provided at each location for handling the stoplogs. A fish way is placed between the two spillway parts.

The head regulator is provided with trash racks to prevent major obstacles from entering the head works of the power station. River bed load is discharges through four silt excluder pipes with their intakes located in the front of the sill with an invert level at El 1481.50 m.These pipes and two additional ones with their intake in the sill immediately upstream of the radial gates are connected to a silt excluding flume discharging into the river downstream of the spillway. These de-silting arrangements, surplus escape and headrace tunnel also fall in this category. A culvert intake and culvert under Buniyar Nallah also are included in this category along with the headrace canal. For development of the layout, comprehensive hydraulic model studies were carried out in Sweden at the Alvkarleby Laboratory of Vattenfall Utveckling.

Further description of these components is provided below. The items which attracted special notice included the functioning of pinch valves of the de-silting basin and oil filled cables of the transformers in the transformer hall.

A De-silting Arrangements

A de-silting facility is situated downstream of the cut and cover culverts, and comprises two parallel basins to cater for Stage I and the future Stage II, each 45–60 m wide and about 300 m long. Each basin connects to the two cut and cover culverts in the upstream end and to a common after-bay and the headrace canal in the downstream end.

Sediment rich bottom water is abstracted from the basins through bottom inlets spaced 4–5.5 m into ducts below the basins. At every 32 and 38 m, respectively, the ducts discharge through rubber pinch valves into two longitudinal concrete culverts, one under each basin invert. In total 64 pneumatically operated pinch valves are installed and include, remotely controlled operation. A pinch valve is essentially composed of a flexible, hose, of a suitable quality of synthetic rubber, passing through a rigid valve house. By the application of high air or water pressure between the hose and valve house, the hose can be pinched to close. This type of valve was preferred instead of the more usual butterfly valve because of the extremely good service record from applications with two-phase solid-liquid flow in the mining industry. The good resistance to sediment erosion results from both the flexible material and the fact that no parts intrude into the waterway when the valve is open, The valves are used only in the fully open or closed position. With the proposed principles of operation at Uri, the technical life of the pinch valves was estimated to be considerably longer than could be expected of steel butterfly valves.

The turbine flow is extracted from the desilting basin by free overfall weirs located along the downstream sides and end of each basin. It is possible to dewater each desilting basin for inspection or maintenance while the other basin is in operation. This can be achieved by closing the relevant radial gate at the head regulator and by closing the overflow section by stoplogs.

B Surplus Escape

A surplus escape with a capacity of 500m^3/s is located in the afterbay just downstream of the desilting basin. It is provided with six 8.0m wide siphons and two 26.0 m wide energy dissipators.

Because of the severe limitations in storage volume, the discharge system at Uri needs to react within a few minutes in the event of major changes in flow, to prevent overtopping of the barrage and open canals. The natural variations in stream flow in the Jhelum River are fairly modest, and more critical conditions are therefore those created by changes in power plant operation. Total load rejection in the Uri power station will, in addition, cause significant surging in the open waterways, which also has to be controlled. Power supply to the spillway gates is primarily by a local 11kV line, which may not be very reliable, and in the event of a fault in the main transmission line from Uri a total load rejection and an interruption of the electricity supply over the 11kV line may occur simultaneously, also a back-up power supply system is provided to the spillway gates by a diesel generator at the dam site. Nevertheless, and automatic system for the case of a rapid increase in discharge was also considered necessary. The primary function of the surplus escape structure is to provide this safe and rapidly available discharge capacity at the point where it is most effective. The solution comprises of a battery of six air-regulated siphons discharging from the afterbay of the desilting basins. This choice was dedicated by safety. For example the siphons operated on the 8th October 2005 when the earthquake struck the power plant and the power evacuation system was temporarily shutdown.

The hydraulic design is based primarily on earlier model test carried out at Wallingford, UK for the Plover Cove Reservoir Siphons, Hong Kong which were designed by Binnie & Partners

C Headrace Canal

The headrace canal is about 470 m long and is provided with a 0.25 m thick concrete lining with an underlying filter with drainpipes. The lining is sloping 1 V: 1.5 H. The canal has a bottom level at El 1483.0 m. At the downstream end the canal is widened and deepened to an intake forebay. The length of the intake forebay at the downstream end of the canal is about 195m.

D Culvert Intake and Culvert under Buniyar Nallah

At the intake forebay an intake to a culvert under the Buniyar Nallah tributary is constructed. The intake is provided with trash racks and two hydraulically operated fixed wheel gates. A raking machine is provided to clean the trash racks. The culvert has an inner area of 104 m^2 and is placed in such a position that the Buniyar Nallah can pass over the culvert.

2. Covered Structures

The covered structures include the cut and cover culverts, the headrace tunnel and Power Station with penstocks and surge arrangements. They also include tailrace tunnel.

A Headrace Tunnel

The headrace tunnel adjoins the culvert just downstream of the Buniyar Nallah. The tunnel intake at the downstream of the Buniyar Nallah. The tunnel intake at the downstream end of the culvert is provided with one fixed wheel gate, which can be used for alternative closing of the headrace tunnels during Stage II of the project. The tunnel intake is provided with a travelling gantry crane to be used for the lifting and moving of the gate between the two gate shafts.

The tunnel is concrete lined and the finished tunnel is horseshoe shaped with a diameter of 8.4 m. The total length of the headrace tunnel is 10.63 km.

B PowerStation with Penstocks and Surge Arrangements

A vertical surge shaft with diameter of 22.5 m adjoins the downstream end of the headrace tunnel. It is supplemented by two galleries, one about 78m long at the top and one T Shaped with a total length of 210 m at the bottom of the shaft. The entire surge arrangement is concrete lined.

From the downstream end of the headrace tunnel, two penstock intakes with short horizontal transition parts and two vertical penstocks, inner diameter 5 m leads the water to the turbines. Each penstock will feed two turbines. The penstock intakes are provided with sliding gates.

Both penstocks and the bifurcations to the four spherical valves are provided with steel linings, embedded in concrete throughout the entire length.

The powerhouse consists of two main halls, the machinery hall and the transformer hall. In addition, as separate draft tube gate gallery is arranged. The main access tunnel ends in an assembly bay at one end of the machinery hall.

The machinery hall houses four hydro-turbine generating units with auxiliary equipment. The rated output of the turbines is 4x122 MW at 222.5 m rated net head. The generators are of vertical shaft salient pole type, three phase, 50 Hz. with the rated continuous output of 136 MVA at 0.9 Power factor. The control block for the power plant is located at the opposite end of the machinery hall as compared to the assembly bay.

Two travelling cranes are provided for erection and maintenance purposes.

The main floor of the transformer hall houses 13 (1 in spare) main single phase transformers. SF6 switchgear equipment, SF6 conductors and an overhead travelling crane for service and maintenance are installed on the floor above the transformers.

A cable and ventilation tunnel houses the 400 kV single conductor cables connecting the 400 kV switchgear in the transformer hall with the pothead yard and the transmission line on the ground surface. The tunnel also serves as a duct for the ventilation plant and as an emergency exit from the power house.

Each unit is provided the draft tube gate. The 6x6m gates are lifted and lowered by means of an electrically operated overhead crane.

Downstream of the partly steel lined draft tubes, the water from the turbines is further transferred to the tailrace tunnel via the four draft tube extensions and one for each unit. Concrete lined surge galleries are linked to this area..

C Tailrace tunnel

The tailrace tunnel has a length of approx. 2 km. The tunnel is concrete lined and the finished tunnel is horseshoe shaped with a diameter of 8.4m.

At the tunnel outlet closing arrangements are provided consisting of two sets of stop logs with electrically operated hoists.

3. Mechanical and Electrical Equipment

Hydromechanical Equipment

ID	Equipment	Supply Erection & Testing Responsibility	Size/Capacity	Status & Spares
1	Spillway radial gates	Kvaerner of U.K, designer SWECO of Sweden. Erection and Commissioning by Kvarerner Boving Construction Co.U.K.	Width 8m.	Seals intact. Other 21 gates in water conductor system covered below.
a	Spillway 6nos Opening 1to 6	Civil works jointly done by Skanska & NCC (Uri Civil Contractors)	Height 7.5m	
B	Under sluice,(3nos) Opening 7 to 9		Height 8.25m	
2	Stoplogs 4 nos.		W 8m H4x2.10=8.4m	
3	Stopologs Gantry Crane		12.5 tonne	
4	Head Regulator, Radial Gates		W=16m	Seals of 1 gate leaking, being replaced with locally manufactured components.
A	Intake bay -1		H 6.1m(with lintel at 1491.50m	
B	Intake bay-2		H 6.1m(with lintel at 1491.50m	
5	Intake screens		W 16m H 7m	
6	Screen cleaning facility, jib crane on stoplog gantry crane		Capacity 1 Tonne	
7	Stoplog, I set of 3 stoplogs		W 16m H 3x2.5=7.5m	
8	Stoplog gantry crane		Rated capacity 30tonne	
9	Slide gates for silt excluding system (6 culverts)		W 1m H 1.6 m	
10	Maintenance gate upstream, 1 off		W 1m H 1.6 m	
11	Maintenance gate down-stream, 1 off		W 1.3m H 2.5 m	
12	Desilting basins			
A	Nos of rubber pinch valves,		34x2=68, 0.6m dia	Sleeves being replaced with locally manufactured components.
B	Nos of Extracting sections,		8	
C	Flushing gates 2x2= 4		W 5m H 1.7 m	
13	Buniyar Nallah Intake, 2 nos, Roller gates		W 7m H 9m	

ID	Equipment	Supply Erection & Testing Responsibility	Size/Capacity	Status & Spares
14	Buniyar Nallah 1 Intake with screen raking facility		W 33.4 m H 15.8m	
15	Intake for future Stage II tunnel with travelling gantry crane		Rated capacity 77 tonne	
16	Surge Shaft and Penstocks		2 nos. Vertical 5m Dia and 220m long	
A	Two sliding bulkhead gates		W 5 m H 7 m	
B	Bulkhead doors		W 5 m H 7 m	
C	Main Inlet Valve-4 nos, for penstocks		3m Dia, spherical	
17	Tailrace tunnel Two sets of stoplog gates		W 4m H 7.35 m	

Electro-Mechanical Equipment

ID	Equipment	Supply Erectio & Testing Responsibility	Size/Capacity	Status & Spares
1	Turbines, Francis type, 120MW, 220 m head	ABB generation Sweden, Civil works by Skanska and NCC (Uri Civil), Project Designer SWECO of Sweden	Francis, vertical shaft 120MW, 220 m head	Runner spacing found oblique during overhaul, frequency 1 in 4 years, outlet seals found loose, runners being repaired
2	Governor System		4 nos Electronic type	
3	Generators		Vertical, synchronous 4-nos, 136MWA, 50Hz, 13.8KV, 333.3 RPM	Spares supply for 15 years assured
4	Excitation system		4 -nos	
5	Transformers (12+1)		13- single Phase-50MVA 13.8KV/230 kV	
6	GIS System		7- circuit Breakers-400kV,SF6	
7	EHV Cables (6+1) Each set with 500kVA capacity		7-400 kV oil filled	1 set of cables leaking and causing cable faults
8	Shunt Reactors		2-400 kV+	
9	Control, Metering and Relay System		1	Experiencing obsolesce in technology, card being repaired indigenously/ being sent to OEM in Norway.
10	Cooling Water System		1	
11	Compressed Air System		1	
12	Dewatering and Drainage System		1	
13	Synchronous Condenser System		1	
14	PLCC	Supplied by ABB (NERA)	1	Experiencing obsolesce in technology, card being repaired indigenously/ being sent to OEM in Norway.

Annex E Jhelum River Flow Record

URI-I Hydroelectric Project

Average 10-daily water availability series (cumecs)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	51.28	101.06	206.06	286.85	501.23	482.46	397.28	673.45	438.14	136.54	84.18	64.17
1976	53.07	156.96	245.19	354.66	482.48	435.22	397.17	823.44	396.01	111.85	76.06	58.70
	69.80	189.07	307.74	482.31	527.20	348.63	279.17	522.75	459.55	99.14	68.04	56.24
ave	**58.05**	**149.03**	**253.00**	**374.61**	**503.64**	**422.10**	**357.87**	**673.21**	**431.23**	**115.84**	**76.09**	**59.70**
	53.09	99.48	114.46	206.34	431.97	386.92	359.42	207.81	168.94	122.75	103.24	68.92
1977	73.54	100.52	126.55	368.96	373.24	302.53	357.72	199.04	170.81	82.12	97.55	66.18
	80.70	108.14	147.95	233.75	408.92	306.33	302.48	220.30	161.40	80.22	80.76	82.66
ave	**69.11**	**102.71**	**129.65**	**269.68**	**404.71**	**331.93**	**339.87**	**209.05**	**167.05**	**95.03**	**93.85**	**72.59**
	76.14	69.55	158.29	262.01	522.61	483.14	321.11	137.11	168.40	117.94	70.59	68.19
1978	63.71	77.16	239.02	406.82	521.79	350.22	360.92	310.89	105.90	70.56	86.76	56.92
	77.30	86.14	277.36	537.50	567.92	298.80	336.40	289.34	119.47	49.38	85.23	46.21
ave	**72.38**	**77.62**	**224.89**	**402.11**	**537.44**	**377.39**	**339.48**	**245.78**	**131.26**	**79.29**	**80.86**	**57.11**
	41.34	47.15	175.28	344.44	374.46	447.17	340.02	168.09	110.38	119.07	63.37	110.04
1979	44.23	57.00	252.81	392.86	426.28	354.30	299.87	139.60	76.34	88.74	79.37	91.38
	51.42	99.59	260.20	383.75	625.88	345.23	266.68	145.04	124.76	72.69	100.95	88.80
ave	**45.66**	**67.91**	**229.43**	**373.68**	**475.54**	**382.23**	**302.19**	**150.91**	**103.83**	**93.50**	**81.23**	**96.74**
	109.05	126.86	360.02	419.68	491.46	452.47	499.30	388.25	184.20	158.40	91.72	103.86
1980	95.45	203.96	354.66	454.17	522.55	493.87	469.63	334.11	329.55	117.12	83.99	84.86
	103.19	301.94	426.39	486.22	491.18	510.55	425.17	220.33	251.82	87.61	96.47	79.51
ave	**102.56**	**210.92**	**380.36**	**453.36**	**501.73**	**485.63**	**464.70**	**314.23**	**255.19**	**121.04**	**90.73**	**89.41**
	89.65	163.95	398.95	717.34	796.83	603.42	399.38	466.68	159.56	118.33	89.68	74.25
1981	80.42	232.11	399.01	748.83	739.88	448.56	371.51	350.56	124.20	99.28	92.14	69.29
	103.41	321.93	482.68	815.01	674.78	378.53	424.66	232.39	118.33	88.52	80.82	64.19
ave	**91.16**	**239.33**	**426.88**	**760.39**	**737.16**	**476.84**	**398.52**	**349.88**	**134.03**	**102.04**	**87.55**	**69.24**
	61.84	83.59	181.93	432.42	581.68	533.88	422.51	281.10	152.06	130.17	153.11	161.72
1982	59.24	104.63	233.72	490.44	515.93	504.57	371.97	345.04	102.85	104.74	159.65	184.99
	71.58	128.16	402.89	560.61	503.55	425.23	313.41	255.05	118.84	114.00	155.66	137.05
ave	**64.22**	**105.46**	**272.85**	**494.49**	**533.72**	**487.89**	**369.30**	**293.73**	**124.58**	**116.30**	**156.14**	**161.25**
	132.58	139.01	290.64	584.71	782.10	786.89	745.63	671.21	524.65	181.96	118.11	92.23
1983	123.04	122.24	491.94	683.59	820.67	685.91	682.03	637.55	370.27	150.93	111.40	88.66
	129.09	141.33	613.00	647.71	824.83	597.39	639.36	550.61	268.58	138.16	99.31	88.32
ave	**128.24**	**134.19**	**465.19**	**638.67**	**809.20**	**690.06**	**689.01**	**619.79**	**387.83**	**157.02**	**109.61**	**89.74**
	82.34	84.89	126.57	364.21	454.96	555.60	295.48	238.85	421.86	107.06	39.11	59.38
1984	82.26	101.88	206.63	425.82	552.43	446.95	216.93	252.61	363.84	55.42	42.84	64.82
	82.91	119.95	322.47	469.97	548.86	370.29	243.83	326.94	225.65	40.15	66.20	45.22
ave	**82.50**	**102.24**	**218.56**	**420.00**	**518.75**	**457.61**	**252.08**	**272.80**	**337.12**	**67.54**	**49.38**	**56.47**
	66.91	67.68	84.84	224.80	554.32	473.03	221.60	349.31	109.10	153.02	103.04	44.68
1985	56.72	72.83	74.78	311.79	525.02	438.06	231.01	320.20	72.58	122.07	92.59	67.11
	74.81	74.16	139.29	286.36	425.99	427.04	557.07	289.14	66.57	112.39	86.99	119.24
ave	**66.15**	**71.56**	**99.64**	**274.32**	**501.78**	**446.04**	**336.56**	**319.55**	**82.75**	**129.16**	**94.21**	**77.01**
	78.80	99.05	201.02	554.58	983.32	456.38	683.79	574.99	224.46	131.50	105.54	226.45

