



Hydropower Sustainability Assessment Protocol

Official Assessment

NHPC Limited

Teesta-V Power Station

India

Project Stage: Operation

Assessment Date: 04/03/2019 to 13/03/2019



Final

Report Date: 19/09/2019

Client: NHPC Limited

Lead Assessor: Dr Joerg Hartmann, Independent Consultant

Co-assessors: Dr Helen Locher, Independent Consultant; Zaglul Khandkar, Manager Environment & Sustainability - South East Asia, SMEC (trainee assessor)

Project size: 510 MW

Cover page photo: Teesta-V reservoir seen from dam, with Dikchu Bazaar in the distance

Acronyms

BIS	Bureau of Indian Standards
CAG	Comptroller and Auditor-General
CAT	Catchment Area Treatment
CCS	Carrying Capacity Study
CEA	Central Electricity Authority
CMD	Chairman & Managing Director
CPGRAMS	Centralized Public Grievance Redress and Monitoring System
CPSEs	Central Public Sector Enterprises
CSR & SD	Corporate Social Responsibility & Sustainable Development
CVC	Central Vigilance Commission
CMC	Central Municipal Corporation
CWC	Central Water Commission
DPE	Department of Public Enterprises
DMP	Disaster Management Plan
DSRP	Dam Safety Review Panel
EAP	Emergency Action Plan
EDM	Environment & Diversity Management
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ERLDC	Eastern Regional Load Despatch Centre
ERP	Enterprise Resource Planning
FIDIC	International Federation of Consulting Engineers
FEWMD	Forests, Environment and Wildlife Management Department
FRL	Full Reservoir Level
GHG	Greenhouse gas
HR	Human Resources
HVOF	High Velocity Oxygen Fuel
GLOF	Glacier Lake Outburst Flood
Gol	Government of India
GoS	Government of Sikkim
GWh	Gigawatthour (=MU, million units)
HoP	Head of Project
IHA	International Hydropower Association
ILO	International Labour Organisation
IMD	India Meteorological Department
IMS	Integrated Management System
INR	Indian Rupee
ISO	International Organisation for Standardisation
ITI	Industrial Training Institute
IUCN	International Union for the Conservation of Nature
LR&MD	Land Revenue and Disaster Management
MDDL	Minimum Draw Down Level
MoEFCC	Ministry of Environment, Forests and Climate Change
MoU	Memorandum of Understanding
NCR	Non-Conformance Report

NGOs	Non-Government Organisations
NGV	National Voluntary Guidelines
OH&S	Occupational Health and Safety
O&M	Operation and maintenance
PAF	Plant Availability Factor
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
R&D	Research and development
R&R	Resettlement and Rehabilitation
RoR	Run-of-river
RTI	Right to Information
SEBI	Securities and Exchange Board of India
SOP	Standard Operational Procedures
SPCB	State Pollution Control Board
STP	Sewage Treatment Plant
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
VCS	Verified Carbon Standard
WII	Wildlife Institute of India
WWF	World Wide Fund for Nature

Table of Contents

Acronyms.....	ii
Table of Contents.....	iv
List of Figures.....	v
Executive Summary.....	vi
Sustainability Profile	vii
Table of Significant Gaps.....	viii
Introduction.....	1
1 Communications and Consultation (O-1).....	7
2 Governance (O-2)	12
3 Environmental and Social Issues Management (O-3).....	20
4 Hydrological Resource (O-4).....	28
5 Asset Reliability and Efficiency (O-5)	32
6 Infrastructure Safety (O-6)	37
7 Financial Viability (O-7)	44
8 Project Benefits (O-8).....	50
9 Project Affected Communities and Livelihoods (O-9)	56
10 Resettlement (O-10)	62
11 Indigenous Peoples (O-11)	67
12 Labour and Working Conditions (O-12)	72
13 Cultural Heritage (O-13).....	80
14 Public Health (O-14).....	84
15 Biodiversity and Invasive Species (O-15)	88
16 Erosion and Sedimentation (O-16)	96
17 Water Quality (O-17)	102
18 Reservoir Management (O-18).....	107
19 Downstream Flow Regime (O-19)	112
20 Climate Change Mitigation and Resilience (O-20).....	121
Appendix A: Written Support of the Project Operator.....	127
Appendix B: Verbal Evidence.....	128
Appendix C: Documentary Evidence.....	131
Appendix D: Visual Evidence	144

List of Figures

Figure 1. Teesta Cascade	3
Figure 2. Teesta-V Location and Layout	4
Figure 3. Teesta-V Seasonal Pattern of Generation	32
Figure 4. Landslides in Teesta Basin, with Teesta-V Dam Location and Areas of High Landslide Intensity Highlighted (CCS 2007)	38
Figure 5. Average Daily Reservoir Levels 2018.....	110
Figure 6. Teesta River from the Teesta-V Dam at Dikchu down to the Rongni River	112
Figure 7. Teesta River between the Teesta-III and Teesta Low Dam V Projects.....	113
Figure 8. Hourly outflow data from the Teesta-V powerhouse between 1-7 January 2018.	117

Executive Summary

This report presents the findings of an assessment of the Teesta-V project using the Operation Stage tool of the Hydropower Sustainability Assessment Protocol. Teesta-V is a 510 MW hydroelectric power project, owned and operated by NHPC, located in Sikkim in northern India. It is part of a cascade of hydropower projects along the Teesta River, most of which are also under NHPC, the largest and most experienced hydropower company in India.

The assessment was carried out over the period January to June 2019, with an on-site assessment, including a visit to the project area and interviews with stakeholders, conducted from the 4th to the 13th of March, 2019. This assessment meets the requirements of an Official assessment, as described in the Terms and Conditions for the Use of the Protocol.

Teesta-V was commissioned in 2008 as the first large-scale power station in Sikkim. It was built to supply power to Sikkim's Energy & Power Department and other state-owned distribution companies in the eastern region. Over the first ten years of operations, NHPC has expanded its activities along the Teesta River and made significant efforts to mitigate its social and environmental impacts, to create socio-economic benefits, and to communicate and cooperate with local communities.

This assessment covers only the hydropower project and not the transmission lines, which connect Teesta-V first to a pooling sub-station at Rangpo and then to West Bengal and beyond. The most significant impacts of the project are related to the loss of agricultural and forest land, with a total of 261 families whose land was partially or totally acquired; changes in the Teesta River which flows north to south from the high Himalayas into the plains of Bengal; and impacts on the traditional way of life in Sikkim's mountain communities. At the same time, the project has provided significant socio-economic benefits, including low-cost electricity and employment.

These issues are reflected in the findings of this assessment, and in a range of high scores that summarise the findings. Teesta-V meets proven best practice on 6 out of 20 topics: O-5 Asset Reliability and Efficiency, O-7 Financial Viability, O-8 Project Benefits, O-13 Cultural Heritage, O-14 Public Health, and O-16 Erosion and Sedimentation.

Teesta-V exceeds Basic Good Practice on 9 topics, each of these with one significant gap against proven best practice: O-1 Communications and Consultation, O-2 Governance, O-3 Environmental and Social Issues Management, O-4 Hydrological Resource, O-6 Infrastructure Safety, O-11 Indigenous Peoples, O-17 Water Quality, O-18 Reservoir Management, and O-20 Climate Change Mitigation and Resilience.

Teesta-V meets Basic Good Practice on 5 topics: O-9 Project-Affected Communities and Livelihoods, O-10 Resettlement, O-12 Labour and Working Conditions, O-15 Biodiversity and Invasive Species, and O-19 Downstream Flow Regime.

Teesta-V is considered as a high-performing asset by NHPC, and improvements at Teesta-V are often replicated across NHPC's fleet of 24 power stations. Some of the gaps identified in this assessment (e.g. regarding land acquisition) are outside NHPC's sphere of influence, but most could be addressed through internal corrective action. In particular, the project would benefit from increased capacity to engage systematically with local communities.

The scores for all topics are summarised in the following Sustainability Profile and Table of Significant Gaps.

Sustainability Profile

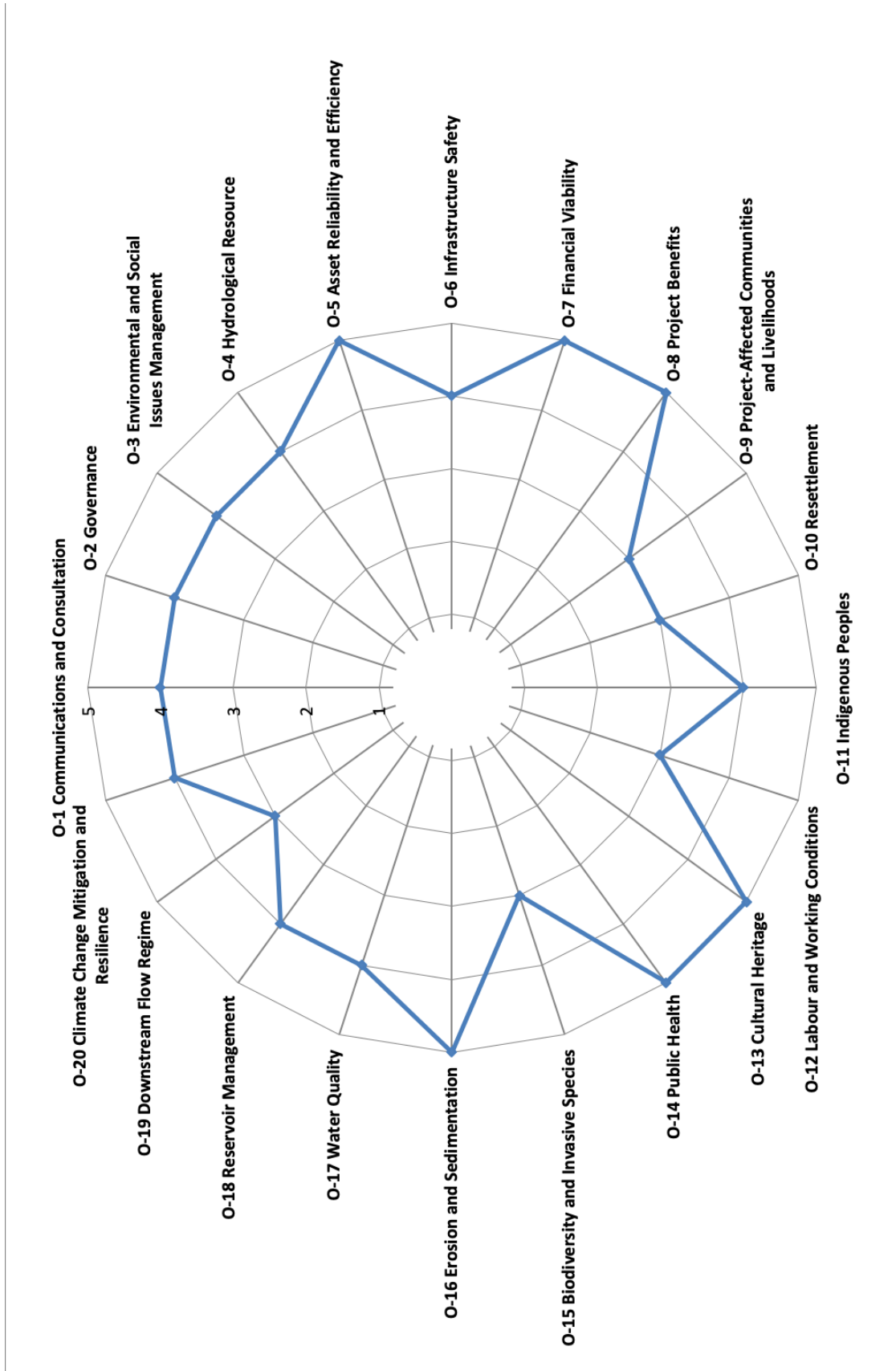


Table of Significant Gaps

	Level 3: Significant Gaps against Basic Good Practice	Level 5: Significant Gaps against Proven Best Practice
Assessment	No significant gaps	<p>O-1 Communications and Consultation: There is a lack of a systematic approach to communications and consultation, based on periodically updated stakeholder mapping (same gap under Management).</p> <p>O-4 Hydrological Resource: Issues with potential to impact water availability and reliability in the Teesta cascade have not been fully evaluated to consider options for long-term optimisation of generation planning (same gap under Management).</p> <p>O-6 Infrastructure Safety: The dam safety analysis has not yet been updated to reflect additional dams in the cascade and the increased PMF.</p> <p>O-9 Project Affected Communities and Livelihoods: There is a lack of ongoing engagement with the 199 partial oustee families, which makes it difficult to identify any ongoing or emerging issues, and risks or opportunities, and to determine whether livelihoods and living standards have improved (same gap under Management and Outcomes).</p> <p>O-10 Resettlement: The new monitoring and maintenance processes are unproven at the time of this assessment (same gap under Assessment and Management).</p> <p>O-15 Biodiversity and Invasive Species: There are shortfalls in the biodiversity assessment relating to fish impacts and the fish hatchery as the key fish mitigation measure.</p> <p>O-17 Water Quality: The monitoring program is not underpinned by an environmental risk framework, and is limited in its ability to identify or understand emerging issues or cumulative impacts.</p> <p>O-18 Reservoir Management: Despite identification of potential benefits of the Teesta-V reservoir in the EIA, and other potential opportunities, there has been no assessment of opportunities for the reservoir beyond power generation.</p> <p>O-20 Climate Change Mitigation and Resilience: No assessments have been carried out of the resilience of the project to different climatic scenarios, or of opportunities to provide adaptation services under different climatic scenarios. Therefore no comprehensive management approaches could be developed, no information on these aspects of the project publicly disclosed, and there is uncertainty regarding the resilience of the project under a broad range of scenarios, and its contribution to adaptation (same gap under Management, Stakeholder Engagement and Outcomes).</p>

Management	No significant gaps	<p>O-3 Environmental and Social Issues Management: The divided responsibilities across the organisational structure and the level of staffing for environmental and social issues management present limitations in the ability to anticipate and respond to emerging risks and opportunities.</p> <p>O-19 Downstream Flow Regime: There are unclear environmental flow objectives, and an absence of ongoing monitoring with respect to effectiveness of meeting objectives.</p>
Stakeholder Engagement	No significant gaps	<p>O-2 Governance: NHPC does not have a process to liaise with and respond to a representative range of stakeholders regarding their interests in regular reporting on Teesta-V sustainability performance.</p> <p>O-9 Project Affected Communities and Livelihoods: The delays in the completion of land acquisition processes are causing significant uncertainty for all involved.</p> <p>O-11 Indigenous Peoples: There are some concerns regarding systematic tracking of and timely responses to requests, and clarity of commitments entered by NHPC.</p> <p>O-12 Labour and Working Conditions: There are shortcomings in the employee engagement processes regarding the ability to raise issues and have them resolved in a timely manner, and documentation to verify this.</p> <p>O-19 Downstream Flow Regime: There have been no, nor are there any plans for, dedicated stakeholder engagement processes with respect to downstream flow regimes.</p>
Conformance/ Compliance	No significant gaps	<p>O-12 Labour and Working Conditions: There are a number of current safety-related non-conformances.</p>
Outcomes	No significant gaps	<p>O-15 Biodiversity and Invasive Species: There is a lack of evidence to demonstrate that the Teesta-V fish hatchery is an effective mitigation measure for addressing Teesta-V impacts on fish.</p> <p>O-19 Downstream Flow Regime: Downstream flow regimes, below the dam and below the power station, are not demonstrated to represent an optimal fit amongst environmental, social and economic objectives.</p>

Introduction

The Hydropower Sustainability Assessment Protocol

The Hydropower Sustainability Assessment Protocol ('the Protocol') is a framework to assess the performance of hydropower projects according to a defined set of sustainability topics, encompassing environmental, social, technical, and financial issues.

Developed by the International Hydropower Association (IHA) in partnership with a range of government, civil society and private sector stakeholders, the Protocol is a product of intensive and transparent dialogue concerning the selection of sustainability topics and the definition of good and best practice in each of these topics. Important reference documents that informed the development of the Protocol include the World Bank safeguards policies, the Performance Standards of the International Finance Corporation, and the report of the World Commission on Dams. To reflect the different stages of hydropower development, the Protocol includes four assessment tools that are designed to be used separately, corresponding to the Early Stage, and Preparation, Implementation and Operation stages of a project.

Applying the Protocol delivers an evidence-based assessment of performance in each topic, with a set of scores providing an indication of performance in relation to basic good practice and proven best practice. The scoring system is as follows:

- 5 Meets basic good practice and proven best practice;
- 4 Meets basic good practice with one significant gap against proven best practice;
- 3 Meets basic good practice with more than one significant gap against proven best practice;
- 2 One significant gap against basic good practice;
- 1 More than one significant gap against basic good practice.

Assessments rely on objective evidence to support a score for each topic that is factual, reproducible, objective and verifiable. Key attributes of the Protocol are: (i) global applicability, i.e. it can be used on all types and sizes of hydropower projects, anywhere in the world; and (ii) consistency, i.e. the consistency of its application is carefully governed by a system of quality control encompassing accredited assessors, terms and conditions for use, and the Protocol Council.¹

Scoring is an essential feature of the Protocol, providing an easily communicated and replicable assessment of the project's strengths, weaknesses and opportunities. The scoring system has been devised to ensure that a Protocol Assessment cannot provide an overall 'pass' or 'fail' mark for a project, nor can it be used to 'certify' a project as sustainable. The Protocol provides an effective mechanism to continuously improve sustainability performance because results identify gaps that can be addressed, and the findings provide a consistent basis for dialogue with stakeholders.

Assessment Objectives

NHPC's objectives for this independent assessment of the Teesta-V project are as follows:

- To document and benchmark key aspects of the project against internationally agreed considerations, through a comprehensive and evidence-based process
- To inform NHPC about the strengths and opportunities for improvement of the project with respect to the topics and scoring criteria contained in the Protocol

¹ Full details of the Protocol and its governance, are available on www.hydrosustainability.org.

- To learn lessons which are applicable to other projects, including the Teesta-IV project which is under development nearby
- To demonstrate leadership as the first company applying the Protocol in India
- To enhance the dialogue with and the reputation of NHPC among stakeholders, as a transparent company interested in continuous improvement.

Project Description

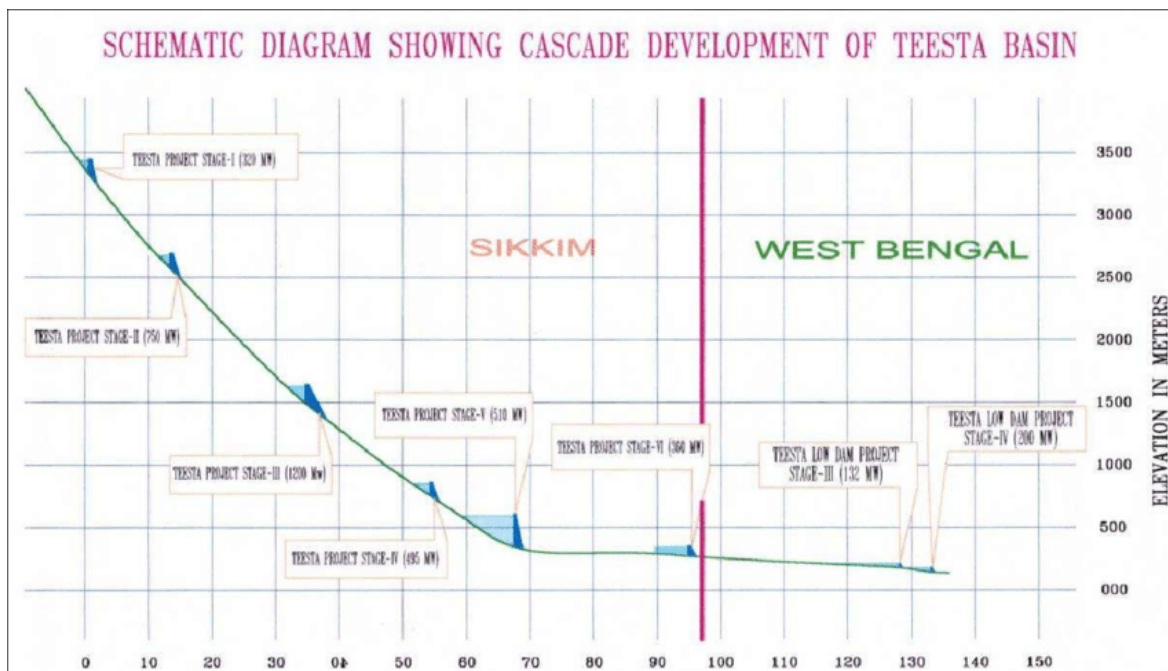
NHPC Limited (formerly known as National Hydroelectric Power Corp.) was incorporated in 1975 as a Central Government Enterprise for development of the hydropower sector. Since then NHPC has become the largest hydropower company in India. NHPC is a Schedule 'A' Enterprise with 'Miniratna' status (allowing a certain financial autonomy) since 2008, with an authorised share capital of INR 150 billion (equivalent to USD 2.2 billion).² NHPC's total installed capacity is 7,071 MW from 24 projects, including joint ventures as well as one solar and one wind project, and the company has a pipeline of additional projects under development and construction.

Sikkim is one of the northern Indian states with high hydropower potential, and hydropower is one of the key economic sectors in Sikkim besides agriculture, forestry and tourism. The state has a low population density and is ethnically diverse. Its government has promoted hydropower development, partly because of royalties due to the state. Its development policy is oriented towards a 'Green State' with sustainable development, and it has achieved notable success in organic agriculture, solid waste management, maintaining high forest cover, and other environmental matters.

The hydropower potential is concentrated along the largest river in Sikkim, the Teesta River, and some of its tributaries. Within a distance of 100 km, the elevation of the Teesta basin drops from 8,598 meters to 213 meters. A total of 36 projects above 30 MW had been proposed for the basin at one time. Along the mainstream of the Teesta River, the different stages of the cascade are numbered from upstream to downstream. Two projects are operational (1,200 MW Teesta-III by Teesta Urja Ltd., majority owned by the state of Sikkim, and 510 MW Teesta-V by NHPC), one is half-finished by a private developer and scheduled to be taken over by NHPC (500 MW Teesta-VI), and one is under development by NHPC (520 MW Teesta-IV). Stages I and II have been cancelled due to the sensitivity of the high alpine environment. Further downstream, after the river crosses from Sikkim into West Bengal, NHPC operates the two projects Teesta Low Dam III (132 MW) and Teesta Low Dam IV (160 MW). Below these two projects, the river enters into the floodplain and eventually flows into Bangladesh.

² In this report, currencies are provided with their ISO codes (INR and USD) and values are provided in international format instead of Indian format (i.e. not using lakh and crore). Monetary values are both in INR and USD. For values during the operation stage, generally the exchange rate at the time of this assessment (INR 1 = USD 0.0144) is used. For values during the construction stage, generally the exchange rate at the time of commissioning of the project (here assumed to be January 1, 2008; INR 1 = USD 0.0254) is used.

Figure 1. Teesta Cascade

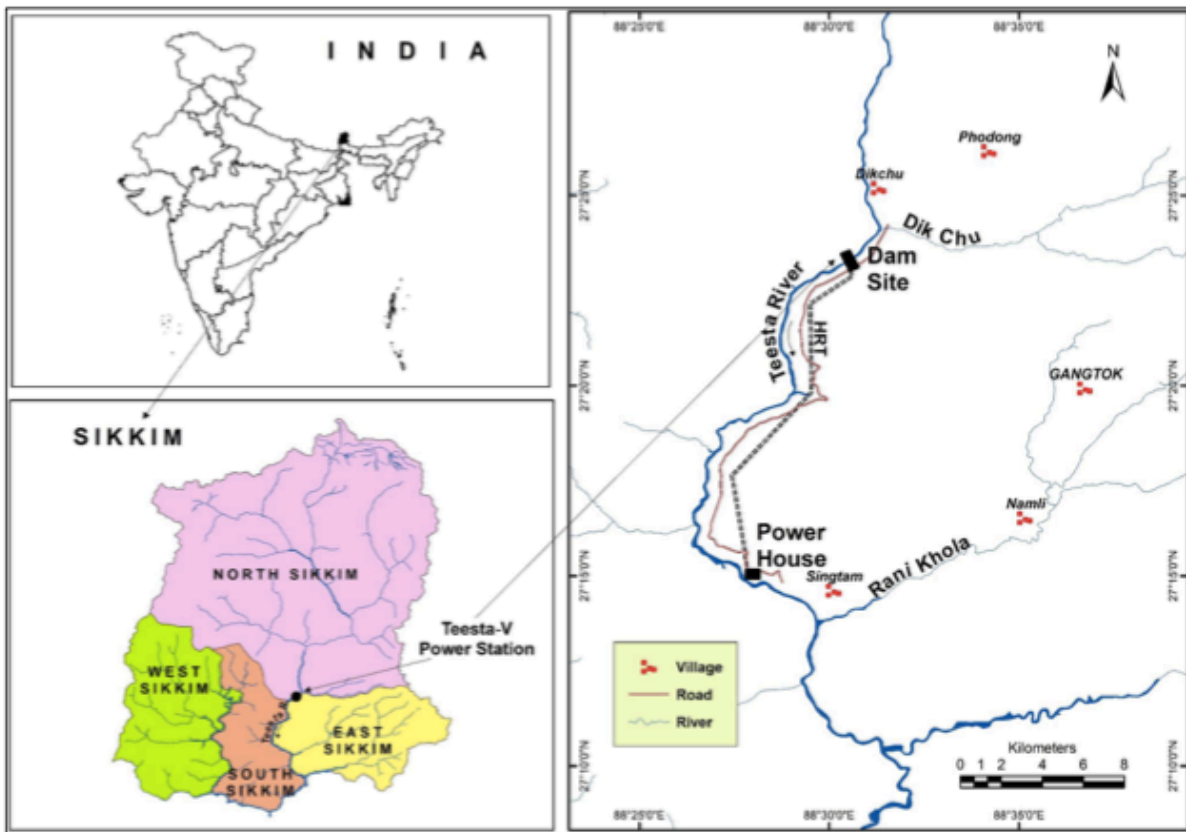


Teesta-V is a run-of-river project with a catchment area of 4,307 km². The concrete gravity dam is 88.6 m high and 176.5 m long, holding back a diurnal storage reservoir with the following features (as per a 2016 survey):

- Full Reservoir Level (FRL) - Elevation 579 m
- Max. Water Level (MWL) - Elevation 580.72 m
- Minimum Drawdown Level (MDDL) - Elevation 568 m
- Gross Storage up to FRL - 8.50 million m³
- Live Storage - 5.41 million m³
- Dead Storage - 3.09 million m³
- Submergence Area - 68 ha

Three vertical intake structures of 6.5 m, each with a capacity of 117 m³/s, lead to three underground desilting chambers, with silt flushing tunnels. A 17.1 km long and 9.5 m diameter headrace tunnel with a design discharge of 292 m³/s leads to a 92 m high, 30 m diameter surge shaft, three 321 m long penstocks, and an underground powerhouse with 3 x 170 MW Francis turbines, that discharges the flow back into the Teesta River through three tailrace tunnels. The location and general layout of the project are shown below.

Figure 2. Teesta-V Location and Layout



The project is designed to operate under a net rated head of 197 m, and to generate 2,573 GWh of energy in a 90% dependable year with 95% machine availability. During the winter (dry season), the project operates as a peaking plant, principally in the evenings; in the summer (wet season), it operates continuously. This is the case for all projects along the Teesta River cascade.

The project was built at a cost of INR 26.569 billion (USD 674 million) and fully commissioned in 2008, as the first large hydropower project on the Teesta River. At the powerhouse site (named Balutar), there is a large compound with staff quarters, offices, workshops, hospital and school, spoil areas, etc. There is also a smaller colony at the dam site (at Samdong village), and a resettlement colony (at Lower Khamdong village). Associated infrastructure includes roads, bridges and transmission lines. Spoil areas (muck dumps) are located near all of the major excavation areas.

Most of the reservoir is located in Sikkim’s North District, and part in the East District. Downstream of the reservoir, the Teesta River forms the boundary between the East District and South District. Most of the project infrastructure is on the left or eastern bank, in the East District. Only a part of the powerhouse colony is on the right or western bank of the river, in the South District. A total of 173 ha of private land and 147 ha of government forest land had to be acquired for the project’s reservoir and dam, spoil areas, colonies and other smaller components (including 25 ha for underground structures). The footprint of the project is relatively small for its installed capacity, because of the small reservoir and the fact that much of the infrastructure is underground. 62 families were displaced by the project and had to be resettled.

From the powerhouse, the village of Dikchu on the bank of the reservoir is 25 km away by road. The distance to the state capital Gangtok is 33 km. The closest towns are Singtam and Rangpo, 6 km and 17 km downstream. The closest large city is Siliguri in West Bengal, 94 km by road.

Assessment Process

The Teesta-V assessment builds on a previous trial assessment of the same project with the draft Protocol, in 2009. In 2018, NHPC tendered the services for this official assessment and awarded the contract on November 22, 2018. The lead assessor conducted an introductory training and scoping visit in January 2019, and worked with the NHPC team on the identification of interviewees and documentary evidence, preparation of a scoping document, population of an electronic data room, development of the assessment schedule, and logistical planning.

The on-site assessment was conducted between March 4 and 13, 2019, by the team of three assessors. The process involved collection of verbal, visual and documentary evidence to evaluate the project's processes and performance against the Protocol's scoring criteria. The assessment team conducted interviews at NHPC's Corporate Office in Faridabad, with government agencies in Delhi and Gangtok, and in the project area. A total of 50 interviews were conducted, most of them with a number of participants. Site visits covered the entire project area, from upstream to downstream, including some villages. Interviews covered the perspectives of the developer, employees and contract workers, government institutions at central and state level, affected communities, families and businesses, and consultants. For every topic, an effort was made to ensure that those with responsibilities and direct insights into the issues were interviewed. Triangulation of evidence – visual, verbal and documentary – is an important requirement for the evidence collection process, and was enabled through the assessment process.

Appendices B and C contain information on the interviews conducted and the documents reviewed. Both NHPC and the assessment team have done their best to ascertain the accuracy of the information provided in those appendices. Appendix D contains photos taken by the assessment team during both site visits.

Follow-up evidence was requested by, and provided to, the assessors in the weeks following the assessment. The draft report was provided to NHPC on April 28, for review of accuracy with respect to project, evidence and institutional references. Comments were received from NHPC on May 20. Following editing in response to NHPC's comments, an Official Assessment report was filed on June 4, 2019. This was published on www.hydrosustainability.org for the required 60-day public commenting period. One comment was received, which resulted in a minor adjustment in topic O-20.

Assessment Experience

This was the first official Protocol assessment in India, one of the countries with the largest hydropower sectors, and commissioned by NHPC as the most experienced hydropower company in India.

NHPC organised the assessment very professionally through staff both from the corporate head office and the project. The Single Point of Contact for the assessment team was Dr Sujit Kumar Bajpayee (Deputy General Manager of the Environment & Diversity Management (EDM) Division), working with Dr A.K. Tripathi (General Manager EDM), Mr Jaspreet Singh (Senior Manager EDM), Dr Ajay Kumar Jha (Senior Manager Environment for Teesta-V and Teesta-IV), and a large coordination team with other managers both from the Corporate Office and from the project. Mr. A.K. Mishra, Executive Director Planning in the Corporate Office, and Mr. Sahadev Khatua, General Manager in charge of the Teesta-V project, provided oversight and support. Many NHPC members were involved in training meetings or as internal observers, in order to spread capacity-building benefits among the staff.

All interviewees shared their views and knowledge openly, thereby assisting the assessment team in its task of understanding the project, and being able to assess and score the 20 relevant topics in accordance with the Protocol's requirements. Much of the documentary evidence is publicly available. Requests for follow-up information were responded to rapidly and comprehensively.

Layout of this Report

This report consists of twenty sections numbered in direct correspondence with the twenty topics of the Protocol's Operation tool. Four appendices are provided, including the written letter of support of the project operator (required for an official Protocol assessment), and detailing the items of visual, verbal and documentary evidence referred to under each topic.

For each topic, findings are provided according to the criteria used in the Protocol's methodology: Assessment, Management, Stakeholder Engagement, Stakeholder Support, Conformance / Compliance, and Outcomes. Findings are presented against a statement of 'basic good practice' and a statement of 'proven best practice' for each, with a 'Yes/No' indication of whether the scoring statement is met. A summary of the significant gaps against the scoring statement, the topic score and a brief summary are presented at the close of each topic section.

1 Communications and Consultation (O-1)

This topic addresses ongoing engagement with project stakeholders, both within the company as well as between the company and external stakeholders (e.g. affected communities, governments, key institutions, partners, contractors, catchment residents, etc). The intent is that stakeholders are identified and engaged in the issues of interest to them, and communication and consultation processes maintain good stakeholder relations throughout the project life.

1.1 Background Information

Directly affected external stakeholders of the Teesta-V hydropower project include land- and homeowners whose land and/or homes were acquired, other local community members (including several hundred short-term contracted staff) and small local businesses, and the Panchayats (elected village representatives) and district administrations.

Other external stakeholders include state and central government agencies, who have various relationships with NHPC in general and the Teesta-V project in particular, such as regulatory oversight, recipients of grants for projects, offtakers of electricity, and ownership. A number of national and international suppliers and consultants occasionally contract with the project. In a wider sense, all citizens of Sikkim (approximately 660,000) and of other states supplied by the project are indirectly affected. There are also a small number of civil society organisations with an interest in the project, such as WWF. The Teesta basin has a total of approximately 30 million inhabitants, but the large majority of these are downstream in Bangladesh and in parts of West Bengal, which do not experience any relevant impacts from the project.

Internal stakeholders include employees at the Teesta-V project (which are part of a regional unit for India's eastern region) and within NHPC generally.

This topic covers communications and consultation processes generally, while topic-specific stakeholder engagement is addressed within each relevant topic.

1.2 Detailed Topic Evaluation

1.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging issues relating to hydropower facility communications and consultation have been identified; requirements and approaches are determined through a periodically updated assessment process involving stakeholder mapping; and effectiveness is monitored.*

NHPC, and specifically the Teesta-V project, have communication and consultation relationships with many stakeholders. Communication and consultation needs are identified in the Corporate Office and in all operating units. Many of these are prescribed by regulations, such as the reporting relationships with state and central level regulators. Others have grown over time as the project has been prepared, constructed and operated over approximately 20 years.

In general, issues relating to communications and consultation are well understood, and Teesta-V staff and managers are open to internal and external communications. However, the only stakeholder maps that were identified are various lists of phone numbers and email addresses, and generic lists of stakeholders such as in NHPC's Corporate Social Responsibility and Sustainable Development (CSR & SD) Communication Strategy.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the stakeholder mapping takes broad considerations into account.*

No systematic overall stakeholder mapping has been conducted to understand: which stakeholders are affected by and interested in Teesta-V; what their specific interests and appropriate communication channels are; to track interaction with these stakeholders over time; and to monitor whether they are satisfied with the information they have available, and their opportunities to discuss questions and suggestions. The lack of a systematic approach to communications and consultation, based on periodically updated stakeholder mapping, is a **significant gap** against proven best practice, because there is a risk of not communicating (or not communicating effectively) with some stakeholder groups. This gap is also related to the lack of social and environmental capacity in the Teesta-V project organisation, described under topic O-3, which makes it difficult to identify and maintain relations with all relevant stakeholders.

Criteria met: No

1.2.2 Management

Analysis against basic good practice

Scoring statement: *Communications and consultation plans and processes, including an appropriate grievance mechanism, are in place to manage communications and engagement with stakeholders; these outline communication and consultation needs and approaches for various stakeholder groups and topics.*

Communications and consultations are managed through a corporate communications division in the Corporate Office, as well as officers/divisions responsible for communication in the various projects. In Teesta-V, public relations and internal communications are handled by the Head of Project (HoP) Office, and the Human Resources (HR) and Environment and Diversity Management (EDM) divisions. There is no specific overall communications plan, but a number of communications processes are in place. For external stakeholders, these include but are not limited to communications:

- With the general public through NHPC's website (topic O-2), periodic reports, press releases and advertisements with national and local newspapers, social media, and occasional events (exhibitions, fairs, sports and cultural events)
- With local communities and elected officials at the village, district and state level, through occasional meetings and general availability of project management including the HoP during designated office hours, mostly regarding issues such as employment, CSR, and scholarships (topics O-8 to O-12)
- Regarding grievances, as described in topic O-2
- Regarding releases from the dam and powerhouse, through sign boards, sirens, press releases, awareness meetings, and direct communication with the police and other emergency officials (topics O-6 and O-19)
- With local health and education services, regarding the hospital and school operations (topics O-8 and O-14)
- In case of Right to Information (RTI) requests (which have to be complied with except when privileged because of commercial sensitivity, security or privacy concerns) through a designated RTI officer
- With the Eastern Regional Load Despatch Centre (ERLDC), regarding availability and generation scheduling (topic O-5)
- With the environmental regulators Ministry of Environment, Forests and Climate Change (MoEFCC) at the central level and State Pollution Control Board (SPCB) at the state level, as well as the banks, regarding implementation of the license conditions, environmental management plan (EMP), consents to operate, and loan conditionalities (topics O-3 and O-7)
- With various committees and their members, as long as these were functional (topics O-3 and O-10)

- With the Central Water Commission (CWC) regarding dam safety and India Meteorological Department (IMD) regarding seismic data (topic O-6)
- With state agencies and other dam operators in the cascade, via a private WhatsApp group, regarding hydrology (topics O-4 and O-6)
- With the Ministry of Power and the Central Electricity Authority (CEA) regarding performance targets and delivery (topic O-5)
- With other central government agencies such as the Comptroller and Auditor-General (CAG), as required
- With contractors, suppliers, consultants, auditors etc. through meetings and correspondence (topic O-2)
- With investors, through annual reports, financial statements and other documentation, mostly accessible through the 'Investor Corner' on the website

External communications are regulated through a number of processes, for example to ensure that NHPC as a corporation listed on the stock market follows disclosure rules. An office order regulates which levels of officials are authorised to communicate various types of information. Some information is released to the public through government channels. A CSR & SD Communication Strategy has recently been formulated and disclosed, which includes principles and procedures for such communications, but has yet to be fully implemented (see also topic O-2). A Corporate Identity Manual and detailed Integrated Management System (IMS) procedures (on Media Relations & Printing, Publicity (Advertisement, Films and Exhibition), Sports & Culture, Social Media Guidelines and Procedures) complement these processes.

For internal stakeholders, i.e. with employees and between different units within NHPC, communication processes include but are not limited to:

- Circulars, other information materials, and meetings with staff at various levels, up to the Board level
- Reporting from the power station to the regional office and to various departments in the Corporate Office
- NHPC's intranet which includes among other features, news, manuals and procedures, and portals for all divisions
- Monthly newsletters from the chairman ('From CMD's Desk'), and quarterly NHPC review

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, communication and consultation plans and processes show a high level of sensitivity to communication and consultation needs and approaches for various stakeholder groups and topics; and processes are in place to anticipate and respond to emerging risks and opportunities.*

The communication measures listed above cover a variety of stakeholder communication needs. However, because they are not based on a systematic stakeholder mapping (see above under Assessment) and systematic evaluation of stakeholder interests (see under topic O-2), they are necessarily limited. For example, there appear to be few channels to communicate specifically with civil society and with groups that may be under-represented in interaction with the project (because of distance or cultural barriers such as education, gender or language) and may need special communication efforts. This might require additional approaches, such as a community liaison officer, regular scheduled visits to communities, a community advisory committee, or a community newsletter. This also limits the project's ability to anticipate and respond to emerging risks and opportunities. This is essentially the same **significant gap** as above under Assessment.

Criteria met: No

1.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *The operation stage involves appropriately timed and scoped, and often two-way, engagement with directly affected stakeholders; engagement is undertaken in good faith; ongoing processes are in place for stakeholders to raise issues and get feedback.*

The multiple communication processes described above allow most directly affected stakeholders access to project representatives and information. Some stakeholders described problems such as language barriers, difficulties to get hold of the right counterparts at the project, or slow responses. Others mentioned that NHPC and Teesta-V could be more systematic, proactive and open in terms of communications. The absence of documented or publicly disclosed agreements have been noted under some topics. There were also some issues regarding timely internal communication between NHPC departments, or managers and staff. Examples for such issues are found under several topics in this assessment. However, these issues are not seen as a significant gap at the level of basic good practice. In general, stakeholders believed that NHPC was acting in good faith and as a public company, was more accessible, responsive and broadly accepted than most private sector hydropower companies.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, engagement is inclusive and participatory; negotiations are undertaken in good faith; and feedback on how issues raised have been taken into consideration has been thorough and timely.*

There are no indications that any stakeholder groups are excluded from engagement, although, as described above, NHPC could be more proactive in seeking out and communicating with additional groups. Stakeholder groups generally reported that they were able to discuss issues and solutions in a participatory way, with NHPC demonstrating good faith. This could be further strengthened with clear, formal community agreements rather than verbal assurances. All indications are that NHPC has been responsive in addressing issues raised by government agencies. There have been delays in responses with respect to some issues for resettlers (see topics O-10 and O-12) and indigenous peoples (see topic O-11), which are gaps but are not counted here, as they are already taken into consideration under those other topics.

Criteria met: Yes

1.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to communications and consultation have been and are on track to be met with no major non-compliances or non-conformances, and communications related commitments have been or are on track to be met.*

There are no indications for major non-compliances or non-conformances of NHPC at the corporate level or the Teesta-V project, regarding communications and consultations. In fact, the public hearing and consultation meetings during the preparation of Teesta-V are still regarded as well implemented, considering that they were the first for a major hydropower project in India after new regulations were introduced in 1994, at a time when new projects were often highly contentious. With its CSR & SD Communication Strategy, NHPC complies with a 2013 guideline from the Department of Public Enterprises (DPE). No stakeholders (including regulators) mentioned communication requirements or commitments that have not been met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, there are no non-compliances or non-conformances.

There are no indications for non-compliances or non-conformances.

Criteria met: Yes

1.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There is a lack of a systematic approach to communications and consultation, based on periodically updated stakeholder mapping.

1 significant gap

1.3 Scoring Summary

Internal and external communications of NHPC and specifically, of the Teesta-V project rely on multiple channels, reflecting the multiple groups of stakeholders which are affected by or interested in the project. Stakeholders generally describe NHPC representatives as accessible, although there are some opportunities for improvement. However, communications are not based on a comprehensive, regularly updated stakeholder mapping and a systematic communications plan, which limits the ability to anticipate and respond to emerging risks and opportunities. This is a significant gap against proven best practice, resulting in a score of 4.

Topic Score: 4

1.4 Relevant Evidence

Interview:	11, 17, 22, 27, 30, 35-38, 42, 44, 46, 49, 50
Document:	1-7
Photo:	13, 20

2 Governance (O-2)

This topic addresses corporate and external governance considerations for the operating hydropower facility. The intent is that the owner/operator has sound corporate business structures, policies and practices; addresses transparency, integrity and accountability issues; can manage external governance issues (e.g. institutional capacity shortfalls, political risks including transboundary issues, public sector corruption risks); and can ensure compliance.

2.1 Background Information

NHPC Ltd., incorporated in 1975, is a Government of India (GoI) Enterprise for the development and operation of hydropower projects. It has a head office in Faridabad near Delhi, and four regional offices, of which the one in Siliguri in West Bengal has responsibility for Teesta-V.

India is a union of 29 states and seven territories, with the capital in New Delhi. There are 58 ministries with 93 different departments in the national government, a number of which have responsibilities relating to NHPC and Teesta-V. Important national government agencies with respect to Teesta-V include the CWC, CEA and MoEFCC.

The Teesta-V project is entirely within the state of Sikkim, which has the smallest population and second smallest land area of any state in India. Sikkim was its own Kingdom in the 17th century, then a princely state of British India in 1890, and after 1947 it had a protectorate status with the Republic of India. In 1975 the monarchy ruling Sikkim was deposed, and Sikkim became the 22nd state of India.

Sikkim is divided into four districts – East Sikkim, North Sikkim, West Sikkim and South Sikkim – using water divides of major and minor tributaries of the Teesta River as boundaries. The four districts are in turn divided into subdivisions. The Teesta-V reservoir is part in North Sikkim and part in East Sikkim. Downstream of the dam the Teesta River forms the boundary between South and East Sikkim. The state capital, Gangtok, is located in East Sikkim. Local government is the third level of government, below the union and state governments. It consists of elected representatives within panchayats (literally meaning “assembly”) in rural areas and municipalities in urban areas.

The Teesta River is a transboundary river, comprising the steep slopes of the catchment in the Indian state of Sikkim, flowing through the gentler slopes of the Indian state of West Bengal, and then through the flatter lowlands in Bangladesh. There is a long-standing dispute between India and Bangladesh over water availability, particularly in the dry season, as both countries have extensive plans for water usage. There do not appear to be any direct implications of the Teesta-V project on transboundary water sharing, given its small storage and run-of-river operations.

The Worldwide Governance Indicators are a research dataset relating to quality of governance. These rank India in the 60th percentile for voice and accountability and for government effectiveness; in the 50th percentile for rule of law and for control of corruption; in the 40th percentile for regulatory quality; and in the 20th percentile for political stability and absence of violence/terrorism. Transparency International’s Corruption Perception Index scores India as a 41 out of 100, with a score of 0 being highly corrupt, and ranks India number 78 out of 180 countries on this index.

2.2 Detailed Topic Evaluation

2.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging political and public sector governance issues, and corporate governance requirements and issues have been identified, and monitoring is being undertaken to assess if corporate governance measures are effective.*

There are several mechanisms by which NHPC identifies ongoing or emerging political and public sector governance issues. At the corporate level, because NHPC is a public sector business enterprise, the government liaises closely with NHPC and even seeks NHPC's advice on policy matters that could affect it. The NHPC Board of Directors, which includes independent directors, has a risk management committee that keeps an eye on a broad spectrum of risks including political. The Company Secretary and staff under this role keep aware of changes in regulations and policies, and raise these matters to the Board for their consideration.

Corporate governance requirements and issues are the responsibility of the Company Secretary, who supports the Board and ensures compliance needs are met. Corporate governance at NHPC follows the DPE Guidelines on Corporate Governance for Central Public Sector Enterprises (CPSEs). The Board's independent directors are experts in accounting, hydropower, and management, and provide guidance through board and committee meetings. There are a number of Board committees for important focal areas: audit, stakeholder relations, nominations and remuneration, CSR and sustainability, risk management, share allotments (to address transfers of shares), and an appellate authority (to address employee appeals).

Monitoring is implemented through extensive internal and external audit processes, and through risk, compliance and non-conformance reporting.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no significant opportunities for improvement in the assessment of political and public sector governance issues and corporate governance requirements and issues.*

No significant opportunities for improvement were apparent at the time of this assessment. As a Public Sector Enterprise, NHPC receives a very high level of scrutiny in all aspects of its activities. The NHPC Vigilance Department, headed by a Chief Vigilance Officer, monitors NHPC regarding transparency, objectivity and quality of decision-making in its operations. The Vigilance Department undertakes planned and unplanned inspections on a regular basis, and documents and follows up on action points. The Chief Technical Examiner of the Central Vigilance Commission (CVC) of the GoI intensively examines any aspects of NHPC that are identified for scrutiny.

NHPC has a Chief Internal Auditor appointed by the Board Audit Committee, with an office of 27 staff. Audit plans are in place for the 57 business units, and reports are provided quarterly to the Board Audit Committee. Representatives of the CAG of the GoI come for two to three months a year and do external audits focussing on different public sector areas, for which they provide consolidated reports for all Public Sector Undertakings of the GoI (for example, one was done for CSR in 2018).

NHPC is guided by international standards, and is certified independently to a number of these. The Integrated Management System (IMS) for NHPC addresses the International Organisation for Standardisation (ISO) standards for:

- ISO 9001:2015 (Quality Management Systems)
- ISO 14001:2015 (Environmental Management Systems)
- OHSAS 18001:2007 (Safety Management Systems), soon to be updated to ISO 45001:2018 (Occupational Health & Safety Management Systems)

There is a well-developed system of external and internal auditing relating to the IMS, with the Bureau of Indian Standards (BIS) conducting the external audits once a year.

Criteria met: Yes

2.2.2 Management

Analysis against basic good practice

Scoring statement: *Processes are in place to manage corporate, political and public sector risks, compliance, social and environmental responsibility, procurement of goods and services, grievance mechanisms, ethical business practices, and transparency; policies and processes are communicated internally and externally as appropriate; in case of capacity shortfalls, appropriate external expertise is contracted for additional support.*

Risks in the business are managed through a process that reports up to the Board Risk Management Committee. Risk Officers at a number of business locations report up to a Risk Assessment Committee, which in turn reports to the Board committee. NHPC has a Risk Management Policy, and maintains a register that documents assessed risks, mitigation measures and responsibilities. Risk Coordinators are assigned to each identified risk, and are responsible for management actions. At the project level, there is a safety and risk management officer with responsibilities covering CSR, the IMS, safety and risk. Four categories of risk are monitored at Teesta-V – operational, financial, compliance and strategic.

Compliance is a strong focus for NHPC, and receives considerable attention in the internal and external auditing processes. The Company Secretary is responsible to ensure compliance with corporate governance requirements listed in the Companies Act 2013; SEBI (Listing Obligations and Disclosure Requirements) Regulations 2015 (SEBI is the Securities and Exchange Board of India); and the DPE Guidelines on Corporate Governance for CPSEs. A Compliance Certificate is published in the Annual Report regarding meeting the SEBI requirements. All NHPC department heads must ensure compliance with legislation guiding their relevant responsibility areas. The HoP reports regularly to the Corporate Office on compliance matters. A team from the Company Secretary and Law divisions of NHPC visit various locations randomly a few times per year to verify compliance.

Social and environmental responsibility are addressed through NHPC's Corporate Environment Policy 2016, although this focuses on environmental aspects. This policy commits to integrate environmental considerations into all stages of hydropower projects; to avoid, minimise, mitigate and compensate environmental and social impacts; to comply with applicable environmental legislation and adopt best environmental practices; and to prevent pollution and mitigate environmental risks from NHPC's activities. NHPC's EDM division has 50 staff across India, most of them posted at specific projects, addressing Environmental Impact Assessments (EIA), environmental policy matters, environmental audit observations, and relevant government requirements.

The social aspect of NHPC's Corporate Environment Policy is primarily in relation to direct impacts of a hydropower project on the local communities. A broader view on social responsibility is addressed through CSR activities, in response to CSR Guidelines issued by the Ministry of Corporate Affairs, aimed at making positive contributions to society at large in the areas surrounding company operations. Section 135 of the Companies Act 2013, applicable to all companies with a net worth over INR 5 billion (USD 72 million), requires a Board CSR Committee to approve annual projects for CSR activities that represent 2% of average net profits of the company (see topics O-3 and O-8). CSR is under the domain of HR at both the corporate and project levels. Each of NHPC's hydropower projects has a CSR committee comprising 3-4 cross-divisional representatives.

Procurement processes are centralised at NHPC, through the Procurement and Contract Division, and guided by manuals, guidelines, procedures and templates. Processes and responsibilities align with the Delegations Manual, which aims to reduce decision-making times and increase overall operational efficiency. Non-specialised procurement can be undertaken at the project level (i.e. for standard or routine items); otherwise it will be delivered at the corporate level in accordance with categories and thresholds set out in the Delegations Manual. NHPC follows international standards for major contracts, and uses the International Federation of Consulting

Engineers (FIDIC) standards for its contract templates. At Teesta-V there are separate units for Contracts and Procurement. More than 95% of requisitions go to open tender, and the remaining is procured through Memorandums of Understanding (MoUs) with vendors and clients set up by the Corporate Office.

There are several different types of grievance mechanisms, depending on the focal area. NHPC has a Grievance Policy and Procedure that is applicable to staff (addressed under topic O-12), to address individual concerns on matters that are not covered by collective bargaining. An Internal Complaints Committee has been set up at various locations of NHPC for redressal of complaints under the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013. The CVC Vigilance Manual outlines processes for complaints that relate to corruption, malpractice or misconduct, which include a Whistle Blower Policy. NHPC's model tender document sets out procedures for issues or disputes relating to contracts, in accordance with the Arbitration and Conciliation Act 1996.

Regarding any grievances from employees or the public, NHPC publishes a Citizens Charter on its website that sets out the grievance mechanism that can be followed, as well as a list of nodal officers and their contact details regarding any employee or public grievances. NHPC provides a link on its website to the Gol's Centralised Public Grievance Redress and Monitoring System (CPGRAMS), an online system for citizens to submit and track grievances, for action to be taken by relevant government agencies. Grievances can also be raised informally through local governments, or can be taken to the courts.

NHPC has implemented a system for Enterprise Resource Planning (ERP) (i.e. integrated management of core business processes through appropriate software and technologies) to integrate all its business functions to improve information availability, transparency and decision making. The Right to Information Act 2005 guides activities of NHPC to maintain accountability and transparency to the public. Many documents have been placed on the NHPC website. Roles at the Corporate Office include an Appellate Authority, Transparency Officer and Central Public Information Officer. Assistant public information officers are at each of the power stations and regional offices.

NHPC has a number of policies and processes to ensure ethical business practices, including the Fraud Prevention and Detection Policy; the Code of Business Conduct and Ethics; the NHPC Conduct, Discipline and Appeal Rules; and the Whistle Blower Policy. Ethical business practices are ensured through the Vigilance Department, which has seven wings as defined by the CVC vigilance manual and guidelines, addressing aspects including prevention, investigations and disciplinary procedures. Vigilance awareness programmes, signage, circulars and guidelines are part of the processes to ensure preventative vigilance. Processes are developed for areas identified as high risk, such as improving manuals and procedures to reduce risks of malpractice.

Policies and processes are communicated internally and externally. Communications (see topic O-1) are managed within the HR area of NHPC with the company intranet as the main vehicle for internal communications on policies and processes, as well as internal notifications and signage in corporate and project locations. The NHPC internet provides public information about many policies and processes. A number of business policies and processes are highlighted in the published NHPC Annual Report, which also provides weblinks for various policies of NHPC.

Appropriate external expertise is contracted to provide additional support in cases of capacity shortfalls or where independence is important to ensure. For example, at Teesta-V, the equipment manufacturers were brought in to address problems with the transformers and the gas insulation system given their understanding of the equipment (see topic O-5), and a contract is presently being implemented by external researchers to provide a post-construction EIA (see topic O-3).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, contractors are required to meet or have consistent policies as the developer; procurement processes include anti-corruption measures as well as sustainability and anti-corruption criteria*

specified in pre-qualification screening; and processes are in place to anticipate and respond to emerging risks and opportunities.

NHPC requires contractors to meet all legal requirements, and spells these out in detail in the model tender document regarding the labour force and employee welfare and safety. Contractors must comply with all requirements of the international standard for Social Accountability SA 8000:2001. Contractors must meet NHPC policies where they go beyond mandatory GoI requirements, such as contributions to the Employee Provident Fund.

Anti-corruption measures are included in procurement processes through procedures that ensure avoidance of inappropriate activities, monitoring and auditing processes to verify proper process has been followed, and whistle blowing mechanisms for raising issues for investigation. The model tender document includes a number of clauses relating to corrupt, fraudulent, collusive or coercive practices, and every bidder enters into a pre-contract Integrity Pact in line with that promoted by Transparency International. NHPC can ban business dealings with any agencies that commit deception, fraud or other misconduct, according to guidelines included as an annex to the Integrity Pact.

Pre-qualification is where potential contractors, suppliers or vendors are short-listed based on a specified set of criteria, and then those who qualify are invited to bid and receive the relevant documentation. NHPC does not tend to use pre-qualification of bidders in its procurement processes, as it prefers to pursue an open market approach where all potential bidders can get all information and ask questions. Anti-corruption and sustainability criteria are adequately included in the procurement processes that all bidders must meet, through the Integrity Pact, the procurement manual, the contract manual, and clauses in the model tender document.

Processes are in place to anticipate and respond to emerging governance-related risks and opportunities. Both risks and opportunities are identified through following international standards and guidelines, and through audits and the Vigilance Office activities. Regarding responding to opportunities, several good examples were evident in relation to procurement, notably the move to online procurement through a Government e-Marketplace (the GEM), and targets for procurement from micro- and small enterprises and from women entrepreneurs.