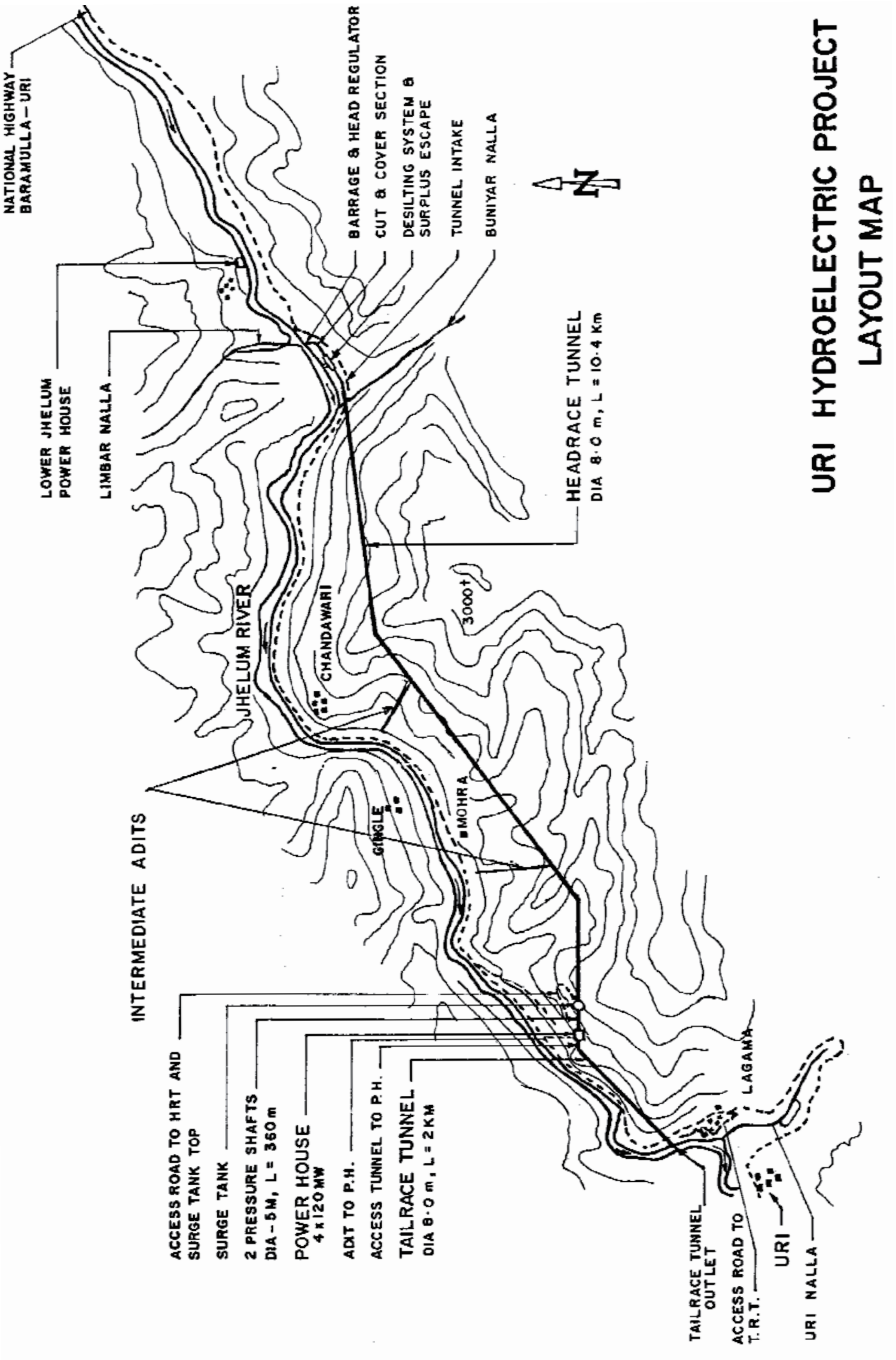
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1986	80.82	123.77	261.19	687.13	852.92	503.35	592.69	492.25	131.67	120.09	161.46	281.64
	84.61	149.43	324.48	977.03	656.52	658.78	523.71	381.54	112.30	153.76	223.22	262.66
ave	**81.41**	**124.08**	**262.23**	**739.58**	**830.92**	**539.50**	**600.06**	**482.93**	**156.14**	**135.12**	**163.41**	**256.92**
	181.59	196.35	433.21	658.84	498.88	473.57	407.30	349.31	266.77	153.93	103.64	81.92
1987	150.39	241.94	442.11	591.81	504.60	452.72	397.51	320.20	230.50	122.78	93.13	83.45
	151.89	337.05	542.12	771.31	504.85	427.52	377.52	289.14	188.98	113.01	87.50	81.55
ave	**161.29**	**258.45**	**472.48**	**673.99**	**502.78**	**451.27**	**394.11**	**319.55**	**228.75**	**129.91**	**94.76**	**82.31**
	57.20	116.10	267.14	571.09	649.44	430.44	301.12	612.43	183.12	480.02	111.17	53.80
1988	65.69	144.98	674.07	596.06	552.09	283.36	475.97	402.89	111.00	237.18	54.31	54.93
	99.93	182.58	573.95	661.59	484.72	268.36	593.06	269.18	219.99	120.46	53.80	78.27
ave	**74.27**	**147.89**	**505.05**	**609.58**	**562.08**	**327.39**	**456.72**	**428.17**	**171.37**	**279.22**	**73.09**	**62.33**
	97.13	71.08	120.74	494.83	601.44	794.05	344.16	653.74	221.66	103.64	146.30	74.76
1989	82.34	68.24	216.17	432.05	605.83	686.02	305.42	368.34	129.97	115.15	101.94	74.47
	56.89	92.74	332.24	372.22	743.73	354.69	392.95	214.78	83.05	129.00	97.98	106.31
ave	**78.79**	**77.35**	**223.05**	**433.03**	**650.33**	**611.59**	**347.51**	**412.29**	**144.89**	**115.93**	**115.40**	**85.18**
	77.59	224.26	180.54	612.26	717.32	581.82	463.38	178.72	210.17	112.70	76.74	48.99
1990	71.93	232.94	340.82	614.91	815.72	367.21	389.57	275.90	186.70	85.80	61.73	48.70
	126.14	189.97	922.60	635.25	765.82	353.11	223.36	233.26	147.25	74.14	54.37	96.38
ave	**91.89**	**215.72**	**481.32**	**620.81**	**766.29**	**434.05**	**358.77**	**229.30**	**181.37**	**90.88**	**64.28**	**64.69**
	181.99	198.22	437.07	1236.92	834.43	988.64	670.56	431.54	313.89	258.50	85.18	63.80
1991	157.44	325.61	526.77	1340.73	809.09	990.00	652.87	383.07	298.31	158.01	59.24	66.63
	144.16	321.39	637.43	838.62	1059.41	884.27	626.36	313.92	294.92	117.32	72.21	72.80
ave	**161.20**	**281.74**	**533.76**	**1138.76**	**900.98**	**954.30**	**649.93**	**376.18**	**302.37**	**177.94**	**72.21**	**67.74**
	74.81	276.14	236.41	772.47	1017.81	869.01	716.52	407.59	402.46	366.64	147.42	128.25
1992	73.54	214.64	318.08	679.43	992.66	765.79	635.96	544.41	1428.57	244.94	121.48	120.26
	111.14	176.33	824.12	979.24	894.49	709.44	436.39	419.57	933.17	176.27	143.90	124.56
ave	**86.50**	**222.37**	**459.54**	**810.38**	**968.32**	**781.41**	**596.29**	**457.19**	**921.40**	**262.62**	**137.60**	**124.36**
	196.60	155.17	295.71	658.53	869.26	770.97	713.46	519.72	145.80	201.39	124.54	115.16
1993	185.53	271.87	560.50	624.78	1110.35	533.11	1083.73	301.12	197.34	157.21	149.26	100.72
	169.28	318.67	906.98	639.24	990.91	699.28	1221.40	165.42	206.00	110.94	115.13	95.94
ave	**183.80**	**248.57**	**587.73**	**640.85**	**990.17**	**667.79**	**1006.20**	**328.75**	**183.05**	**156.51**	**129.64**	**103.94**
	103.21	196.23	356.70	830.13	670.59	707.35	590.03	448.02	541.95	391.90	83.25	86.09
1994	94.01	153.53	399.32	553.81	893.41	713.21	548.86	448.34	524.00	325.78	72.49	137.62
	121.70	201.44	492.76	403.88	895.23	600.25	605.07	550.70	280.87	345.69	60.60	98.08
ave	**106.31**	**183.73**	**416.26**	**595.94**	**819.74**	**673.60**	**581.32**	**482.35**	**448.94**	**354.46**	**72.11**	**107.26**
	148.95	101.38	256.47	628.05	749.05	728.31	442.94	1245.18	328.43	166.18	150.72	34.81
1995	104.21	300.50	249.52	606.03	787.22	570.84	351.14	1042.08	265.22	179.93	155.12	97.84
	93.71	274.67	695.58	729.18	895.17	523.87	964.75	738.35	157.77	140.28	86.47	116.63
ave	**115.62**	**225.51**	**400.52**	**654.42**	**810.48**	**607.67**	**586.28**	**1008.54**	**250.47**	**162.13**	**130.77**	**83.09**
	111.51	102.66	321.07	667.74	727.94	925.35	1371.56	460.54	972.59	196.92	122.23	87.96
1996	121.28	248.57	699.77	576.18	712.20	986.06	976.14	396.26	286.01	185.67	80.97	79.74
	104.83	311.42	895.62	624.30	891.98	1426.76	567.54	938.36	187.60	164.49	87.21	73.54
ave	**112.54**	**220.88**	**638.82**	**622.74**	**777.37**	**1112.72**	**971.75**	**598.39**	**482.07**	**182.36**	**96.80**	**80.41**
	78.11	70.83	116.50	299.21	573.47	472.34	421.06	238.74	702.10	125.92	121.70	127.89
1997	61.85	40.00	190.40	405.47	522.64	431.64	262.14	185.53	398.06	120.43	114.12	123.10
	66.66	78.40	266.70	430.60	464.43	429.63	224.28	319.68	177.20	121.01	107.44	99.11
ave	**68.87**	**63.08**	**191.20**	**378.43**	**520.18**	**444.54**	**302.49**	**247.98**	**425.79**	**122.45**	**114.42**	**116.70**
	84.39	122.70	327.07	666.16	883.23	582.76	444.36	157.87	118.85	145.22	68.08	53.47

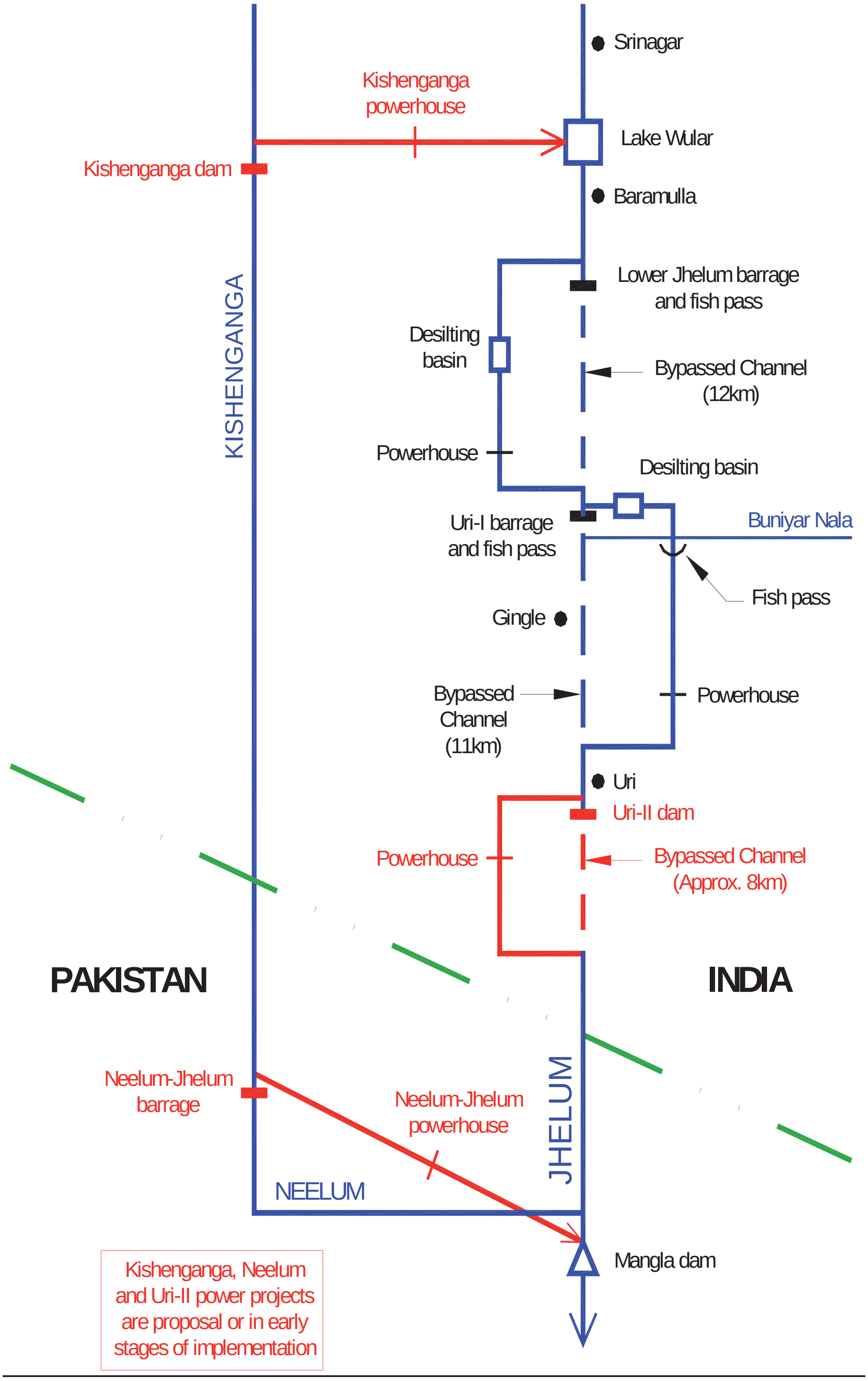
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1998	118.95	183.40	307.94	761.02	651.81	441.80	402.93	147.67	130.39	91.69	60.12	48.44
	110.90	199.88	431.71	883.73	631.42	386.87	302.52	145.53	154.09	86.53	54.15	48.29
ave	**104.75**	**168.66**	**355.57**	**770.30**	**722.15**	**470.48**	**383.27**	**150.36**	**134.44**	**107.81**	**60.78**	**50.07**
	46.85	87.02	206.02	251.57	363.43	155.83	86.17	125.65	105.90	80.25	62.09	47.45
1999	49.19	124.87	214.89	329.50	364.29	99.45	88.45	164.32	85.50	59.75	80.21	57.26
	76.36	134.88	188.51	308.43	278.19	106.32	94.07	125.19	84.25	42.49	62.11	82.57
ave	**57.47**	**115.59**	**203.14**	**296.50**	**335.30**	**120.53**	**89.56**	**138.39**	**91.88**	**60.83**	**68.14**	**62.43**
	40.51	76.11	94.16	220.60	275.29	181.04	264.04	105.13	293.30	98.15	38.72	40.83
2000	52.95	83.70	122.19	222.17	361.31	105.52	335.49	85.28	191.88	85.80	39.49	44.97
	62.18	66.01	138.70	287.21	305.22	93.47	291.31	175.64	119.00	97.72	41.95	47.13
ave	**51.88**	**75.27**	**118.35**	**243.32**	**313.94**	**126.68**	**296.95**	**122.01**	**201.39**	**93.89**	**40.05**	**44.31**
	40.87	34.53	47.45	118.94	261.14	126.85	114.18	152.29	79.85	56.35	86.31	48.73
2001	36.43	31.25	57.96	173.73	346.14	114.73	104.04	115.56	77.85	50.80	66.21	50.98
	37.13	48.60	82.60	192.20	253.57	149.29	116.75	105.51	78.45	45.68	56.39	50.79
ave	**38.14**	**38.13**	**62.67**	**161.62**	**286.95**	**130.29**	**111.66**	**124.45**	**78.71**	**50.94**	**69.64**	**50.16**
	43.91	64.55	153.20	451.39	435.55	317.96	234.84	64.22	152.00	105.57	51.64	42.48
2002	77.68	88.73	204.05	487.14	523.67	214.30	129.13	154.36	156.32	72.31	46.60	42.27
	72.61	181.64	378.52	548.76	517.30	287.00	85.94	142.63	156.49	61.49	43.03	46.53
ave	**64.73**	**111.64**	**245.26**	**495.77**	**492.17**	**273.09**	**149.97**	**120.40**	**154.94**	**79.79**	**47.09**	**43.76**
	40.55	40.37	382.14	423.30	922.13	634.23	295.90	169.16	153.54	175.90	58.93	54.22
2003	36.62	70.19	369.88	651.57	770.97	523.56	253.79	142.76	170.05	126.80	55.07	91.83
	35.82	216.67	391.24	688.63	708.38	362.75	178.31	143.35	157.71	85.64	61.44	80.71
ave	**37.66**	**109.08**	**381.09**	**587.83**	**800.49**	**506.85**	**242.67**	**151.76**	**160.43**	**129.45**	**58.48**	**75.59**
	87.46	114.86	233.20	204.57	609.33	275.96	175.25	96.43	95.46	78.07	68.73	58.88
2004	84.02	149.22	313.57	262.85	548.00	187.43	172.61	96.57	67.93	95.07	52.92	48.96
	91.79	180.43	443.07	328.60	436.00	201.78	110.75	104.20	84.61	87.01	49.11	51.70
ave	**87.76**	**148.17**	**329.95**	**265.34**	**531.11**	**221.72**	**152.87**	**99.07**	**82.67**	**86.72**	**56.92**	**53.18**
	105.02	94.35	167.33	493.68	553.21	467.14	564.72	316.03	111.20			
2005	81.14	174.20	206.89	445.36	571.08	459.75	600.65	190.53	123.04			
	73.06	162.74	629.06	540.11	468.86	489.38	506.85	152.48	126.28			
ave	**86.40**	**143.76**	**334.43**	**493.05**	**531.05**	**472.09**	**557.41**	**219.68**	**120.17**			

Annex F Determination of Water Quality & Compensation Flows

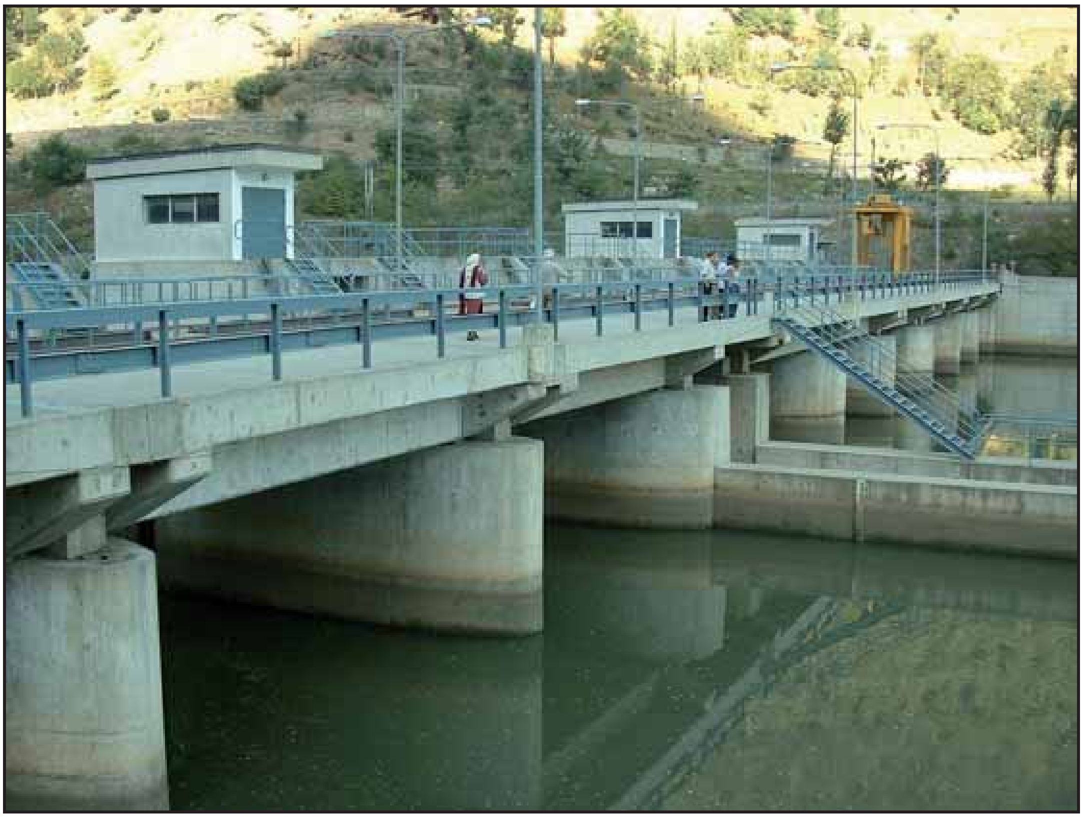
Date	Reference Documents	Position
1989	Sida Appraisal Report	Proposes surveys and assessment of aquatic environment
August 1990	POE Report	POE advised NHPC of the need for a water quality monitoring study, leading to implementation of a water quality management plan.
May 1993	Monitoring Team Report	Restates government-to-government agreement that investigations of impact of waste from Gingle should be performed, as a desk study, by NHPC and a report had been expected in January 1992. (It may be assumed that Gingle colony and septic tank would have been constructed and operational in 1993 or soon afterwards).
October 1995	POE Report	POE again concerned about signs of organic pollution and need for regular monitoring of water quality. Sida had advised water quality monitoring equipment should be procured with NHPC funds. NHPC had approved this proposal; equipment expected within current financial year. POE suggested that NHPC should prepare a sampling and analysis schedule for POE review.
November 1995	Monitoring Team Report	Noted POE's concerns about water quality (Oct 1995) and receipt of mid-term report of IFR (Sep 1995) on biological status of the river – water quality, fish and benthic fauna. IFR had recommended, inter alia, a guaranteed minimum flow (5–10 m^3/s).
February 1996	POE Report NB. 12 months before project completion	Water quality monitoring equipment not yet received by NHPC. NHPC monitoring expected to begin later in the year. Very critical POE comments made on IFR's mid-term report (Sep 1995) – too much on environmental audit, not enough on impact assessment, especially on water quality, no justification for some comments and recommendations. POE shifting responsibility for water quality matters to NHPC. No specific comment made on compensation water releases for dilution of Gingle and other effluents.
April 1996	Monitoring Team Report	Noted NHPC's response to IFR's mid-term recommendations. Regarding a guaranteed minimum flow, NHPC responded that only the first kilometre below the barrage needed a certain minimum flow to maintain aquatic biodiversity and "this matter will be taken care of". The assumption was made that perennial flow of the Buniyar Nallah (and other minor inflows, plus any fish pass flow releases for the first kilometre) would satisfy requirements of the remaining 10 km.
April 1997	Monitoring Team Report	Noted periodic water quality monitoring by NHPC would continue.
May 1997	POE Final Report	Noted NHPC had conducted a water quality survey in winter months of 1996, showing low to moderate pollution. Recommendations made for continuing monitoring in low and high flow conditions for preparing and implementing water pollution control measures, if necessary.
November 1997	Monitoring Team Final Report	Noted the fourth and final surveys of fish, benthic fauna and water quality by IFR were ongoing and final report expected in April 1998. NHPC water quality surveys in December 1996 and July 1997 indicated "no pollution" of the river.