Criteria met: Yes

2.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *The business interacts with a range of directly affected stakeholders to understand issues of interest to them; and the business makes significant project reports publicly available, and publicly reports on project performance, in some sustainability areas.*

Stakeholder mapping and interests were described in topic O-1. In the NHPC CSR & SD Communication Strategy, NHPC notes that its key stakeholder groups are employees, local communities and affected populations, District Administration and State Government Departments, elected public representatives, shareholders and investors, Non-Government Organisations (NGOs), community-based organisations, civil society, contractors, and educational institutions. Regarding Teesta-V, the stakeholders who NHPC appears to primarily liaise with are government agencies at the 3 levels of government, and contractors across a range of areas of expertise. NHPC appears to have a quite high level of engagement with government stakeholders.

At this stage of Teesta-V, NHPC appears to have passive processes in place for engagement with other directly affected or interested stakeholders, in that they are free to approach the HoP or other executive to raise issues and have them considered.

Regarding making significant Teesta-V project reports available, NHPC has a webpage from which the most recent six-monthly reports relating to the power station compliance with their Environmental Clearance can be

downloaded, including for Teesta-V. All six-monthly compliance reports for any project can be found publicly available through the MoEFCC website.

At the corporate level, NHPC publishes its Annual Report and its CSR Annual Report. These describe environmental and social activities of the business, including those relevant to Teesta-V. There are no environmental, social or CSR reports specific to Teesta-V on NHPC's website other than the most recent six-monthly Environmental Clearance compliance report.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the business makes significant project reports publicly available and publicly reports on project performance in sustainability areas of high interest to its stakeholders.*

NHPC publicly reports on corporate performance in sustainability areas of high interest to its stakeholders, but does not do so at the project level. In its Annual Report, NHPC follows the framework recommended by the National Voluntary Guidelines (NGV) on Social, Environmental and Economic Responsibilities of Business, published in 2011 by the Ministry of Corporate Affairs. This framework follows 9 principles, addressing: 1) ethics, transparency and accountability; 2) products life cycle sustainability; 3) employees' well-being; 4) stakeholder engagement; 5) human rights; 6) environment; 7) policy advocacy; 8) inclusive growth; and 9) customer value. The CSR & SD Communication Strategy includes that NHPC will issue sustainability reports following the Global Reporting Initiative (GRI), but evidence of this was not seen by the assessors at the time of this assessment.

NHPC does not publish any reports itself, specifically dedicated to providing a current view of sustainability aspects of Teesta-V, that stakeholders have indicated are of high interest. The need to identify and focus sustainability reporting on material aspects, that is those aspects of high interest to its stakeholders, is noted in the CSR & SD Communication Strategy but no process was evident for how these areas were determined, based on diverse stakeholder inputs, at the project level. The six-monthly report on compliance with the Environmental Clearance has been highly repetitive over recent years, given that most compliance requirements were concluded as met back in 2010.

On NHPC's website regarding Teesta-V specifically can be found a brief technical summary, a diagram of the layout, technical specifications, and photos. There is a Frequently Asked Questions area of the NHPC website, under Environment, which does have some references to and data for Teesta-V.

NHPC does not provide a link to the MoEFCC site that has all of the six-monthly reports on compliance with the Environmental Clearance. The Teesta-V EIA, EMP and subsequent environmental or social study reports (see topic O-3) are not available in the public arena.

The absence of a process by which NHPC liaises with a representative range of Teesta-V stakeholders to canvas what would be of interest to them regarding reporting on project performance in various sustainability areas, and regularly uploads such information, represents a **significant gap** against proven best practice.

Criteria met: No

2.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *The project has no significant non-compliances.*

There are no significant non-compliances with respect to Teesta-V. Compliance is reported in the Annual Report, and in the audits. At the corporate level, NHPC is compliant with corporate governance requirements listed in the Companies Act 2013; SEBI (Listing Obligations and Disclosure Requirements) Regulations 2015; and the DPE Guidelines on Corporate Governance for CPSEs. Some non-compliances of NHPC are listed in Report No.18 of 2018 Compliance Audit on General Purpose Financial Reports of CPSEs of Union Government, but these are not

significant at the level of Teesta-V. At the project level, no non-compliances were identified in audits undertaken under the IMS. All regulators interviewed for this assessment confirmed that NHPC was fully compliant with regulatory requirements relating to Teesta-V.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *The project has no non-compliances.*

No non-compliances were identified in relation to the activities of Teesta-V.

Criteria met: Yes

2.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *There are no significant unresolved corporate and external governance issues identified.*

There are no significant unresolved governance issues identified. Emerging issues appear to be well identified and monitored or managed.

An example of a potential issue could be a lack of alignment between state and national regulations, for example regarding minimum wage. NHPC addresses this by always following the stricter of the two jurisdictions. For the example cited it pays the national minimum wage for Teesta-V even though it is about 30% higher than the state wage.

Issues that are being closely watched relating to Teesta-V include, but are not limited to, the following.

- State government elections are pending in the next few months, which has led to a number of local strikes. NHPC is doing what it can to avert a strike occurring at Teesta-V, by ensuring that any issues are recognised and resolved at an early stage.
- Contract workers have higher expectations, driven by social media and lots of local economic growth. The payment of contract workers at the national (rather than state) minimum wage, plus extending the Employee Provident Fund contribution requirement to contract workers, are measures taken to ensure this issue is managed.
- The CWC is considering development of environmental flow requirements for all hydropower projects based on hydrological specifications (see topic O-19). NHPC is anticipating that this may have consequences in the future for operating projects such as Teesta-V. Proactive and voluntary measures being taken for Teesta-V include installing a flow meter downstream of the dam and undertaking a post-construction EIA on a voluntary basis.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no unresolved corporate and external governance issues identified.*

There are no unresolved corporate and external governance issues identified. The examples listed above all show that actions have been or are being implemented to manage identified issues.

Criteria met: Yes

2.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

NHPC does not have a process to liaise with and respond to a representative range of stakeholders regarding their interests in regular reporting on Teesta-V sustainability performance.

1 significant gap

2.3 Scoring Summary

NHPC has sound corporate business structures, policies and practices that cover the key areas expected for a mature and established national corporation, and that are guided by national and international standards. NHPC addresses transparency, integrity and accountability issues in a number of ways, including through dedicated policies, monitoring by its Vigilance Department, and Integrity Pacts guided by Transparency International. NHPC demonstrates that it can manage external governance issues and can ensure compliance. Whilst NHPC's CSR & SD Communications Strategy sets out best practice approaches to stakeholder engagement and external sustainability reporting, at the time of this assessment these are not fully implemented and not evident at the Teesta-V level. There is one significant gap at the proven best practice level, reflecting the lack of a process to liaise with and respond to a representative range of Teesta-V stakeholders regarding their interests in regular reporting on Teesta-V sustainability performance, resulting in a score of 4.

Topic Score: 4

2.4 Relevant Evidence

Interview:	1, 3, 5, 9, 17, 28, 34, 41, 49, 50
Document:	8-30, 51, 53, 54, 132-134, 137, 172, 174-176, 179, 180
Photo:	67, 68

3 Environmental and Social Issues Management

(O-3)

This topic addresses the plans and processes for environmental and social issues management. The intent is that negative environmental and social impacts associated with the hydropower facility are managed; avoidance, minimisation, mitigation, compensation and enhancement measures are implemented; and environmental and social commitments are fulfilled.

3.1 Background Information

The national Environment Protection Act (1986) sets out requirements for EIAs, EMPs and Environmental Clearances that apply to all medium and large hydroelectric projects in India. A Forest Clearance is also required under the Forest Conservation Act 1980. The MoEFCC is the environmental regulator for the GoI.

The 510 MW Teesta-V HPP completed the EIA and EMP in 1998, and received the Environmental Clearance and Forest Clearance certificates in 1999. EIA studies have also been conducted for hydropower developments upstream and downstream of Teesta-V. The HPPs upstream are Teesta-III (1200 MW, EIA completed 2006, commissioned 2017, presently operational) and Teesta-IV (520 MW, EIA completed 2014, presently in the process of getting the Forest Clearance Stage-II). The HPPs downstream are Teesta-VI (500 MW, EIA completed 2006, presently half constructed and being taken over by NHPC), Teesta Low Dam III (132 MW, EIA completed 2002, commissioned 2013) and Teesta Low Dam IV (160 MW, EIA completed 2002, commissioned 2016). Plans for additional low head HPPs in West Bengal (Teesta Low Dams I and II and an intermediate stage dam) are presently on hold.

Two Carrying Capacity Studies (CCS) have been completed, in Sikkim for the upper Teesta basin in 2008 and in West Bengal for the lower Teesta basin in 2015. These covered the cumulative impacts from the projects in the Teesta Cascade, but did not include the projects already constructed, including Teesta-V. Based on the 2008 CCS, the proposed HPPs farther upstream of Teesta-III (Teesta-I, Teesta-II and Lachen) were cancelled.

Once the Environmental Clearance requirements are confirmed as met, the national level regulatory processes have a lower profile than the State level regulatory processes. The SPCB for the Government of Sikkim (GoS), under the Forests, Environment and Wildlife Management Department (FEWMD), issues annual Consents to Operate with respect to state legislation regarding water pollution, air pollution, hazardous wastes, and bio-medical wastes.

This topic concerns processes for environmental and social issues management, and environmental management of the dam and power station sites during the operations stage. Other environmental and social topics provide a more detailed assessment of topic-specific issues.

3.2 Detailed Topic Evaluation

3.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Systematic processes are in place to identify any ongoing or emerging environmental and social issues associated with the operating hydropower facility, utilising appropriate expertise; and monitoring programs are in place for identified issues.*

The main processes to identify environmental and social issues associated with the operating hydropower facility have been and are:

- Responsibilities of the EDM staff at Teesta-V (3 staff persons), supported by the Corporate Office EDM staff. EDM staff at Teesta-V are responsible for environmental monitoring, compliance, audit observations, policy matters, and responses to government.
- Six-monthly reports from Teesta-V submitted to the MoEFCC, and published on the MoEFCC as well as NHPC websites, which report on the status of all requirements under the Environmental Clearance.
- A Central Level Monitoring Committee composed of experts from different government departments, NGOs, and Teesta-V to monitor and evaluate all requirements of the Environmental Clearance plus to identify any additional environmental safeguards that may be required. This committee had nine meetings between 2001 and 2010, after which it agreed that all Environmental Clearance requirements had been met. It met again in 2017 due to issues arising, the most significant of which was with regards to the fish hatchery (see topic O-15). This committee can be activated at any time over the life of the operating project, and can revoke or alter the Environmental Clearance at any time based on emerging issues. The MoEFCC, which issues the Environmental Clearance, has a regional office that does occasional inspections of Teesta-V.
- A Project Level Monitoring Committee focussed on the Teesta-V Catchment Area Treatment (CAT) Plan, involving the FEWMD, Teesta-V and the local community. The CAT Plan is considered fully completed, and this committee is no longer operational.
- A Project Level Monitoring Committee focussed on the Resettlement and Rehabilitation (R&R) Plan (see topic O-10). The R&R Plan is considered fully completed, and this committee is no longer operational.
- Annual reports and annual inspections of the SPCB in relation to the Consents to Operate, focussed on water and air pollution, and hazardous and bio-medical wastes. Monitoring is conducted in relation to these consents, for air quality, drinking water quality, river water quality, sewage treatment plant effluent, noise levels, and stack emissions from the diesel generators and the incinerator for bio-medical wastes.
- Audits by the CAG, which include environmental and CSR compliance.

Appropriate expertise is ensured through the qualifications of the EDM team, the independent researchers, and the government agency representatives. It is noted that NHPC's EDM team is stronger on the environmental qualifications than it is on the social.

Monitoring in terms of data collection is undertaken in accordance with the requirements of the SPCB for air, water and noise. Visual inspections are undertaken as a form of monitoring through the numerous audit and inspection processes.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes to identify ongoing and emerging environmental and social issues take broad considerations into account, and both risks and opportunities.*

In the Environmental Clearance for Teesta-V, several additional studies were required to better understand and manage areas identified to be of potential risk. An Ethnographic Study was completed in June 1999, and is further discussed in topic O-11. An Ecological Assessment of Teesta-V was completed in 2000, and is further discussed in topic O-15.

Several processes for Teesta-V environmental and social issues assessment go beyond basic good practice. These relate to the Environmental Management System (EMS), the CSR initiatives, and the post-construction EIA.

NHPC and all of its operations are certified under the International Standards Organisation standard ISO 14001:2015 Environmental Management Systems. NHPC manages this, and its other ISO certifications through an IMS. There is a system of regular internal audits for the IMS at Teesta-V, which raise non-conformances and track follow-up actions. External auditing is also conducted at Teesta-V for the IMS, conducted annually or bi-annually by the BIS.

CSR guidelines issued by the Gol Ministry of Corporate Affairs are being implemented by NHPC, including at all power stations. Each project has a CSR committee that oversees implementation, and there is a Board level CSR

committee. For Teesta-V, actions have been in relation to village level rural development and social services (see topic O-8). NHPC is in the process of signing a contract with Sikkim University to do a review of impact effectiveness of its CSR activities at Teesta-V.

A post-construction EIA for Teesta-V is presently being conducted by an independent accredited company, RS EnviroLink. At present the CWC is seeking to formulate a policy on post-construction EIAs. A post-construction EIA is not mandatory for Teesta-V, but the NHPC Board of Directors agreed to do this on a voluntary basis, following an earlier one for the Dhauliganga project. The study started in July 2018 and will continue for at least 15 months. The objective is to evaluate the commitments of the project under the EMP, and their effectiveness, based on comparative field studies. Secondary data will be reviewed, and primary data will be collected on terrestrial and aquatic ecology, fish, land use, land cover, reservoir stratification, greenhouse gas emissions, and socio-economics. The effectiveness of mitigation measures will be evaluated and documented. The study is broad in scope, especially with respect to taking into account greenhouse gas emissions and reservoir stratification, but could go farther towards addressing concerns about environmental flows downstream of the dam and power station (see topic O-19).

Criteria met: Yes

3.2.2 Management

Analysis against basic good practice

Scoring statement: *An environmental and social management system is in place to manage measures to address identified environmental and social issues, and is implemented utilising appropriate expertise (internal and external).*

NHPC's EMS provides the framework for management of environmental and social issues at Teesta-V. The EMS is underpinned by NHPC's Corporate Environment Policy 2016, and is supported by procedures.

Measures at Teesta-V for management of environmental and social issues during construction were set out in the EMP, which contained a number of more specific plans:

- Resettlement and rehabilitation plan
- Green belt around the project area
- Compensatory afforestation plan
- Catchment area treatment plan
- Reservoir rim treatment plan
- Free fuel provision
- Restoration plan for spoil tips (dumping sites)
- Landscape plan
- Restoration plan for quarry site and borrow pits

There is no further work required for Teesta-V in relation to these plans, as they were all focussed on the construction stage, and the EMP did not address the operations stage.

The Environmental Clearance and meetings of the Central Level Monitoring Committee introduced some additional requirements beyond the EMP that are applicable during operations, including the following:

- The prevention and control of waterborne disease aimed to avoid pooling of water downstream of the dam to avoid mosquito breeding. This has been met through provision of 2 pipes at the dam that release a continuous 1 m³/sec of water (see topic O-19).
- A Wildlife Management Plan that included development of a butterfly park (see topic O-15)
- A Fishery Management Plan that included development of a fish hatchery (see topic O-15)
- Stabilisation of landslides between Singtam and the dam (see topic O-16)
- Adoption of local villages (see topic O-8)

During the operations stage, the IMS Procedures for Teesta-V set out 21 procedures that are followed, many of which are relevant to environmental aspects. These include specific focal areas such as waste management, housekeeping, and storage and handling of chemicals and oils. Processes embedded in these procedures address hazard identification, risk assessment, compliance, competence, control of documentation, communication, emergency preparedness and response, monitoring, evaluation, internal audit, nonconformity and corrective action, and incident investigation.

Responsibilities for various aspects of environmental and social issues management during the operations stage are shared across divisions at Teesta-V, as follows.

- The ISO 14001 certification, and audits and follow up relating to this, are the responsibility of the IMS Division.
- The EDM division is primarily responsible for monitoring, reporting and compliance with SPCB requirements (air quality, water quality, noise, emissions); maintenance of gardens and parks; regular plantation works in the colony area; any follow-up relating to the EIA, EMP, Environmental Clearance; and supervision of the post-construction EIA.
- The HR department is responsible for implementing the CSR activities.
- The Infrastructure Division is responsible for waste management and general site management.
- The Medical Services Division is responsible for bio-medical waste disposal, following the Bio-Medical Waste Management Plan and national rules.
- The Central Store Department is responsible for appropriate storage of fuel, oil and hazardous materials.
- Sediment data is the responsibility of the Dam (Civil) department/division.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and plans and processes are embedded within an internationally recognised environmental management system which is third party verified, such as ISO 14001.*

The EMS, certified to ISO 14001, is one of the core processes in place by which NHPC ensures that it can respond to risks and opportunities. Processes relating to implementation of the EMS enable identification and responses to a number of emerging risks and opportunities. In particular, the system of internal and external audits that raise non-conformities and track corrective actions ensures a process for issues to be identified.

NHPC and Teesta-V have taken up some opportunities for positive environmental and social outcomes beyond compliance obligations, for example:

- Teesta-V participates in state and national activities and events promoting environmental responsibility and values. Examples at Teesta-V include World Environment Day celebrations, a Flower Show, and Clean Up and hygiene awareness days.
- NHPC has a formal arrangement in place for MSTC, a Gol e-commerce website, to auction its e-wastes (electronic products near the end of their useful lives) and scrap.
- The CSR program and other additional benefits, as described under topic O-8.

The divided responsibilities across the organisational structure and the level of staffing for environmental and social issues management at Teesta-V present limitations in the ability to anticipate and respond to emerging risks and opportunities, which is a **significant gap** against proven best practice. Whilst the IMS is intended to provide an integrated approach to environmental, safety and quality issues, issues tend to be strongly allocated to particular divisions with little cross-divisional interactions on these. For example, the environment staff take no responsibility for litter or for hazardous waste management. The divided responsibilities mean there is not a comprehensive view on all dimensions of the environment within any one division's role, raising risks of issues being missed. Some environmental staff are split between Teesta-IV and Teesta-V and not dedicated fully to

Teesta-V, further raising risks of insufficient attention to Teesta-V. Finally, the limited social expertise amongst the staff at the project and corporate level means that social aspects are addressed primarily as compliance obligations rather than social development approaches.

In recognition of some of these issues, NHPC committed in May 2019 to introduce a mechanism for continuous environmental and social monitoring during the operation stage of their hydropower projects, also aiming to detect emerging issues, through six-monthly visits of EDM staff from the corporate office to the projects. The benefits of this in closing the identified gap will need to be evaluated in the future.

Criteria met: No

3.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for stakeholders to raise issues and get feedback.*

Key stakeholders for Teesta-V regarding environmental and social issues management include a number of government agencies at the 3 levels of government, with which NHPC regularly liaises and through which issues can be raised and responded to. These include:

- MoEFCC
- FEWMD, GoS
- SPCB, within the FEWMD
- Land Revenue and Disaster Management (LR&MD) Department, GoS
- Social Impact Assessment Unit, Department of Economics, Statistics, Monitoring and Evaluation, GoS
- District level administrations of Sikkim
- Gram (village) Panchayat Units, which are the local elected bodies, each representing 2-3 villages

Project-affected communities in the areas of the reservoir, dam, powerhouse, and river reaches downstream of the dam and powerhouse are key stakeholders. The CSR activities have provided a process by which Teesta-V liaises with these communities, and considers requests for support (see topic O-8).

There does not appear to currently be any active engagement processes of Teesta-V with civil society, including NGOs. WWF Sikkim was represented on the Central Level Monitoring Committee for Teesta-V, and this mechanism allowed for engagement if significant issues arose, but it is unclear if any NGOs have a more current role on this committee. The Affected Citizens of Teesta, Save Dzongu and other groups have campaigned strongly against dams on the Teesta River. A number of concerns are raised in websites and published articles regarding Teesta River hydropower developments. These concerns include but are not limited to: impacts to and loss of biodiversity, impacts on livelihoods of those directly and indirectly affected, seismic risks, landslides, public safety, loss of flow in the rivers, and impacts to fish. For Teesta-V, there were a number of issues of very high concern at the time of project approval, including that not all assessment studies were completed at the time of issuing of the Environmental Clearance, and the de-linking of Teesta-V from the Teesta Basin CCS. During construction, concerns included the influx of migrant worker issues, public health impacts, inappropriate muck dumping, loss of local water supplies caused by groundwater impacts from tunnelling, and problems with the resettlement village and land stability.

A number of these issues and concerns were addressed during the 9 meetings of the Central Level Monitoring Committee between 2001 and 2010. Processes continue to be available through political and legal avenues to campaign against the project or argue for changes. The assessors are not aware of any current issues or campaigns regarding environmental and social issues at Teesta-V. At this point in time, much of the engagement of NHPC with these key stakeholders and their concerns is taking place with respect to the other HPPs. For example, NHPC is seeking approval for Teesta-IV, immediately upstream, and is taking over Teesta-VI, immediately downstream.

The post-construction EIA for Teesta-V provides a current process for scrutiny and re-evaluation of social and environmental issues for the project. The methodology includes evaluation of the socio-economic condition and change in quality of life of project-affected families and the local population, and will involve interviews. Although not a significant gap at basic good practice, there is an opportunity for NHPC to consider for future post-construction EIAs to undergo an engagement process with stakeholders with regards to the scope and methodology, and with regards to the draft findings, and to demonstrate that local knowledge is drawn on in the data collection across all focal areas.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely.*

All indications are that NHPC has been responsive in addressing issues raised by government agencies interviewed for this assessment. There have been delays in responses with respect to some issues for resettlers (see topics O-10 and O-12) and indigenous peoples (see topic O-11), which are gaps but are not counted here, as they are already taken into consideration under those other topics.

Criteria met: Yes

3.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in environmental and social management plans have been and are on track to be met with no major non-compliances or non-conformances, and environmental and social commitments have been or are on track to be met.*

The environmental regulators at the national and state level advised that NHPC was fully compliant with regards to implementing its compliance requirements at Teesta-V. Compliance is closely tracked through the numerous monitoring processes listed under the Assessment criterion, and is one of the procedures under the EMS.

Regarding meeting environmental and social commitments, NHPC has met all commitments that it is required to deliver as captured in the environmental management plans and the conditions of the Environmental Clearance. It has gone beyond mandatory requirements, and is delivering its voluntary commitments such as the post-construction EIA.

NHPC received a loan from a consortium led by Deutsche Bank, which required reporting on a number of environmental and social conditions. These were effectively the same that NHPC needed to report to the MoEFCC and SPCB. All environmental and social requirements of Deutsche Bank's loan have been met, and this loan has now been closed out by NHPC.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances at Teesta-V with its environmental or social obligations.

Non-conformances are identified during regular audits, but are followed up with corrective actions to ensure that there are not outstanding non-conformances.

Criteria met: Yes

3.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *Negative environmental and social impacts associated with hydropower facility operations are avoided, minimised and mitigated with no significant gaps; and land disturbance associated with development of the hydropower project is rehabilitated or mitigated.*

Teesta-V was the first EIA undertaken in India for a hydropower project following new EIA legislation and rules introduced in 1994. Based on the impacts identified in the Teesta-V EIA, environmental and social management measures were broad in scope and covered a wide range of impact areas. Where shortfalls were identified, further studies and commitments were required and undertaken with additional mitigation actions implemented.

Rehabilitation of land disturbance has received considerable attention in the environmental management actions of Teesta-V. At the time of this assessment, all land disturbed during the construction phase had been rehabilitated, often to provide for other uses. For example, the seven muck dumps which were located near all major underground excavation areas, covering a combined area of almost 130 ha, have been restored following the application of bio-engineering methods to ensure long-term stabilisation (including some turned into gardens, playgrounds and community use areas).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, negative environmental and social impacts associated with hydropower facility operations are avoided, minimised, mitigated and compensated with no identified gaps.*

Based on a contemporary view of proven best practice environmental and social mitigation of hydropower impacts, there are negative impacts of Teesta-V that are not avoided, minimised, mitigated and compensated. The environmental flow is not aimed at or delivering on any aquatic environment objectives (see topic O-19), and the fish hatchery is not providing any mitigation of impacts of Teesta-V on fish (see topic O-15). The conditions at the resettlement colony could be improved (see topic O-10), and a number of measures for indigenous and other communities are not based on formal, publicly disclosed agreements (see O-8, O-9, O-10, and O-11). Whilst it is anticipated that the post-construction EIA will highlight these issues and propose further management measures, at the time of this assessment these are shortfalls in outcomes. Where significant, these issues are identified as gaps in their respective topics and so are not double-counted here.

The assessment team observed that there are opportunities for improvement in the implementation of the EMS at Teesta-V, notably in the areas of litter management and hazardous materials storage. The assessors noted numerous areas of litter in small dump areas as well as scattered, despite a procedure for housekeeping and regular clean-ups. The assessors also noted an absence of any containment bunding around fuel storage areas which would contain any spills. Similar findings have been noted in the internal audit reports for the IMS, highlighting the need for more rigorous ongoing attention to proper waste and litter management, as well as fuel, oil and chemical management to avoid any adverse environmental outcomes.

Criteria met: Yes

3.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The divided responsibilities across the organisational structure and the level of staffing for environmental and social issues management present limitations in the ability to anticipate and respond to emerging risks and opportunities.

1 significant gap

3.3 Scoring Summary

NHPC at a corporate level and at the level of Teesta-V demonstrate a high level of commitment to assessing and managing negative environmental and social impacts associated with the hydropower facility. A number of aspects of management of these issues at Teesta-V were leading examples nationally of implementing best practice, most particularly evident during the project development stage. Numerous impact avoidance, minimisation, mitigation, compensation and enhancement measures have been implemented through a range of EMPs and through more current CSR initiatives. All environmental and social commitments have been fulfilled with respect to NHPC's direct responsibilities. At the level of proven best practice, there is one significant gap, in that there are limits in the ability of Teesta-V to anticipate and respond to emerging environmental and social risks and opportunities given the divided responsibilities across different divisions, the very limited staff, the low representation of social impact expertise amongst the staff, and priorities for attention being on compliance areas and new hydropower project developments. This gap against proven best practice results in a score of 4.

Topic Score: 4

3.4 Relevant Evidence

Interview:	1, 2, 6, 15, 18, 25, 31, 38, 41, 43, 49
Document:	9, 17-19, 26-28, 31-68, 132, 134, 137, 156, 221
Photo:	8, 23, 45, 52, 57-63, 82

4 Hydrological Resource (O-4)

This topic addresses the level of understanding of the hydrological resource availability and reliability to the operating hydropower facility. The intent is that power generation planning and operations take into account a good understanding of the hydrological resource availability and reliability in the short and long-term, taking into account other needs, issues, or requirements for the inflows and outflows as well as likely future trends (including climate change) that could affect the facility.

4.1 Background Information

The Teesta River, a perennial and snow fed river, originates from Cho Lamo glacier in the Himalayas and flows through the Indian states of Sikkim and West Bengal before entering Bangladesh. This is the largest river of Sikkim, with about 95% of the total area of the state within its catchment area. The length of the Teesta River from its origin to Melli (the border with West Bengal) is around 188 km. The average discharge in the river varies from a maximum of 645 m³/s during the monsoon, to a minimum of 61 m³/s in the lean period during January. Between 1984 and 2005, the site (recorded at Dikchu) experienced a high variability in the annual peak flow, ranging between 690 m³/s (in 1994) and 2,593 m³/s (in 2002). Apart from natural phenomena such as precipitation and snow melt, inflows to the Teesta-V reservoir are also influenced by the operations of the upstream Teesta-III and Dikchu projects which were commissioned in 2017 and 2016, respectively.