Annex G Illustrations of the Scheme Layout and Components

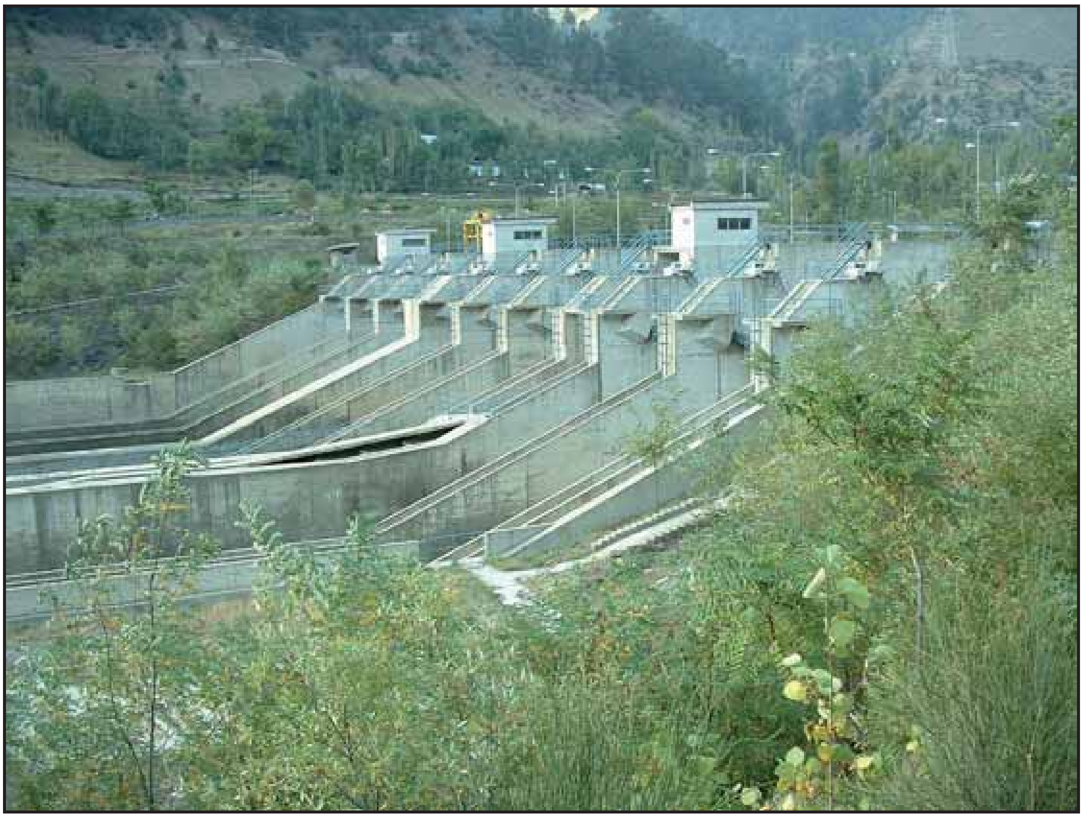



Srinagar
Kishenganga powerhouse
Lake Wular
Kishenganga dam
Baramulla
KISHENGANGA
Lower Jhelum barrage and fish pass
Desilting basin
Bypassed Channel (12km)
Powerhouse
Desilting basin
Uri-I barrage and fish pass
Buniyar Nala
Fish pass
Gingle
Bypassed Channel (11km)
Powerhouse
Uri
Uri-II dam
Powerhouse
Bypassed Channel (Approx. 8km)
PAKISTAN
INDIA
Neelum-Jhelum barrage
Neelum-Jhelum powerhouse
JHELUM
NEELUM
Mangla dam
Kishenganga, Neelum and Uri-II power projects are proposal or in early stages of implementation

Annex H Photographs taken during the Evaluation



1. Upstream face of Uri barrage



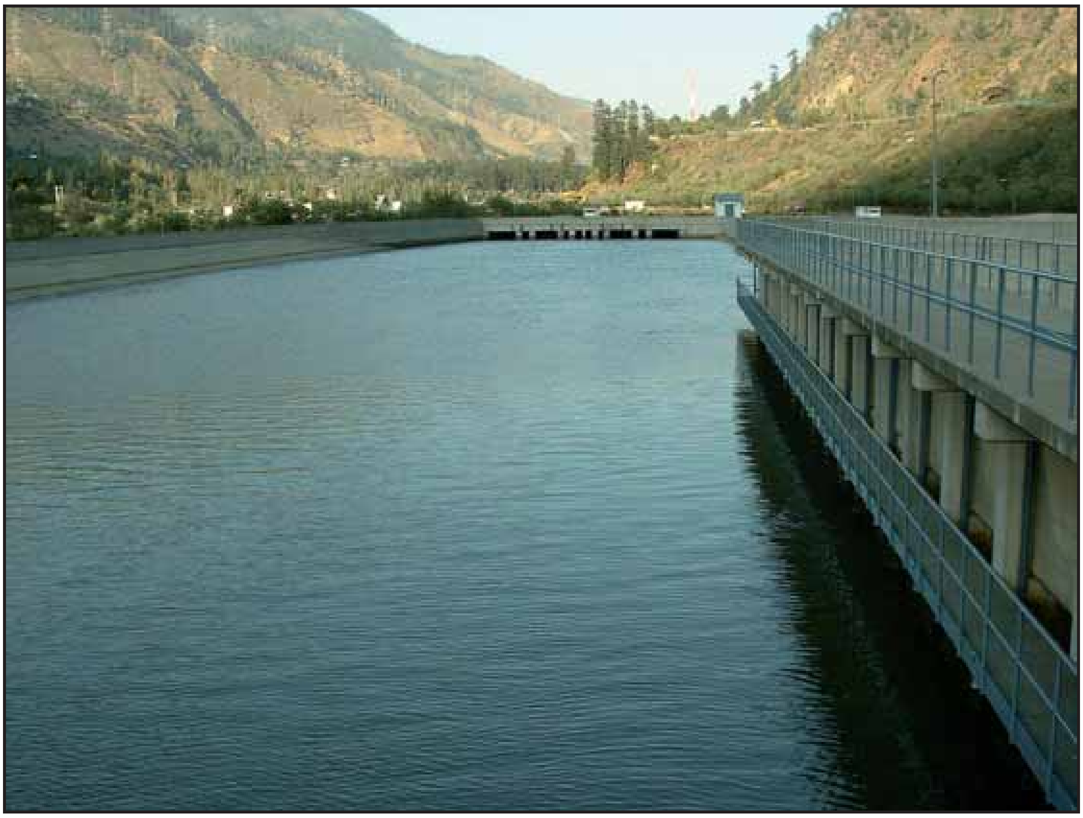
2. Downstream Face of Uri Barrage

3. Uri Barrage Stilling Basin

4. View of Headpond from Uri barrage

5. Radial Gate at Uri Barrage

6. Project Team at Uri HEP



7. Lefthand side De-sanding Pond

8. Reject Siphon Spillway

9. River Channel downstream of Uri Headworks

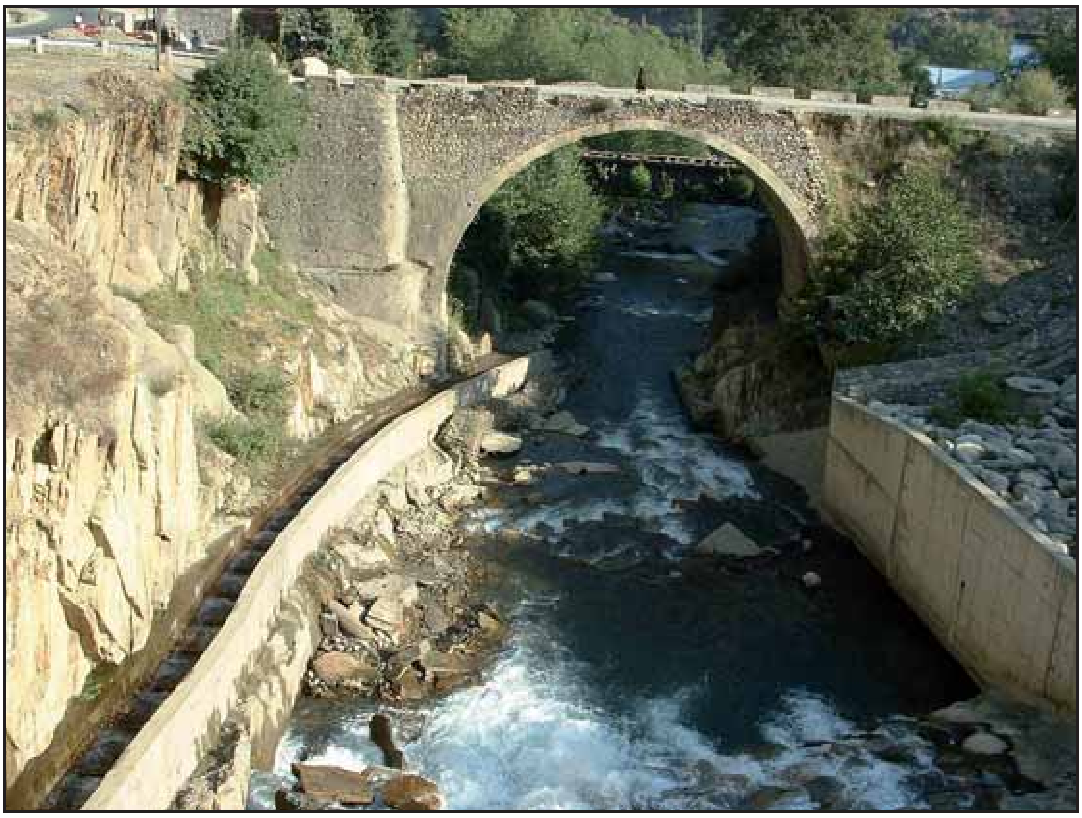
10. Canal Leading to Headrace Tunnel

11. Transmission Line from Uri HEP to Wagoora

12. Landscaped Spoil Disposal Area


13. Bus Using "Parallel Road"


14. Fish Pass (left of picture) at Uri Barrage



15. Buniyar Nallah Fish Pass

16. NHPC Operator's Village shortly after 8th October 2008 Earthquake

Supplementary Socio-Economic Studies – Report June 2008

Acronyms, Abbreviations and Definitions

ADB	Asian Development Bank
BPL	Below Poverty Line
BSF	Border Security Force
CISF	Central Industrial Security Force (responsible for security at Uri HEP)
EPC	Engineering Procurement and Construction
GOI	Government of India
Govt.	Government
GRC	Grievance Redressal Cell
ha	Hectare
HCC	Hindustan Construction Company (contractor on Uri-II)
HEP	Hydroelectric Project
INR	Indian Rupees
J&K	Jammu and Kashmir
km	kilometre
KV	Kenrya Vidhyalaya (Secondary School)
LJHEP	Lower Jhelum Hydroelectric Project
MOSPI	Ministry of Statistics and Programme Implementation (Government of India)
MW	Megawatts (=1000 watts)
NGO	Non-governmental Organisation
NH-1A	National Highway-1A
NHPC	National Hydroelectric Power Corporation (of India)
pacca (house)	durable block or brick built house with solid roof
PAF	Project-affected families
PAP	Project-affected persons
PHC	Primary Health Centre
PHE	Public Health Engineering (Department)
PRA	Participatory Rural Appraisal
PWD	Public Works Department
Rs	Rupees
SC	Scheduled Caste
SEK	Swedish Kroner
Shamlat (land)	Land owned by the village / community
SIA	Social Impact Assessment
Sida	Swedish International Development Cooperation Agency
ST	Scheduled Tribe
Tehsil	Administrative Division
TV	Television
UHEP	Uri Hydroelectric Project
URICO	Uri Consortium (EPC Contractor)
WHH	Women Headed Households

Executive Summary

1 Introduction and Methodology

The 480 MW Uri Hydro Electric Project (UHEP) on the Jhelum River in Jammu & Kashmir State of India was constructed by a Swedish-British Consortium between the years 1989 to 1997. Funding for the offshore components of the project was provided by the Government of Sweden and the United Kingdom whereas the INR Component was funded by National Hydroelectric Power Corporation (NHPC) and Government of India (GOI).

As part of its routine procedures Sida has commissioned an independent evaluation of the Swedish Support for the Uri Hydro Electric Project. The initial assessment carried out by Scott Wilson in 2005 was interrupted by the massive earthquake which stuck north Pakistan and India in October 2005, which disrupted the socio-economic fieldwork. As a consequence Sida has commissioned this supplementary study, in order to carry out a more detailed assessment of this aspect of Uri HEP.

2 Objectives of the STUDY

The objective of this supplementary social evaluation is to ascertain the "Pre and Post Construction Social Scenario" of the Project-Affected Families, villages and the area as a whole due to construction and operation of Uri HEP, and in particular to:

- Identify and analyse project related effects and how the socio-economic issues were addressed during project planning and implementation stages.
- Determine the living conditions of affected families.
- Establish the impacts on public health in the affected area that could be attributed to the project.
- Evaluate the planned or unplanned social mitigation measures adopted during construction and post-construction.
- Evaluate the capacity building programmes for the project-affected families.
- Analyse the project's direct and indirect effects on commercial and other income generating activities.
- Analyse the project's direct and indirect effects on social and other service facilities.
- Establish and analyse the impacts of facilities provided by NHPC for local people.

3 Socio-economic Context

3.1 Demographics and Administration

The project is situated in the State of Jammu and Kashmir (J&K) which is the most northerly state in India. The region includes disputed territory between India and Pakistan, and the de-factor border between these two countries, the "line of control" runs some 15 km to the east of Uri HEP.

Some of the key indicators for the State of J&K are as follows:

Area:	106,567 km^2 (3.24% of India's total)
Divisions:	Kashmir (8 districts); Jammu (6 districts)
Capital:	Summer (May–Oct) – Srinagar Winter (Nov–Apr) – Jammu
Population (2001):	10,069,917 (0.98% of India's total)
Literacy Rate:	54% (compared with 65.4% all-India average)
Religion:	Predominantly Muslim
Project Location:	Uri Tehsil, Baramula District
Baramula area:	4,588 km^2 (4.3% of J&K)
Baramula population (2001):	1,116,722 (10.5% of J&K)
Baramula literacy rate:	44.5%
Baramula population growth rate (2001):	2.8% (J&K – 2.63%)

3.2 Economic Development of J&K

Despite the militancy in J&K the Gross Domestic Product of the State has continued to grow in recent years, both in INR and in USD terms. The compounded annual rate of growth during the twelve year period 1993–94 to 2005–06 is 11.2% in current INR prices, or 4.9% in constant prices. This is a respectable rate of growth considering the disruption to the economy caused by the militancy in the region.

It is believed that in addition to the official economy reflected in the Government statistics, a substantial parallel economy exists based on unrecorded inflow of funds.

A substantial share of GDP is derived from Agriculture, Forestry and Fishing, although the aggregate share from these sectors has declined from 33% in 1993–94 to 29% in 2005–06. Manufacturing accounts for a very small share of GDP, and has declined from 8% in 1993–94 to 5% in 2005–06. Services account for a large part of GDP, rising from 45% in 1993–94 to 52% in 2005–06. Of this Public Administration has seen the biggest growth, followed by banking and insurance services.

3.3 Insurgency

The most significant factor affecting the project area over the past 20 years is the rise of insurgency and militancy in Jammu and Kashmir. The initial signs of the insurgency started with a series of bomb attacks and kidnappings in late 1988, at the time that the contract for construction of Uri HEP was being negotiated.

The level of insurgency increased through the late 1980s and early 1990s to a level where all aspects of life in J&K were affected. The construction of Uri HEP was also affected, as discussed in Section 2.6 of the Main Report.

3.4 Tourism

Prior to 1988 tourism was one of the major economic activities in J&K, with nearly three-quarters of a million tourist arrivals in 1988. The tourism industry virtually ceased following the start of the insurgency in the late 1980s. A minor re-emergence of tourism in the late 1990s was short-lived.

3.5 Poverty Level

There has been a remarkable reduction in the percentage of the population living below the poverty level (the "Poverty Ratio") in J&K over the period between 1993 and 1999. This reduction is most pronounced among the rural population. In 1993 the J&K Poverty Ratio was comparable to the average for India (30.3% J&K compared with 32.3% for all-India). By 1999 the Poverty Ratio in J&K was 4.0%, compared with the average for India of 27.1%. A similar, although less pronounced, reduction in Poverty Ratio is observed for the Urban Population in J&K.

The reduction in Poverty Ratio in J&K has been explained as resulting from the social structure providing support at the poorest levels. An alternative explanation, not accorded much credulity, is that the enumerators in 1999–00 were unable or unwilling to enter poor rural areas to collect data.

3.6 Basic Infrastructure

Typically the level of basic infrastructure, measured in terms of quality of housing, access to potable water, telephone connections and use of banking facilities, in J&K is generally comparable with that of the rest of India, with the exception of the percentage of households with electricity connections. The provision of electricity in J&K, and particularly in the Kashmir Valley, is a tradition dating back to the establishment of the first hydroelectric scheme at Mohra in 1907. It is expected that all but the most remote households in J&K will have access to electricity within a few years.

Per capita electricity consumption in J&K remained fairly static during the period of construction of Uri HEP. It is likely that this is partly due to supply constraints, since during this period demand for electricity exceeded supply on the Kashmir Grid. On completion of Uri HEP additional supplies became available from the project itself, and from the interconnection of the Kashmir Grid with the Northern Grid. This was less of an issue in the Jammu area, which was already interconnected with the Northern Grid.

3.7 2005 Earthquake

On the morning of 8th October 2005 a massive earthquake registering 7.6 on the Richter scale struck the Western Himalayas. The epicentre of the earthquake was some 20 km north of Muzaffarabad. This is around 125 km WNW of Srinagar, and around 60 km from Uri town.

The devastation caused by the earthquake is reflected in the casualty toll: around 3 million people affected and around 80,000 fatalities (the great majority on the Pakistan side of the Line of Control).

The earthquake was felt with an intensity of IX at Uri, with a consequence that most stone masonry houses at Uri and closer to the epicentre were destroyed, although the earthquake did not affect Uri HEP.

Since the earthquake there has been considerable reconstruction activity in the project area. Initially the relief efforts were led by the Army. However the state government and a range of NGO's quickly took over, and new houses, public infrastructure and other facilities have been constructed.

4 Survey of Affected Villages

The area affected by Uri HEP spreads over nearly 35 km along the National Highway 1A. Land was required for construction of the various project components such as the barrage complex, power house complex, labour colony, administrative complexes, residential colonies and for dumping of spoil. Approximately 300 ha of land were acquired for this purpose, of which 191 ha was private land.

As a consequence of land acquisition for the main project 246 families were affected in 12 villages. Of these 246 families, 77 families in 10 villages were severely affected due to acquisition of their houses and land, while 169 families were partly affected due to acquisition only of their land.

In addition 20 ha land was acquired for construction of the road parallel to the National Highway 1A on the right bank of river Jhelum (the "Parallel Road") for transportation of materials. As a consequence of acquisition of this land 225 families were affected. Of these, 44 families were displaced due to acquisition of their houses or shops.

In total for the construction of the various project components and Parallel Road 471 families were affected, out of which 121 families lost their houses and land.

The most severe impacts of the project were experienced by those families which lost both their houses and land.

4.1 Socio-economic Conditions

It became apparent during the field surveys that the original affected families have been divided into multiple families over the past 15 years. The average original affected family is now divided into three families, and hence around 1400 families now represent the original 470 affected families.

The number of children per family varies from 2 to 8, and the average number of children per family is 4. It was considered during discussions with these families that awareness of family planning methods is limited.

Most of the families surveyed send their children to schools. The literacy level among these children is encouraging, and the overall literacy level among these children is estimated to be around 85%.

The sources of earning of livelihood in the Uri HEP area are limited. The majority of the population of the area is traditionally dependent on agricultural related activities. However the existing hydroelectric schemes and those under construction also provide employment. Other sources of employment in the area are services to the Army, State Government departments, and private commercial and business activities.

Our surveys show that of the adults of working age in the affected families, the largest group of about 37% are engaged in cultivation; the next largest group is 28% employed as labourers on daily wages in agricultural and other activities; 12% are employed in Government Services or the Army; 6% are engaged in small business activities; the remaining 17% are non-workers or un-employed.

Only 9 persons among the affected families, representing less than 1% of the employable adults in the Project-affected Families, are working in NHPC as regular employees.

On average there are 1.4 employable adults (adults of working age) per family.

Based on the field interviews with the affected families and physical surveys of their living standards, the income from all the sources of the households of affected families varies from INR 3,500 to INR15,000 per month (equivalent to USD 140 to USD 600 per month at current exchange rates). On average 60% of families have a monthly income less than INR 4,000 (USD 160) per month and around 28% of families have income greater than INR 6,000 (USD 240) per month.

The type of house occupied by a family is generally a good indicator of its living standard. However in the case of the project area this is not applicable, as most of the non-durable houses in the area were damaged in the October 2005 earthquake. New “pacca” (durable) houses have been constructed to replace these damaged houses using aid granted by the State Government and with support from NGOs. As a consequence the survey conducted after the earthquake recorded 90% of the families occupying “pacca” houses constructed with bricks, cement and masonry.

About 60% of families have television sets in their houses; about 8% of families have motor vehicles such as motor cycles and four-wheelers.

4.2 Infrastructure in the Project Area

Assessments were carried out of the access of the people in the project area to basic amenities such as education facilities, medical/health centres, drinking water, sanitation, access roads and electricity. Access to civic amenities including banks, post offices, markets and communication facilities have also been surveyed.

It is observed that in most cases these basic and civic amenities result from the implementation of various State and Central Government social and economic development programmes, and are largely unconnected with Uri HEP.

Generally the project area is well-served by the National Highway, which provides good access along the south bank of the Jhelum River. The "Parallel Road" constructed as part of the project, and now handed over to the State Government, provides much improved access to the several villages on the north bank.

Medical facilities in the project area are typically restricted to primary health care. More serious conditions require transportation to either Uri or Baramula.

NHPC runs a Dispensary in the Gingle Colony with trained doctors and medical staff. However access to the Dispensary does not appear to be freely available to the local population.

Primary schooling is generally available in most villages of the project area. However access to secondary and tertiary education is more restricted, and requires travel to the major towns.

NHPC runs a Secondary School (Kendrya Vidhyalaya) in the Gingle Colony, but attendance by students from the local population is limited to 12% of the enrolment.

Civic amenities such as banks, post offices and police posts are available in the largest towns and villages, and the population from the smaller villages need to travel to get access to these facilities. Most villages have shops and markets selling food and general goods.

5 Rehabilitation Procedures

Land acquisition for the project was partly governed by the J&K Land Acquisition Act. The land and property acquisition requirements and the powers of the Officers for the project were notified by the District Collector through a Public Notice in the Government Gazette, in accordance with Section 4 of the J&K Land Acquisition Act. Following the publication of the Notice, private negotiations were carried out with the representatives of the affected families. The basis of compensation was the official schedule of prevailing rates for land and structures, although compensation paid generally appears to have exceeded the statutory rates.

An important factor is that the Rehabilitation Plan for affected families was not prepared by NHPC in association with the State Government before the start of the land acquisition process in 1990. However in 1992 NHPC prepared *"Rehabilitation Plan of Uri HE Project"* by which time the land acquisition and compensation disbursement processes were almost over.

Public consultations were not carried out prior to the acquisition procedure.

Most of the affected people were opposed to the acquisition as their livelihood was based on agriculture. In view of this the State Government and NHPC issued an "Assurance Certificate" on 29 August 1991 which promised:

Employment at least one member of dislocated families,

- Housing
- Colony
- Medical Facilities
- Free Education
- Free Power
- Families Insurance Scheme and other project provision for rehabilitation.

However it is considered by the project-affected families that the above assurances were not honoured in full.

For the acquisition of property only cash compensation was provided, and this was given only to legal titleholders, following private negotiations with representatives of the affected families.

In the field survey it was claimed that part of the cash compensation (about 20%) is still pending for about 25% of the affected families; this has also been confirm by NHPC.

Non-title holders, such as occupiers of Shamlat (common) Land, tenants, encroachers and squatters, whose livelihood was based on land were not paid any compensation when the land was acquired. The cases of these affected families are still pending in the courts.

Socially vulnerable groups were not given any special consideration during the rehabilitation process.

The compensation package for affected families was restricted to payment of cash. No other benefits or allowances were paid and no income restoration and rehabilitation programmes were organised. It is apparent that many of these families at the time were not aware of alternative sources of income generation or investment, and hence were poorly equipped to sustain their livelihoods.

6 Post Project Social Impacts

6.1 Employment during Construction

During the construction phase the Contractor, Uri Consortium (URICO), employed more than 4,700 Indian Nationals at the peak of the construction activity between 1993 and 1995, of whom the majority were recruited locally. A total of around 9,000 people were employed during the seven-year construction period.

URICO promised to employ at least one person from each project-affected family, and it appears that this promise was fulfilled.

The wage levels paid by URICO were around four times higher that those paid by other local employers including NHPC.

Some 25 to 30 people from the local area who were trained during the course of construction have obtained construction employment elsewhere in India and in the Middle East.

6.2 Employment during Operation

NHPC currently employs 216 staff at Uri HEP, of whom only 9 are from project-affected families, and 93 are from Uri Tehsil. A further 50 or so local people are employed by contractors providing services to NHPC, such as trash collecting at the barrage.

6.3 Improvement in Access

There have been significant improvements to the regional and local transportation infrastructure as a consequence of the project. The main highway serving the area (National Highway 1A) was upgraded for construction of the project, and a “Parallel Road” on the right-bank of the river was constructed. This now provides good access for villages north of the Jhelum River.

6.4 Resettlement Issues during Land Acquisition

Since only cash compensation was paid for the loss of property, and this was only paid to title-holders of the properties, it has been difficult for those who lost property to sustain their livelihoods. Some of the previous landlords have become labourers. This is exacerbated by the failure of NHPC to give preference to project-affected families for employment during the operation of the project, although NHPC contends that the promise to provide employment only related to the construction period.

6.5 Reasons for Positive or Negative Impacts

Adverse Impacts

1 No social studies and public consultations were conducted among the affected families prior to land acquisition to understand the problems of those who would lose their land.

2 The Resettlement Plan was not prepared in advance of the property acquisition; the Rehabilitation Plan was only prepared in 1992 when land acquisition and payment of compensation were almost completed.

3 The resettlement package was entirely based on cash compensation, without options such as replacement land and houses, land-less allowances, transportation assistance, jobs for land-less families, water supplies to replace natural water sources, education and medical facilities, as would now be expected.

4 NHPC did not have a plan for recruiting members of affected families as long-term employees, so that they could sustain their livelihood and quality of life.

5 NHPC did not organise any awareness programs or vocational training for income restoration and replacement.

6 There was no monitoring and evaluation program for distribution of compensation. Part of the compensation for many affected families appears still to be owed 15 years after payment was due.

7 There was no grievance redressal mechanism established for the affected families. As a consequence dissatisfaction among the project-affected families has resulted in litigation.

8 Most of the project-affected families maintain that the Kendriya Vidhyalaya (Secondary School) and dispensary facilities located within the Gingle Colony premises are not generally available for affected and local people.

9 Various welfare activities organised by NHPC from time-to-time are considered to be insignificant and cosmetic in nature, and do not give significant direct and indirect benefits to the affected families and locals.

Beneficial Impacts

1 Many people from the local area, including project-affected families, were employed at attractive rates by URICO Contactor during the construction period. It is considered that local people received very substantial benefits and enjoyed an "improved quality of life" for about seven years.

2 NHPC currently provides employment to 216 persons, of which 93 belong to Uri Tehsil.

3 The communications infrastructure, has been substantially upgraded, providing significant benefits for the local population.

4 About 14 shops have been opened by local people outside the Gingle Colony to serve the residents of the Colony.

5 About 17 local vehicles have been hired by NHPC from local people on a monthly basis, providing employment and income.

6 Around 50 local people work for various contractors at the Uri barrage, guesthouse, Colony and NHPC Office.

7 NHPC contributed to water supply to part of Boniyar and Gingle villages.

8 NHPC occasionally organises welfare programs, such as book distributions in schools and medical camps in villages, for the benefit of the local community.

6.6 Utilisation of Compensation by Affected Families

Studies and interviews carried during the fieldwork indicate that most of the project-affected people did not have an adequate awareness of investment schemes, income substitution methods and proper utilisation of compensation to sustain their quality of life and livelihood.

No significant awareness programmes and income restoration vocational training was provided for the project-affected families.

In view of the high level of militancy and lack of industrial activity in area the affected families did not have many options for income restoration.

Use of Compensation

1 About 80 project-affected spent their compensation on building another house, on weddings and on routine household expenditure. Very soon they had spent the entire compensation package in an unplanned manner.

2 About 5% of project-affected families invested their compensation money in the purchase of public-carrier vehicles. However as they did not have any experience of operating transportation vehicles they were generally unable to run profitable businesses.

3 Only about 15% of the project-affected families spent their compensation in a planned manner. Typical expenditure by this group includes education of their children and purchase of assets and investments.

4 In the absence of a grievance procedure some project-affected families instigated litigation against NHPC, spending a substantial part of compensation on lawyer's fees, court costs, and travel to pursue their cases.

6.7 Impacts on the Public Health of the Area

During construction the natural water supplies to some villages were destroyed. Replacement supplies have been provided to some areas, but others still remain without adequate supplies. This has been reported to have affected the health of some local residents.

Residents who live adjacent to Uri barrage complain of disruption to their sleep from the noise of the hooter which is sounded when water is discharged.

6.8 Direct and Indirect Effects on Income Generating Activities

As result of construction and operation of Uri HEP, positive peripheral impacts can be clearly observed in the area. About 14 shops have been opened by local people outside Gingle Colony. At other villages around 30 shops are flourishing largely as a result of the purchasing capacity of NHPC employees and people associated with Uri HEP.

About 17 vehicles have been hired by NHPC from local people on a monthly contract basis, which gives employment to 17 local drivers plus support staff and provides an income stream in the area.

Numerous small contracts are awarded by NHPC for maintenance of their guest houses, Colony and other facilities. Most of these are awarded to local residents and the workers deployed for these works also come from the local area.

In total, in addition to the 216 people directly employed by NHPC on Uri HEP, a further 200 or so people derive their livelihood directly or indirectly from the project. Since each household on average has 1.4 income earners, this suggests that some 300 families derive their livelihood from Uri HEP, supporting a total of 1800 local people.

A number of banks were opened in the major towns and villages of the area to cater for the needs of construction workers, and these now serve the local communities.

The improvements in the transportation infrastructure due to the project results in reduced distribution costs for commodities reaching the area and reduced transportation costs for export of products from the area.

6.9 Gender Issues

It is traditional in this area, partly as a result of the Islamic Culture, that the women are not allowed to work as labourers, although women may work on their own agricultural land. Families which lost the majority of their land were left with unemployed females, who had previously worked on their own farms. This has affected the economic and social status of these families. No specific efforts have been made to provide employment opportunities for these women.

During interviews it was apparent that women would be willing to work in Centres where commercial activities such as sewing, embroidery and knitting could be undertaken.

7 Lessons Learnt

The social performance evaluation of Uri HEP has been carried out taking into account the rehabilitation measures adopted during the land acquisition process and the social welfare programmes undertaken during construction and operation of the project. The strengths, weaknesses and lessons learnt are described below:

7.1 Strengths

- Compensation levels paid for acquired land were reasonably generous, and were higher than the statutory rates.
- Land acquisition for the project was executed under extremely complicated circumstances resulting from peak levels of militancy and serious pressure from militant groups in the area.
- The process of land acquisition was largely in line with the J&K Land Acquisition Act and the prevailing local regulations.
- URICO, the construction Contractor provided employment to a large workforce (a peak of 4,700) and trained up to 9,000 workers for the project.
- Trickle-down economic benefits from the operation of the project support up to 300 families or 1800 people in the local community.

7.2 Weaknesses

- The nature and magnitude of the anticipated social impacts were not studied prior to land acquisition. NHPC prepared the *"Rehabilitation Plan of Uri HE Project"* in 1992 when land acquisition and compensation disbursement processes were almost completed.
- Rehabilitation was based on cash compensation rather than land and property based compensation; little awareness and livelihood sustenance training was provided, resulting in most of the affected families not being able to sustain their 'quality of life' after the acquisition process.
- Part of the cash compensation is still outstanding for several affected families 15 years after it was due.
- Affected families were not compensated for indirect losses incurred following loss of their property, and non-title holders did not receive compensation.

- Without adequate advice and financial awareness most affected people could not utilise their cash compensation properly.
- An effective monitoring mechanism to evaluate impacts of land acquisition on affected families was not implemented during or after the acquisition process.
- There was no effective grievance redressal system established during and after the land acquisition.
- The living standard of most of the project-affected families has degraded, and many of them are currently unemployed. The few who started small businesses on the basis of their compensation have generally been unsuccessful, and these businesses have failed. Most project-affected families regret that they have been separated from their land.

7.3 Lesson Learnt

For projects such as Uri HEP, where land acquisition is essential, social impact assessment (SIA) studies should be conducted at the time of conceptualisation of the project, well before the initiation of land acquisition.

The rehabilitation needs of the affected families should be identified and social mitigation measures should be implemented to minimize the anticipated social impacts. Resettlement plans should be prepared based on national legislation and international guidelines.

It would now be standard practice to ensure compliance with the Equator Principles, and to ensure compliance with the IFC Performance Standards. These standards place a strong emphasis on livelihood sustenance, consultation, grievance procedures and monitoring where resettlement is involved.

Before finalisation of the rehabilitation plans, full public consultation and information disclosure meetings should be arranged among the affected families and other stakeholders.

Rehabilitation plans should offer choices of compensation packages, including cash and substitute land and property. Preferably alternative locations and livelihood schemes should be available.

To sustain the “quality of life” of affected families, social mitigation measures such as allowance and vocational training should be provided.

A mechanism for monitoring the implementation of the rehabilitation plan should be instigated.

A grievance redressal system should be established to deal with complaints in a timely and satisfactory manner.

8 Outcome and Suggested Actions

Although there have been significant improvements to the local socio-economic conditions as a result of the project, it is apparent that the quality of life of the majority of the project-affected families has degraded as a result of the land and property acquisition process. As a consequence the majority of the directly affected families appear to be dissatisfied.

As the largest local industrial employer people look to NHPC for contributions towards the provision of basic amenities such as water supply, power, health and educational facilities and for employment opportunities. It is also considered that NHPC has social responsibilities to provide some tangible benefits in the local area, in order to propagate good community relations.

The following suggestions would improve the general socio-economic conditions, and improve the quality of life for project affected families:

1 The outstanding compensation should be disbursed with appropriate interest. It is suggested that an office be established at the Gingle Colony for rapid disbursement of the outstanding compensation.

2 NHPC should consider the formation of a Grievance Redressal Cell (GRC) to resolve the complaints of local people, and if possible resolve the outstanding legal cases.

3 The opportunity could be taken on Uri-II HEP and Kishanganga to give preferential employment to members of the Uri-I project-affected families. Also NHPC could give similar preference when employing staff to work on the operation and maintenance of Uri HEP.

4 NHPC has could actively encourage the enrolment of students from the local area at the Kendriya Vidyalaya (secondary school) within the Gingle Colony area. The employment of teachers from the local area would facilitate this process.

5 The use of the Dispensary facilities in the colony should be actively extended to local people and some medical staff should be recruited from the area.

6 NHPC could support capacity building centres for the women of project-affected families and the local area for commercial activities such as sewing, embroidery, knitting and dry food preservation.

7 As the drinking water sources of Pringle village and parts of Boniyar and Gingle villages of were destroyed due to construction of Uri HEP, NHPC should restore the water supplies with the help of the PHE Department.

8 With the support of NHPC the Labour Colony at Bela Salamabad could be used to create a Complex housing a Higher Secondary School, Vocational Centres, Industrial Training Institute and Dispensary.

9 NHPC also has abandoned land at Chahal village which could be used for construction of a market for locally prepared goods and handicrafts.

10 NHPC has developed a Children Park on the spoil disposal area at Boniyar Village. Regular maintenance of this park is required to provide good recreational facilities for local people and for visitors travelling on NH-1A.

1 Introduction

The 480 MW Uri Hydro Electric Project (UHEP) on the Jhelum River in Jammu & Kashmir State of India was constructed by a Swedish-British Consortium between the years 1989 to 1997. Funding for the offshore components of the project was provided by the Government of Sweden and the United Kingdom whereas the INR Component was funded by National Hydro Electric Power Corporation (NHPC) and Government of India (GOI). The total Swedish funding for the project amounted to around SEK 3,335 million with a concessionality level of nearly 36%. The Swedish Funding provided about 65% of the original cost. As part of its routine procedures Sida has commissioned an independent evaluation of the Swedish Support for the Uri Hydro Electric Project.

In August 2005, Sida signed a contract with the British consultancy firm Scott Wilson Ltd to carry out an independent post-project evaluation of the Uri Hydro-electric Power Project (Uri HEP).

Scott Wilson's fieldwork related to post-project social issues and consequently the social evaluation and reporting were hampered by the major earthquake in Kashmir during the autumn of 2005. The epicentre was close to the hydropower plant and the quake occurred when the project team was on the site. This fact, in combination with the complex security arrangements and problems with organising interviews with affected families and stakeholders at the time of the earthquake, made the study somewhat incomplete in comparison to the socio-economic part of the Terms of Reference. In addition, the paucity of baseline data made comparative evaluation impractical within the scope of the original study.

This led Sida to conclude that supplementary studies on the socio-economic issues of Uri HEP were required in order to complete the evaluation of the Swedish Support. The findings and results from the supplementary studies will complement the analysis already carried out, and be appended to the Evaluation Report.

In order to carry out the supplementary social studies Scott Wilson has carried out document reviews and conducted sample surveys, interviews, informal discussions and public consultation among the affected families and other stakeholders. This has been followed by analysis and reporting of the results.

1.1 ObjectiveS of The Supplementary Social Evaluation

The objective of this supplementary social evaluation is to ascertain the "Pre and Post Construction Social Scenario" of the Project-Affected Families, villages and the area as a whole due to construction and operation of Uri HEP.

The studies carried out in order meet the overall objectives of the assessment were as follows:

- Identify and analyse project related effects and how the socio-economic issues were addressed during the project planning and implementation stages.
- Determine the living conditions of affected families.
- Establish the impacts on the public health in the affected area that could be attributed to the project.
- Evaluate the planned or unplanned social mitigation measures adopted during construction and post construction.
- Evaluate the capacity building programmes for the project-affected families.
- Analyse the project's direct and indirect effects on commercial and other income generating activities.
- Analyse the project's direct and indirect effects on social and other service facilities.
- Establish and analyse the impacts of facilities provided by NHPC for local people.

2 Methodology Adopted to Conduct the Study

The supplementary socio-economic evaluation of UHEP as a result of Swedish Support is being carried out in the context of the original expectations for the project, which were identified in late 1989 when process of acquisition of land was initiated for the construction of the project components and parallel road.

During the social evaluation of the project a variety of methods and approaches were adopted in order to gather high quality and diverse data. Both secondary and primary data as well as quantitative methods and more participatory methodologies, such as Participatory Rural Appraisal (PRA) techniques were followed, which are well suited to discussing sensitive issues with communities with low levels of literacy.

The team of experienced social experts visited the affected families and the project area and also met with some of those who were involved in the original land acquisition process, in order to understand the constraints. The objective of this fieldwork was to improve the teams knowledge through collection of data, interviews with affected families, community and religious leaders, representatives of commercial entities and civic services (including health and education), local government, in accordance with the original 'Terms of Reference' and the to analyse the data.

The Swedish Embassy in New Delhi and NHPC have given positive support to assist with this post-project evaluation. The "Post Construction Environmental and Social Impact Assessment Study for UHEP" prepared by NHPC was provided by the Corporate Office of NHPC in New Delhi and provided good background information for the study.

During the field studies, sample socio-economic survey, discussions and public consultations were conducted among the affected families to establish "Pre and Post Construction Social Scenario" of the project. It endeavoured to draw conclusions from both quantitative and qualitative information, within the constraints of data and information availability.

The methodology adopted for pre and post socio-economic evaluation of UHEP is described below:

- collection of primary and secondary data.
- interviews with project-affected persons (PAP) and project-affected families (PAFs).
- interaction with community and religious leaders.
- interaction with the NHPC and State Govt. Officials to gather information on resettlement measures and social welfare schemes implemented during the past years.

Supplementary socio-economic evaluation, field survey, discussions, and interview with project-affected persons and other stakeholders were focused on following aspects:

A Identification and analysis of project related effects and how the socio-economic issues were addressed during project planning and implementation.