4.2 Detailed Topic Evaluation

4.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken of hydrological resource availability and reliability, and ongoing or emerging issues have been identified; inputs include field measurements, appropriate statistical indicators, issues which may impact on water availability or reliability, and a hydrological model.*

Pre-construction water resource availability was modelled and estimated based on discharge data collected between 1984 and 1996 at the CWC gauge and discharge stations along the Teesta River, with the closest upstream site located at Dikchu. After construction, NHPC is continually monitoring inflow (to the reservoir) and outflow (through spillway gates, turbines and e-flow channels) at the project site. This data is used for predicting water availability for power generation. As an ongoing activity, NHPC coordinates with the CWC to collect meteorological data (such as precipitation, temperature, humidity, solar radiation and duration, wind, and evaporation) from CWC's weather stations operating nearby. Similarly, river discharge data is also collected from CWC river gauging stations located both upstream and downstream of the Teesta-V Dam. A World Bank funded project (National Hydrology Project) is currently installing a number of hydro-meteorological stations along the Teesta River. These stations, when operational, are likely to provide additional data that may assist Teesta-V to assess water availability and reliability more effectively and efficiently.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, issues that may impact on water availability or reliability have been comprehensively identified; and scenarios, uncertainties and risks are routinely and extensively evaluated over the short- and long-term.*

In the short term, reservoir inflows and water availability for generation depends on precipitation, temperature (and thereby snowmelt and glacial melt), evapotranspiration and other factors in the catchment that are being regularly forecasted, or of which NHPC has a good understanding.

In the long term, water availability and reliability in the Teesta basin is influenced by climate change, as discussed in topic O-20. Climate change may contribute to changes in annual and seasonal river flow; intensity and duration of flooding events including Glacier Lake Outburst Floods (GLOFs); and sediment content in river water. In addition, water use in the upper catchment, predominantly by other hydropower projects, also has a direct relationship with water availability at the Teesta-V site. River flow is likely to be further altered after construction of the upstream Teesta-IV project, located between Teesta-III and Teesta-V, is completed. Regulatory changes, reflecting the 2015 National Green Tribunal ruling that requires all rivers in India to maintain a minimum 15% to 20% of the average lean season flow of that river, may also affect the water availability to and power generation capacity of Teesta-V. It is noted that Teesta-V is operated as a run-of-river scheme with diurnal storage where all excess flows are released downstream through spillways and regular sediment flushing is undertaken to maintain reservoir's generation capacity. Thus, high flows in the river are unlikely to have a significant impact on the power generation.

It is also noted that for power generation planning, NHPC has followed CEA guidelines which consider 90% dependability criteria. In determining 90% dependable years, that is the year when the annual generation has the probability to achieve or exceed 90% generation target, NHPC has analysed long-term historical river flow data and taken annual and seasonal flow variation due to climate change into consideration. It is also evident that Teesta-V has been coordinating with downstream and upstream power stations to exchange hydrological and other pertinent information on regular basis. However, there is no evidence of a process by which NHPC (or another agency) routinely and extensively identifies and evaluates issues with the potential to impact future water availability and reliability, establishing short-term and long-term inflow scenarios by taking various climatic, regulatory and operational scenarios and risks into consideration, and determining Teesta-V operations within a set of cascade operating rules. This represents a **significant gap** against proven best practice.

Criteria met: No

4.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to guide generation operations that are based on analysis of the hydrological resource availability, a range of technical considerations, an understanding of power system opportunities and constraints, and social, environmental and economic considerations.*

Power generation decisions at Teesta-V are guided by various factors including water availability at the dam site; plant efficiency and readiness; and compliance with reservoir operation rules and regulatory downstream flow requirements.

The operators of Teesta-V are required to estimate and declare daily availability and power generation targets to the ERLDC, one day in advance. Such estimation is largely done by assessing inflows to the reservoir over the previous 10 days and data on recent precipitation in the upper catchment area.

The Teesta-V reservoir operates in accordance with Reservoir Operation and Silt Flushing Guidelines. During the non-flood season, when the discharge is least and stable, the spillway gates are adjusted to maintain the minimum drawdown level at the reservoir. During flooding months, the spillway gates are raised to allow flood water to pass through the dam. The design flood for the Teesta-V dam is 9,500 m³/s.

Separate reservoir operational rules are set and followed during non-flood and flood seasons to attain efficiency in power generation. Power generation efficiency is achieved through optimising inflow at the intake. Power generation data that shows that three units operate at full capacity during the monsoon season.

Since commissioning, Teesta-V has been achieving annual generation and profitability targets in most years. In the 2017-18 financial year, Teesta-V made a profit of approximately USD 46 million.

With the integration of more variable renewable capacity (solar and wind) in the Indian grid, the operational requirements for hydropower stations may change over time, and initial research into such changes including possible adjustments to power market regulations (in terms of payments for peaking and ancillary services) is under way.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, generation operations planning has a long-term perspective; fully optimises and maximises efficiency of water use; and has the flexibility to adapt to anticipate and adapt to future changes.*

Due to limited storage at Teesta-V, the operational flexibility is also limited, and under current conditions, water usage can be considered fully efficient, with spillage minimized. However, because no long-term water availability scenarios have been established (see above under Assessment), there is also no basis for considering options for long-term generation optimisation planning. This might involve, for example, changed operations in the low flow season, coordinated operations along the cascade, or infrastructure changes (for example, to increase storage or peaking capacity). This **significant gap** against proven best practice is closely related to the one above under Assessment, and is not double counted here.

Criteria met: No

4.2.3 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

Issues with potential to impact water availability and reliability in the Teesta cascade have not been fully evaluated to consider options for long-term optimisation of generation planning.

1 significant gap

4.3 Scoring Summary

Before construction, long term historic hydrological data was analysed and modelled to assess water availability at Teesta-V. During operation, meteorological data (such as precipitation, temperature, humidity, solar radiation and duration, wind, and evaporation) are being monitored on an ongoing basis. NHPC has a good understanding of short-term water availability which is used to estimate its daily generation target; and through implementation of established procedures, such as Reservoir Operation and Silt Flushing Guidelines, NHPC has been optimising inflow at the intake during both monsoon and non-monsoon seasons. However, there is no process in place by which NHPC (or another agency) routinely and extensively identifies and evaluates issues with the potential to impact future water availability and reliability, establishing short-term and long-term inflow scenarios by taking various climatic, regulatory and operational scenarios and risks into consideration, and determining Teesta-V operations within a set of cascade operating rules. In absence of established long-term water availability scenarios, long-term generation optimisation planning is also not possible. This gap against proven best practice results in a score of 4.

Topic Score: 4

4.4 Relevant Evidence

Interview:	12, 21, 39
Document:	69-77, 209, 212, 213, 217, 219, 224
Photo:	1, 13, 31, 32, 66

5 Asset Reliability and Efficiency (O-5)

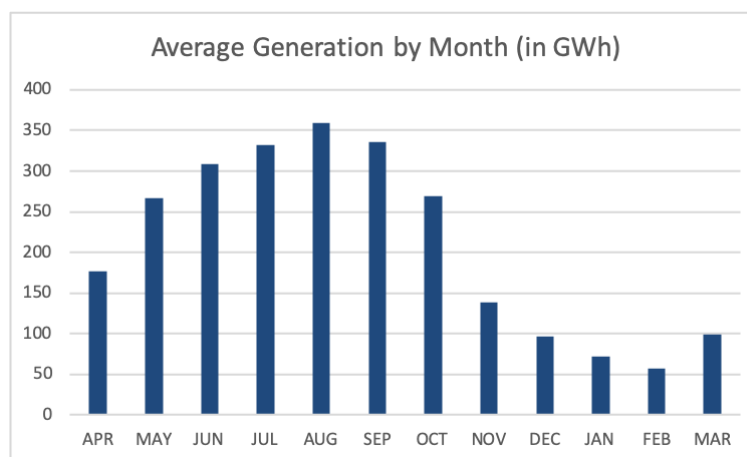
This topic addresses the reliability and efficiency of the hydropower facility and associated network assets. The intent is that assets are maintained to deliver optimal performance in the short- and long-term in accordance with the overall electricity generation and supply strategy of the owner/operator.

5.1 Background Information

Reliable and efficient power supply from the Teesta-V project is important, as the project is a significant asset for NHPC and the second-largest power station in Sikkim. The book value of Teesta-V (Property, Plant & Equipment as of March 31, 2018) was INR 14.9 billion (USD 215 million). Generation from Teesta-V (and the other power stations in the Teesta cascade) provides reliable baseload power during the wet season, and valuable peaking power during the dry season. Offtakers from several eastern states (principally West Bengal, Orissa – renamed Odisha in 2011 -, Bihar, Jharkhand and Sikkim itself) with a total population of approximately 300 million depend on low-cost supplies, under long-term Power Purchase Agreements (PPAs) with NHPC. Delivery to those states relies on the transmission network. Power is sent by two 400 kV lines to a sub-station at Rangpo, where it is pooled with power from other hydropower projects in Sikkim and evacuated to Siliguri. Availability and stability of the transmission network are considered very good in recent years.

Operation and maintenance (O&M) strongly depend on seasonal flows, as shown below.

Figure 3. Teesta-V Seasonal Pattern of Generation



Teesta-V is operated and maintained by a unit under the NHPC Technical Department and its Regional Office in Siliguri. The NHPC Regional Office is also responsible for one other power station in Sikkim, on a tributary of the Teesta River (Rangit), and two other power stations downstream in West Bengal (Teesta Low Dams III and IV), as well as several other projects in operation or under preparation. The Corporate Office provides technical support, and NHPC has significant operational experience across its multiple power stations.

While some of the project infrastructure is underground, much of it (such as the dam, colonies, roads and transmission lines) is exposed to the elements. The dam and turbines require regular maintenance because of damages by sediment, which is also addressed under topic O-16. The monitoring and maintenance of safety-relevant assets is also covered under topics O-6 (public safety) and O-12 (employee safety). Maintenance of the R&R colony is addressed under topic O-10, and maintenance of CSR projects is addressed under topic O-8.

5.2 Detailed Topic Evaluation

5.2.1 Assessment

Analysis against basic good practice

Scoring statement: Routine monitoring of asset condition, availability and reliability is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging asset maintenance and management issues have been identified.

Generation and other operational parameters are monitored constantly and recorded in several records, from hourly logbook entries to annual reports. Availability of the power station is monitored constantly, and declared on a daily basis to the load dispatch centre, taking into account the availability of generating units and of water (see topic O-4).

Asset monitoring is focused on safety and performance-related assets, i.e. the dam, spillway gates, intake and associated structures on the one hand, and the powerhouse with turbines, generators and transformers on the other hand. It is mostly performed by NHPC staff, but also involves external experts e.g. from the BIS. A number of systems are checked and tested regularly, e.g. daily visual inspections of the dam and monthly checks of the fire suppression system in powerhouse. There are quarterly technical inspections of the power station (including power house, dam, switchyard, sub-station, surge shaft), with immediate corrections where possible, reports issued, and follow-up monitoring of corrective action requests until these are resolved (guided by an IMS procedure). Monitoring is increasingly condition-based, for example through continuous vibration monitoring at the generating units. Dam monitoring is partly based on pre- and post-monsoon safety and stability inspections, and on an array of 66 instruments, for which monthly graphs are prepared (see also topic O-6).

Some of the data analysis is done in the Corporate Office, with reports given back to the project. Maintenance projects are prioritised based on data analysis, e.g. frequency of failures.

Issues that have been identified were e.g. initial problems with transformers and gas-insulated switchgear, ongoing erosion damage of turbines and the spillways, including stoplogs, radial gates and glacis, and increased seepage at the dam.

There are also longer-term monitoring schedules at NHPC. For example, every 5 years, the construction equipment available at different power stations is reviewed, to allocate it efficiently. Surplus material such as a bailey bridge left over from construction is offered to other power stations before disposal.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, identification of ongoing or emerging asset maintenance and management issues takes into account both risks and opportunities.

Since 1997, NHPC has maintained a broad research and development (R&D) programme, which has included many initiatives of relevance for O&M. A number of these initiatives have benefitted the Teesta-V project, for example through an energy audit, through the coating of turbine runners to improve erosive wear resistance, and through an online turbine cavitation monitoring system. The R&D programme is ongoing.

There are some indications (visual observations as well as absence of formal reporting) that non-core assets, i.e. those not related to safety and performance, receive less attention. This refers to monitoring, maintenance and housekeeping in residential and administrative buildings, for example. However, this is not considered a significant gap, as there are no indications that it affects reliability and efficiency of the power station.

Criteria met: Yes

5.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to address routine monitoring and maintenance requirements of the operating facility in accordance with the overall electricity generation and supply strategy of the owner/operator.*

Monitoring and maintenance measures are carried out as per O&M procedures and guidelines, laid down in the IMS. There are umbrella monitoring procedures as well as specific ones, for example for analysis of tripping reports, to prevent repeated tripping of generating units and lines. Routine and emergency O&M are mostly carried out by Teesta-V's own staff; a considerable workforce is available on site. Specialists from the Corporate Office and contractors (including on occasion, original equipment manufacturers) are brought in as required. For example, there is an IMS procedure for Technical Support/Assistance (from the O&M unit at the Corporate Office) in case of Generating Unit Breakdown, and an IMS procedure for the Processing of Purchase Proposal Pertaining to Power House Equipment.

Maintenance and capital expenditure are funded through annual budgets, which can be increased if required. For 2018-2019 and 2019-2020, the combined budgets were INR 824 million (USD 11.9 million) and INR 462 million (USD 6.7 million), respectively (not including personnel costs). The major expenditure in 2018-2019 was a new runner and 30 guide vanes from Toshiba, the OEM. Much of the maintenance is planned for and contracted during the wet season, and then implemented during the dry season. Average plant availability is lowest in January, at below 70%.

All three generating units are maintained every year, under a highly detailed maintenance schedule. Average maintenance time for one unit has been 16.4 days over the past 10 years, gradually reducing to only 11.8 days in the last 2 years, which has contributed to increased plant availability. The last maintenance cycle was implemented between Dec. 8, 2018 and Jan. 23, 2019. Maintenance is documented with detailed reports following daily, monthly and annual templates, including measurements, photos and videos (under a dedicated IMS procedure).

Spare parts are kept in a central store and at various other locations, close to where they might be needed, to reduce response times. A spare runner is available for every generating unit, which allows for rapid exchange during major overhauls, and repairs at a later stage.

The spillway glacis, gate seals and other components of the dam are also maintained every year, as they are regularly damaged by bedload during the monsoon season.

NHPC has an inventory management system for consumables, but not a broader, software-based asset management system along the lines of e.g. the ISO 55000 series standards. However, its existing processes are delivering good results.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and asset maintenance management plans include a long-term program for efficiency improvements and asset upgrades.*

The processes described above are sufficient to identify emerging risks and opportunities. O&M strategies have been finetuned over time, for example by using turbine overload capacity and by extending maintenance cycles. Changes have made in response to many different emerging issues (for example, the replacement of halogen in firefighting due to environmental concerns). Generation operations have been fully automated from the beginning, and could be remotely controlled from the dispatch centre if that should be decided. Station computers are kept separate from the internet, for cyber security.

There is no long-term program for future maintenance and upgrades, but this is not seen as a gap because (1) the power station has only been operating for approximately 10 years, (2) the major maintenance needs – for the generating units and the dam spillways – are recurring annual requirements, (3) there is forward planning with regards to some asset upgrades – e.g. the powerhouse SCADA system, and steel liners for the spillway glacis, to reduce the annual costs for high-performance concrete, and (4) there is an IMS procedure on Planning for Renovation and Modernisation of Power House Equipment.

Coordinated operations along the Teesta cascade could contribute to increased efficiency in the future, but are currently not formalised, are focused on operational safety, and partly depend on the goodwill of upstream operators to share data. This is not a significant gap because all stations in the cascade have limited storage, and thus the potential efficiency gains would not be large.

Criteria met: Yes

5.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to asset maintenance and management have been and are on track to be met with no major non-compliances or non-conformances, and any asset related commitments have been or are on track to be met.*

Performance is measured against targets agreed annually in an MoU between NHPC and the Ministry of Power. The MoUs contain multiple targets including generation, plant availability, forced outages, as well as financial targets, and define different levels of performance. Over the past years, monitoring by the CEA has shown consistent meeting of 'excellent' performance targets by Teesta-V (see also under Outcomes below).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no indications of non-compliances or non-conformances. There are some observations regarding power station O&M in technical inspection, safety inspection, internal audit and comparable reports, but these are not considered non-conformances.

Criteria met: Yes

5.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Asset reliability and efficiency performance is in line with the objectives of the owner/operator and any asset performance guarantees with only minor gaps.*

The management of NHPC as well as the state and central government institutions with which NHPC has agreements related to performance and power deliveries, consider that Teesta-V has currently no major technical issues. Initial technical problems that led to reduced plant availability and generation have been resolved, and recurring maintenance issues appear to be well understood and managed.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *Asset reliability and efficiency performance is fully in line with the objectives of the owner/operator and any asset performance guarantees.*

The design energy from Teesta-V was for 2,573 GWh/year, and this has been achieved in 6 out of the first 10 years, including the last 4 years. 2017-2018 saw the highest generation yet, at 2,818 GWh. Annual ‘Excellent Targets’ for generation, which are agreed with government from year to year, were also exceeded in the last 4 years.

The nominal plant availability factor (i.e. as assumed during design) was 85%. This was achieved in 8 out of the first 10 years, including the last 4 years. 2017-2018 saw the highest plant availability factor (PAF), at 97% (compared to an average PAF of hydropower plants in India of 92%). Annual ‘Excellent Targets’ for PAF, which are agreed with government from year to year, were also exceeded in the last 4 years. The targets are currently based on assumed 20 days of maintenance per unit, and 4x36 hours of reservoir flushing.

Annual ‘Excellent Targets’ for forced outages have been agreed with government from year to year since 2015-2016, and were exceeded in the last 2 years. In 2017-2018, there were 47 hours of forced outages.

Criteria met: Yes

5.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

5.3 Scoring Summary

Teesta-V is monitored, operated and maintained by a large and capable workforce, under detailed procedures and with back-up from the Corporate Office, which supervises and assists a total of 24 power stations. Maintenance needs are rapidly identified and attended to, and upgrades have been made where necessary. While there are some observations, for example regarding maintenance of non-core assets and the absence of a software-based asset management system, the performance of the power station has been above average, and above the targets agreed with government. There are no significant gaps, resulting in a score of 5.

Topic Score: 5

5.4 Relevant Evidence

Interview:	1, 4, 11, 17, 19, 22, 24, 46, 50
Document:	15, 77-87, 90, 203
Photo:	10, 15, 16, 29-32, 39, 40, 42, 43, 46, 66, 69

6 Infrastructure Safety (O-6)

This topic addresses management of dam and other infrastructure safety. The intent is that life, property and the environment are protected from the consequences of dam failure and other infrastructure safety risks.

6.1 Background Information

Teesta-V is situated in a part of the Eastern Himalayas characterised by numerous geological structures including faults, fractures, joints and folds. Flooding, earthquakes, landslides and debris flows, erosion (with or without a disaster event) and soil subsidence are the most common natural hazards in the district. Associated with high rainfall, flooding and landslides usually occur during the monsoon between April and September. Teesta-V lies in Seismic Zone IV (severe intensity zone) and is prone to earthquakes. Earthquakes with moderate magnitude (greater than 5) occur in the nearby area almost every year. The strongest recorded earthquakes (magnitude 6.8) were in 1988 and in 2011. The latter occurred after Teesta-V had been operational, and the project, which was built in accordance with Indian Earthquake Resistant Design Standard IS:1894-1984, was unaffected.

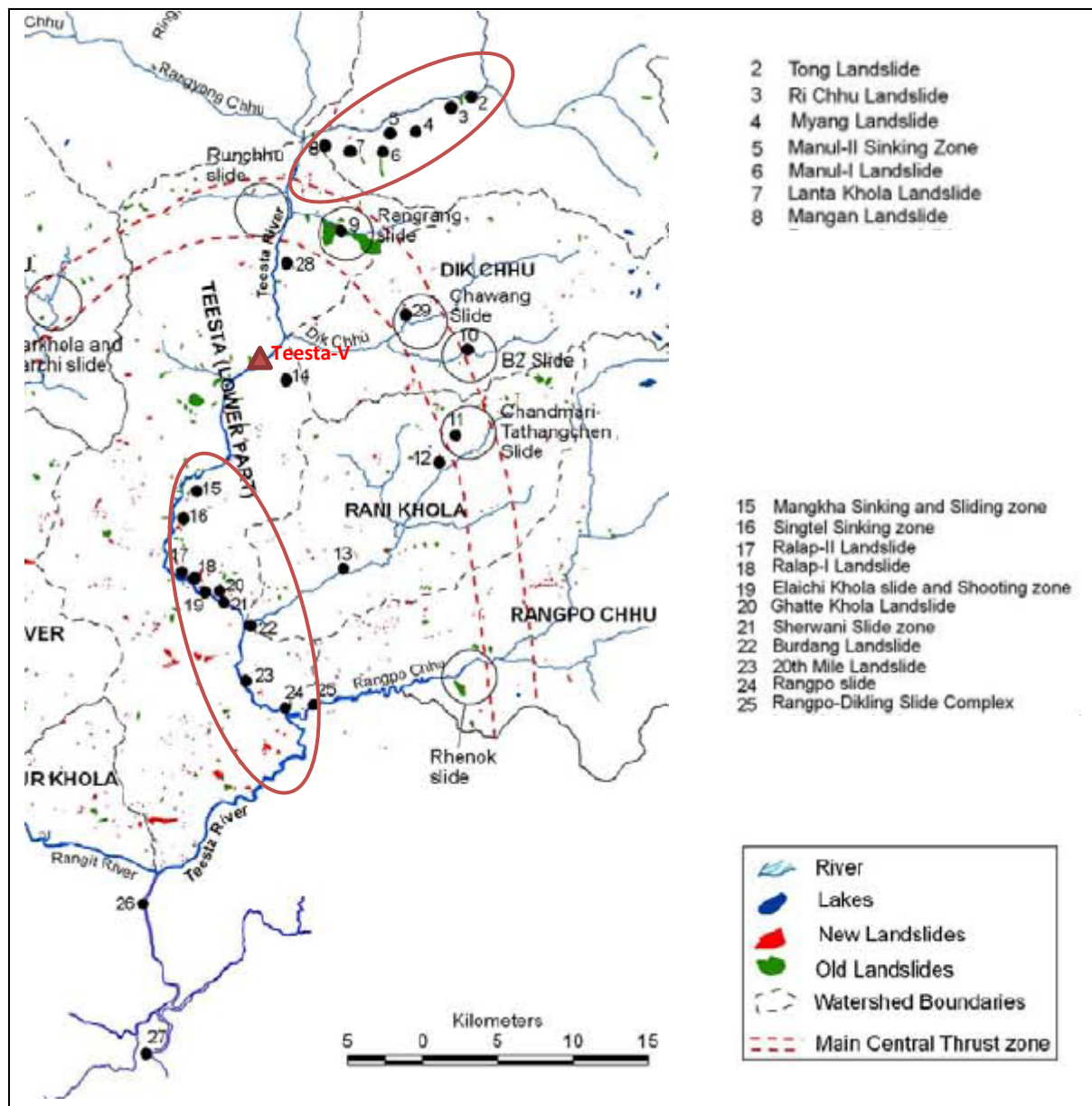
Landslides are common in the Teesta basin, and the Teesta Basin CCS identified more than 100 new landslide areas (see figure below). Recently in 2016, a massive landslide occurred on the Kanaka River, a tributary of the Teesta River, which is about 20 km upstream of the Teesta-V dam. The landslide completely blocked the Kanaka River and a lake was formed behind it which is now slowly draining.

Teesta-V has been designed for a probable maximum flood (PMF) of 9,500 m³/s. Later in 2011, CWC revised this to 14,596 m³/s. The maximum flood recorded over the past 20 years was 3,397m³/s, in 2002. Landslides and floods are also addressed in topics O-16 and O-4.

The Sikkim State Disaster Management Authority, an agency of the GoS, is responsible for planning and co-ordination of monitoring, mitigation, preparedness and management in the state, and released the Sikkim State Disaster Management Plan in 2015. Its counterparts are District Disaster Management Authorities in each district. The district and state levels, through various crisis management committees and sub-committees, work closely together to implement disaster management plans.

This topic focuses on public safety issues associated with dam failure and downstream flows but excludes safety issues associated with road traffic and working conditions. Road safety implications of additional traffic related to the project appear to be minor, and are addressed jointly with occupational safety in topic O-12. Public safety on the reservoir is not relevant, because it does not appear to be used by anybody.

Figure 4. Landslides in Teesta Basin, with Teesta-V Dam Location and Areas of High Landslide Intensity Highlighted (CCS 2007)



6.2 Detailed Topic Evaluation

6.2.1 Assessment

Analysis against basic good practice

Scoring statement: Routine monitoring of dam and infrastructure safety is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging dam and other infrastructure safety issues have been identified.

Safety inspections of the Teesta-V Dam are carried out at periodic intervals, that is pre-monsoon and post-monsoon, in accordance with CWC's Guidelines for Safety Inspection of Dams (revised 2018). These safety inspections generally use CWC issued dam safety inspection forms/checklists and cover major components of the dam and appurtenant structures including reservoir, spillways, and intake; access roads; adits; surge shaft area; and the powerhouse complex of Teesta-V. At the dam site, dam instrumentation is also inspected. This covers all

installed instruments including: multi-point bore-hole extensometer, pore pressure gauges, stress-strain meter, uniaxial (one directional) joint meter, perimetric joint meter, temperature meter, pendulum, uplift measuring standpipe, seepage measuring weirs (V-notch), strong motion accelerograph, survey instruments, survey points, and automatic weather station.

The safety inspection also reviews the status of remedial actions undertaken by NHPC against observations made during previous inspections. Upon receiving the inspection report, NHPC develops an action plan to address issues raised in the report and periodically updates its plan until individual actions are closed. The current action plan is dated 13 April 2019, and during the on-site assessment maintenance works at spillway gates and downstream areas were ongoing.

While it is evident that NHPC undertakes remedial actions in timely manner, delays in undertaking a few remedial measures were also identified. For example, March 2018 pre-monsoon inspection identified some damage to the access roads to the dam and recommended urgent repair of the damaged stretch of road. However, repairs were not undertaken as the following post-monsoon inspection (in October 2018) again reported this damage. Similarly, moderate leakage from spillway (Bay S2) were observed during both pre and post monsoon inspections in 2018. Leakage from spillway Bay S2 was considered significant.

The dam is also subject to a 10-year inspection by a dam safety review panel (DSRP), which was carried out in February-March 2019.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging safety issues takes into account consideration of a broad range of scenarios and both risks and opportunities.*

Two key initiatives have been undertaken to assess additional risks to dam safety and to minimise impacts of dam failure on the downstream environment and communities. These are a comprehensive dam break study and a study of potential GLOFs in the South Lhonak System of the Teesta basin.

After approximately eight years of operation, NHPC engaged the National Institute of Hydrology (NIH) to undertake a comprehensive dam break modelling study for Teesta-V to assist with the preparation of an emergency action plan and inundation maps for downstream areas in the case of a dam breach event. This study utilises up-to-date meteorological and hydrological data and software (MIKE 11) to estimate the extent of the dam break flood at different sections of the downstream reach along with the speed, water level, discharge, and timing to reach that particular section. Three cases are considered, with different assumptions about flood magnitude, reservoir level, and status of spillway gates. Inundation maps for each of these cases are then prepared to guide preparation of the emergency action plan.

Based on the outcome of previous studies, a Teesta-V specific GLOF risk and vulnerability assessment was carried out in 2015. Previously in 2003, a study had identified 18 glacier lakes with the potential to cause GLOFs in the Teesta basin. Many of these lakes are growing in size due to a rise in global temperature that accelerates the rate of ice melt. The areas of at least two of these lakes are more than 1 km² and therefore, if moraine dams are breached, likely to have significant impact on downstream communities and infrastructure including Teesta-V. One of these lakes is linked to the South Lhonak lake system which has very high potential for causing GLOF. In 2015, the CWC commissioned a GLOF study for this lake system with particular focus on four lakes. Five scenarios were considered to assess vulnerability of downstream infrastructure including Teesta-V. The study concluded that unless all four lakes burst at the same time (very low probability), the Teesta-V dam is likely to survive under all scenarios.