- Local participation in planning
- Consultation with community groups and representatives of all sections
- Compensation plans and results
- Process management by NHPC and the Contractor

B The living conditions for affected people and families

- Impact of construction works – employment opportunities and improvement in access and facilities versus exclusion and the need to migrate

- Resettlement issues and resulting impacts on families with improved conditions and those with reduced standard or opportunity
- Reasons why positive or negative impacts arose – deviations from planned actions or incomplete actions
- How and why families used compensation as they did – awareness generation missing or adequate or limited. Opportunities limited by location, religion etc.
- Lessons learnt for future projects

C Impacts on the public health situation in the area that could be attributed to the project.

- Water supply: change in access to safe and sufficient water compared to baseline
- Sanitation: change as a result of project interventions and sustainability
- Health status from the perspective of the PAPs – positive or negative impacts
- Facilities planned versus those actually provided and relevance for all sections of PAPs
- Lessons learnt for future projects

D Planned or Unplanned Mitigating Measures.

- Compensation process and its suitability
- Employment by NHPC for PAPs and other locals
- Other measures introduced to provide positive benefit to PAPs
- Lessons learnt for future projects

E Capacity Building Effects.

- Training provided and impacts felt by PAPs on long-term livelihoods
- Long-term impacts of employment during construction period
- Organised transfer of knowledge planned and impacts
- Temporary or permanent nature of capacity building effects
- Lessons learnt for future projects

F Analysis of the project's direct and indirect effects on commercial and other income generating activities.

- Farming and small industries
- Shops and small businesses such as taxis, etc
- Banks and commercial services generated
- Markets created for local demand; supplies produced for outside markets
- Indirect impacts from improved access, cash compensation and capacity building

G Analysis of the Project's direct and indirect effects on social and other service facilities.

- Schools and education
- Banks, post offices
- Religious institutions
- Water supply and sanitation
- Roads and transportation

H Confirmation and Impact Analysis of NHPC's services provided to local people.

- Medical and health facilities,
- Water supply and drainage
- Culture, education, religion and recreation facilities
- Canteen facilities and cheap source of domestic goods and food
- Electricity supply

3 Socio-economic Context

In order to set the socio-economic assessment of the Uri HEP in context we present below some of the more significant events and indicators for the project area over the last 20 years.

3.1 Demographics and Administration

The project is situated in the State of Jammu and Kashmir (J&K) which is the most northerly state in India. The region includes disputed territory between India and Pakistan, and the de-factor border between these two countries, the "line of control" runs some 15 km to the east of Uri HEP.

Some of the key indicators for the State of J&K are as follows:

Area:	106,567 km^2 (3.24% of India's total)
Divisions:	Kashmir (8 districts); Jammu (6 districts)
Capital:	Summer (May–Oct) – Srinagar Winter (Nov–Apr) – Jammu
Population (2001):	10,069,917 (0.98% of India's total)
Literacy Rate:	54% (compared with 65.4% all-India average)
Religion:	Predominantly Muslim
Project Location:	Uri Tehsil, Baramula District
Baramula area:	4,588 km^2 (4.3% of J&K)
Baramula population (2001):	1,116,722 (10.5% of J&K)
Baramula literacy rate:	44.5%
Baramula population growth rate (2001):	2.8% (J&K – 2.63%)

Source: J&K State Plan

The estimated growth of population in the State of Jammu and Kashmir is illustrated in Figure 3-1 *(source: MOSPI)*.

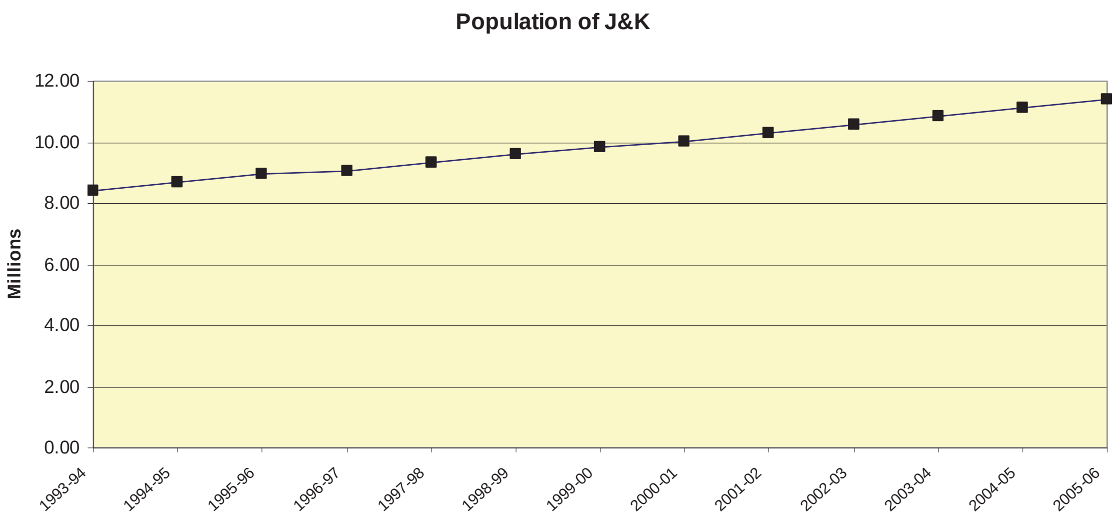


Figure 3-1: Population Growth J&K 1993 to 2005

3.2 Economic Development of J&K

Despite the militancy in J&K the Gross Domestic Product of the State has continued to grow in recent years, both in INR terms and in USD equivalents, as shown in Figure 3-2 *(source: MOSPI INR data converted at 1st January exchange rates for each fiscal year)*.

The compounded annual rate of growth during the twelve year period 1993–94 to 2005–06 is 11.2% in current INR prices. When considered in constant 1993–94 INR terms the annual rate of growth is 4.9% *(source: MOSPI data)*. This is a respectable rate of growth considering the disruption to the economy caused by the militancy in the region.

It is believed that in addition to the official economy reflected in the Government statistics, a substantial parallel economy exists based on unrecorded inflow of funds.

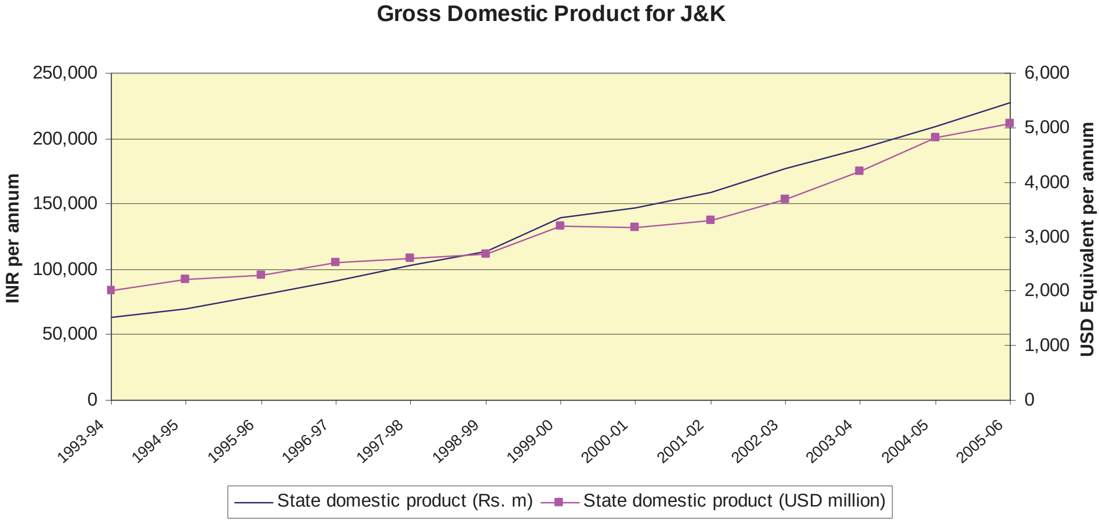


Figure 3-2: Gross Domestic Product Growth for J&K

The make-up of the J&K State economy, and the change during the twelve year period for which records have been obtained, is illustrated in Figure 3-3 and Figure 3-4 for the years 1993–94 and 2005–06 respectively *(source: MOSPI data)*.

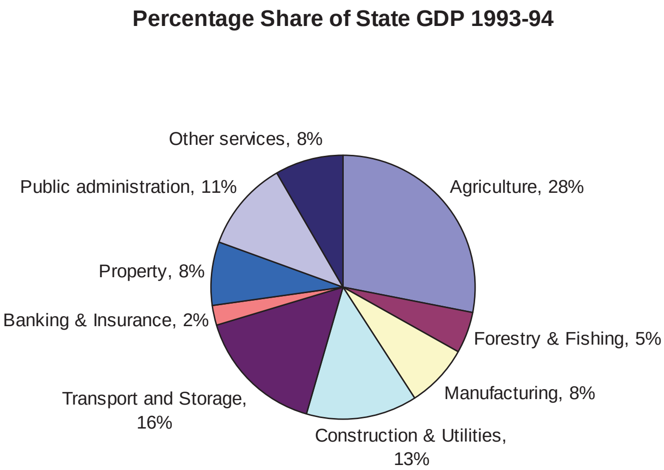


Figure 3-3: Make-up of J&K GDP in 1993–94

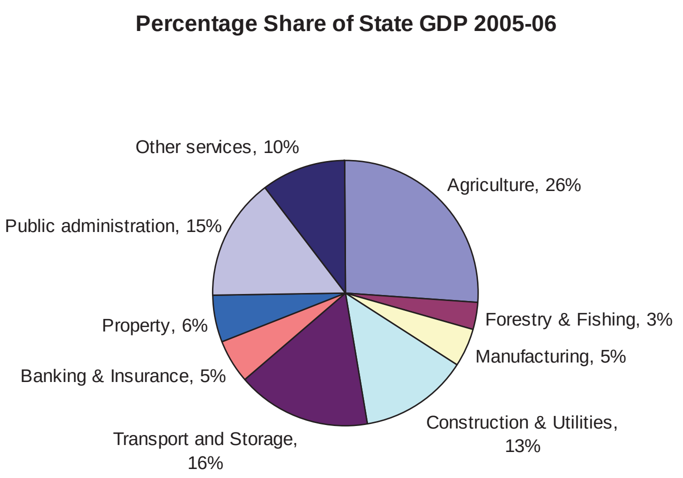


Figure 3-4: Make-up of J&K GDP in 2005–06

It can be seen that a substantial share of GDP is derived from Agriculture, Forestry and Fishing, although the aggregate share from these sectors has declined from 33% in 1993–94 to 29% in 2005–06.

Manufacturing accounts for a very small share of GDP, and has declined from 8% in 1993–94 to 5% in 2005–06.

Services (comprising Transport, storage, banking, insurance, property services, public administration and other services) account for a large part of GDP, rising from 45% in 1993–94 to 52% in 2005–06. Of this Public Administration has seen the biggest growth, followed by banking and insurance services.

The per capita income growth of J&K has grown steadily in recent years, both in INR terms and in USD equivalent terms, as shown in Figure 3-5 *(source: MOSPI INR data converted at 1st January exchange rates for each fiscal year)*.

The compounded annual rate of Per Capita Income growth during the twelve year period 1993–94 to 2005–06 is 8.4% in current INR prices. When considered in constant 1993–94 INR terms the annual rate of growth is 2.2% *(source: MOSPI data)*. Although this level of growth is not exceptional for an emerging economy, it is still surprisingly high considering the disruption to the economy caused by the militancy in the region.

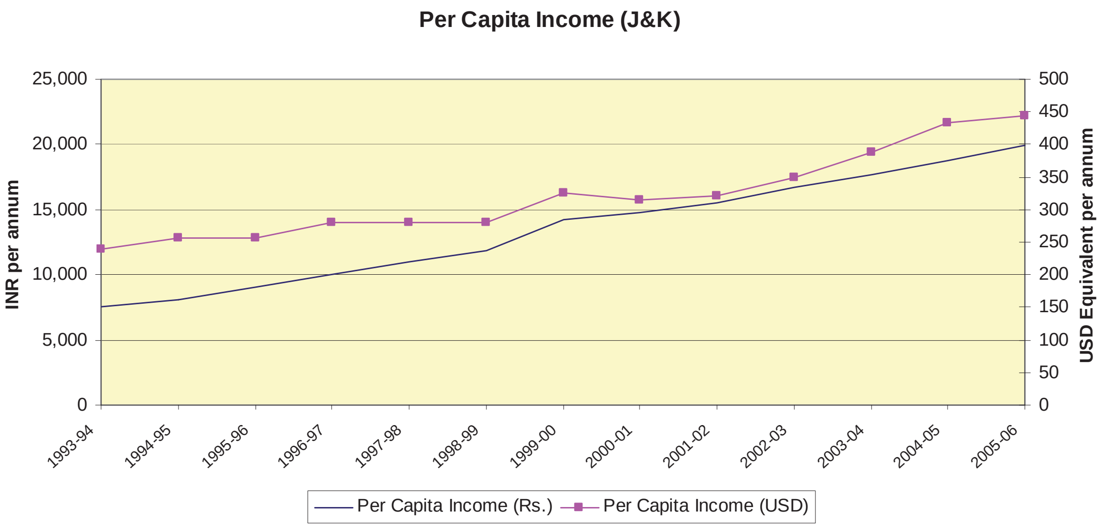


Figure 3-5: Per Capita Income in J&K

3.3 Insurgency

The most significant factor affecting the project area over the past 20 years is the rise of insurgency and militancy in Jammu and Kashmir. The initial signs of the insurgency started with a series of bomb attacks and kidnappings in late 1988, at the time that the contract for construction of Uri HEP was being negotiated.

The level of insurgency increased through the late 1980s and early 1990s to a level where all aspects of life in J&K were affected. The construction of Uri HEP was also affected, as discussed in Section 2.6 of the Main Report.

Among the impacts of the insurgency, together with the border conflict with Pakistan, are the following:

- Loss of life, injury and kidnapping – estimates of the death toll over the 17 years of insurgency range from 40,000 upwards *(source: Reuters reporting GOI statement);*
- Almost complete cessation of tourism activity (see section 3.4);
- Massive deployment of Indian Army troops in J&K – around 500,000 Indian troops are deployed in the region *(source: Reuters reporting GOI data);*
- Curfews and restriction of movement;
- Problems with public administration, particularly in remote areas;
- Massive military spending in J&K (reliable figures not available) on the Indian army and support services;
- Reportedly considerable cross-border funding to support the insurgency *(source: various newspaper articles)*.

These issues need to be taken into account when considering the socio-economic development of the project area, and account for some of the difficulty in quantifying the project impacts.

3.4 Tourism

Prior to 1988 tourism was one of the major economic activities in J&K, with nearly three-quarters of a million tourist arrivals in 1988.

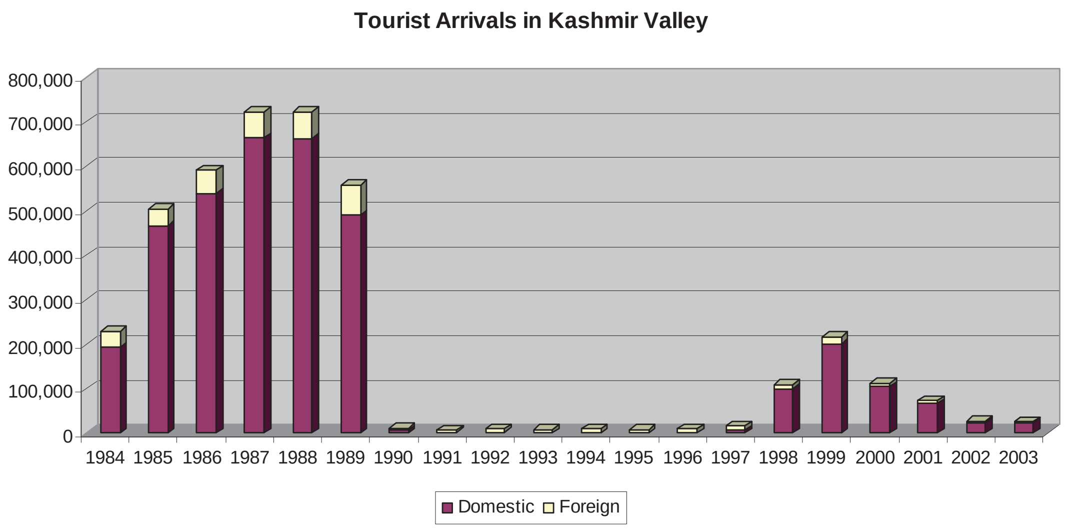


Figure 3-6: Tourist Arrivals in Kashmir Valley

As can be seen from Figure 3-6 *(source: J&K Govt)*, the tourism industry virtually ceased following the start of the insurgency in the late 1980s. A minor re-emergence of tourism in the late 1990s was short-lived.

Newspaper reports (Government statistics are difficult to obtain) suggest that by 2005 tourist arrivals had reached close to 500,000, although these levels do not appear to have been sustained. Also the approximately 10% of higher spending foreign tourists among the pre-insurgency arrivals have not been present in the recent numbers, which have been almost exclusively domestic.

3.5 Poverty Level

There has been a remarkable reduction in the percentage of the population living below the poverty level (the "Poverty Ratio") in J&K over the period between 1993 and 1999, as illustrated by the graphs in Figure 3-7, Figure 3-8 and Figure 3-9 *(source Planning Commission Data)*. This reduction is most pronounced among the rural population. In 1993 the J&K Poverty Ratio was comparable to the average for India (30.3% J&K compared with 32.3% for all-India). By 1999 the Poverty Ratio in J&K was 4.0%, compared with the average for India of 27.1%. A similar, although less pronounced, reduction in Poverty Ratio is observed for the Urban Population in J&K.

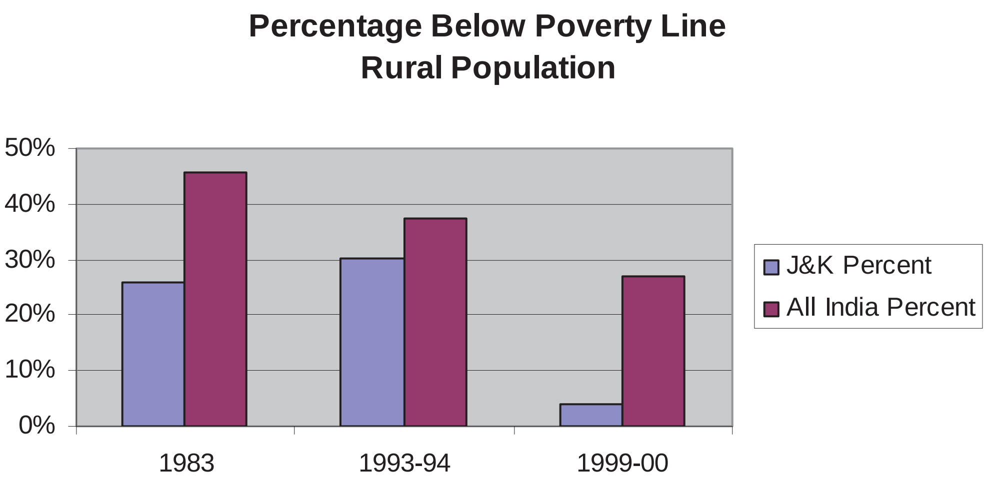


Figure 3-7: Percentage of Rural Population below Poverty Level

The reduction in Poverty Ratio in J&K relative to the average for India is not reflected in other socio-economic indicators, where J&K appears to be lagging behind the rest of India. For example the per capita income for J&K in 2005 is INR 17,174 compared with the national average of INR 25,907.

The reduction in Poverty Ratio in J&K has been explained as resulting from the social structure providing support at the poorest levels. An alternative explanation, not accorded much credulity, is that the enumerators in 1999–00 were unable or unwilling to enter poor rural areas to collect data.

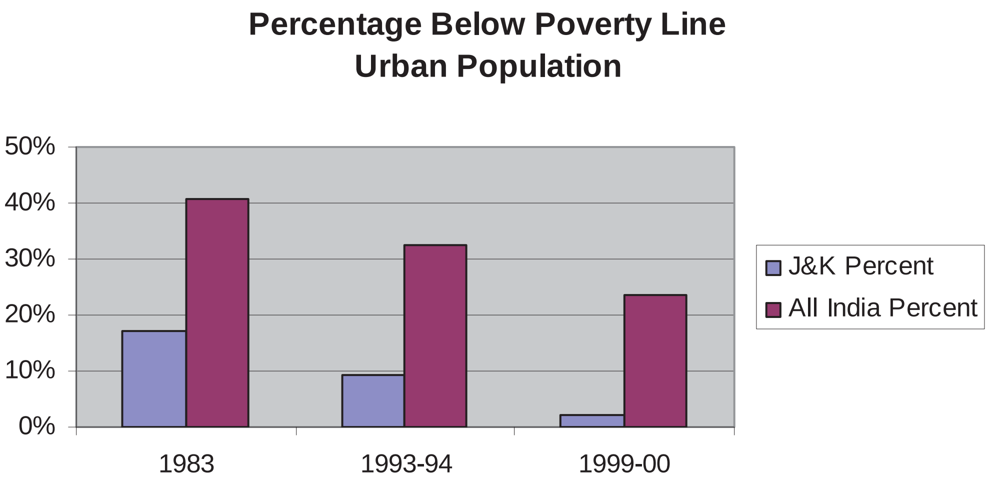


Figure 3-8: Percentage of Urban Population below Poverty Level

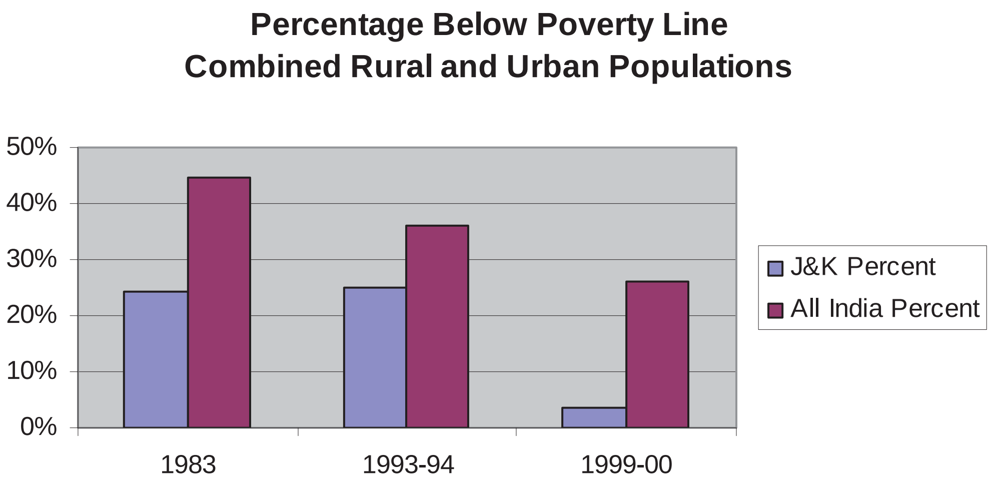


Figure 3-9: Percentage of J&K Population below Poverty Level

3.6 Basic Infrastructure

The typical level of basic infrastructure in J&K, with reference to the average for India is illustrated in Figure 3-10 *(source: 2001 census data)*. It can be seen that the level for J&K is generally comparable with that of the rest of India, except for the percentage of households with electricity connections. The provision of electricity in J&K, and particularly in the Kashmir Valley, is a tradition dating back to the establishment of the first hydroelectric scheme at Mohra in 1907. It is expected that all but the most remote households in J&K will have access to electricity within a few years.

The electricity infrastructure is discussed in more detail in Section 3.3 of the Main Report.

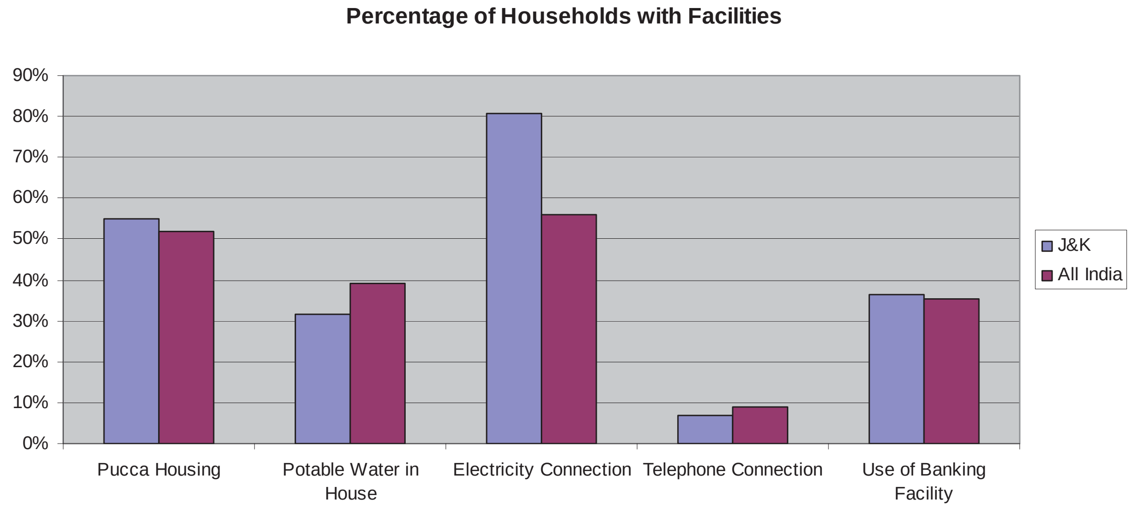


Figure 3-10: Household Infrastructure (J&K and India Average)

Per capita electricity consumption in J&K remained fairly static during the period of construction of Uri HEP, as illustrated in Figure 3-11 *(source: Indiastat)*. It is likely that this is partly due to supply constraints, since during this period demand for electricity exceeded supply on the Kashmir Grid.

On completion of Uri HEP additional supplies became available from the project itself, and from the interconnection of the Kashmir Grid with the Northern Grid. This was less of an issue in the Jammu area, which was already interconnected with the Northern Grid.

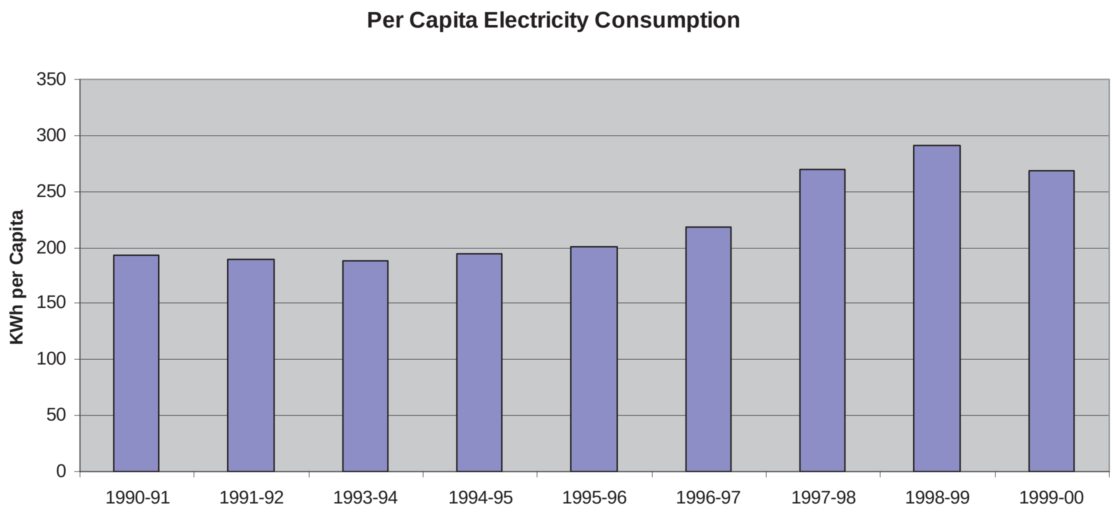


Figure 3-11: Per Capita Electricity Consumption in J&K

3.7 2005 Earthquake

On the morning of 8th October 2005 a massive earthquake registering 7.6 on the Richter scale struck the Western Himalayas. This was followed by a series of aftershocks, including more than 500 in the following week. The epicentre of the earthquake was at 34.432° N, 73,537° E, in the Neelum Valley some 20 km north of Muzaffarabad. This is around 125 km WNW of Srinagar, and around 60 km from Uri town.

The devastation caused by the earthquake is reflected in the casualty toll: around 3 million people affected and around 80,000 fatalities (the great majority on the Pakistan side of the Line of Control).

The earthquake was felt with an intensity of IX at Uri, with a consequence that most stone masonry houses at Uri and closer to the epicentre were destroyed.

The Consultant's project team carrying out the original evaluation studies of Uri HEP were based in Gingle Colony at the time of the earthquake, and although the earthquake did not affect the project itself, the socio-economic aspects of the study were disrupted.

Since the earthquake there has been considerable reconstruction activity in the project area. Initially the relief efforts were led by the Army. However the state government and a range of NGO's quickly took over, and new houses, public infrastructure and other facilities have been constructed.

4 Survey of Affected Villages

4.1 Background of Land Acquisition

The area affected by Uri HEP spreads over nearly 35 km along the National Highway 1A from Gantamulla to Lagama villages. Land was required for construction of the various project components such as the barrage complex, power house complex, labour colony, administrative complexes, residential colonies and for dumping of spoil. Approximately 300 ha of land were acquired for this purpose, of which 191 ha were private land.

As a consequence of land acquisition for the project 246 families were affected in 12 villages, namely: Boniyar, Gingle, Pringal, Nowagran, Rajarwani, Bandi, Lagama, Mohura, Gantamulla, Helad Peernia, Bela Salamabad and Chahal.

Of these 246 families, 77 families in 10 villages were severely affected due to acquisition of their houses and land, while 169 families were partly affected due to acquisition only of their land.

About 20 ha land was also acquired for construction of the road parallel to the National Highway 1A on the right bank of river Jhelum (the "Parallel Road") for transportation of materials. This land was in the villages of Dawaran, Gingle, Noorkhan, Kachan, Azadpur, Tathamulla and Iehtishampora. As a consequence of acquisition of this land 225 families were affected. Of these 44 families were displaced due to acquisition of their houses or shops.

In total for the construction of the various project components and Parallel Road 471 families were affected, out of which 121 families lost their houses and land.

Details of the affected families and the type of loss are given in Table 4-1 and illustrated in Figure 4-1:

Table 4-1: Numbers of Families Affected and Type of Loss

Type of Acquisition	Project Components	Parallel Road	Total
Entire House	30	44	74
Entire House and land	47	–	47
Some Land Only	169	181	350
Total Number of Affected Families	246	225	471

Number of Families and Type of Loss

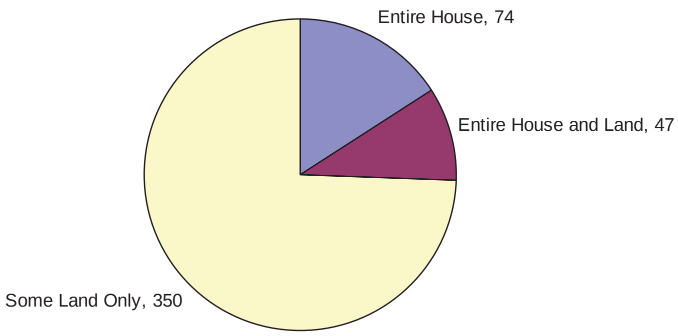


Figure 4-1: Number of Families and Type of Loss

The most severe impacts of the project were experienced by those families which lost both their houses and land.

Project-affected Family Consultation

For the post-project socio-economic evaluation efforts have been made to gather information through discussions and interviews with the affected families. Where members of affected families were not available during the fieldwork visits, information was obtained through discussions with their neighbours.

Stakeholder/Public Consultation

As a part of the post-project socio-economic evaluation study, information was also obtained from other stakeholders of the project. Public consultations were also held in the villages during the field studies.

4.2 Socio-Economic Conditions of Affected Families

4.2.1 Number of Families and Family Size

It became apparent during the field surveys that the original affected families have been divided into multiple families over the past 15 years. The average original affected family is now divided into three families, and hence around 1400 families now represent the original 470 affected families.

The number of children per family varies from 2 to 8, and the average number of children per family is 4. It was considered during discussions with these families that awareness of family planning methods is limited.

4.2.2 Literacy among the Children

The affected families appear aware about the importance of literacy and education of their children. They are very keen to educate their children to improve their economic prospects.

Most of the families surveyed and contacted send their children to schools. The literacy level among the children is encouraging, and overall literacy level among the children is estimated to be around 85%. This is above the average all-ages literacy level for the State, although it would be expected that child literacy would be greater than adult literacy. The J&K Government is actively promoting literacy in the area.

4.2.3 Occupational Pattern of Affected Families

The sources of earning of livelihood in the Uri HEP area are limited. The majority of the population of the area is traditionally dependent on agricultural related activities. However, Lower Jhelum HEP (Operational), Uri-I HEP (Operational) and Mohura (Mohra) HEP (Non operational) are major sources of regular and contract employment, and Uri-II HEP (which is now under construction) also provides employment. Other sources of employment in the area are services to the Army, State Government departments, and private commercial and business activities.

Table 4-2: Livelihood Source of Affected Families

Sn.	Type of Occupation	Percentage
1.	Government Service & Army	12
2.	Cultivator	37
3.	Labour (Agricultural & other activities)	28
4.	Small Business	6
6.	Non-Workers (Unemployed)	17
	Total	**100**

Based on our field surveys, the livelihood source of the affected families is described in Table 4-2, and illustrated in Figure 4-2. The tabulated data indicates that of the adults of working age in the affected families, the largest group of about 37% is engaged in cultivation; the next largest group is 28% employed as labourers on daily wages in agricultural and other activities; 12% obtained employment in Government Services or the Army; 6% are engaged in small business activities; the remaining 17% are non-workers or un-employed.

Only 9 persons among the affected families, representing less than 1% of the employable adults in the Project-affected Families, are working in NHPC as regular employees.

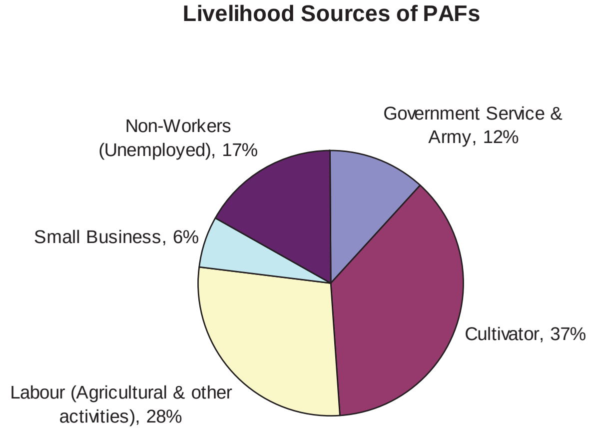


Figure 4-2: Livelihood Sources of Project-affected Families

4.2.4 Numbers of Employable Adults in Affected Families

In the 15 years since the land acquisition the families have expanded and divided into some 1400 families. On average there are 1.4 employable adults (adults of working age) per family.

4.2.5 Household Income

Based on the field interviews with the affected families and physical surveys of their living standards, the income from all the sources of the households of affected families varies from INR 3,500 to INR15,000 per month (equivalent to USD 140 to USD 600 per month at current exchange rates). On average 60% of families have a monthly income less than INR 4,000 (USD 160) per month and around 28% of families have income greater than INR 6,000 (USD 240) per month. These percentages are illustrated in Figure 4-3.

This level of income can be approximately compared with the J&K per capita income level of INR 20,000 per annum. For an average family of 5.4 members the State average is around INR 108,000 per annum. This compares with the surveyed median household income of INR 48,000. This appears to suggest that the income of the Project-affected Families is below the J&K State average. However it is considered that the difference reflects the basis of data collection rather than any disparity in income levels. The State per capita income level is derived by dividing the gross revenue from all productive income generating activities in the State by the number of people, whereas the surveyed data reflects disposable cash income.

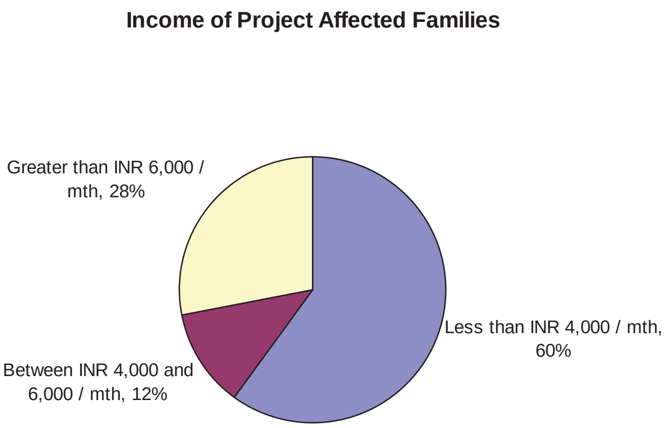


Figure 4-3: Income Levels of Project-affected Families

4.2.6 Type of Houses

The type of house occupied by a family is generally a good indicator of its living standard. However in the case of the project area this is not applicable, as most of the non-durable houses in the area were damaged in the October 2005 earthquake. New "pacca" (durable) houses have been constructed to replace these damaged houses using aid granted by the State Government and with support from NGOs.

As a consequence the survey conducted after the earthquake recorded 90% of the families occupying "pacca" houses constructed with bricks, cement and masonry.

4.2.7 Assets and Consumable Items

The Project-affected Families were also surveyed in relation to their assets as indicators of living standard. About 60% of families have television sets in their houses; about 8% of families have motor vehicles such as motor cycles and four-wheelers (cars, jeeps and trucks).

From interviews it was determined that in around 50% of cases these assets were received as wedding gifts from in-laws when sons were married.

4.3 Infrastructure in the Project Area

The basic infrastructure and civic amenities available in the affected villages provides a measure of the quality of life and standard of living. Assessments have therefore been carried out of the access of the people in the project area to basic amenities such as education facilities, medical/health centres, drinking water, sanitation, access roads and electricity. Access to civic amenities including banks, post offices, markets and communication facilities have also been surveyed.

It is observed that in most cases these basic and civic amenities result from the implementation of various State and Central Government social and economic development programmes, and are largely unconnected with Uri HEP.

4.3.1 Road Communications

Most of the project-affected villages are located on the National Highway 1A, or in close proximity to it.

The villages of Gantamula, Chahal (Nowshera), Boniyar, Mohura, Rajarwani, Bandi and Lagama are located on the National Highway 1A.

The villages of Hilad Peernia and Bela Salamabad are approached by semi-metalled approach road up to a distance of 1 km from the National Highway, then unpaved roads for the remainder of the distance. The main settlements of these villages are reached by unpaved footpaths like those in other hilly areas.

The village of Gingle is connected to the National highway by a metalled road constructed by NHPC for its colony/office.

The villages of Pringle and Nowgran, which are on the right bank of the Jhelum River (near LJHEP Powerhouse) are reached from the National Highway by a link road which is also semi-metalled.

The villages affected by construction of the Parallel Road are Dawaran, Gingle, Noorkhan, Kachan, Azadpur, Tathamulla and Iehtishampora. These villages can be reached by the all-weather metalled Parallel Road which is now maintained by the Public Works Department (PWD).

4.3.2 Medical Facilities

Generally the medical facilities in the project area are not satisfactory. Village Boniyar has a primary health centre (PHC) and a medical health centre which caters for the medical needs of the populations of the surrounding villages including Bela Salamabad, Hilad Peernia, Pringle, Nowgran and Gingle. Village Mohura also has a primary health centre.

For treatment of serious ailments villagers from these villages must travel either to Uri or to Baramula.

For the villages Rajarwani, Bandi and Lagama the nearest medical facilities are at Uri, which has a medical sub-centre / medical centre and a hospital.

The other villages in the project area do not have formal medical facilities.

NHPC operates a Dispensary at Gingle Colony with three qualified doctors, one dentist and four nurses. This facility is typically used by employees of NHPC working at Uri HEP and Uri-II HEP construction site, CIEF and the Army. A few local people from Gingle and Mohura villages use NHPC's Dispensary, although the numbers are small.

The study team collected information from NHPC Dispensary on the numbers of patient treated in recent years as shown in Table 4-3.

Table 4-3: Patients Treated at NHPC's Dispensary

Sn.	Period	No. of Patients Treated	Daily Average
1	01/04/2005 to 31/03/2006	2191	7.3
2	01/04/2006 to 31/03/2007	6073	20.3
3	01/04/2007 to 31/10/2007	917	5.2
	Daily Average of Patients Treated		**11**

Note: Daily average is based on assumption of 300 operational days every year.
Source: NHPC Dispensary, Gingle (Uri)

From Table 4-3 it can be seen that on an average only 11 patients are treated every working day. This indicates that the NHPC Dispensary has spare capacity which could be offered to local people to supplement the medical facilities in the project area.