In response to the growing number of dams in the cascade, the EMP of the Teesta-IV project in 2014 for the first time in the Teesta basin considered the risk of cascade dam failure events. This became relevant as there are now four operational hydropower projects on the main course of the Teesta River in Sikkim and West Bengal,

several projects on tributaries such as the Dikchu and Rangit, and two new mainstream hydropower projects at planning or development stages. Breaching of one dam could lead to the failure of another, or more downstream dam(s) and if such events occur, the cumulative impact of cascade dam failure could be significant. The EMP concluded that Dikchu village and the Teesta-V dam were not likely to be affected due to dam break of all three upstream dams (Teesta-IV, Panan and Teesta-III). However, cascade failure analysis is only partial as there is no evidence of a process by which NHPC or another entity has identified or assessed the risk of a Teesta-V failure on downstream dams.

The implications of CWC's revision of the PMF in 2011 have not yet been taken into account comprehensively. Increasing the spillway capacity was initially not considered feasible, for topographical and geological reasons. After several years, in 2019 the DSRP recommended exploring potential technical changes (raising a parapet wall on top of dam, and reactivating the diversion tunnels) and revisiting the structural safety and stability analysis.

The fact that the Teesta-V dam safety analysis has not yet been updated to reflect additional dams in the cascade and the increased PMF constitutes a **significant gap** against proven best practice.

Criteria met: No

6.2.2 Management

Analysis against basic good practice

Scoring statement: *Dam and other infrastructure safety management plans and processes have been developed in conjunction with relevant regulatory and local authorities with no significant gaps, and provide for communication of public safety measures; emergency response plans and processes include awareness and training programs and emergency response simulations.*

NHPC as the operator of Teesta-V has developed and implemented an Emergency Action Plan (EAP) for the Teesta-V dam and associated infrastructure in accordance with CWC's Guidelines for Development and Implementation of Emergency Action Plan for Dams (2006). The main purpose of the EAP is to assist emergency officials in saving lives, minimising damage to property, structures and homes, and also minimising environmental impacts in the event of flooding caused by heavy water releases from the dam, dam failure, or other such events. The EAP identifies and addresses risks such as heavy rainfall, earthquake, and landslides which have potential to cause dam failure or a significant flood event. It has also taken other non-natural events such as structural damage/failure and sabotage into consideration. The EAP defines roles and responsibilities for the Teesta-V operator and other government and state agencies.

The EAP sets out a process by which emergency conditions and levels can be identified by reviewing regular monitoring data such as flow data, dam instrumentation data, safety inspection data, and other monitoring data. Based on the emergency level, appropriate actions are executed. This includes emergency notification of concerned Teesta-V personnel as well as district, state and national level authorities and personnel. The EAP also defines preventative and surveillance activities to be undertaken prior to and during emergency situations.

In addition to the EAP, NHPC has also recently developed and implemented a Disaster Management Plan (DMP) (February 2019) to take precautionary and proactive measures to deal with an imminent or potential emergency situation in the Teesta-V power station area including the residential colonies. Under the DMP, a committee of NHPC officials has been created to assess risk, identify and implement appropriate preventative measures and in case of emergencies, implement emergency procedures in accordance with the DMP. The DMP defines functions and responsibilities of all concerned managerial, operational and support services, fire services, medical services, security forces and civil administration during an emergency situation.

In 2016 NHPC updated the Standard Operational Procedures (SOP) to minimise the impact on the people living in the downstream areas of the dam during sudden release of water. The SOP identify vulnerable areas and adopts safety measures including erection of warning boards, fencing and barricading identified stretches of river, awareness campaigning and installation of lights and sirens. As part of the DMP, the operator of Teesta-V

has established a public warning system which includes installation of 11 siren/alarm systems between the dam (at Dikchu) and the mining check post at Rangpo as well as two control rooms at the dam site and at the powerhouse. Operators implement a 5-minute “hold point” when first starting up the power station, at about 35-40 MW, which in combination with downstream siren alerts is for the purposes of warning any downstream parties that the water level is about to rise (see topic O-19).

As part of emergency preparedness, NHPC has identified emergency assembly areas, evacuation mechanism and guidelines, and evacuation routes. Emergency response drills (mock drills) are also regularly organised at different areas with the participation of NHPC staff including medical centre professionals and local authorities such as the state LR&MD Department. Emergency responses measures including medical professionals and ambulance services, and fire trucks are available on site.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and public safety measures are widely communicated in a timely and accessible manner.*

NHPC, at both project and corporate level, has undertaken initiatives that are directly or indirectly contributing to improved dam and infrastructure safety. Investments have also been made into research projects, the findings of which have the potential to further improve dam safety and efficiency.

It is evident that the operator of Teesta-V is working closely with local authorities and other dam operators to identify risks and address these risks jointly, as appropriate. It coordinates and shares information with other dam operators and local authorities through an online forum (i.e. a WhatsApp Group) to exchange dam operational and monitoring data including reservoir level, net river flow, spillage through gates, average generation, average river inflow and weather data, on hourly basis (or when needed, every 15 minutes). All dam operators including Teesta-V's are notified of any regular or unexpected changes in river hydrology or other natural events (such as earthquake, landslide, or GLOF) in a timely manner and take appropriate mitigation measures to minimise risks.

Teesta-V's emergency notification system and public warning systems have proved effective and reliable. The warning system extends up to 17 km downstream of the power station and thus, in case of emergency is capable of reaching wider downstream communities.

The 2019 DSRP inspection has provided additional recommendations to enhance the safety of the dam.

Criteria met: Yes

6.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to safety have been and are on track to be met with no major non-compliances or non-conformances, and safety related commitments have been or are on track to be met.*

NHPC is compliant with its legal obligations regarding dam and infrastructure safety, and conforms with its Safety Policy for Power Stations.

An EAP and a DMP have been prepared and implemented to comply with requirements set in the National Water Policy 2012. The EAP is developed in accordance with CWC's Guidelines for Development and Implementation of Emergency Action Plan for Dams (2006). The DMP has been prepared to meet the requirements of the following acts, policies and plans:

- Disaster Management Act 2005

- National Policy on Disaster Management (2009)
- Suggested structure of DMP by National Disaster Management Authority (April 2015)
- Guidelines for Development and Implementation of Emergency Action Plan for Dams (2006)
- SOP for sudden release of water from dam to downstream areas

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

As above, NHPC is compliant with its legal obligations regarding dam and infrastructure safety.

Criteria met: Yes

6.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Safety risks have been avoided, minimised and mitigated with no significant gaps.*

During the last 10 years of operation, there were no major safety breaches at Teesta-V. During a major earthquake of magnitude 6.8 in 2011, no visible damage was sustained by the dam or other infrastructure. In 2016 when a lake was created on the Kanaka River due to a landslide, to minimise the effect of a potential sudden flood, it was considered to draw down the Teesta-V reservoir to contain flood flows. However, such event did not occur.

Over the last 10 years of operation, one drowning death was linked to Teesta-V operation. On 18 April 2014, an 11-year old girl drowned due to a release from Teesta-V, and an ensuing court case against NHPC resulted in orders to introduce a number of public safety measures. Subsequently, in April 2016, NHPC updated its standard operating procedures for sudden water release to protect downstream communities.

The LR&DM Department also confirmed that drowning in the Teesta River is extremely rare and therefore, it can be concluded that Teesta-V is managing downstream water releases efficiently and not increasing safety risks to downstream communities.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, safety risks have been avoided, minimised and mitigated with no identified gaps; and safety issues have been addressed beyond those risks caused by the operating facility itself.*

According to the 2019 DSRP inspection report, the Teesta-V dam is functioning satisfactorily for the design flood, but requires additional analysis and possibly, technical adjustments for the larger revised PMF value, as discussed above under Assessment.

The LR&DM Department recognises that the siren/warning system installed at Teesta-V is efficient and serves its purpose. It is noted that the state police often use this system to warn and evacuate people during flooding in the area.

The LR&DM Department confirms that they occasionally seek assistance from dam operators in the Teesta basin to deal with external emergency situations. On two occasions, one involving a fire incident in the Rangpo area and the other relating to the massive upstream landslide, the DDMA requested NHPC to provide assistance with resources, and in both cases these requests were obliged.

The improvements of roads and communication infrastructure by the project have contributed to public health and safety in the area.

Criteria met: Yes

6.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The Teesta-V dam safety analysis has not yet been updated to reflect additional dams in the cascade and the increased PMF.

1 significant gap

6.3 Scoring Summary

NHPC is monitoring and is conducting internal and external safety inspections of the dam and other infrastructure on a regular basis. Findings of these inspections help NHPC to undertake appropriate mitigative or maintenance works to enhance infrastructure safety. In addition, studies have been undertaken to identify external safety risks (such as GLOF and dam break). Emergency action and disaster management plans have been prepared to enhance emergency preparedness and response capacity. NHPC works with other dam operators and regulatory agencies to share pertinent information, create awareness and implement emergency response plans. However, NHPC has not yet undertaken a comprehensive assessment of the implications of additional dams and an increased PMF. This gap against proven best practice results in a score of 4.

Topic Score: 4

6.4 Relevant Evidence

Interview:	4, 16, 21, 26, 31, 39
Document:	10, 15, 88, 91-111, 167, 169, 183, 217, 219, 228
Photo:	13, 14, 17, 18, 34, 37, 38, 44, 64, 65, 83

7 Financial Viability (O-7)

This topic addresses financial management of the operating hydropower facility, including funding of measures aimed at ensuring project sustainability, and the ability of the project to generate the required financial returns to meet funding requirements as well as to optimise its financial opportunities. The intent is that the operations of the hydropower facility are proceeding on a sound financial basis that covers all funding requirements including social and environmental measures and commitments, and that it is aware of and responding to market trends which may influence its long-term viability.

7.1 Background Information

NHPC was incorporated in 1975 and listed on the National Stock Exchange and Bombay Stock Exchange in 2009; currently 3/4 of the shares are held by central and state governments, and 1/4 by financial institutions and about 700,000 members of the general public. During the financial year 2017-2018, NHPC power stations generated a total of 22,625 GWh, resulting in sales of INR 68.7 billion (USD 989 million) with a net profit (after tax) of INR 27.6 billion (USD 397 million).

The final completion cost of Teesta-V was INR 26.6 billion or USD 674 million (at exchange rate Jan 1 2008), about 21% more than the budget initially approved by the GoI, mainly due to price escalation. A detailed report was prepared to justify this cost overrun, and approved by the Ministry of Power. About 42% of the investment was provided as equity, 30% as domestic loans (largely from the Indian public corporations LIC (Life Insurance Corp) and PFC (Power Finance Corp), and 27% denominated in Yen from a consortium of 6 international lenders led by Deutsche Bank, over 16 years and now fully repaid.

The bulk of NHPC's revenue comes from selling energy from its operating hydropower plants including Teesta-V to bulk customers/offtakers, mainly state-owned utilities. For Teesta-V, the main off-takers are from West Bengal, Orissa – renamed Odisha in 2011 -, Bihar, Jharkhand and Sikkim. NHPC holds PPAs with these entities to supply power for 35 years, from commissioning in 2008 to 2043.

The Central Electricity Regulatory Commission (CERC) determines the tariffs for individual power plants under the provisions of the Electricity Act, 2003. A key issue for tariff determination is which expenditures are eligible for reimbursement through the tariff. CERC regularly updates the terms and conditions for determination of tariff of the generating companies and interstate transmission systems under its jurisdiction. In March 2019 a new set of regulations were enacted which will be used to determine tariffs for all power stations, including Teesta-V, for the five-year period from April 2019 to March 2024. As for other hydropower projects in India, the tariff of Teesta-v comprises capacity and energy charges (50/50). Capacity charges are determined based on the annual fixed cost (AFC) and directly linked to the PAF which is certified by ERLDC. Energy charges are determined based on actual energy generation compared with design energy. Therefore, to maintain strong financial performance, it is important to achieve strong operating performance, discussed under topic O-5.

7.2 Detailed Topic Evaluation

7.2.1 Assessment

Analysis against basic good practice

Scoring statement: Routine monitoring of the operating hydropower facility's finances is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging financial management issues have been identified.

At Teesta-V, NHPC maintains a finance team with the primary functions of budget preparation and monitoring, payroll, accounts and taxes. The local team provides support to the corporate (Faridabad Office) and regional

(Siliguri Regional Office) counterparts in financial monitoring and controls. For the preparation of annual budgets, the team collects relevant information from all departments, as well as certain costs of the Corporate Office. The budget generally consists of three parts:

- Revenue budget includes general expenses; administration and other expenses; employee remuneration and benefits; depreciation; and interest and finance charges
- Capital budget includes O&M expenses
- Restoration budget (against insured assets)

Budgets are reviewed and approved by the corporate Finance Department who also monitor inflow and outflow of funds, and ultimately by the Board. The trend of annual budget utilisation by Teesta-V is monitored for future budgeting purposes.

The internal audit department under the Executive Director (Finance) undertakes regular (twice a year) and special audits of different operational units. In the case of Teesta-V, the Kolkata-based internal audit unit is responsible. The power station finances are also externally audited by registered chartered accountants, appointed by the CAG.

Recent challenges in financial management include the India-wide introduction of a general sales tax (GST) with multiple bands in 2017.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging financial management issues takes into account both risks and opportunities including factors and trends that might influence future demand for electricity, water and ancillary services.*

NHPC recognises a number of risks to the financial viability of their hydropower operations. For new projects, these include time and cost overruns, difficulties in entering into PPAs for power stations with high costs, and opposition to hydropower development. As an operational plant, Teesta-V's financial viability is directly linked to operational costs and the regulated price of generated power. NHPC has identified these and other emerging/potential financial risks, and mechanisms are in place to reduce risks. These include:

- Cost overrun. Periodic technical audits take place for early identification of potential maintenance issues (see under topic O-5). Financial risks associated with O&M works have been reduced by regular internal financial performance monitoring.
- Delayed payments by offtakers. The state-owned distribution companies in India are known for financial problems and delayed payments; however the Teesta-V offtakers have above-average payments performance.
- Power demand. During the planning phase of Teesta-V, a detailed study was conducted to analyse energy demand in the Eastern region including the States of Bihar, Orissa, Sikkim and West Bengal. It was estimated that in 2005-2006, the annual peak load demand would be 15,597 MW against peak availability (without Teesta-V) of 12,827 MW and therefore, that the entire generation of Teesta-V would be absorbed from its first year of production. This was proven correct, and to meet growing demand, in addition to Teesta-V, new hydropower projects have been and are being developed.
- Changes in hydropower competitiveness. CERC's tariff determination mechanism is directly linked to capital and operating expenses. Therefore, Teesta-V's revenue stream is expected to be largely protected even if there should be a surge of cheaper electricity, through other renewable sources such as wind and solar. Because of a 35-year tenure of the PPAs, offtakers are contractually required to pay the tariff as determined by CERC, leaving Teesta-V financially unaffected.
- Transmission cost. Evacuation of power from the delivery point of the relevant NHPC power station to the bulk power customers is done through the transmission system of Power Grid Corp. of India Ltd

(PGCIL). Bulk power customers are required to make necessary arrangements separately with transmission companies for payments of evacuation and other charges.

- Reduction of storage capacity. The small reservoir is exposed to life span risks from infilling with sediment, which have to be constantly managed through sediment flushing and close monitoring (see under to topic O-16).

Criteria met: Yes

7.2.2 Management

Analysis against basic good practice

Scoring statement: Measures are in place for financial management of the operating hydropower facility.

A well-structured and functioning financial management system is in place for Teesta-V, which is managed as its own profit centre, with separate balance sheet and profit & loss statements. The project financial team, with support from Siliguri Regional Office, has responsibility for the preparation and management of the O&M budget. The corporate Finance Department is responsible for financial planning, reporting and controls, hedging, cash management, financial risk management and auditing. Financial management measures include but are not limited to the following.

- Financial decisions are taken by authorised NHPC personnel in accordance with prevailing Delegation of Powers (DoP) rules, i.e. financial authority thresholds for each management level.
- A management information system is in place to coordinate between various departments and increase efficiency by identifying and addressing financial risk areas. ERP software is used to manage and report financial issues efficiently. An electronic Record Management System is also used to store and share all relevant documents including financial information among all NHPC staff based on their job
- Internal audit and vigilance units (including a Vigilance Officer at Teesta-V who reports directly to the Corporate Office Vigilance Officer, who in turn reports directly to the Chairman) have strong roles in the corporation.
- NHPC maintains a system to monitor and report capital expenditure. Before each contract approval, the finance team has to verify that it is within budget. Regular monitoring of capex budget is done at both corporate level and project levels. Any variations identified are addressed based on merit, and internally reported in accordance with the DoP.
- Time and cost overrun due to staffing issues related to contract workers has been mitigated through paying contract workers on time based on the work completed.
- Revenues are collected on monthly basis. The offtakers provide an irrevocable Letter of Credit in favour of NHPC for an amount equivalent to 105% of their average monthly billing. This is used as a security against payment. A surcharge is imposed in case there is a delay in payment, and a discount to incentivise early payment.
- Payments are generally made via internet banking to nominated bank accounts. An authorised Engineer in Charge for each contract, and a finance officer verify claims before payment is made. For larger payments, in excess of INR 500,000 (USD 7,200), a centralised vendor payment system is used whereby the corporate Finance Department authorises transactions electronically. The ERP software does not allow booking expenditures beyond approved budgets.
- Regarding staff salaries, the corporate Finance Department makes payments centrally based on timesheets submitted by the site finance department. Staff expense claims are processed locally but payment is made by the corporate office, on the basis of attendance records.
- Transfers from the CO to the local project's bank account are based on monthly cash flow forecasts, compiled from all divisions.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and financial contingency measures can be implemented for environmental and social management plans if required.*

NHPC systematically reduces exposure to exchange and interest rate risks, by focusing on lending denominated in INR, and preferring fixed over variable rates.

NHPC holds a comprehensive 'mega risk' insurance policy which covers all power plants including Teesta-V. It provides protection against physical loss or damage to all properties and equipment due to any natural (such as floods, earthquake) or man-made events (such as terrorism). It also covers loss of income/business interruption due to physical loss and damage to any equipment.

NHPC has recently set up a contingency Emergency Relief Fund, administered jointly with the GoS, of INR 5 million (USD 72,00) to fund any emergency measures. There is also a National Disaster Response Fund for rapid responses to natural disasters.

No major upgrades or rehabilitation expenditures are expected for the foreseeable future in the Teesta-V project, as it has been designed for a 35-year lifespan. As a large and financially stable company with the backing of the Gol, NHPC has the resources and processes in place to handle any unexpected environmental or social expenditure in the Teesta-V project, although none are expected.

Major risks and opportunities can be expected from the ongoing shifts in the Indian electricity market, which has recently seen trends towards full electrification, strong competitive pressures and falling power costs, policy commitments to renewables, and massive entry of solar and wind power, that require backup generation. NHPC is aware of these shifts, although through its long-term PPAs, it is partly isolated from them. CERC is expected to adjust its power tariff formulas over time, for example to encourage provision of ancillary services, which Teesta-V is in a good provision to provide.

Criteria met: Yes

7.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to financial management have been and are on track to be met with no major non-compliances or non-conformances, and funding commitments have been or are on track to be met.*

The financial statements of Teesta-V are annually audited by accredited Chartered Accountants. For 2017-18 financial year, Ray and Ray Chartered Accountants from West Bengal was engaged. Similarly, at the corporate level, annual financial reports are audited by accredited accountants. No major observations have been reported.

Teesta-V conforms with applicable national and state regulations, including the Electricity Act 2003 and CERC (Terms and Conditions of Tariff) Regulations, 2009 & 2014.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no indications of any non-compliances or non-conformances. Some observations have been made by internal auditors, but do not qualify as non-conformances.

Criteria met: Yes

7.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *The operating hydropower facility or the corporate entity to which it belongs can manage financial issues under a range of scenarios, can service its debt, and can pay for all plans and commitments including social and environmental.*

Teesta-V has been consistent in achieving financial targets and operating as a profitable entity since it started operations in 2008. In the 2017-2018 financial year, it earned INR 6.2 billion (USD 88.9 million) as revenue and made a profit of INR 3.2 billion (USD 46.4 million, or 52% of revenue). This was achieved even though the plant's tariff per unit is comparatively cheaper than that of other plant in the Eastern region. During 2014-2019, Teesta-V's energy tariff was set at INR 2.33/kWh (USD 3.4 cents) when the average tariff in the region was INR 4.00.

The Indian rating agency ICRA has rated NHPC as AAA (stable) in December 2018, and considers that this rating will remain unchanged after acquisition of the Teesta-VI project from Lanco. This rating reflects NHPC's established position in India's hydropower industry, its sizeable operating projects and its strategic importance to the GoI. Moodys recently upgraded NHPC's international rating from Baa3 positive to Baa2 stable. As a publicly traded company, NHPC's finances are also reviewed by investment advisory firms.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the operating hydropower facility or the corporate entity to which it belongs can manage financial issues under a range of scenarios, and has optimised or is on track to optimise its market position with respect to supply and demand for electricity, water and ancillary services.*

With the current financial management and O&M approach and the necessary refurbishments, Teesta-V can be expected to deliver a positive cash flow to NHPC and its owners for a very long time, beyond its originally planned lifespan of 35 years. CERC's tariff formulas effectively protect NHPC's projects, once approved by the GoI and successfully completed, from a range of financial risks, for example the risk of drought or the risk of non-delivery of power due to faults in the transmission network. The overall direction of change in the market is uncertain. Expected changes in the tariff formulas over time (for example, a better recognition of peaking power and ancillary services) will tend to benefit Teesta-V and NHPC in general, while decreases in the average cost of power in the Indian market will be negative.

Within the very limited flexibility that Teesta-V's design and offtaker agreements offer, the project has optimised its market position.

Criteria met: Yes

7.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

7.3 Scoring Summary

Teesta-V is managed as a separate profit centre under NHPC's financial management process and receives its revenue under long-term PPA's regulated by CERC. Finances are closely monitored by the Corporate Office Financial Department, as well as internal and external auditors. The project has repaid its foreign loans, and is now making significant contributions to NHPC's overall profits and dividend payments, which are expected to continue for the foreseeable future. There are no significant gaps, resulting in a score of 5.

Topic Score: 5

7.4 Relevant Evidence

Interview:	7, 33
Document:	13-15, 19, 29, 75, 77, 112-123, 128, 215
Photo:	-

8 Project Benefits (O-8)

This topic addresses the benefits that were committed to alongside development of the hydropower facility, in cases where these commitments are well-documented against a pre-project baseline. The intent is that commitments to additional benefits and benefit sharing strategies made during development of the hydropower facility are fulfilled, and that communities affected by the hydropower development have benefitted. In the case of older projects where there is an absence of well-documented commitments to project benefits made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to project benefits should be taken into consideration under topic O-3 Environmental and Social Issues Management.

8.1 Background Information

This topic covers those commitments to benefits made during the development of the hydropower facility, that are above and beyond compensation and mitigation for negative impacts to project affected communities (which are addressed under topic O-9). The following key benefits associated with the development of the Teesta-V project are therefore discussed under this topic:

- At the level of the state, the GoS received an estimated INR 220 million (USD 5.6 million at the exchange rate of Jan 1, 2008) in sales and similar taxes during construction. More importantly, the GoS permanently receives 12% of the power generated at Teesta-V for free, which has amounted to a total of 3,224 GWh (equivalent to INR 7,245 billion or USD 104 million at current exchange rates) from commissioning to December 2018. Together with the free power from other hydropower stations, this has allowed Sikkim to maintain low tariffs, despite the relatively high transmission and distribution costs associated with low population density and mountainous terrain. Households below the poverty line receive 100 kWh per month for free, and low tariffs have helped attract considerable industrial investments recently.
- NHPC applies a systematic policy of preferential local employment and procurement (beyond those families who were displaced by the project and for whom employment is a form of livelihood restoration, as discussed under topic O-9). Locals initially benefited from direct employment, or employment through contract workers, during construction and implementation of several of the EMP programs such as the catchment area treatment. Labour and working conditions for local employees are covered under topic O-12.
- The project initially adopted two villages as model villages for community development activities. In line with the Companies Act 2013, which requires all large companies to invest 2% of their average net profits over 3 years in corporate social responsibility activities, this has since been broadened to other communities in the project area.
- The school and hospital in the powerhouse colony have been open without charge to local communities since the construction period, and are in fact used more by local communities than by project staff (see also under topic O-14).

A number of other benefits are not covered under this topic:

- NHPC regularly pays dividends to its owners (since its initial public offering in 2009, this also includes private shareholders) as well as taxes and fees to the central government. The return on equity target used in the calculation of the tariff from Teesta-V is 16%. While these are important benefits, they are part of the original rationale of the project, not additional, and only a very small part could be seen to benefit project-affected communities.
- The reliable power from Teesta-V has contributed to the electrification of India's eastern region. India recently achieved near-universal electrification of all households, including all 98,768 households in Sikkim. Again, this is not covered in detail here because it is not an additional benefit, but part of the

original rationale of the project, and was spread over a large area with approximately 300 million people.

- The renewable power from Teesta-V is helping to avoid emissions from thermal power stations, and the reforestation campaigns (beyond just compensation of lost biomass) have helped to absorb carbon dioxide (CO₂), thus mitigating climate change. This benefit is covered under topic O-20.
- Local communities have benefited in other ways from project infrastructure and operations. For example, transport and communications have improved because roads, bridges, telephone exchanges, mobile phone towers etc. were built, including a substantial upgrade of the 28 km road stretch between Singtam and Dikchu. Some communities received flat grounds from landscaped spoil dumps, or stabilisation measures on steep hills. Access to the river for extracting construction materials is easier in some stretches and at some times, because of reduced flows. These benefits are not covered here because they are not additional but simply a result of project requirements. They are considered under topic O-9.

Beyond those already committed to at the time of development, no other additional benefits have arisen from the project as a result of NHPC's ongoing environmental and social issues management, and hence none are covered under topic O-3. Benefits for employees are addressed under topic O-12.

8.2 Detailed Topic Evaluation

8.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken to assess if commitments to project benefits have been delivered and if management measures are effective; and ongoing or emerging issues relating to delivery of project benefits have been identified.*

Monitoring of the four key benefit areas listed above relies on the following mechanisms:

- 12% free power: Delivery of free power is monitored closely between NHPC and the offtaker, the Energy & Power Department of Sikkim.
- Preferential local employment and procurement: As of September 2018, approximately 676 locals were employed in various functions by the project: 70 regular employment, 96 from Indian Reserve Battalion and 30 from Home Guard for project security, 440 as contract workers for miscellaneous works, and 40 as drivers for hired vehicles. NHPC reported that during construction, it had awarded 1,400 contracts worth a total of INR 1 billion (USD 25 million at exchange rate of Jan 1, 2008) to local contractors, as well as a transport contract with a Sikkim state transport company. There is currently no separate reporting on local procurement, but this is ongoing, for example for transport services.
- Model villages and CSR program: NHPC reported publicly on the use of INR 5 million (USD 128,000 at exchange rate of Jan 1, 2008) for the model villages of Lum and Rakdong. For several years after the passing of the Companies Act 2013, the Teesta-V project reported separately publicly on its CSR activities; since then joint reports for all NHPC projects are being published.
- School and hospital in the powerhouse colony: Both the school and the medical services in the project maintain detailed records and regularly report to project management and to the public education and health authorities.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging issues relating to project benefits takes into account both risks and opportunities.*

The four key benefit areas are closely monitored, and there are no indications of any important ongoing or emerging issues related to any of them. All stakeholders have the flexibility to adjust the benefits programs to their needs. For example, with increasing industrial development and power demand within Sikkim, the state Energy & Power Department is likely to distribute an increasing share of free power deliveries within the state, rather than on-selling it to neighbouring states. Local communities are likely to adjust their requests for CSR activities as their needs change over time. As Sikkim develops rapidly, local workers and contract workers increasingly have other alternatives regarding employment or contracting with the project. The same applies to local families in their choice of schools and medical providers. The school is likely to remain attractive as it is considered one of the best in the region, as documented by exam results. The hospital has been receiving fewer patients over time, as other facilities have been created and transport links have been improved.