4.3.3 Educational Facilities

The education facilities in the villages affected by the project appear to be inadequate. Of the all project-affected villages, Boniyar has the best educational facilities, which include nursery schools, primary schools, a secondary school and a senior secondary school. These schools are also catering for the educational needs of students from Gingle, Mohra, Gantamula, Chahal, Pringle, Nowgran, Bela Salamabad and Hilad Peernia.

There is only one primary school each in the villages of Bela Salamabad and Hilad Peernia, whereas the villages of Pringle and Nowgran have two primary schools each. The village of Gingle has two primary schools and one secondary school. Mohura, Rajarwani, Bandi and Llgama only have primary schools. Many students of these villages get their middle, secondary and a senior secondary level education at Uri town. The nearest degree college is located in Baramula, while the nearest post-graduate College is located in Srinagar.

It is considered that the educational facilities in the area need to be strengthened and augmented.

NHPC operates a Kendrya Vidhyalaya (KV) (Secondary School) within the Gingle Colony premises. The students attending the KV are from families of employees of NHPC (URI-I, URI-II, Kishanganga Projects), CISF, BSF, the Army, Becon, Hindustan Construction Company (HCC), Banks and the local area. Details of the employer's of the student's families in the various classes were obtained during the field studies and presented in Table 4-4.

The data for Gingle KV, as shown in Figure 4-4, indicates that participation of local students is only 12% of the total enrolment. In Classes VI and X there are no students from the local area, while in Classes II, VII and IX there is only one student in each class from the local area.

Table 4-4: Gingle KV Enrolment by Category of Parent's Employment

		Employment of Student's Parents									
Sn	Class	UHEP-I	UHEP-II	Kishanganga	CSIF, BSF. Army	KV	Banks	BECON	HCC	Locals	Total
1	I	5	3	–	9	–	–	1	6	3	27
2	II	3	–	–	8	1	–	1	3	1	17
3	III	6	–	–	13	–	–	1	4	3	27
4	IV	7	3	–	10	–	–	–	3	3	26
5	V	2	2	–	10	1	–	–	3	10	28
6	VI	2	4	–	15	1	–	1	1	–	24
7	VII	3	–	1	9	–	–	–	2	1	16
8	VIII	6	1	–	6	–	1	–	–	2	16
9	IX	1	2	–	3	–	1	–	–	1	08
10.	X	3	4	–	2	–	–	–	1	–	10
	Total	38	19	1	85	3	2	4	23	24	199

Source: Kendrya Vidhyalaya, NHPC, Gingle (Uri)

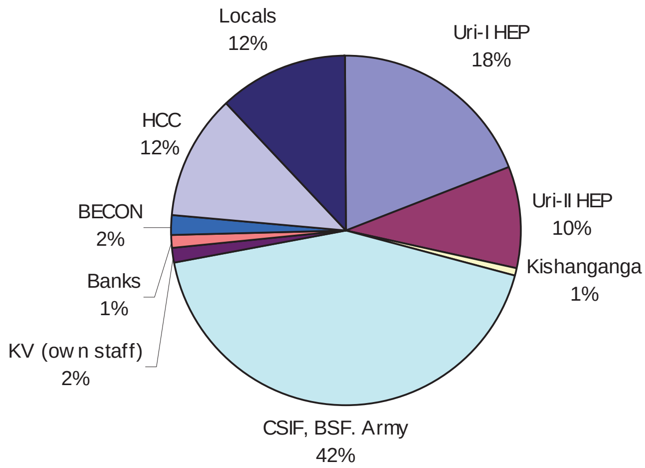


Figure 4-4: Employment Category of Parents of Gingle KV's Students

4.3.4 Civic Amenities

The village of Boniyar has the best civic amenities of the villages in the project area, comprising banks, a post office, a police post, a Chauki (jail) and locals markets. These facilities cater for the needs of the populations of Pringle, Nowgran, Bela Salamabad and Hillad Peernia. The village of Gingle has two banks, and Mohra has one post office. The village of Lagama has a post office a bank and a police post, which also serves the needs of Rajarwani and Bandi villages.

All the villages have shops and markets of providing general goods, fruit and vegetables and other produce. Mobile facilities are also available is most villages.

5 Rehabilitation Procedures Followed

At the time of acquisition of land and structures (1990) for construction of Uri HEP, the prevailing land acquisition legislation was the J&K Land Acquisition Act 1990.

Discussions with project-affected persons and the Officer engaged for land acquisition reveal that land acquisition for the project was partly governed by the J&K Land Acquisition Act. The land and property acquisition requirements and the powers of the Officers for the project were notified by the District Collector through a Public Notice in the Government Gazette, in accordance with Section 4 of the J&K Land Acquisition Act. Following the publication of the Notice, private negotiations were carried out with the representatives of the affected families. The basis of compensation was the official schedule of prevailing rates for land and structures, although the compensation paid generally appears to have exceeded the statutory rates.

An important factor is that the Rehabilitation Plan for affected families was not prepared by NHPC in association with the State Government before the start of the land acquisition process in 1990. However in 1992 NHPC prepared *"Rehabilitation Plan of Uri HE Project"* by which time the land acquisition and compensation disbursement processes were almost over.

Based on interviews with project-affected families, Contemporary Revenue Officers and NHPC Officials, various features of land acquisition and compensation paid to affected families are described below:

5.1. Public Consultation and Participation of Local Peoples

Public consultations were not carried out prior to the acquisition procedure to establish the status and concerns of the affected people, in order that an effective resettlement programme could be established.

Most of the affected people were opposed to the acquisition as their livelihood was based on land and dry fruits trees. They realised that after acquisition of land and structures, they might not be able to sustain their livelihood and "quality of life". In view of this the Contemporary Collector (Land Acquisition) and Mr. G.S. Gothra, Chief Engineer, Uri H.E. Project issued "Assurance Certificate" on 29 August 1991 *(Copy included as Appendix 1)* to the affected families. This document provided the following assurance:

Representatives of rehabilitated families whose total holding properties (house and land) stand acquired for the construction of UHEP would be given all the rehabilitated sources such as

- Employment at least one member of dislocated families,
- Housing
- Colony
- Medical Facilities
- Free Education
- Free Power
- Families Insurance Scheme and other project provision for rehabilitation.

However it has been reported by the project-affected families that the above assurances were not honoured in full.

At the time of the land acquisition, the circumstances in the project area were very difficult due to a high level of militancy, incidents of kidnapping and pressure from militant groups, and therefore the project-affected families could not orchestrate a campaign for suitable compensation and rehabilitation packages.

5.2 Payment of Compensation

For the acquisition of land, trees and structures only cash compensation was provided, and this was given only to legal titleholders, following private negotiations with representatives of the affected families.

In the field survey it was claimed that part of the cash compensation (about 20%) is still pending for about 25% of the affected families; this has also been confirm by NHPC. This balance of compensation was supposed to be paid to affected families after NHPC took possession of the property. However the affected families have not received the balance of compensation despite the elapsed 15 year period. Land Officers of NHPC have informed the Consultants that they are in process of releasing the compensation due to the affected families.

Non-title holders, such as occupiers of Shamlat (common) Land, tenants, encroachers and squatters whose livelihood was based on land required for the project, were not paid any compensation when the land was acquired. The cases of these affected families are still pending in the courts.

5.3 Social Vulnerability of Affected Families

Socially vulnerable groups in the project area such as those who were below the poverty line (BPL), those who belong to Scheduled Castes (SC), Scheduled Tribes (ST), Women Headed Households (WHH), elderly and disabled affected persons were not given any special consideration to ensure that they did not become more vulnerable following the acquisition of their land and structures for the project.

5.4 Income Restoration Program for Affected People

The compensation package for affected families was restricted to payment of cash based on, but slightly in excess of the prevailing compensation rates. No other benefits, such as homeless, landless and transportation grants or allowances were paid to the project-affected families to help them sustain their 'quality of life' following loss of their livelihood. Furthermore no income restoration and rehabilitation programme was organised for the affected families by NHPC or the State Government.

5.5 Awareness Programmes and Vocational Training

During the land acquisition and payment of compensation, NHPC and the State Government did not institute an awareness and vocational training programme among the affected families, which would have been helpful in livelihood restitution.

At the time of payment of compensation, most of the project-affected families were engaged in agriculture related activities. From the field interviews it is apparent that many of these families at the time were not aware of alternative sources of income generation or investment, and hence were poorly equipped to sustain their livelihoods.

6 Post-Project Social Impacts Evaluation

For post-project socio-economic evaluation, discussions, interviews and sample surveys have been conducted among the project-affected families and other stakeholders. In addition, information was also obtained from NHPC Officers from the Corporate and Site Office at Gingle, government officers engaged during land acquisition and local people. Beneficial and adverse impacts of Uri HEP on socio-economic conditions of the affected families and local people are discussed below:

6.1 The Living Conditions for Affected Families

6.1.1 Social Impact of Construction Works and Operation of Project

Social impacts observed during the construction and operation phase of the project in terms of employment opportunities, improvement in access and facilities and exclusion are described in the following section, focusing the project-affected families:

Employment during the Construction Phase

During the construction phase, many people from the region including project-affected families were given the opportunity of employment. The project construction Contractor, Uri Consortium (URICO), employed more than 4,700 Indian Nationals at the peak of the construction activity between 1993 and 1995, of whom the majority were recruited locally, as shown in Table 6-1.

Table 6-1: Number of Indian Workers Employed at Uri HEP

Period	Number of Indian Workers Employed at Uri Project
Nov 1989 to Dec 1993	0 to 2,500
Jan 1993 to Sep 1995	2,500 to 4,700
Oct 1995 to Oct 1996	1,000 to 2,500
Nov 1996 to March 1997	500 to 1,000
April 1997 to Oct 1997 and onwards	less than 500

During the seven-year construction period URICO estimates that about 9,000 people were trained and worked on the project. Following initial unrest among the locally recruited labour, it was agreed that only skilled persons would be employed from outside the Kashmir region, and that three locals would be employed for every person employed from elsewhere. As a consequence considerable employment was provided to the local population.

During the construction phase URICO undertook to employ at least one member from each of the project-affected families. This promise of employment was only for the duration of construction.

From interviews conducted during the fieldwork it was revealed that rates of pay by URICO were about four times higher than those paid by NHPC at the time.

The interviews revealed that about 25 to 30 people trained during construction of Uri HEP in specialised construction jobs, such as operation of heavy construction plant, rock blasting and tunnelling, subsequently obtained well-paid employment on other similar construction sites such as Uri-II HEP, Kisanganga HEP and Delhi Metro Project. A few of these trained personnel have found employment in the Middle East.

Employment During the Operation Phase

Currently the total number of staff employed by NHPC at Uri HEP is 216 persons. From information provided by NHPC only 9 employees belong to project-affected families and 93 employees belong to Uri Tehsil of Baramula District.

As a consequence most of the project-affected families do not have members employed by NHPC. There is a sense of dissatisfaction and grievance with NHPC for not giving preference in employment to the families who lost their properties and subsequently their livelihood. However NHPC contends that the promise of employment to members of the Project-affected Families only related to the construction period.

Improvement in Access

Before construction of Uri HEP, the condition of the bridges on the section of NH-1A between Srinagar and Baramula was inadequate to carry the load of heavy vehicles bringing construction materials. Therefore upgrading and strengthening of the bridges was completed before the start of project construction.

In addition 33 km section of NH-1A from Baramula to the project site was single lane, and unsuitable for the delivery of construction materials. Therefore substantial upgrading was carried out on this section, including widening to two lanes and re-surfacing. Also temporary site access roads were developed to provide access between the various project components and temporary works areas including quarries and access adits for the tunnels.

These elements of the project have subsequently become part of the local and regional infrastructure.

A road parallel to National Highway 1A along the Right Bank of Jhelum River, referred to as the "Parallel Road" was constructed as an alternative for transportation of construction materials and equipment. This road connects the villages of Dawaran, Gingle, Noorkhan, Kachan, Azadpur, Tathamulla and Iehtishampora. Prior to the project, there was only a poor quality unpaved narrow footpath, trafficable only by cycles or two wheelers. Local villagers faced problems with access, especially when emergency medical support was required. Following the completion of construction the Parallel Road was not required for Uri HEP, and it was handed over to State Public Works Department. Currently this motorable "Parallel Road" provides good access to above villages.

6.1.2 Resettlement Issues during Land Acquisition

As discussed previously only cash compensation was paid for the loss of property, and this was only paid to title-holders of the properties. The preference given to project-affected families for employment during construction has not been continued during the operation of the project.

Discussion with affected families reveals that following the land acquisition for the project, some landlords have become labourers and are struggling hard to earn their living. The quality of life of such project-affected families has suffered long-term degradation as a consequence of Uri HEP.

6.1.3 Reasons for Positive or Negative Impacts

As a part of the post-project social evaluation it is important to ascertain the reasons why positive or negative impacts affected the local population, and the deviations from planned actions and incomplete actions during construction and operation phase of the project.

Field surveys and interviews with various stakeholders indicate overall adverse negative social impacts on the project-affected families due to the loss of their land, houses, shops, dry fruit trees, and subsequently loss of livelihood. However for the more general project area and region beneficial impacts are observed from construction and operation of Uri HEP. These positive and negative impacts are described below:

Reasons for Adverse Social Impacts on the Project-affected Families

1 Before the start of the acquisition process no social studies and public consultations were conducted among the affected families to understand the problems of those who would lose their land for the project.

2 The Resettlement Plan was not prepared for effective rehabilitation of affected families by NHPC or State Government in advance of the property acquisition. NHPC prepared a Rehabilitation Plan in 1992 when land acquisition and payment of compensation were almost completed.

3 The resettlement package was entirely based on cash compensation. This rehabilitation plan did not offer other rehabilitation options such as replacement land and houses, land-less allowances, transportation assistance, jobs for land-less families, water supplies to replace natural water sources, education and medical facilities, as would now be expected.

4 NHPC did not have a plan for recruiting members of affected families as long-term employees, so that they could sustain their livelihood and quality of life.

5 NHPC did not organise any awareness programs or vocational training for income restoration and replacement.

6 There was no monitoring and evaluation program for distribution of compensation. Part of the compensation for many affected families appears still to be owed 15 years after payment was due.

7 There was no grievance redressal mechanism established for the affected families. As a consequence dissatisfaction among the project-affected families has resulted in litigation.

8 Most of the project-affected families maintain that the Kendriya Vidhyalaya and dispensary facilities located within the Gingle Colony premises are not generally available for project-affected and local people. The reason given for this lack of availability is the maintenance of security of the Colony. The numbers of students from the general population in various classes in Kendiya Vidhyalaya as listed in Table 4-4 confirms the lack of local participation.

9 Various welfare activities organised by NHPC from time-to-time are considered to be insignificant and cosmetic in nature, and do not give significant direct and indirect benefits to the affected families and locals.

Reason for Beneficial Impacts on the Local Area and Region

1 During the construction phase, many people from the local area, including project-affected families, were given the opportunity of employment at attractive rates by URICO Contactor. At the peak of construction activity, URICO employed more than 4,700 Indian Nationals of whom the majority were recruited from local areas. During the seven-year construction period URICO estimates that about 9,000 people were trained and worked on the project. It is considered that local people received very substantial benefits and enjoyed an "improved quality of life" for about seven years.

2 NHPC currently provides employment to 216 persons, of which 93 belong to Uri Tehsil of Baramula District.

3 The communications infrastructure, including National Highway 1A and the Parallel Road has been substantially upgraded, providing significant benefits for the local population.

4 About 14 shops have been opened by local people outside the Gingle Colony. Generally residents of the Colony (mainly NHPC employees) shop at these establishments.

5 About 17 local vehicles have been hired by NHPC from local people on a monthly basis. This provides employment to at least 17 local people and income in the area.

6 Around 50 local people work under various contractors at the Uri barrage, guesthouse, Colony and NHPC Office, collecting trash, and providing other services.

7 NHPC contributed to water supply to part of Boniyar and Gingle villages.

8 NHPC Officers advise that occasionally welfare programs such as book distributions in schools and medical camps in villages are organised by NHPC for the benefit of the local community.

6.1.4 Utilisation of Compensation by Affected Families

During this post-project social evaluation, the study team attempted to elicit from the project-affected families how their compensation had been used, and what factors influenced this expenditure. Among the factors considered were awareness (missing, adequate or limited) and opportunities (limited by location, religion etc.).

The field studies indicate that most of the affected people did not have an adequate awareness of investment schemes, income substitution methods and proper utilisation of compensation to sustain their quality of life and livelihood. NHPC and the State Government did not organise any awareness programmes and income restoration vocational training for the project-affected families. In view of the high level of militancy and lack of industrial activity in area the affected families did not have many options for income restoration.

Based on data obtained from the field surveys, the ways in which the project-affected families used their compensation payments are given below:

1 About 80 project-affected families who lost their houses and land spent their compensation on building another house, weddings of daughters and on routine household expenditures. Very soon they had spent the entire compensation package in an unplanned manner due a lack of awareness.

2 About 5% of project-affected families invested their compensation money in the purchase of public-carrier vehicles. However as they did not have any experience of operating transportation vehicles they were generally unable to run profitable businesses, and subsequently they became labourers with reduced "quality of life".

3 Only about 15% of the project-affected families, typically those who had better financial conditions and had family members in State Government services or in the Army, spent their compensation in

a planned manner. Typical expenditure by this group includes education of their children and purchase of assets in Srinagar and Baramula and Jammu.

4 In the absence of a grievance procedure, and as a consequence of dissatisfaction with NHPC for not providing long-term employment, some project-affected families instigated litigation against NHPC. According to discussions with such families they spent a substantial part of compensation on lawyer's fees, court costs, and travel to pursue their cases.

6.1.5 Lessons Learnt for Future Projects

For Uri HEP a formal social assessment study was not conducted and a rehabilitation plan was not prepared before start the land acquisition. Furthermore the anticipated social impacts were not identified so that suitable mitigation measures could be implemented during and after land acquisition, in order to avoid or minimize the adverse social impacts.

For future projects lessons should be learnt from Uri HEP in order to achieve well-planned rehabilitation of affected families, so that they can sustain their quality of life after property acquisition.

It is considered that preferential employment opportunities on the project should be offered to members of affected families in line with their skills and capabilities.

A range of other rehabilitation options should be offered, rather than limiting compensation to cash payments. Other options for rehabilitation may include replacement land and houses and part-land and part-cash compensation packages. In addition to paying compensation to affected families, it is also important to propagate income restoration methods suitable for local conditions to affected people, so that they can earn their livelihood. Wherever cash compensation is provided, the affected peoples should be made aware of investment and insurance schemes in order to secure their futures.

For proper implementation of rehabilitation plans, monitoring of the rehabilitation process is important. Although the project structure included a good monitoring process for the technical, contractual and commercial aspects of the project, the socio-economic monitoring was less than adequate.

In future projects, monitoring of the rehabilitation process should be carried out by engaging expert organisations or NGOs. In addition, in order to address grievances of affected families during rehabilitation, a Grievances Redressal Cell (GRC) should be created, comprising representatives of the project authority, state government, supporting/funding agencies and affected families.

6.2 Impacts on the Public Health of the Area

6.2.1 Water Supply

During construction of the project, some natural water sources were destroyed, which were dominant sources of potable water for local people of Boniyar, Gingle and Pringle villages. At the time of land acquisition, NHPC assured residents of these villages that water supply facilities would be restored for these villages.

NHPC provided substantial financial support to PHE Department for supplying water in part of Boniyar village. The water supply scheme for Gingle Colony of NHPC also includes provision for supplying water for part of Gingle village.

Residents of Pringle village advise that initially NHPC was supplying water to this village but subsequently they withdraw this facility. It is observed that the natural drinking water source and one hydro rice mill in Pringle village were destroyed for construction of Uri barrage. Currently residents of this village face sever problems in obtaining drinking water.

6.2.2 Sanitation

During the field studies no problems relating to sanitation were reported by affected families and local people. Therefore, no social impact is observed on sanitation of the area.

6.2.3 Health Status of PAFs

The project was constructed many years ago and no baseline record have been found for contemporary health status. During the recent field studies the following issues relating to health were raised by affected families and local people.

Resident of Pringle village advise that their natural water sources have been destroyed for barrage construction. As there is no water supply from NHPC or PHE, they are forced to use natural drain water which sometimes causes water-born diseases. Parts of Boniyar and Gingle villages, which are not receiving water supplies from NHPC/PHE also reported similar types of health problems resulting from the project.

Villages located around barrage, such as Boniyar, Gingle, Pringle, Nogran, Mohra and Azadpur have adverse impacts from high noise levels generated by the hooter sounded during discharge of water from the barrage. Local people complain that their sleep is disturbed by this hooter noise at night.

6.2.4 Facilities Planned compared with those Actually Provided to PAF

As discussed in Section 5-1 the Contemporary Collector (Land Acquisition) and NHPC issued an "Assurance Certificate" promising certain facilities to families whose properties were to be acquired.

A number of the promised facilities have not been provided, as discussed in Table 6-2.

Table 6-2: Status of Original Assurances

Sn.	Assurances	Compliance Status
1.	Employment to at least one member of dislocated families.	The Contractor, URICO, provided employment to most of the affected families during construction of the project. NHPC has given employment to only 9 persons among 471 affected families (246 affected families due to construction of project components and 225 affected families due to construction of parallel road).
2.	Housing Colony	NHPC did not provide any housing colony for the affected families.
3.	Medical Facilities	NHPC has a dispensary within the Colony at Gingle; however affected families and local people advise that they are not generally allowed to use this facility due to security constraints.
4.	Free Education	NHPC did not provide a free education facility. NHPC has a Kedriya Vidhyalaya within the Colony premises but participation of local students is at a very low level.
5.	Free Power Surrendered Area	NHPC do not provide power to any affected families or affected villages.
6.	Families Insurance Scheme and other project provision for rehabilitation.	There was no such scheme or rehabilitation provision except cash compensation for affected families. NHPC occasionally organises some welfare programmes, such as book distributions and medical camps. However these seem to be insignificant for welfare of the affected families and area.
7.	Payment of Compensation	Cash compensation was paid to affected families for acquired land, house, shop and trees. For about 25% families, part of compensation appears still to be outstanding 15 years after payment was due.

6.2.5 Lessons Learnt for Future Projects

As a result of land acquisition and construction of the project, health related problems may arise due to destruction and contamination of existing water sources. Pollution levels, including dust and noise, may increase.

In future projects residual impacts could be avoided if these issues are addressed before start the construction. During and after construction of such projects, public health studies should be conducted by engaging professional organisations, to ensure the success of the implemented mitigation and rehabilitation measures.

6.3 Planned or Unplanned Mitigating Measures Taken by NHPC

As discussed in previous sections the Resettlement Plan was not prepared prior to land acquisition. Cash compensation was given to the affected families to enable them to acquire replacement land, and no other resettlement options were offered to the affected families. Various planned or unplanned mitigating measures taken by contractor URICO and NHPC are described below:

6.3.1 Planned Mitigation Measures

At the peak of construction activities URICO employed more than 4,700 persons of whom majority were recruited locally. During seven years construction period, URICO estimates that about 9,000 people were trained and worked on the project. This employment over a seven-year period provided a significant boost to the local economy, and provided many local people, including members of project-affected families, with a high level of income during this period. The monthly wages paid by URICO were some four times higher than those offered by NHPC at the time.

Following completion of Uri HEP NHPC has employed 216 persons from the area and region, out of which 93 employees belong to Uri Tehsil of Baramula district. However NHPC has not given preference to project-affected families and only 9 people form the 471 affected families (246 affected families through project components and 225 affected families through parallel road) are employed directly on the operation of Uri project.

Other employment opportunities associated with the on-going operation of the project include work for contractors engaged in trash removal at the barrage.

NHPC has contributed to the provision of the water supply for part of Boniyar and Gingle Villages.

6.3.2 Unplanned Mitigation Measures

From time-to-time NHPC organises welfare programmes and activities for local people. However these programmes are fairly limited, beneficial impacts of these welfare programmes seem to be fairly insignificant. From information provided by the NHPC Site Office, the welfare programmes undertaken in recent years are as listed in Table 6-3.

Table 6-3: Social Programmes Organised by NHPC

Year	Activity
2000	Tables, chairs, sports items, exercise books, uniforms, etc, were distributed at Dhani Syedan High School.
2001	Free medical camp was organised at Chhulan on 31 July 2001.
2002	Free medical camp was organised at Chhulan on 28 October 2002.
2006	Free medical camp was organised at Chhulan on 12 December 2006.
2007	Distribution of books at Govt. High School, Gingle on 06 March 2007.

6.3.3 Lessons Learnt for Future Projects

The Uri HEP project was started at a time when the social impact assessment and mitigation process was not well-developed in Kashmir, and hence the procedures followed were inadequate by current standards.

A number of planned and unplanned mitigation measures have been implemented by NHPC but these seem insufficient, particularly for the project-affected families. One major reason is considered to be the failure to undertake the Rehabilitation Plan in advance of the land acquisition process, and the absence of a dedicated Rehabilitation Officer who could be fully familiar with the needs and problems of affected families.

It is considered that the appointment of a dedicated Rehabilitation Officer for future projects would facilitate the handling of the social issues during construction and operation phases of the project.

6.4 Capacity Building Effects

6.4.1 Training Provided and Impacts felt by PAFs on Long Term Livelihoods

From the interviews with project-affected families and other stakeholders, it was reported that no awareness and vocational training programmes were organised for income restoration of the families whose property was acquired.

Information obtained from NHPC indicates that training in backyard poultry farming was given to some affected families. However since household poultry rearing is already practiced in the area, none of the project-affected families opted for poultry farming as a source of income.

6.4.2 Long-term impacts of Capacity Building due to Employment during construction

As discussed previously URICO trained about 9,000 persons during the seven year construction period to work on the project, and the great majority of these were locals from the Kashmir region. The training and work experience provided by URICO has improved the knowledge and skill levels of these people, and also their economic status during the construction period.

A few of these construction workers have subsequently obtained employment on other large hydroelectric projects in India, or on Delhi Metro and in the Middle East. However most of them are currently unemployed. The situation may improve in the near future as construction activities on Uri-II HEP increase, and also if NHPC is successful in the appointment of a contractor to undertake the Kishanganga HEP, which is also in the region.

NHPC also directly employs 216 people from the local area and region on Uri HEP, out of which 93 people belong to Uri Tehsil of Baramula district. In addition, about 50 people are employed through contractors as labourers on trash collection at Uri. Hence the socio-economic status and quality of life of these people working with NHPC on a regular or contract basis have improved significantly.

6.4.3 Lessons Learnt for Future Projects

The lack of training and capacity building for the project-affected families appears to have contributed significantly to their loss of sustainable livelihood. On future projects much greater attention needs to be given to training and capacity building in order to maintain and improve the livelihoods of affected people.

Ideally the large pool of trained labour would have been used for construction of follow-on hydroelectric projects in the region. However with there was a significant gap between the completion of Uri HEP and the next hydroelectric project in the area, and hence continuity of employment could not be provided. Where possible such continuity should be provided, in order that best use can be made of the trained labour force, and continued income can be provided.

6.5 Direct and Indirect Effects on Income Generating Activities

6.5.1 Shops and Small Businesses

As result of construction and operation of Uri HEP, positive peripheral impacts can be clearly observed in the area. About 14 shops have been opened by local people outside Gingle Colony. At other villages such as Guntamula, Boniyar, Nawagran, Bandi a total of around 30 shops are flourishing largely as a result of the purchasing capacity of NHPC employees and people associated with Uri HEP.

About 17 vehicles have been hired by NHPC from local people on a monthly contract basis, which gives employment to 17 local drivers plus support staff and provides an income stream in the area.

Numerous small contracts are awarded by NHPC for maintenance of their guest houses, Colony and other facilities. Most of these are awarded to local residents and the workers deployed for these works also come from the local area.

In total, in addition to the 216 people directly employed by NHPC on Uri HEP, a further 200 or so people derive their livelihood directly or indirectly from the project. Since each household on average has 1.4 income earners, this suggests that some 300 families derive their livelihood from Uri HEP, supporting a total of 1800 local people.

6.5.2 Banks and Commercial Services

Following the commencement of construction of the Uri HEP branches of J&K Bank, Kamraj Rural Bank and State Bank of India were opened in the area. It is considered that the opening of these banks was largely in response to the income stream of the construction workers. These banks now offer various saving schemes and also loan facilities for the local population.

6.5.3 Indirect Impacts from Improved Access, Cash Compensation and Capacity Building

Indirect impacts are also observed as a result of the cash compensation and capacity building of people working on the project during the construction and operation phases of the project. About 15% of the project-affected families who were compensated for loss of property and who had sound financial awareness used their compensation for education of their children, for building good houses and for buying land for agriculture or houses.

Workers trained during the construction period in specialised construction jobs such as operation of heavy construction equipment, controlled blasting and tunnelling found work on other construction sites. These people often work away from home, including in Delhi and the Middle East, and repatriate a large part of their earnings to their families.

The upgrading of the National Highway 1A as part of the project has contributed considerably to the regional infrastructure, and is considered to have played an important role in the development of the regional economy. This upgrading has probably also contributed to the ability to run the regular bus services between Muzaffarabad and Srinagar, which was initiated in April 2005.

6.5.4 Farming and Small Industries

The construction and operation of Uri HEP does not appear to have had any significant impact on farming patterns and small industries. There has been no observable change in faming patterns which can be attributed to the project. Similarly no significant change in the local industry can be attributed to the construction and operation of the project. It appears that the project has little dependence on local suppliers for spare parts or locally fabricated equipment, all of which appears to be imported from outside the region.

6.6 Gender Issues During Construction and Operation Phase

It is traditional in this area, partly as a result of the Islamic Culture, that the women are not allowed to work as labourers. Women may only work on their own agricultural land. Families which lost the majority of their land were left with unemployed females, who had previously worked on their own farms. This has affected the economic and social status of these families. No specific efforts have been made to provide employment opportunities for these women.

NHPC has not specifically recruited women on Uri HEP, and few employment opportunities are available to women in the area. During interviews it was apparent that women would be willing to work in Centres where commercial activities such as sewing, embroidery and knitting could be undertaken.

7 Social Performance Evaluation – Lessons Learnt

A social performance evaluation of Uri HEP has been carried out taking into account the rehabilitation measures adopted during the land acquisition process and the social welfare programmes undertaken during construction and operation of the project. The sections below describe the strengths and weaknesses of the programmes and the lessons learnt.

7.1 Strengths

- Interviews with the project-affected families indicate that compensation level paid through private negotiation were reasonably generous, and were higher than the statutory rates prevailing rates at the time of acquisition.
- Land acquisition for the project was executed under extremely complicated circumstances resulting from peak levels of militancy and serious pressure from militant groups in the area.
- The process of land acquisition was largely in line with the J&K Land Acquisition Act and the prevailing local regulations
- URICO, the contractor for construction of the project provided employment to a large workforce (a peak of 4,700) and trained up to 9,000 workers for the project, including many for specialised work. Trained personnel from the local area have obtained employment in various part of country and abroad.
- Trickle-down economic benefits from the operation of the project support up to 300 families or 1800 people in the local community, including direct employees, contract workers, shopkeepers and other service providers.

7.2 Weaknesses

- The nature and magnitude of the anticipated social impacts were not studied for Uri HEP prior to land acquisition. NHPC prepared the "Rehabilitation Plan of Uri HE Project" in 1992 when land acquisition and compensation disbursement processes were almost completed.
- The rehabilitation approach for affected families was based on cash compensation rather than land and property based compensation; little awareness livelihood sustenance training was provided, resulting in most of the affected families not being able to sustain their 'quality of life' after the acquisition process.
- Part of the cash compensation is still outstanding for several affected families 15 years after it was due.
- Affected families were not compensated for indirect losses incurred following loss of their property, and non-title holders did not receive compensation.
- Without adequate advice and financial awareness most affected people could not utilise their cash compensation properly.
- An effective monitoring mechanism to evaluate impacts of land acquisition on affected families was not implemented during or after the acquisition process.
- There was no effective grievance redressal system established during and after the land acquisition.
- The living standard of most of the project-affected families has degraded, and many of them are currently unemployed. The few who started small businesses on the basis of their compensation have generally been unsuccessful, and these businesses have failed. Most project-affected families regret that they have been separated from their land.

7.3 Lesson Learnt

For projects such as Uri HEP, where land acquisition is essential, social impact assessment (SIA) studies should be conducted at the time of conceptualisation of the project, well before the initiation of land acquisition.

The rehabilitation needs of the affected families should be identified and social mitigation measures should be implemented to minimize the anticipated social impacts. Resettlement plans should be prepared, based on state and national rehabilitation policies, and incorporating international guidelines including those of the funding nation and of international agencies such as ADB and World Bank.

Where commercial funding is to be employed it would now be standard practice to ensure compliance with the Equator Principles, and to ensure compliance with the IFC Performance Standards. These standards place a strong emphasis on livelihood sustenance, consultation, grievance procedures and monitoring where resettlement is involved.

Before finalisation of the rehabilitation plans, full public consultation and information disclosure meetings should be arranged among the affected families and other stakeholders. This will generally assist in establishing the concerns of the affected people, and formulating appropriate mitigants. It will also help to reduce the propensity for litigation and court cases.

Rehabilitation plans should offer choices of compensation packages, including cash, substitute land and property, part-cash and part-property. Preferably alternative locations and livelihood schemes should be available.

To sustain the "quality of life" of affected families, social mitigation measures such as houseless allowance, landless allowance, transportation allowance, vocational training should be implemented. The effectiveness of these measures should be monitored.

A monitoring mechanism is an essential part of effective implementation of the rehabilitation plan. Experienced NGOs or community-based organisations may be selected for monitoring the implementation of the rehabilitation plan.

Grievances and complaints on any aspect of the compensation and rehabilitation plan should be addressed in a timely and satisfactory manner. Establishment of an effective grievance redressal system should form part of the rehabilitation plan.

8 Outcome and Suggested Actions

Based on the discussions held with stakeholders of Uri HEP, including project-affected families, it is apparent that the quality of life of the majority of the project-affected families has degraded as a result of the land and property acquisition process. As a consequence the majority of the directly affected families appear to be dissatisfied.

As the largest industry in the area, local people look to Uri HEP for direct contributions for providing basic amenities such as water supply, power, health and educational facilities and for employment opportunities. It is also considered that NHPC has social responsibilities to provide some tangible benefits in the local area, in order to propagate good community relations, bearing in mind the need to perpetuate this relationship.

From the lesson learnt from the post-project social evaluation, NHPC may consider implementing the following suggestions for improving the socio-economic conditions of the area and enhancing the quality of life of the project-affected families.

1 The outstanding portions of the compensation packages which have been owing for 15 years should be disbursed with appropriate interest. It is suggested that an office be established by the Collector (Land Acquisition) and NHPC Senior Management at the Gingle Colony for rapid disbursement of the outstanding compensation.

2 NHPC should consider formation of a Grievance Redressal Cell (GRC) to resolve the complaint of local people, and if possible resolve the outstanding legal cases. The GRC should report to the General Manager (Uri HEP) and it should be monitored from NHPC Corporate Offices in Faridabad.

3 The opportunity could be taken on Uri-II HEP and Kishanganga to give preferential employment to members of the Uri-I project-affected families. Also NHPC could give similar preference when employing staff to work on the operation and maintenance of Uri HEP.

4 NHPC has a Kendriya Vidyalaya within the Gingle Colony area, with the number of students consistently less than its capacity. NHPC/Kendriya Vidyalaya Principal should advertise the available places in the surrounding villages when registering admissions. When students come from the local area, it would helpful to create a friendly and co-operative atmosphere for these local students. Consideration should be given to the employment of teachers from the local area (preferably from Uri and Baramula) so that they can relate well to the local students.

5 The use of the Dispensary facilities in the colony should be actively extended to local people and some medical staff should be recruited from the area. Records should be maintained of the number of local people treated at the Dispensary for monitoring and evaluation purposes.

6 It is suggested that NHPC could support capacity building centres for the women of project-affected families and the local area. Vocational training centres for commercial activities such as sewing, embroidery, knitting and dry food preservation could be created in the affected villages in consultation with the District Collector, and handed over to local government for proper operation.

7 As the drinking water sources of Pringle village and parts of Boniyar and Gingle villages of were destroyed due to construction of Uri HEP, NHPC should restore the water supplies with the help of the PHE Department.

8 The Labour Colony at Bela Salamabad constructed on land acquired from residents of Bela Salamabad at the time of construction of the project is now largely abandoned, with only a few quarters being by used by the Army. This colony is in good condition. NHPC could take the initiative with local government to create a Complex housing a Higher Secondary School, Vocational Centres, Industrial Training Institute and Dispensary in this abandoned colony. If this happens NHPC would be the largest contributor to development of local area.

9 NHPC also has abandoned land at Chahal village which was acquired for crushing and concrete preparation purposes. This land is close to National Highway-1A, and could be used for construction of a market for locally prepared goods and handicraft. These shops could be given to project-affected families on a loan basis or at discounted rates.

10 NHPC has developed a Children Park on the spoil disposal area at Boniyar Village. Regular maintenance of this park is required to provide good recreational facilities for local people and for visitors travelling on NH-1A.

Photo Documentation

Discussions at Bandi Village

Discussions at Bandi Village

Discussions at Bandi Village

Discussions at Rajarwani Village

Discussions at Pringle Village

Discussions at Bela Salamabad Village

Discussions at Pringle Village

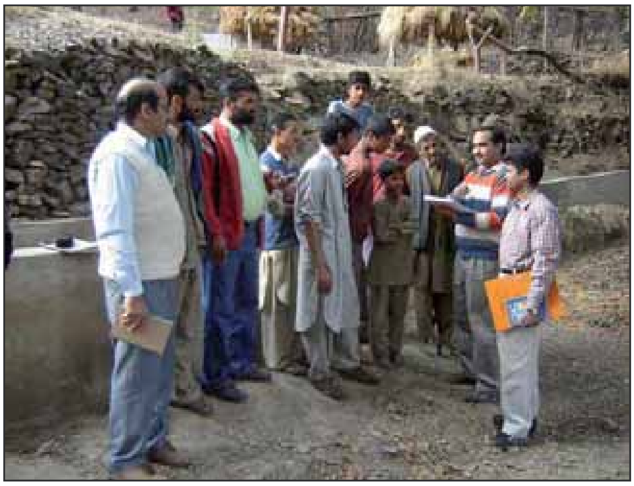
Discussions at Kanchan Village

Discussions at Rajarwani Village

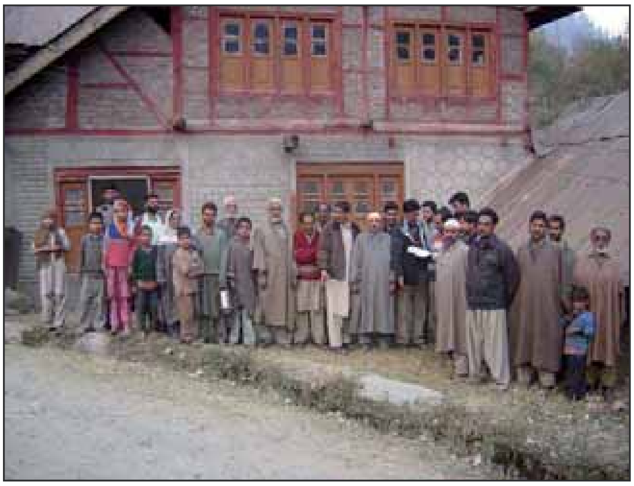
Discussions at Mohura Village

Discussions at Mohura Village

Discussions at Mohura Village



Discussions at Nowgran Village



Discussions at Nowgran Village

Discussions at Boniyar Village

Discussions at Guntamula Village

Appendix 1 Assurance Certificate of 29th August 1991

Annexure – A

URI H. E. PROJECT

OFFICE OF THE COLLECTORATE LAND ACQUISITION
URI H.E. PROJECT, NHPC GANTAMULLA.

ASSURANCE CERTIFICATE

TO WHOM IT MAY CONCERN

It is assured to representatives of rehabilitated families whose total holding property (house and land) stands acquired for the construction of UHEP would be given all the rehabilitated sources as per demanding of the owners. Whereas, the project authorities agreed all such demands of the owners as appended below:-

1. Employment atleast one member of dislocated families.
2. Housing Colony
3. Free Education
4. Medical Facilities
5. Free Power Surrendered Areas
6. Family Insurance Scheme and other project provision for rehabilitation.

However, it may be ensured that provision of dislocation families in the project, the authority take the constructive measures for the rehabilitated families.

Now therefore, all the house owners are served with the notice that they should fulfil the terms of the deed, by dismentling the houses without any obstruction. Failing which the department shall be at liberty to demolish the house and clear the site at his cost & risk. The notice shall be served to the house owners through Tehsildar Uri.

(G. S. GOTHRA)
CHIEF ENGINEER,
URI H.E.PROJECT,
GANTAMULLA.

Collector Land Acquisition
URI H.E.P. COLLECTOR LAND
ACQUISITION

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