Criteria met: Yes

8.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to deliver commitments to project benefits, and to manage any identified issues relating to these commitments; and commitments to project benefits are publicly disclosed.*

Management of the four key benefit areas listed above relies on the following mechanisms:

- 12% free power: Free power as per central government regulations is delivered at the power station. The Energy & Power Department of Sikkim publicly reports on deliveries, for example in its tariff applications with the Sikkim State Electricity Regulatory Commission.
- Preferential local employment and procurement: Local employment was an Environmental Clearance condition, and is managed by the project's HR division (see also under topic O-12). The status of local employment is reported in the 6-monthly compliance reports to the MoEFCC. Commitments towards local procurement were informally agreed with the state government. Procurement is managed as described under topic O-2. NHPC publishes an annual procurement plan for medium and small enterprises, which are more likely to be local companies (for example, <http://www.nhpcindia.com/writereaddata/images/pdf/MSME-TeestaV-2017-18.pdf>), and a new public procurement policy favouring medium and small enterprises came into effect on April 1st, 2019.
- Model villages and CSR program: The model village program was part of the EMP as approved by government, and the CSR program is mandatory (see topic O-2). The CSR program is implemented through the project's IMS and HR divisions, and coordinated by CSR committees at the project and corporate Board level. Requests from communities, self-help groups, schools, district administrations, state government and other entities are quite varied, and are discussed with the community and evaluated by project representatives according to their impact, numbers of beneficiaries, sustainability, and avoiding duplication. The final decision on budget allocation is taken by the Board committee. For larger CSR projects (such as the Industrial Training Institute (ITI) at Chandey in North Sikkim), MoUs are concluded with recipients. Some requests do not fit under the CSR program priorities (for example, a request to use project facilities for an event), but may be considered at the discretion of the project management. In addition, the Teesta-V project area also benefits from countrywide NHPC CSR programs such as scholarship funds, skills development programs, and others.
- School and hospital in the powerhouse colony: The secondary school is a Kendriya Vidyalaya ('central school'), one of approximately 1,200 of these schools in India (2 of which are in Sikkim) in locations with central government presence, overseen by the central Ministry of Human Resource Development, with above-average quality of education. This school as well as the primary school are funded by NHPC. The medical services are managed by the Teesta-V project, with support from the Corporate Office. They were part of the EMP as approved by government, and are also funded by NHPC.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to risks and opportunities.*

As described above, all four key benefits areas are being monitored. Processes for their adaptive management over time are either prescribed in central or state government regulations (free power, CSR program, Kendriya Vidyalaya school, public procurement) or are managed by NHPC through similar approaches for all power stations (local employment, medical services).

There is some monitoring of CSR activities during and after implementation. For example, NHPC engineers from Teesta-V will inspect ongoing works in the villages. The ongoing impact assessment study for CSR programs of three NHPC power stations in Sikkim, by Sikkim University will provide inputs for further increasing effectiveness. The lack of formal community agreements for smaller CSR projects could result in uncertainties over responsibilities for O&M. This gap is related to those under topics O-10 and O-11 but is not considered significant under this topic, given that there are no documented examples of such problems arising with regards to CSR. The selection of projects is made by NHPC, without involvement of community or government representatives, or reference to documents such as local or state development plans. Again, this is a gap but not a significant one, as there are no indications of criticism over project selection.

Criteria met: Yes

8.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage project benefits have been and are on track to be met with no significant non-compliances or non-conformances, and commitments have been or are on track to be met.*

Compliance and conformance regarding the four key benefit areas has been confirmed by regulators and stakeholders. The MoEFCC has accepted the full implementation of all environmental and social commitments under the EMP and the conditions of the Environmental Clearance. The central government supervises the delivery of the CSR budget. The state government has confirmed the delivery of the free power, as well as other commitments to project benefits by NHPC.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

While there are some issues regarding responsiveness of NHPC and clarity of commitments (see under topics O-10 and O-11), there are no known non-compliances or non-conformances regarding project benefits.

Underspensing against the approved CSR budget has occurred from time to time (for example, as noted by NHPC's Internal Audit for the 2017-2018 program year). However, reportedly the remaining funds are rolled over into the following year, so this is not seen as a non-conformance. A CAG evaluation of CSR programs of central level state-owned companies has recommended against rushing expenditures towards the end of the program year.

Criteria met: Yes

8.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Communities directly affected by the development of the hydropower facility and any other identified beneficiary of the facility have received or are on track to receive benefits.*

All four key benefit areas have been delivered as planned, and benefits have been received either by all citizens of Sikkim or by directly affected communities. NHPC tends to invest more than officially required – for example, in the EMPs or under the CSR regulations – in social programs.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, benefits are significant and sustained for communities affected by the project.*

All four key benefit areas have made significant and sustained contributions to the livelihoods and quality and life in the project area.

The state Energy & Power Department projects an energy requirement of GWh 1,185 for the year 2019-2020, out of which GWh 457 will be provided from free power.

The employment of approximately 676 locals is a significant contribution to employment in wage labour in the relatively small state of Sikkim, and local procurement supports a significant share of local economic activity.

The CSR program with a budget of INR 13.5 million (USD 194,000) in 2018-2019 funds small but important projects in health, education, water supply and sanitation, and other local needs such as training for women, which complement government investments and community efforts. CSR budgets fluctuate from year to year according to NHPC's profits and according to the allocation of funds to Teesta-V, relative to other power stations.

The medical and school services provided by the project are of high quality and are used extensively by the local population.

Because benefits are provided through various mechanisms, there is a high probability of reaching all affected households.

Criteria met: Yes

8.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

8.3 Scoring Summary

Through various permanent mechanisms, the Teesta-V project provides substantial benefits to project-affected communities and the citizens of Sikkim, during the operation stage of the project. These contribute to the relatively high standard of living in the project area. There are some opportunities for improvement of the CSR program, but these are not considered significant gaps. NHPC follows regulatory requirements, and voluntarily increases the level of benefits beyond those requirements. There are no significant gaps against best practice, resulting in a score of 5.

Topic Score: 5

8.4 Relevant Evidence

Interview:	6, 15, 20, 27, 30, 37, 41
Document:	11, 12, 18, 19, 36, 49, 57, 75, 118, 124-137, 140-142, 144, 146, 163, 182
Photo:	23, 27, 28, 71

9 Project Affected Communities and Livelihoods

(O-9)

This topic addresses how impacts of development of the hydropower facility on project affected communities have been addressed, in cases where these commitments are well-documented against a pre-project baseline. The intent is that livelihoods and living standards impacted by the project have been improved relative to pre-project conditions for project affected communities with the aim of self-sufficiency in the long-term, and that commitments to project affected communities have been fully fulfilled. In the case of older projects where there is an absence of well-documented commitments to project-affected communities made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to project affected communities should be taken into consideration under topic O-3 Environmental and Social Issues Management.

9.1 Background Information

Sikkim is the smallest Indian state by population and one of the states with the highest levels of income, at 2.5 times the Indian average, with a relatively low tax burden and above-average government expenditures.

The total population of Sikkim was recorded as 540,000 in the 2001 census, which was the census closest to the EIA of the Teesta-V project. The population density in the state was 76/km², with a literacy rate of 69%. The population was 59% Hindu and 27% Buddhist, included 21% from Scheduled Tribes, and had a 12% urban share. The 2011 census recorded a total population of 610,000. Population growth in Sikkim has slowed down, and non-Sikkimese citizens face restrictions on settling in the state.

In the EIA, 204 families with 1,498 members (average size 7.3) from 8 villages were identified as directly affected by the project (i.e. with land and/or homes to be acquired by the project), and subjected to a detailed survey. The main characteristics of this group were similar to the general population of Sikkim:

- 63% of household heads were literate, 37% illiterate
- 65% Hindus and 35% Buddhists
- Non-Backward Classes 41%, Other Backward Classes 34% (educationally and socially disadvantaged), Scheduled Tribes 23% (indigenous groups) and Scheduled Castes 2% (historically disadvantaged, previously called 'untouchables')
- 84% of households with agriculture, 14% services and 2% business as primary occupation, with a total of 1,049 livestock and 593 poultry

There were no specific commitments or baseline information for indirectly affected people in the project area; for example, people who could be affected by traffic, noise, dust, loss of homes or lands that they rented, loss of jobs associated with acquired land, community-workforce interactions, or changes in river flows. Generally available data, for example from the different censuses and National Family Health Surveys as well as individual reports such as the 2001 and 2014 Sikkim Human Development Reports, are not detailed enough to track livelihoods and living standards of indirectly affected communities over time.

The scope for dealing with community impacts in this assessment is therefore as follows. The process of land acquisition for those families whose land was partially acquired and who did not have to move, is covered under this topic O-9. Other community impacts are covered, as relevant, under O-8, O-10, O-11, O-12, O-13, O-14, O-18 and O-19. Topic O-3 addresses the processes and procedures within the corporation and project for management of social (and environmental) issues

9.2 Detailed Topic Evaluation

9.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken to assess if commitments to project affected communities have been delivered and if management measures are effective; and ongoing or emerging issues that affect project affected communities have been identified.*

Partial oustees (covered here) in the Teesta-V project were originally estimated at 132 in the EIA, but this number increased to 199 during the more detailed surveys in the acquisition process. 127 of the 199 partial oustees were farmers. 62 were full oustees (covered under topic O-10), of which all were farmers.

Public corporations like NHPC are required to follow the official land acquisition process through public authorities. Land acquisition in the Teesta-V project was governed by the 1894 Land Acquisition Act, which was effective at the time. Under the 1894 Act (for the acquisition of land for public purposes and for companies), land owners received compensation at market value for their land and improvements.

Minor acquisitions above the powerhouse area and in the reservoir area have also taken place after the commissioning of the project, mainly due to safety concerns. Payments to compensate these owners have been made to public authorities, however, the acquisition process is still not fully completed. Meanwhile, the new land acquisition act “Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013” entered into force with effect from January 1, 2014. The 2013 Act added rehabilitation and resettlement benefits to owners who lose their livelihood from the land, and defines the minimum compensation as a multiple of market value and other factors laid down in the Act. Compensation entitlements are now considered relatively generous, and projects have encountered many more owners interested in selling their land than before, and more than necessary for project purposes. The Act also introduced consent requirements from certain percentages of landowners, and a compulsory social impact study and clearance, in case certain thresholds of impacts are met. The public authorities are well aware of legal requirements, and have monitored the project impacts accordingly.

NHPC has been keeping track of the compensation process by the public authorities, which is partly still ongoing, to ensure that once the process is concluded, NHPC receives the title for land.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging issues for project affected communities takes into consideration both risks and opportunities, and interrelationships amongst issues.*

There is no evidence for a continued relationship with, and monitoring of land owners who sold land to NHPC for the Teesta-V project, but did not qualify for the Resettlement and Rehabilitation (R&R) program because they were able to stay in their homes.

All of these owners were originally known to NHPC, and a large majority probably stayed in their homes until now and are still known to NHPC through employment or other relationships, but there has been no systematic way to identify ongoing and emerging issues (in the worst case, impoverishment due to loss of land and subsequent loss of compensation payment). Such issues were also not identified and discussed in the EIA, EMP, and R&R plans, which are very much focused on full oustees.

The post-construction EIA is expected to provide information on the livelihoods and quality of life of families affected by land acquisition, through a detailed survey and through analysis of secondary data. Nevertheless, it is unclear if the post-construction EIA will be able to cover all partial oustees (for example, because some might have moved away), and it is not a replacement for an ongoing engagement with partial oustees. The lack of

ongoing engagement with the 199 partial oustee families to identify any ongoing or emerging issues relating to Teesta-V is a **significant gap** at the level of proven best practice, and is the same gap as under Management and Outcomes.

Criteria met: No

9.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to deliver commitments to project affected communities, and to manage any identified issues relating to these commitments; and if there are any formal agreements with project affected communities these are publicly disclosed.*

Surveys of private land (including any structures and fruit-bearing trees) required for the project were done, and compensation values were defined, by the LR&MD department and the district Land Acquisition Officers of the Districts, for a total of 173 ha owned by 261 families. 199 of these related to the partial oustees covered in this topic, while 62 were full oustees covered under topic O-10. The surveys also included forest lands which were surveyed by the state Forestry Department, for a total of 147 ha, and a small amount of other government-owned land. Compensation was paid by NHPC to the LR&MD department, which then distributed the payments among the affected land owners, through the Land Acquisition Officers. Where aspects of the process were contested (for example, when oustees refused to accept the determined level of compensation), NHPC deposited funds into accounts of the LR&MD department, for later settlement with land owners. As of July 9, 2018 part of the land acquisition had not been fully resolved, and NHPC had not yet received all ownership titles. One transfer was finalized in 2018, of a total of 3.76 ha, consisting of 28 small parcels that NHPC acquired for consolidation purposes. A total of INR 68 million (USD 980,000) was paid through the North Sikkim District Administration.

The entitlements of families losing land to the project are regulated by law and thus publicly known. For partial oustees, no replacement land or other direct support was offered. There is very little documentation on the land acquisition process and on the current status of partial oustees. An NHPC internal audit report suggests that an amount of INR 63.6 million (USD 916,000) is unresolved because of a case before the Sikkim High Court, which at the same land value as above, would be about approximately 3.5 hectares, or 2% of the private land acquired. It is unknown what the court case is about, whether this is the only unresolved case, and how many families are affected.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to risks and opportunities.*

There are some processes such as the grievance mechanism, the process for CSR requests, and the post-construction EIA (see topic O-3) through which the project can learn about social issues as they arise, but there is no specific engagement process, for example through community liaison officers or other dedicated social expertise and capacity among the Teesta-V staff. Without such processes the project cannot proactively address potential risks or opportunities. Because of the lack of ongoing engagement specifically with the 199 partial oustee families, there is also no management process to address any potential shortcomings for these families regarding their living standards or livelihoods, due to impacts caused by economic displacement from the project. This a **significant gap**, closely linked to the gap under Assessment and Outcomes.

Criteria met: No

9.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for project affected communities to raise issues and get feedback.*

Project affected communities including families who lost part of their land to the project, may and do approach project representatives at any time. These could be management staff including the HoP, or anybody else from the project who they encounter. Depending on the issue at hand, feedback may be provided by management, the HR division, the CSR official, or others.

Regarding compensation for land acquisition, it is equally relevant for affected families to be able to raise issues with and get feedback from the state government and district administrations. There are a number of processes to do that, including through elected representatives and the legal process.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised are taken into consideration is thorough and timely, and project affected communities have been involved in decision-making around relevant issues and options.*

There is no evidence to indicate that feedback has been thorough and timely, for example through tracking of the resolution of land acquisition cases by NHPC and/or the district administrations, and an ability of affected families to stay informed about the status of their cases. In cases, the final resolution has taken years, which has also delayed transfer of ownership titles to NHPC. The slow land acquisition processes are considered a **significant gap** against proven best practice, causing significant uncertainty for all involved. NHPC does not carry primary responsibility for these delays.

All families affected by land acquisition have been offered cash compensation, and can thus decide for themselves how they want to invest the funds. (Full oustees were additionally offered the R&R package, including plots and funds to rebuild homes, as discussed under topic O-10).

Criteria met: No

9.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage delivery of commitments to project affected communities have been and are on track to be met with no significant non-compliances or non-conformances, and commitments have been or are on track to be met.*

Land acquisition is subject to the relevant national acts (Land Acquisition Act, 1894 and Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013), and is also subject to laws and regulations specific to Sikkim, primarily those meant to keep lands in the ownership of indigenous groups, farmers, and Sikkimese citizens in general.

When required under the regulations, NHPC has transferred funds for land acquisition to the competent authorities. For most land the acquisition has been resolved, while for a part it is still pending, following the legal process.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no indications of any non-compliances or non-conformances, as the resolution of land acquisition has been going through the prescribed process.

Criteria met: Yes

9.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *Livelihoods and living standards impacted by the project have been or are on track to be improved; and economic displacement has been fairly compensated, preferably through provision of comparable goods, property or services.*

Livelihoods and living standards in the project area have seen rapid improvements over the approximately 20 years since the project was approved, partially because of the benefits resulting from the project and described under topic O-8, the improvements in infrastructure, and the adequate mitigation and compensation of negative impacts. It is highly probable that all or almost all families affected by land acquisition are better off than they were before the project.

Land and improvements on the land, which are the focus under this topic, were compensated at least at current market rates and where there were disagreements over compensation, these could be pursued through legal channels. Only full oustees were compensated with comparable land to build homes (although not as owners but as long-term tenants), while other oustees were compensated in cash only. There is some evidence that this was preferred by land owners, and no issues regarding the compensation were brought up during this assessment, except the delays mentioned above.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the measures put in place to improve livelihoods and living standards are on track to become self sustaining in the long-term.*

As mentioned above, because of the lack of continued and systematic engagement to monitor the well-being of partial oustees, it is not possible to determine that all or nearly all families affected by land acquisition are on track to experience improved and self-sustaining livelihoods and living standards, which should be demonstrated at the level of proven best practice. The inability to demonstrate this is the same **significant gap** as under Assessment and Management. It is possible that the ongoing post-construction EIA will provide data to make this determination, at least for a significant segment of the affected families; as it is still ongoing the scope could be adjusted to ensure that it does.

Criteria met: No

9.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There is a lack of ongoing engagement with the 199 partial oustee families, which makes it difficult to identify any ongoing or emerging issues, and risks or opportunities, and to determine whether livelihoods and living standards have improved.

The delays in the completion of land acquisition processes are causing significant uncertainty for all involved.

9.3 Scoring Summary

This topic focuses on land acquisition from those families who were economically but not physically displaced, i.e. lost part of their lands but not their homes. Land and improvements were compensated in cash at least at market rates, but in some cases the compensation process and transfer of titles has taken a long time and is still unfinished. While there is a high probability that all or almost all families are better off than they were before the project, there has been no systematic and ongoing engagement with communities and specifically with the partial oustees, and thus their issues and their status are not well understood and documented. There are two significant gaps against proven best practice, resulting in a score of 3. It should be noted that this is a narrow view of community impacts, but it is the only impact for which there were clear commitments and a clear baseline.

Topic Score: 3

9.4 Relevant Evidence

Interview:	2, 11, 17, 20, 27, 32, 35, 36, 42, 47
Document:	18, 31, 32, 36-42, 46, 49, 57, 138-148, 150-156, 179, 180, 220-222
Photo:	7, 19, 20, 27, 47-51, 53, 54, 85, 87

10 Resettlement (O-10)

This topic addresses how the physical displacement arising from development of the hydropower facility has been addressed, in cases where resettlement occurred and commitments are well-documented against a pre-project baseline. The intent is that the dignity and human rights of those physically displaced have been respected; that these matters have been dealt with in a fair and equitable manner; that livelihoods and standards of living for resettles and host communities have been improved; and that commitments made to resettles and host communities have been fully fulfilled. In the case of older projects where there is an absence of well-documented commitments in relation to resettlement made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to resettlement should be taken into consideration under topic O-3 Environmental and Social Issues Management.

10.1 Background Information

This topic covers the process of resettlement and rehabilitation of an originally estimated 72 households who were considered 'oustees', i.e. who would lose their land and homes completely, or have less than 1 acre left. These resettlers came from almost all areas acquired for the project, with the exception of the most upstream areas (reservoir and dam site) where only partial landholdings were acquired (see topic O-9).

In the original surveys as reported in the EIA, the 72 oustee households were identified as farmers with very low monthly cash incomes (INR 200–1,200 or USD 5–30, at the exchange rate of Jan 1, 2008) and land holdings of between 0.2 and 12.4 acres. Household sizes ranged from 1 to 17 members. 33 households were categorised as Other Backward Classes, 10 as Scheduled Tribes (see also under topic O-11) and 2 as Scheduled Castes. After finalisation of the Resettlement & Rehabilitation (R&R) Plan, 62 oustee households remained.

10.2 Detailed Topic Evaluation

10.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken to assess if commitments made to resettles and host communities have been delivered and if management measures are effective; and ongoing or emerging issues relating to resettlement have been identified.*

There have been various mechanisms for monitoring of the implementation of the R&R Plan, initially through the R&R committee formed in 1998 (with representatives from state government, districts, panchayats and NHPC, and chaired by the LR&MD Department) as well as the Environment Monitoring Committee, and following commissioning of the project through those 59 resettlers who became and have since remained NHPC employees (only 3 families chose not to take up NHPC's employment offer). The current post-construction EIA will also provide an opportunity to review the effectiveness of the R&R program and document the status of the resettlers.

The six-monthly reporting to MoEFCC does not provide new information on resettlement, as the R&R Plan has been considered closed. The 2017 meeting of the Central Level Multi-Disciplinary Monitoring Committee did not address resettlement. There has been no systematic monitoring of conditions among the resettlers by NHPC or by government. The most pressing issue currently identified by the resettlers themselves was water supply, as addressed below under Management (previous issues related to abandonment of the initial resettlement site and employment are described below and under O-12). One additional family had to be resettled after several years of operations, due to erosion at the tail end of the reservoir.

The number of resettler families residing amongst host communities (and not in the resettlement colony and other NHPC colonies) is small. No specific commitments were made to these host communities, and no issues have been identified; hence no monitoring is required.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging resettlement issues takes into account both risks and opportunities.*

As mentioned above, there has been insufficient monitoring to identify resettlement issues. After the on-site assessment, NHPC has now committed to additional 6-monthly monitoring visits by EDM division officials to each project and power station (see topic O-3), and a new maintenance mechanism for the Teesta-V resettlement colony (see below). These processes have yet to be worked out in detail, and thus their effectiveness in identifying and managing risks and opportunities is unproven at the time of this assessment. This was a **significant gap** at level 5, the same as below under Management.

Criteria met: No

10.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures to address resettlement are documented in a Resettlement Action Plan; measures are in place to deliver commitments to resettles and host communities, and to manage any issues relating to resettlement, including provision of grievance mechanisms; and formal agreements with resettles and host communities are publicly disclosed.*

The R&R Plan included the following measures for each resettler household:

- Compensation for land and improvements (as covered under topic O-9)
- Employment of one member by NHPC
- 200 m² land allotment in resettlement colony for construction of home
- House building grant of INR 200,000 (USD 5,100 at exchange rate of Jan 1, 2008) for families deciding to build a home in the colony, in two instalments
- Infrastructure such as roads, water supply, community buildings, levelling of plots and LPG connections in the R&R colony (some of which were provided by the state government)
- Various allowances including for subsistence (transitional until household member starts employment with NHPC), fertilizer and seeds, transportation, disturbance, and special grant for members of disadvantaged groups (Schedules Tribes, Scheduled Castes, Other Backward Classes)
- Free health and education services
- Initial vocational/computer training and seed funding for cooperative

Various sites were considered for resettlement, and development started on one site (including several houses built) but had to be abandoned in 2005-2006 because of slope stability issues. The finally selected site and current colony at Lower Khamdong village is near the surge shaft, about 20 minutes by vehicle from the powerhouse colony, with a total of 55 plots. Approximately 30 families built homes on their plots, while others chose to use their compensation funds to build, buy or rent elsewhere (and therefore only received one of the two instalments for home building). A number of them also moved their families at a later stage, for example into NHPC staff housing at the powerhouse or dam site colonies. Some moved after building their homes, and are now letting other relatives live in the homes, or are renting them to third parties. The originally allocated plots only left room for a small kitchen garden besides the house, but families at the resettlement colony are now able to use some land not claimed by other resettlers.

There are a number of operational and maintenance issues at the resettlement colony, compared to the original plans. A building meant for shops and a dispensary is unused, as the population numbers are lower than expected and residents are able to use other shops and health facilities nearby. The community centre is unused except for occasional meetings. The cooperative has been disbanded after being active from 2006-2010. Some homes have damages from the 2011 earthquake and some drains have not been maintained, although this could be rectified by residents themselves. The main issue of the residents is that their water supply was interrupted more than two years ago (due to lack of maintenance and theft of pipes), and they had to come to a temporary arrangement, paying a private household nearby who has access to water.

Instead of a title, residents only received a letter in 2008 indicating which plot they had been allocated on a long-term lease basis. As the land is still owned by NHPC, the state government and district authorities have not responded to requests from residents to restore the water supply. Although a grievance mechanism is available at the project in principle, no grievance on water supply has been registered, and it is unclear whether and how the residents had brought this issue to the attention of project management, and requested restoration of the service.

The R&R Plan that was approved does not include the final numbers of eligible resettlers, final selection of resettlement sites, or clarity on commitments. There is no written documentation on the implementation of the R&R Plan, handover of facilities, or agreements about maintenance that may have been made at the time of residents moving in; reportedly NHPC provided some maintenance in other parts of the colony (such as repairs of collapsed terraces) after handover to residents. The prolonged time for resolving the water supply issue and more generally, the uncertainty over responsibilities for maintenance is a gap, and is related to the gap identified under topic O-11 regarding formal and publicly disclosed commitments.

However, this gap is not considered significant at the level of basic good practice, as after the on-site assessment NHPC committed to resolving the water supply issue (expected by end of May 2019) and more generally, to formulate a permanent mechanism for the maintenance of basic amenities in the Teesta-V resettlement colony in consultation with the residents.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

As mentioned above, the new monitoring and maintenance processes are unproven at the time of this assessment, which was a **significant gap** against proven best practice, the same gap as under Assessment.

Criteria met: No

10.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for resettlers and host communities to raise issues and get feedback.*

Resettlers and host communities initially had opportunities to raise issues and get feedback during the public hearing for the project and through their representatives on the R&R committee. Resettlers were also involved in the choice between potential resettlement sites (individual plots were selected by drawing lots).

Following handover of plots to resettlers, there has been no resettlement-specific coordination mechanism. Employment related matters can be and have been brought up through processes described under topic O-12, and matters related to the resettlement colony and host communities through the processes for grievances and CSR requests described under topics O-2 and O-8. Representatives of the resettlers employed by NHPC were not

satisfied with the responsiveness of these processes; one resettler described NHPC as ‘approachable but bureaucratic’.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely, and resettles and host communities have been involved in decision-making around relevant issues and options.*

The issue of water supply to the resettlement colony was not resolved for a prolonged time, reflecting uncertainty over responsibilities for maintenance and a lack of formal agreements, communication and joint decision-making between resettlers and NHPC. While this is expected to improve under the new maintenance arrangements, it constituted a **significant gap** at the time of the assessment.

Criteria met: No

10.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in the Resettlement Action Plan have been and are on track to be met with no major non-compliances or non-conformances, and any resettlement related commitments have been or are on track to be met.*

The R&R Plan was approved by the state and central governments. It originally foresaw expenditures of INR 54.5 million (USD 1.4 million at exchange rate of Jan 1, 2008), and the final cost was recorded as INR 76.6 million (USD 2 million). The R&R Plan was considered closed by 2010, with all original commitments delivered. Its provisions went substantially beyond the legal provisions on land acquisition prevailing at the time (Land Acquisition Act, 1894). They were largely aligned with NHPC’s later R&R Policy of 2008, which went beyond the National Rehabilitation and Resettlement Policy 2007. The current legal framework is provided by the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. NHPC is considering to update its own R&R Policy to reflect the new act.

There is a lack of clarity whether NHPC made any commitments for ongoing maintenance of the resettlement colony or regarding entry levels for resettlers employed by NHPC.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances have been identified.

Criteria met: Yes

10.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *Resettlement has been and is being treated in a fair and equitable manner, and resettles and host communities have experienced or are on track to experience a timely improvement in livelihoods and living standards relative to the pre-project baseline.*

The same conditions were offered to all resettled families, and reflected the substantial disruptions associated with physical displacement. A number of families chose not to take up employment with NHPC and not to build homes within the colony, presumably because they had better alternatives available.

The livelihoods and living standards of resettled families have improved largely because of their formal employment by NHPC. After some initial disagreements over the status of new employees (all were hired at entry level, irrespective of previous qualifications), they received between 1 week and 6 months of formal training and now have permanent status, mostly employed as electricians, scientific assistants and welders (see also topic O-12). Wages are significantly higher than pre-project farming incomes. Other family members have also gained employment directly or indirectly associated with the project. A number of families own cars and relatively large homes. The post-construction EIA is expected to confirm these gains.

The improvements could have been more substantial if the resettlement colony were better maintained and organised, for example, by using the dispensary/shop building which is falling into disrepair, for other purposes.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the measures put in place to improve livelihoods and living standards are on track to become self-sustaining in the long-term.*

The employment arrangements in the project are permanent, and in combination with other educational, infrastructural and economic improvements in the project area, have allowed affected families to build significantly improved livelihoods and living standards for the long term.

Criteria met: Yes

10.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The new monitoring and maintenance processes are unproven at the time of this assessment.

There has been uncertainty over responsibilities for maintenance and a lack of formal agreements, communication and joint decision-making between resettlers and NHPC.

2 or more significant gaps

10.3 Scoring Summary

The 62 physically displaced families were all offered compensation, permanent employment with the project, and the opportunity to build new homes in NHPC's resettlement colony, as long-term tenants of NHPC who maintained ownership. This approach to resettlement went substantially beyond legal requirements at the time. However, the resettlement colony could be better organised and maintained, and has not proven to be attractive to many families, who have chosen to live elsewhere. After the on-site assessment, NHPC committed to improving the water supply in the colony as well as maintenance and monitoring processes. There are two significant gaps against proven best practice, resulting in a score of 3.

Topic Score: 3

10.4 Relevant Evidence

Interview:	15, 20, 30, 35
Document:	18, 31, 32, 36, 37, 40, 46, 49, 57, 138-141, 143, 147, 149-157, 179, 180, 220-222
Photo:	77-84, 86

11 Indigenous Peoples (O-11)

This topic addresses the rights, risks and opportunities of indigenous peoples with respect to the hydropower facility, recognising that as social groups with identities distinct from dominant groups in national societies, they are often the most marginalized and vulnerable segments of the population. The intent is that the operating facility respects the dignity, human rights, aspirations, culture, lands, knowledge, practices and natural resource-based livelihoods of indigenous peoples in an ongoing manner throughout the project life.

11.1 Background Information

India has the second-largest indigenous population in the world, and as in other countries, indigenous groups are often disadvantaged in terms of livelihoods and standards of living, and at risk of losing their identity. There are various policies to benefit indigenous people, for example by recognising them as 'Scheduled Tribes' in each state and providing them with preferential access to higher education and public employment.

Sikkim is a multi-ethnic state, with a majority population of Nepali origin and several other ethnic and language groups. Four of these are officially recognised as Scheduled Tribes - the Bhutia, Limboo, Lepcha and Tamang - and together they constituted 34% of the state's population in the 2011 census. The Bhutia are the largest group and are related to the majority population in neighbouring Bhutan. The Lepcha are the third-largest group and the original inhabitants of the state. Indigenous groups tend to be Buddhists, with some Animist beliefs, while the Nepali majority tend to be Hindu.

To maintain the special character of Sikkim, there are constitutional restrictions on residency and property ownership for non-Sikkimese citizens. There are also restrictions on non-members of Scheduled Tribes buying land and residing in tribal areas, particularly the 158 km² Dzongu area in the North District, which is reserved for Lepcha only, with about 7,000 inhabitants. As a consequence of these protections and affirmative action, in Sikkim indigenous groups are generally not disadvantaged regarding land and home ownership, educational attainment, political representation and other parameters. In fact, many Nepalis work on lands or rent homes owned by indigenous families.

The Dzongu area is located on the right (or west) bank of the Teesta River, north of the dam site. A number of Lepcha families residing in the Dzongu area and elsewhere in the northern part of the project area were affected by the Teesta-V project. A number of Bhutia and other indigenous families from several villages in the southern part of the area were also affected. More generally, the development of infrastructure and industry in the state is changing the identities and traditions of indigenous communities. Some planned hydropower projects in the upper part of the Teesta basin and particularly in the Dzongu area have been cancelled after opposition from indigenous people; but there are also many indigenous people expecting significant benefits from, and therefore in favour of, hydropower development.

11.2 Detailed Topic Evaluation

11.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging issues relating to the operating hydropower facility that may affect indigenous peoples have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

As part of the project preparation process for Teesta-V, the socio-economic survey of affected families for the EIA registered ethnic identities. As a condition of the Environmental Clearance, a more in-depth Ethnographic Study was also conducted. The study indicated that among the 11 villages in the project area, with a total

population of 8,637, there were 2,104 members of Scheduled Tribes (note that these numbers are from the 1991 census, i.e. from a time when only Bhutia and Lepcha were recognised as Scheduled Tribes in Sikkim), with their share increasing from south to north, calling for particular attention in the area around the dam and reservoir. A detailed survey of a sample of 100 families was undertaken.

The study noted the tendency of affected indigenous groups to adopt the majority Nepali language (and in some cases, also Hindi and English) and to assimilate within mainstream culture. The population on the left (or east) bank of the Teesta River was already mixed, with many traditions diluted and few apparent conflicts between ethnic and religious groups; social impacts and mitigation requirements here would focus on economic issues, such as compensation and employment. The Dzongu area however, was still homogeneous, and social impacts would include cultural change through increased exposure to mainstream culture.

Following construction of the project, there has been significant socio-economic development in indigenous communities. For example, Lum village (on the right bank just downstream of the dam site) has expanded with many additional homes, social infrastructure, and an improved access road, partially due to investments both by the state government and by NHPC. Identification of issues has been through NHPC employees and contract workers who are members of indigenous groups, and through regular interaction with representatives of indigenous villages and district administrations. The ongoing post-construction EIA is also expected to provide some information, although there are few specific references to indigenous groups in the Terms of Reference and in the Inception Report.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of issues that may affect indigenous peoples is undertaken with the free, prior and informed participation of indigenous peoples; and takes into account both risks and opportunities.*

The original Ethnographic Study identified a number of risks and opportunities and how they would affect indigenous and non-indigenous people differently. For example, opportunities for employment and contracting with the project were expected to be more relevant for Nepalis, while Lepcha and Bhutia could run the risk of losing Nepali labourers on their farms. The intensity of socio-cultural, economic and health impacts was predicted for seven different work areas of the project, based on factors such as man-months of culturally different workers, proportion of indigenous people, and previous exposure. Not discussed in the study were risks related to the spiritual significance of natural features, particularly the Teesta River and the adjacent land in the Dzongu area, and to internal divisions within the indigenous communities over their approach to hydropower development.

Today, indigenous people in the project area can interact with NHPC and participate in the identification of issues, through the same mechanisms that are available for all residents, which can be described as free, prior and informed.

Criteria met: Yes

11.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified issues; and formal agreements with indigenous peoples are publicly disclosed.*

The Ethnographic Study recommended the following management measures to minimise the impact on indigenous people:

- Restrict mixing of project workers with indigenous people, in particular by enforcing restricted access to the Dzongu area, with no work camps and with check posts, particularly on the road from the dam to Lum village
- Employment and skills development specifically for indigenous people (who would prefer non-manual labour)
- Hygienic conditions in work camps, and access to modern medical treatment for indigenous people

These recommendations were largely followed during project construction, and measures were maintained during operations. Additionally, the project initially focused its CSR activities on Lum (at about 2 km distance, the closest entirely indigenous village to the dam and reservoir) and Rakdong (with a large share of indigenous inhabitants) as ‘adopted’ or ‘model’ villages, and is still providing support to indigenous areas. For example, the largest ongoing CSR project (INR 50 million or USD 720,000) is an ITI at Chandey in the North District, with two thirds indigenous population.

Indigenous people generally received the same treatment as other directly affected people under employment policies and practices for local people (see topics O-8 and O-12), the Resettlement & Rehabilitation Plan (see topic O-10) and under the medical services and some other benefits provided by the project (see topics O-8 and O-14). No special skills training for indigenous people was provided, but affected people employed by the project did receive up to 6 months of training.

Formal agreements have been concluded for most of these measures. Documents such as the EIA, EMP, Ethnographic Study, R&R Plan, and Minutes of Meetings on the adoption of Lum and Rakdong villages have been shared with local government officials and representatives of indigenous communities, although it is unclear to what extent they are publicly accessible. Meetings have been chaired by indigenous representatives (e.g. the local member of the Sikkim Legislative Assembly), and minutes signed by multiple local leaders. Many agreements date back a considerable amount of time, and are not easily available for today’s village leaders or have not been followed up closely, which leads to some uncertainties about commitments and expectations.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, measures to address ongoing or emerging issues that may affect indigenous peoples have been developed with the free, prior and informed participation of indigenous peoples; and processes are in place to anticipate and respond to emerging risks and opportunities.*

The main concerns of indigenous people with regards to the Teesta-V project at this time appear to be socio-economic, specifically requests for support under the CSR program and requests for employment. There are no rules for preferential treatment of indigenous people in this regard, and their requests are handled through the regular channels (see topics O-8 and O-12), which allow for free, prior and informed participation. NHPC is mainly reacting to requests, and has no formal monitoring process regarding indigenous communities. This is not considered a gap because direct impacts on indigenous people are relatively minor, and the ongoing post-construction EIA and the recently committed half-yearly general monitoring visits by EDM division officials will help identify emerging issues.

Criteria met: Yes

11.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing and mutually agreed processes are in place for indigenous peoples to raise issues and get feedback.*

The Ethnographic Study noted that indigenous people in the vicinity of the Teesta-V project were initially reluctant to participate in surveys and share information, as they were uncertain, for example, how this would

affect their rights to compensation. However, this has been overcome with time and in their ongoing engagement with the project, indigenous people themselves select priority projects to be requested from NHPC. This applies, for example, to a new request recently made by Lum village for improvement of a section of the access road that is owned by NHPC. This request is being processed. One indigenous group (Save Dzongu) has issued a 'ban' on villages accepting grants from NHPC, as part of its opposition to hydropower projects; however this does not seem to affect relations with indigenous groups in the Teesta-V area of influence.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely; and directly affected indigenous peoples have been involved in decision-making around relevant issues and options.*

Indigenous people have access to the same processes as other inhabitants, as described under topics O-1, O-2, O-3, O-8, O-9 and O-10. There are no indications that these processes are not supported by indigenous communities; though some of them voiced concerns over the way the processes are implemented (e.g. regarding systematic tracking of and timely responses to requests, and clarity of commitments by NHPC). This is considered a **significant gap** against proven best practice.

Criteria met: No

11.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage issues that may affect indigenous peoples have been and are on track to be met with no significant non-compliances or non-conformances, and commitments made to indigenous peoples have been or are on track to be met.*

There are no indications for non-conformances or non-compliances. Because some commitments may have been made verbally or formulated vaguely, however, it is difficult to determine with certainty that all of them have been kept by NHPC.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no indications for non-conformances or non-compliances.

Criteria met: Yes

11.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *The rights of indigenous peoples affected by the operating hydropower facility are respected in an ongoing manner.*

There are no indications that any rights of indigenous peoples, protected in the Indian constitution and under central and state laws, are not being respected by the Teesta-V project or third parties.

33 members of Scheduled Tribes are currently employed permanently by NHPC in the Teesta-V project, including 8 in executive positions. In addition, a significant number are short-term contract workers with the project, or have otherwise benefited from project-induced changes.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, where opportunities have been identified, measures to address issues that may affect indigenous peoples beyond those impacts caused by the operating hydropower facility have been or are on track to be achieved.

The Teesta-V project has supported indigenous communities in various ways which are unrelated to project impacts, based on priorities identified by the communities.

Criteria met: Yes

11.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are some concerns regarding systematic tracking of and timely responses to requests, and clarity of commitments entered by NHPC.

1 significant gap

11.3 Scoring Summary

Many people affected by the Teesta-V project belong to indigenous communities, recognised and protected by government as ‘Scheduled Tribes’. Direct negative impacts have been relatively minor, although there are some concerns about the dilution of indigenous cultures as a consequence of hydropower development in Sikkim. However, from a socio-economic point of view indigenous people are not disadvantaged, are participating fully in political processes and economic development, and are generally not treated differently by NHPC, for example regarding employment or benefit sharing.

There is one significant gap against proven best practice, regarding concerns over systematic tracking of and timely responses to requests, and clarity of commitments by NHPC, resulting in a score of 4.

Topic Score: 4

11.4 Relevant Evidence

Interview:	15, 20, 30, 35, 36, 38
Document:	46, 135, 136, 140, 141, 158-164, 187
Photo:	19, 20

12 Labour and Working Conditions (O-12)

This topic addresses labour and working conditions, including employee and contractor opportunity, equity, diversity, health and safety. The intent is that workers are treated fairly and protected.

12.1 Background Information

NHPC, as a Public Sector Enterprise, operates in a context of multiple and detailed legal requirements regarding labour and working conditions.

NHPC had 7,351 employees as of 31 March 2018. It has the capability to implement hydropower projects from concept right through all life cycle stages. NHPC presently staffs 24 hydropower stations, is constructing two more, and has plans for up to 6,000 MW of further hydropower development. The workforce is spread across the Corporate Office in Faridabad, four regional offices, and the power stations.

The Teesta-V workforce as of 19 February 2019 consists of 96 executives, 4 supervisors, and 125 workers, totalling 225 positions (of which 20 are women). This number is 119 less than the 344 positions that were approved for NHPC staff at Teesta-V at the time of commissioning. The HoP is supported by a number of divisions, with the most major ones being Dam (Civil) and Powerhouse (Electrical). Other divisions are Infrastructure, Finance, HR, Contracts, Procurement, Safety, Environment, Medical, IT, and Planning. Employees are all eligible to live at the powerhouse or dam colonies in accommodation provided and maintained by NHPC.

In addition to the NHPC staff, Teesta-V has 440 contract labourers that are primarily involved in maintenance. These are mostly local contract workers, hired through 32 contracts. There are also 30-40 drivers (separate to the 440 contract workers), hired by the owners of vehicles and covered by 4 contracts. Specialist contractors are brought in as needed for more infrequent requirements, as noted in topic O-2.

This topic covers the HR policies, plans and processes of NHPC and how these are followed with respect to the workers and contractors at Teesta-V. This topic has some inter-relationships with topic O-8 and topic O-10, in that NHPC committed to hire local community members and resettlers, and with topic O-11 in that NHPC monitors and has welfare measures for ethnic minorities amongst their employees.

12.2 Detailed Topic Evaluation

12.2.1 Assessment

Analysis against basic good practice

Scoring statement: *A periodically updated assessment has been undertaken of human resource and labour management requirements for the operating facility, including occupational health and safety (OH&S) issues, risks, and management measures, with no significant gaps; monitoring is being undertaken to assess if management measures are effective; and ongoing or emerging labour management issues have been identified.*

Manpower requirements for Teesta-V are assessed annually by the Corporate Office, in consultation with the Regional Office and the project, based on project requirements, specifications, and legal requirements.

There are 17 staff in the HR division at Teesta-V. They liaise closely with the corporate HR division, and keep up-to-date on legal requirements, policies and processes relating to labour.

The power station colony health centre and its subsidiary at the dam colony provides a mechanism for monitoring of staff and contract worker health and well-being. Medical services are free of charge to all employees, contract workers and local community members (see also topic O-14). All employees have comprehensive annual health checks, which can include tests that may need to be done at external health facilities such as at Siliguri or Gangtok (e.g. abdominal sonography, or mammography and a gynaecological check for women). Occupational health

issues are tested for as appropriate to the role, for example audiometry (hearing) tests for powerhouse employees. All tests, and any travel and costs for going to other health facilities, are fully covered by NHPC.

Occupational health and safety (OH&S) issues, risks and management measures are guided by NHPC's certification to OHSAS 18001:2007, which will soon be updated to ISO 45001:2018 for OH&S management systems. NHPC's safety management system is embedded within its IMS. The internal and external auditing system for the IMS ensures regular monitoring and identification of safety issues, issuing of non-conformances, and tracking of corrective actions.

Safety risks that are closely monitored at Teesta-V include: fire, working at heights, working near water, electrical safety and road safety. Issues raised in the most recent internal audit included insufficient documentation, workers not wearing personal protective equipment (PPE), loose wires, inadequate emergency preparedness, and switchboard covers left open. Analyses are done by the IMS team to look for repetitive issues, such as loose electrical wires or deteriorating safety signage.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging labour management issues takes broad considerations into account, and both risks and opportunities.*

Labour-related policy is constantly evolving in India, and NHPC is well-positioned to be informed about emerging trends. For example, NHPC has adopted a Whistle Blower Policy that allows employees and contract workers to raise unethical or improper conduct, in line with the Companies Act 2013 and the SEBI (Listing Obligations and Disclosure Requirements) Regulations 2015. As another example, NHPC has constituted Internal Complaints Committees regarding sexual harassment of women in the workplace, in line with provisions of Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013.

Principle 3 of the NGV on Social, Environmental and Economic Responsibilities of Business, published in 2011 by the Ministry of Corporate Affairs, addresses employees' well-being. Principle 4 addresses stakeholder engagement (internal and external), and Principle 5 addresses human rights. NHPC provides data at a corporate level against the NGV framework for these principles in its Annual Report. This framework provides a means to identify and track labour management issues of high material importance nationally. Questions regarding employee well-being relate to the number of permanent employees versus temporary or contract, the number of women, those with disabilities, the percentage of staff receiving skills training, and the number of complaints relating to child labour, forced labour, involuntary labour, sexual harassment, and discriminatory employment.

At the Teesta-V level, the HR team and HoP keep abreast of any labour-related issues, and follow any emerging trends that can be seen at other infrastructure projects or industrial sites in the region. At the time of this assessment, they were keeping a close eye on agitations by locals across Sikkim and West Bengal, some of which caused the Teesta Low Head Dams III and IV to shut down for several months in 2017.

Criteria met: Yes

12.2.2 Management

Analysis against basic good practice

Scoring statement: *Human resource and labour management policies, plans and processes are in place to address all labour management planning components, including those of contractors, subcontractors, and intermediaries, with no significant gaps.*

NHPC's human resource and labour management policies are in line with government legislation. The Indian Factories Act 1948 stipulates requirements for the workplace, health and safety provisions, welfare provisions, working hours, annual leave, and information requirements regarding accidents and dangerous incidents.

Important Acts include those in relation to payments into the Employee Provident Fund, payment of wages, payment of bonuses, payment of gratuity, equal remuneration, minimum wages, maternity benefits, industrial disputes, injury compensation, insurance, immigration, etc. An extensive document on Conduct Discipline and Appeal Rules sets out expectations for employees; for example, section 23 on drugs and alcohol.

NHPC has unions and staff associations that liaise with the executive regarding issues of importance for employees. Notably, NHPC signed an MoU on Wage Revision of Workmen with its Apex Level Union Representatives in February 2019, to be in effect for ten years from January 2017 to December 2026. This wage agreement addresses pay scales and allowances that apply to around 4,500 workers of NHPC. The Apex Level Unions include the All India NHPC Workers & Employees Federation, All India NHPC Employees & Workers Council, NHPC Karamchari Mahasangh, All India NHPC Employees Front and National Coordination of NHPC Employees Union.

Section 12 of the model tender document contains extensive requirements for contractors with regards to their employees or sub-contractors, and Section 13 details expectations regarding safety.

The HR division has the main responsibility for policies, procedures and implementation of these, and works closely with the Corporate Office. HR manages its own portal on the NHPC intranet, and has policies, communications and orders (e.g. for transfer, retirement) published there. All divisions have responsibilities for employee safety, and for ensuring all policies and requirements are met for any employees or contract workers in that division. The Health Centre staff have a role in conducting the annual health checks, testing for occupational health issues, helping with on-job OH&S awareness activities, and treating injuries. Facilities are maintained by the Infra Division.

In addition to competitive pay levels and accommodation at the colonies, Teesta-V employees receive a number of benefits, including access to:

- the health centre and free medical care and annual health checks
- a nursery school and a primary school
- facilities such as the temple, ATM and shops
- gardens, playgrounds, playing fields and a badminton court

OH&S risks are managed through designated safety officers, signage, training, PPE, procedures, and safety audits. PPE includes, as appropriate to the work area: helmets, belts, boots, ear plugs or ear muffs, and safety glasses. Near water, additional safety measures include personal flotation devices, and water rescue equipment. Procedures are developed for routine work, and a work permit is required for specialised work.

At Teesta-V, the safety team is combined with IMS. There are six employees and four contract workers in the team. The safety team is responsible to ensure that internal safety officers are designated, signage is appropriate, safety committee meetings are held regularly, training sessions and mock drills are conducted, audits and reports are implemented and responded to, statistics are maintained, and incidents and accidents are analysed regarding their root causes, and that root causes are addressed.

Individual divisions at Teesta-V have IMS representatives who are trained to act as internal auditors. Internal audits are conducted twice a year against the IMS Manual and IMS Procedures. Non-conformance reports (NCR) are issued, and the IMS team lists these on the intranet for follow-up. Each division is sent their NCR report, and must respond to the IMS team. A consultant has been hired for one year from Quality System Services to provide support to the IMS team in reviewing and analysing the NCRs.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

NHPC reviews and updates its policies and processes in response to emerging issues, risks and opportunities.

Some examples of responding to risks include:

- The NHPC Transfer Policy 2015, developed to cater to the changing needs of the organisation. This policy aims to optimise human resource utilisation, upgrade skills, and support creating a knowledge-based organisation.
- Movement of staff in positions where they have access to information that might be sensitive, and hence susceptible to misuse, according to a rotational schedule.

Some examples of responding to opportunities include:

- The scheme introduced at NHPC for “Unlocking Creativity and Innovation at Work Place”, which has the objective to encourage innovation, creative thinking and ideas generation.
- NHPC’s adoption of 13 ITIs in India, in cases with preferential access to NHPC staff and their relatives.
- Participation of the Medical Services division in safety-related training and drills (examples include mock drills for fire safety and earthquake safety, and provision of first aid and cardiovascular life support training).
- Creation of the Women in Public Sector Forum at the Corporate Office, aiming to inspire and promote integrated growth of women in NHPC and enhance their effectiveness in employment. Women constitute 10% of NHPC’s workforce, with many of them in the lowest level roles (e.g. sweepers).

The internationally certified OH&S management system within the IMS ensures that NHPC has the processes at both the corporate and Teesta-V project levels to respond to emerging risks and opportunities regarding employee occupational health and safety. The IMS Manual and IMS Procedures are regularly updated, and provide the framework for expectations and actions regarding OH&S. These have already been updated to reflect the new ISO 45001 standard of 2018, that will gradually replace the previous OHSAS 18001 standard of 2007 to bring it in line with other ISO standards (notably 9001 and 14001). External audits are also conducted once a year for Teesta-V’s IMS by the BIS.

Criteria met: Yes

12.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for employees and contractors to raise human resources and labour management issues and get feedback.*

NHPC promotes a culture of accessibility, in which any employees can be approached regarding issues, right up to the Chairman & Managing Director (CMD). NHPC’s website lists the names, positions, telephone numbers and email addresses for executives at the Corporate Office and at each of the projects. Employees at Teesta-V who were interviewed for this assessment said they can raise any issues or concerns with the HoP directly. The HoP tells them to come see him with any issues, and he also sometimes calls on workers to meet with him.

NHPC has a clear Grievance Policy and Procedure that applies to all employees. The scope is with respect to wage payment, increments, recovery of dues, working conditions, leave, allotment of quarter, medical facility, seniority, transfer, promotion, etc. Matters that relate to collective bargaining (e.g. wages, allowances, bonus, hours of work and other benefits), and also grievances arising from discharge and dismissal, are outside the scope of this procedure.

NHPC publishes a list of Nodal Officers for the employee and public grievance redressal. HR includes an Employee Grievance Redressal cell to handle all complaints. Grievances must be reported to the immediate supervisor, who must dispose of it within 15 days. If not satisfied, the employee can escalate up a level and it must be resolved within 30 days. There is a Management Information System that includes grievances, and the

government reviews the data on those received, pending and disposed of. Employees also have the option to raise issues through the CPGRAMS, which has an online portal.

The number of complaints received relating to child labour, forced labour, involuntary labour, sexual harassment and discriminatory employment are published in the Business Responsibility report within the NHPC Annual Report. Similarly, the number of complaints received by the Employee Grievance Redressal cell, and the number raised in the CPGRAMS linked with the Ministry of Power, are also published in the Annual Report.

Regarding raising OH&S issues, there is a Safety Committee at Teesta-V with 50% representation from management, and 50% from workers including contract workers. Meetings are held quarterly, concerns are raised, and suggestions are noted down.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely.*

The Teesta-V grievance register was reviewed for this assessment. No grievance has been recorded from 2013-14 to present. The assessors were advised that only written complaints or grievances are recorded in the register, and that all efforts have been made, successfully, to resolve issues when they were verbally expressed.

NHPC states that there is a complaints box at every location, and also a suggestion box, but these were not observed at Teesta-V during the assessment. It is unknown to what degree they are promoted and used at Teesta-V.

The HoP advised of some examples of complaints communicated and resolved verbally with him. One was for creation of a gym, to which he agreed. The other was an issue with an erratic water supply, which was due to a damaged water tank that was repaired within 4-5 days.

The assessors were informed that the lack of female toilets was an issue. The lack of female toilets was verified by the assessors. There is no record of this issue being documented or responded to. This suggests that the mechanism for employees to raise issues and have them considered and responded to has some opportunities for improvement.

The most significant employee grievance that was brought to the attention of the assessors related to jobs for resettlers. Resettlers were given one permanent job per family. They were all given jobs at the lowest level, a worker grade 0 (entry level), regardless of their skills or qualifications, due to NHPC procedures for staff who have not entered through competitive exams or hold a degree such as medical or legal that does not require competitive exams. 50 were employed in 2004, 9 in 2007, and 2 in 2011. The resettlers raised a grievance that they were not employed in accordance with their skills. The assessors were advised that two of the employees had bachelor degrees and one was an engineer, and jobs commensurate with their qualifications were not made available to them. In 2011, NHPC sent most of the resettler employees for training at one of the ITIs in Punjab, all costs paid, so that they could be trained in one of a limited choice of options, including scientific assistant, electrician, welder or crane operator. At this point in time, the resettlers are mostly at grade 4 or 5, with some at lower grades. Whilst the upskilling at the ITI was a resolution to some degree, constrained by the options offered for upskilling, it could by no means be considered timely given that 50 of the resettlers had worked for 7 years before this was addressed.

Proven best practice would typically include comprehensive documentation on issues raised and how and within what timeframe they were addressed, regardless of whether they were formally considered grievances or not. Shortcomings in the employee engagement processes regarding the ability to raise issues and have them resolved in a timely manner represent a **significant gap** against proven best practice.

Criteria met: No

12.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to human resource and labour management have been and are on track to be met with no major non-compliances or non-conformances, and any labour related commitments have been or are on track to be met.*

The assessors were not made aware of any non-compliances regarding labour at Teesta-V. At each power station, there is a committee to ensure that all labour laws are complied with. Labour inspectors visit Teesta-V to do inspections and review records. The HR team at Teesta-V reports to the Corporate Office HR division quarterly, and the Corporate Office acts on any issues arising.

The Environmental Clearance requires that “full efforts must be made to employ maximum number of local people in not only unskilled category but also in semi-skilled and skilled categories by making provision for imparting skills through training to selected locals”. NHPC advised that a number of direct and indirect employment opportunities were provided to locals during the construction phase, and that many locals were employed with major and small contractors in unskilled, semi-skilled and skilled roles during this phase. Since project commissioning, many locals are getting employment with various running and maintenance service providers that are contracted to Teesta-V. The local people employed, contracted or otherwise engaged to work at Teesta-V as of March 2018 totals 676, with the breakdown as follows:

- 59 resettlers employed through the Rehabilitation & Resettlement plan
- 11 locals with regular employment in other cadres
- 96 engaged from the Indian Reserve Battalion for project security
- 30 engaged from the Home Guards
- 440 local people contracted in other miscellaneous works
- 40 local people contracted as drivers for hired vehicles

Observations are recorded in the internal and external safety audits, and these are followed up until they are closed out. As with any good system that promotes continuous improvement, there will be observations prompting follow-up in every audit. There are no major non-compliances or non-conformances.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no identified non-compliances relating to labour and working conditions. The observations recorded in the safety audits represent non-conformances with safety procedures. The assessors noted a number of areas in which safety improvements could be made, including exposed electrical wires at the dam, workers not wearing their PPE during repairs, seatbelts not being worn in company vehicles, and non-adherence to speed limits on the powerhouse site. Whilst a number of non-conformances have corrective actions in various stages of being processed, there is still considerable scope to improve on safety outcomes. The prevalence of a number of current safety non-conformances is a **significant gap** against proven best practice.

Criteria met: No

12.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *There are no identified inconsistencies of labour management policies, plans and practices with internationally recognised labour rights.*

Labour management at Teesta-V appears to be fully consistent with internationally recognised labour rights. Internationally recognised labour rights are documented in places such as the IFC Performance Standard 2, the International Labour Organisation (ILO) standards, and the Human Rights Council 2008 Report of John Ruggie “Protect, Respect and Remedy: A Framework for Business and Human Rights”. These rights include:

- freedom of association;
- the right to equal pay for equal work;
- the right to organise and participate in collective bargaining;
- the right to equality at work, right to non-discrimination;
- the right to just and favourable remuneration;
- abolition of slavery and forced labour;
- the right to a safe work environment;
- abolition of child labour;
- the right to rest and leisure;
- the right to work; and
- the right to family life.

No inconsistencies were identified with the above list in this assessment.

Regarding outcomes on safety, Teesta-V enjoys an excellent safety record. There have been no cases of injuries at work in the last few years, including employees, contract workers, visitors and security personnel. This was verified by the health centre. There have been non-work related injuries, mostly involving traffic accidents, but nothing of a serious nature.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, labour management policies, plans and practices are demonstrated to be consistent with internationally recognised labour rights.*

NHPC has committed to conduct its business in a socially and ethically responsible manner by conforming to all of the requirements of the SA 8000:2001 standard. This standard is based on the principles of international human rights norms as described in ILO conventions, the United Nations Convention on the Rights of the Child, and the Universal Declaration of Human Rights. It guides the performance of companies in eight areas important to social accountability in the workplace: child labour, forced labour, health and safety, free association and collective bargaining, discrimination, disciplinary practices, working hours and compensation. This policy extends to contract workers as well as employees, and is embedded within clause 12.19 of NHPC’s model tender document.

Criteria met: Yes

12.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are shortcomings in the employee engagement processes regarding the ability to raise issues and have them resolved in a timely manner, and documentation to verify this.

There are a number of current safety-related non-conformances.

2 or more significant gaps

12.3 Scoring Summary

NHPC has well-established processes, consistent with and in some cases going beyond national legislative requirements. Policies and processes are in place for all aspects of labour and working conditions, including employee and contract worker opportunity, equity, diversity, health and safety. Employees and contract workers are treated fairly and protected. Occupational health and safety receives a high degree of attention, and processes are certified to international standards. There were two significant gaps noted against proven best practice, relating to shortcomings in the processes for employee engagement and issue resolution, and the prevalence of a number of safety-related non-conformances, resulting in a score of 3.

Topic Score: 3

12.4 Relevant Evidence

Interview:	13, 17, 23, 24, 27, 28, 29, 30, 41
Document:	9, 16, 19, 20, 26-28, 51-54, 107-109, 126, 145, 165-183, 189-190, 227
Photo:	12, 14, 17, 18, 29, 33, 35-37, 44, 49, 52, 55, 56, 64, 65, 70-73, 75, 76, 85

13 Cultural Heritage (O-13)

This topic addresses cultural heritage, with specific reference to physical cultural resources, associated with the hydropower facility. The intent is that physical cultural resources are identified, their importance is understood, and measures are in place to address those identified to be of high importance.

13.1 Background Information

Sikkim has a rich cultural heritage due to its long history and diversity of human settlement (see also topic O-11). There are many intangible expressions of heritage such as crafts, dances, festivals and rituals (which are covered under O-9 and O-11), as well as a number of physical cultural resources. Among the latter are Hindu and Buddhist monasteries, temples and stupas, sacred natural features such as forest groves, cremation sites, and others. However, only a few of these are located in the vicinity of the Teesta-V project.

13.2 Detailed Topic Evaluation

13.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging cultural heritage issues with respect to physical cultural resources have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

During the preparation of the Teesta-V project, only one relevant physical cultural heritage asset was identified in the EIA and EMP, a small Shiva temple in Dikchu Bazaar where access at high reservoir levels would be affected. Various options regarding the temple were discussed in the EMP, with a solution to be chosen by the local community. Other resources were not identified. The CCS for the Teesta basin did not address physical cultural resources, and neither are they identified in the scope of the Teesta-V post-construction EIA.

A number of broader mapping exercises have been undertaken in Sikkim regarding physical resources. The Archaeological Survey of India recognises three Monuments of National Importance in Sikkim, all in the West District and thus not affected by Teesta-V. The Government of Sikkim published lists of protected sacred peaks, caves, rocks, lakes, hot springs and stupas, in 1998 and 2001. Many of these features are protected through Khangchendzonga National Park in the north-west of Sikkim, which is also a UNESCO World Heritage Site because of its universal outstanding natural and cultural value. None of the listed sites are affected by Teesta-V. Another mapping exercise concerning sacred groves also did not identify any groves near the section of the Teesta River affected by the project.

The Cultural Affairs & Heritage Department of the GoS has published a Cultural Resource Mapping for the state in four volumes, one for each district, with a total of 380 sites. This exercise identified two sites along the Teesta River affected by the Teesta-V project: Dikchu Bazaar in the North District which became the first market town for the Dzongu area about 80 years ago, with the temple mentioned above directly on the bank of the Teesta-V reservoir; and the confluence of the Teesta River with its tributary Rangit downstream in South District, a site of spiritual importance. Neither of the sites are protected. In this mapping exercise:

- the site of Dikchu Bazaar was said to be threatened by modern construction; however its archaeological, historical, architectural, religious and natural value is low and only the social value is high;
- the site of the Teesta-Rangit confluence was said to be threatened by water pollution and showing signs of deterioration; its archaeological and historical value is low, religious and social value is medium, and the natural value is high.

Impacts on the confluence of the Teesta and Rangit rivers from water level fluctuations caused by the project have not been identified in the mapping exercise, and would not be significant from a cultural heritage point of view (see also under O-19). The only other ongoing or emerging cultural heritage resource are cremation platforms and other cremation sites along the Teesta River. These are well known, are generally not physically affected by the project, and if they were affected, could easily be moved. Cremation rituals can be affected by water level fluctuations, which are relevant to topics O-6 and O-19, but no issues regarding these have been identified. The cultural significance of the Teesta River to the indigenous group of the Lepcha is discussed under O-11.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging cultural heritage issues takes broad considerations into account, and both risks and opportunities.*

There is no specific process to identify ongoing or emerging cultural heritage issues, and due to the distances to identified sites, it is unlikely that new cultural heritage impacts will emerge. Some positive opportunities to support cultural heritage initiatives could emerge from the project's CSR program.

Criteria met: Yes

13.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified cultural heritage issues.*

The Shiva temple in Dikchu remains in place, with a raised access and reservoir rim protection works (reinforced concrete wall). No issues have been reported regarding reservoir level fluctuations (see also topic O-18), and no formal monitoring is required. The project is aware of cremation sites near some project locations, e.g. near Adit III, which is a regular monitoring site.

In the powerhouse colony, a small temple has been constructed from donations and is being actively used. A small gumpa (monastery/temple) has been constructed upon local requests in the Lepcha village Lum which was 'adopted' by the project (see also O-8 and O-11). However, as new constructions, these two temples are strictly speaking not part of the area's cultural heritage.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

As mentioned above, there are no specific processes to anticipate or respond to emerging cultural heritage risks or opportunities. Any such risks or opportunities would likely be minor and could be easily handled through the project's environmental and social management processes. There is little awareness of chance find procedures (including on the part of government representatives), and these are not explicitly specified in NHPC's standard contract documents (beyond a general requirement for contractors and their employees to follow regulations), but this is not considered a significant gap because there is little excavation in this operating project, and the area is not considered rich in archaeological resources, with no chance finds to date.

Criteria met: Yes

13.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage cultural heritage issues have been and are on track to be met with no significant non-compliances or non-conformances, and cultural heritage related commitments have been or are on track to be met.*

There are no significant processes and objectives for managing cultural heritage issues, and hence no important compliance or conformance issues. The Cultural Affairs and Heritage Department of the GoS confirmed that there are no concerns regarding compliance of the project with any relevant regulations. NHPC's own approach to resettlement includes the renovation/relocation of religious structures or structures of archaeological importance, and this was also met in the Teesta-V project.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances have been identified.

Criteria met: Yes

13.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative cultural heritage impacts arising from activities of the operating hydropower facility are avoided, minimised, mitigated and compensated with no significant gaps.*

The only identified negative impact from the construction period (access to the Dikchu temple) has been well managed. No other significant negative impacts have been identified regarding physical cultural resources during the operation period.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, where opportunities have been identified, measures to address cultural heritage issues beyond those impacts caused by the facility have been or are on track to be achieved.*

NHPC's corporate social responsibility policy explicitly includes the "preservation & promotion of sports, heritage, art, music & culture in keeping with the Indian tradition" among its focus areas. However, besides the construction of two new temples, only one request for sponsoring cultural heritage activities has been received: the Lepcha village Lum in February 2017 requested repair works for an existing gumpa as well as the construction of at least two rooms in the monastic school adjacent to the gumpa. This request was granted and included in the 2018-2019 CSR budget. The heritage value of these structures is unknown, but is probably minor as they are not listed in any of the above-mentioned mapping exercises.

As there are ongoing threats to both intangible and tangible cultural resources in Sikkim, a systematic assessment would be able to identify further opportunities. However, to date there has been little collaboration with the state governments in this regard. Additional investment in cultural heritage preservation was not mentioned as a priority by any stakeholder, and hence the fact that no such assessment has been undertaken is not considered a significant gap.

Criteria met: Yes

13.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

13.3 Scoring Summary

There are only minor physical cultural heritage resources in the vicinity of the Teesta-V project, and these have been managed appropriately, as part of the overall social management approach. There would be opportunities to be more explicit about chance find procedures and to proactively support cultural heritage preservation in the wider area around the project, but these have not been identified as a priority. There are no significant gaps, resulting in a score of 5.

Topic Score: 5

13.4 Relevant Evidence

Interview:	44
Document:	184-187
Photo:	9, 26, 73, 74

14 Public Health (O-14)

This topic addresses public health issues associated with the operating hydropower facility. The intent is that the operating facility has not created or exacerbated any public health issues; that ongoing or emerging public health issues associated with the facility are identified and addressed as required; and commitments to implement measures to address public health are fulfilled.

14.1 Background Information

According to India's regular National Family Health Surveys, significant progress is being made across almost all health indicators both nationally and within Sikkim. The situation in Sikkim is also generally better than the national average.

Table 1. Selected Public Health Indicators for India and Sikkim (National Family Health Survey 2015-2016)

	India	Sikkim
Institutional births	79%	95%
Infant mortality per 1,000 live births	41	30
Underweight adults (Body Mass Index below normal, average between men and women)	22%	4%
Households using improved sanitation facility	48%	88%

Health facilities are largely provided by the public sector, with a large hospital in the state capital Gangtok and a network of district hospitals, community health centres, primary healthcare centres and sub-centres. Public health care (including basic medicines and food for inpatients) is generally provided for free, and to incentivise some treatments, cash grants are provided to patients. An increasing share of the population is additionally covered by health schemes or health insurance (30% in Sikkim in 2015-2016, compared to 7% ten years earlier). Accessibility of health facilities can be an issue in the more remote rural areas.

Employee health and safety is covered under topic O-12, and public safety is covered under O-6.

14.2 Detailed Topic Evaluation

14.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging public health issues associated with the operating hydropower facility have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Before construction of the Teesta-V project, there were some health concerns regarding the influx of workers from other parts of India (primarily regarding bacterial infections), and the spread of disease vectors, including for malaria. The EIA contained a health profile and proposed health mitigation measures, including health examinations for workers, NHPC health facilities within the project, and avoidance of creation of mosquito breeding opportunities. This last measure was also part of the rationale for environmental flow releases (see topic O-19).

At this stage, there are no known ongoing or emerging public health issues associated with the operation of the Teesta-V project. Regular monitoring of disease incidence by the project health facilities as well as periodic surveys have not identified any adverse patterns. The operation of the project also has no significant impact on water quality (see topic O-17), the river and reservoir are not used for domestic water supply, and there is only minor consumption of fish from the river and reservoir, and minor exposure of people through other river uses (washing, rafting, gravel extraction). Environmental hygiene in the powerhouse and dam colonies has reportedly improved after introduction of the EMS.

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging public health issues takes into account public health system capacities, access to health services, and health needs, risks and opportunities for different community groups.*

The wider project area enjoys an above-average and continuously improving health status. Health issues are monitored both at the project level and at the level of the public health system. The Teesta-V hospital sends monthly reports on patients from the local community to the district health authorities. In January 2019, for example, the hospital (including medical camps organised by the hospital) attended to 1,173 cases from local villagers, including 38 cases of communicable diseases (30 diarrhoea and 8 respiratory) and 1,125 of other diseases and injuries.

Isolated cases of Dengue and Malaria have been identified over the years. An HIV test campaign with approximately 100 participants yielded no positive test results. There are some issues with skin diseases, in particular in the wet season.

The post-construction EIA that has recently been initiated will also cover health issues, both through gathering of primary health information from project-affected people through a survey, and through analysis of secondary public health data.

Criteria met: Yes

14.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified public health issues.*

The Teesta-V project includes a hospital at the main powerhouse colony, a dispensary at the Samdong dam colony, and 3 ambulances. A dispensary was also built at the resettlement colony but is not functional. The total medical staff includes 4 doctors, one I.T. executive, 7 paramedics, 5 helpers, and 26 contract workers. The medical service's annual budget is approximately INR 10 million (USD 147,000).

The main hospital is well equipped including haematology and radiology facilities, and has 25 beds for inpatients. In coordination with the district hospital and other public health facilities, including referral hospitals in Gangtok and Siliguri, the hospital is serving patients within a radius of approximately 30 km, including occasionally residents of larger towns such as Singtam who come because of the good reputation. The hospital is a recognised provider under several government health initiatives (reproductive and child health, family planning, tuberculosis etc.), offers direct observation treatment of tuberculosis, participates in vaccination and testing campaigns, and organises a number of medical camps in villages every year.

In a wider sense, the public health measures also include CSR measures such as improvements for water supply, sanitation and waste disposal in the project area, and enhanced accessibility of health services through improved roads and bridges.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Annual health check-ups for project staff as well as monthly analyses of case data at the hospital are done to detect any trends. There are established lines of communication between the project medical service and the

public health authorities, for example in case of epidemics. The hospital is also included in mock drills for emergency preparedness.

Criteria met: Yes

14.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage public health issues have been and are on track to be met with no significant non-compliances or non-conformances, and public health related commitments have been or are on track to be met.*

The project plans for the medical service have been fully implemented except in the case of the dispensary in the resettlement colony (see also topic O-10). The lack of functioning of that dispensary is not a significant gap, as there are fewer residents than expected and they can easily reach other health facilities.

Medical waste was initially disposed of jointly with other solid waste, and later incinerated on site. However, the SPCB has now mandated that the incinerator can only be used with a higher chimney, and in the meantime medical waste is disposed of through deep burial.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances have been identified.

Criteria met: Yes

14.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative public health impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

The construction and operation of the project has brought a significant number of additional people to the area. However, the associated health risks have been well managed and there are no indications for any ongoing negative public health impacts.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, where opportunities have been identified, measures to address public health issues beyond those impacts caused by the operating hydropower facility have been or are on track to be achieved.*

Since the beginning of construction of the project in 2000-2001, more than 370,000 medical cases among the local population have been attended to free of charge, the large majority of which are unrelated to any negative impacts of the project. The number of local cases has steadily declined from a peak of 30,700 in 2005, reflecting the increasing availability of other health care providers (and perhaps, the departure of camp followers). The reasons have not been formally analysed. The project medical service is actively engaged with the public health authorities, NGOs and others to identify other opportunities and participate in ongoing health campaigns.

Several health-related activities have been and are being supported in the framework of the CSR program, such as regular medical camps, the provision of medical equipment such as an ultrasound machine for the district hospital in Singtam, and investments into water supply, sanitation and waste disposal.

14.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

14.3 Scoring Summary

There are no indications of any negative public health issues associated with the operation of the Teesta-V project. On the contrary, the health services, road improvements and CSR measures offered by the project play an important role in the prevention and treatment of health issues for the local population. There are no significant gaps, resulting in a score of 5.

Topic Score: 5

14.4 Relevant Evidence

Interview:	27
Document:	36, 141, 178, 188-191, 225
Photo:	69, 81

15 Biodiversity and Invasive Species (O-15)

This topic addresses ecosystem values, habitat and specific issues such as threatened species and fish passage in the catchment, reservoir and downstream areas, as well as potential impacts arising from pest and invasive species associated with the operating hydropower facility. The intent is that there are healthy, functional and viable aquatic and terrestrial ecosystems in the area that are sustainable over the long-term; that biodiversity impacts arising from the operating hydropower facility are managed responsibly; that ongoing or emerging biodiversity issues are identified and addressed as required; and that commitments to implement biodiversity and invasive species measures are fulfilled.

15.1 Background Information

The state of Sikkim in India is listed as a global hotspot for biodiversity conservation, primarily for its floral species. The extreme elevation difference from north to south in the Teesta basin, from 8,598 m to 213 m over a distance of 100 km, gives rise to ecosystems that vary from alpine to tropical. Vegetation of Sikkim is classified, based on elevation, as:

- Tropical deciduous to semi-evergreen trees (250-900 m)
- Sub-tropical mixed broad-leaved hill forest (900-1,800 m)
- Himalayan wet temperate forests (1,800-2,700 m)
- Sub-Alpine forests (2,700-3,700 m)
- Moist Alpine forests (3,700-4,000 m)
- Dry Alpine forests (>4,000 m)

The International Union for the Conservation of Nature (IUCN) recognises Sikkim as part of the Indo-Burma hotspot. Some of the highlights of the biodiversity of the state of Sikkim include the following.

- Flora: 4,250 flowering plant species have been recorded in Sikkim, of which 123 are endemic. The Teesta basin has 445 species of orchids belong to 117 genera, found in all parts of the basin, of which more than 20 species are endemic to Sikkim. 36 species of rhododendrons are found in the Teesta basin. More than 50 species of plants from the Teesta basin are listed by the IUCN as endangered, threatened, vulnerable, or rare.
- Fauna: 169 species of mammals, more than 40 species of bats, 541 species of birds, and 689 species of butterflies have been recorded in Sikkim. Of the 1,400 butterfly species recorded in India, around 50% are from Sikkim, in particular from the lower altitudes of the Teesta-Valley.

The Teesta Basin CCS completed in 2008 defined 3 fish zones in the Teesta basin, with more species found as one descends. Above 1,400 m elevation are found trout streams, dominated by exotic trout (rainbow and brown), and characterized by low temperature, turbidity, alkalinity and hardness. Between 1,400 m and 850 m elevation are found snow trout streams, with relatively higher temperatures, turbidity, alkalinity and hardness. Streams below 850 m elevation are known as mahseer streams, which are more meandering with higher temperatures and lower current velocities. Teesta-V reservoir full supply level is at 579 m.a.s.l., so in the lowest fish zone. The CCS noted that more than 50 fish species have been recorded in the Teesta River, of which the CCS studies found 37 fish species from the families of Salmonidae, Cyprinidae, Cobitidae, Sisoridae, Chanidae, Schilbedae and Anguillidae.

Bhatt *et al* (2017) published that the upland region of Teesta basin is inhabited by 103 fish species from 13 families, dominated by Cyprinidae (43 species), Sisoridae (23 species), and Balitoridae (18 species). Some of the common fish include *Schizothorax richardsonii* (Snow Trout), *Schizothoraichthys progastus* (Dinnwah Snow Trout), *Neolissochilus hexagonolepis* (Copper Mahseer), *Garra gotyla gotyla* (Gotyla Garra), *G. lamta* (Lamta Garra), *Crossocheilus latius latius* (Stone Roller), and *Barilius* spp. Regarding species on the IUCN Red List, *Schistura spilopterus* is listed as 'critically endangered', *Tor putitora* (Golden Mahseer) and *Schistura kanjupkhuensis* are

'endangered,' and *Schizothorax richardsonii*, *Cyprinion semiplotum* (Assamese Kingfish), *Glyptothorax manipurensis*, and *Danio naganensis* are 'vulnerable.' *Tor putitora* and *Schizothorax richardsonii* are popular game fish in the Teesta basin, and fish commonly seen in the markets include *Neolissochilus hexagonolepis*, *Schizothorax richardsonii*, and *Schizothoraichthys progastus*.

Twelve species are migratory, and prior to the impacts from dams would have ascended from the foothills to the upstream tributaries of the Teesta basin: *Tor putitora*, *Tor tor* (Deep Bodied Mahseer), *Labeo boga* (Boga Labeo), *L. dyocheilus*, *L. pungusia*, *Clupisoma garua* (Bachcha Garua), *C. Montana* (Kocha Garua), *Channa gachua* (Dwarf Snakehead), *C. orientalis* (Striped Snakehead), *Bagarius bagarius* (Devil Catfish), and *Anguilla bengalensis* (Mottled Eel). *Tor putitora* and *Anguilla bengalensis* are known to undertake relatively long-distance upstream migrations in these rivers. *Tor putitora* uses the same spawning grounds throughout the lifespan, mostly small tributaries at lower elevations, and identified in the CCS as the foothill stretch of the Rangit River in the CCS. *Anguilla bengalensis* uses estuaries for spawning. A second CCS was completed in 2015 of the Lower Teesta Basin in West Bengal and recorded a number of impacts of existing projects on fish. The Lower Teesta Basin CCS noted that, despite fish passage facilities included in the Teesta Low Dam III and IV projects, the migration of *Tor putitora* and *Anguilla bengalensis* is hampered and they are not reaching their breeding grounds in the Rangit and Teesta rivers upstream of their confluence. The Lower Teesta Basin CCS also noted that reduced flows downstream of dams not only limit fish habitat area but also allow increased access for fishing and higher fish predation.

India has four categories of Protected Area - National Parks, Sanctuaries, Conservation Reserves and Community Reserves - under the Wildlife (Protection) Act 1972. In Sikkim there is 1 National Park (see also topic O-13) and there are 7 Wildlife Sanctuaries, that together cover almost 31% of the state. The Sikkim Forest Cover Survey 2017 documented a forest area of 5,841 km² totalling 82.31% of Sikkim's land area, of which 93.34% are Reserved Forests and 6.66% are Protected Forests.

15.2 Detailed Topic Evaluation

15.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging biodiversity issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

The Teesta-V EIA studies relating to biodiversity addressed flora in detail, fauna to a lesser degree, and only a very passing evaluation of fish. All areas involved review of secondary data and interviews. The flora studies included surveys of the submergence zone and catchment area, inventories using sample plots, and analyses applying the Shannon-Weaver Diversity Index, the Pielou Equitability Index, and the Importance Value Index. The fauna studies included transect surveys conducted during several visits over a six-month period, a night drive, and interviews with local people. The fisheries study involved no primary data collection, and drew largely on a report of the Zoological Survey of India (Calcutta) and an interview with the GoS Fisheries Department.

The Environmental Clearance required additional biodiversity-related studies to be undertaken. It considered the EIA fauna survey to be inadequate, and required a thorough evaluation of the impact of the development on biodiversity and bio-habitat, remediation to be proposed, and a detailed implementation plan for management measures provided. It further required a separate chapter of the bio-habitat and biodiversity study to be dedicated solely to butterflies, evaluating the project impact and outlining management plans for conservation of the species and their habitat. A third requirement for further biodiversity-related studies in the Environmental Clearance was for an aquatic ecology study to be undertaken to evaluate the impact of reduced flows in the 23 km reach between the dam and the powerhouse on the river aquatic ecology.

The Wildlife Institute of India (WII) completed an Ecological Assessment of Teesta-V in 2000, which sought to address these three additional biodiversity-related study requirements in the Environmental Clearance. The study provided more detailed evaluation of the flora, involving on-ground floristic surveys, inventories and analyses based on 10 m diameter circular sample plots, direct observations, personal interviews and literature review. The flora surveys provided additional inventory data; they confirmed that the area of the project was generally degraded, and that species in the area of submergence were also found in other areas of the basin.

Mammals, birds, reptiles, and butterflies were also evaluated in the WII study, with butterflies receiving the most detail. The mammals, birds, reptiles and butterflies were surveyed based on field transects and drew on direct and indirect evidence, interviews and secondary data sources. 17 species of mammals, 47 species of birds, 4 reptile species, and 183 species of butterflies were recorded from these studies. The butterfly species recorded were from five different families, 20 sub-families, and 106 genera; 13 of the species were classified as rare. Impacts were largely seen to be due to direct submergence, or damage to habitat and significant flora species through direct and indirect construction activities.

The fish assessment of the WII study did not involve any instream surveys, but collected information by visiting local fish markets, observing catches of local fishermen on the river banks, and interviewing local fishermen. This did not appear consistent with the Environmental Clearance requirement for an aquatic ecology study, but was accepted by the MoEFCC. Six species of fish were recorded in the WII study:

- Indian longfin eel (*Anguilla bengalensis*), locally known as “Balm”
- Dinnawah snow trout (*Schizopyge progastus*), locally known as “Chuchey Asala”
- Alwan snow trout (*Schizothrax richardsoni*), locally known as “Dothay Asala”, and considered a valuable game fish
- Katli (*Acrossochellus hexagonlepis*), locally known as “Katley”
- Sulcatus fish (*Pseudechensis sulcatus*), locally known as “Kabray”
- Annandale garra (*Garra annanddei*), locally known as “Buduna”

Mahseer (*Tor putitora*), the migratory species locally known as “Sahar”, was reported from the Teesta River but no evidence was found of this fish in the project area in the WII study. This was consistent with the EIA, which stated that the farthest upstream that the Mahseer has been observed was at the confluence of the Teesta and Rangpo rivers, which is about 12-13 km downstream of the Teesta-V powerhouse.

Impacts to fish were noted in the WII study including disruption to fish migration, reduced habitat area due to the reduction in water flow, and impacts to fish food resources in the form of benthic flora and fauna due to the reduced flow. The WII study stated that the impacts of Teesta-V would severely affect the aquatic fauna, and that if appropriate mitigatory measures were not taken to ensure sufficient water between the dam and the powerhouse, there would be destruction of habitats and populations of benthic fauna and other aquatic species. It went on to recommend a minimum flow of 1 m³/sec, but the basis for this specific flow value was unclear.

Follow-up inspections relating to biodiversity conditions and implementation of the Teesta-V environmental management plans have been conducted regularly by the FEWMD, whose officers are often in touch with the project through the operation stage, for example regarding permits for lopping of trees or removal/breakdown of river boulders. NHPC applied to the FEWMD for removal of boulders from the river near the powerhouse to minimise damage to the river protection walls; however only 4 were permitted to be removed.

Follow-up inspections relating to the fish hatchery, which was constructed in 2012, revealed that this was not functional. Issues included cracks in the tanks, drying up of the water source, soil deposition in the tanks and chambers, and poaching. There was a significant lapse in attention on functioning of the fish farm by all parties involved between its inauguration on 3rd September 2012 and when the issues impacting on its effectiveness were highlighted and escalated starting in early 2017. The Central Level Monitoring Committee for Teesta-V had ceased its meetings in 2010, after having held 9 meetings, due to the conclusion that all Environmental Clearance requirements had been met. However, the issue of the lack of functionality of the fish hatchery was raised during

a 10th meeting on 15 November 2017, at which the GoS Fisheries Department advised that funds for work on the water supply had been sanctioned and work should be completed in April 2018. Since then, these issues have been closely followed by NHPC with the GoS Fisheries Department, and actions taken to rectify the issues.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging biodiversity issues takes into account both risks and opportunities.*

Several assessment measures relating to biodiversity have been implemented that go beyond basic good practice.

In addition to the EIA and WII studies of Teesta-V, the Teesta CCS studies, undertaken between 2000 and 2007, provided a basin-scale inventory of environmental characteristics of the Teesta basin, with a strong emphasis on biodiversity but limited assessment of the cumulative impacts of fish. Specific biodiversity-related activities undertaken in the CCS were:

- An inventory of floral and faunal species, diversity in terrestrial, aquatic and aerial ecosystems
- Mapping of endangered or rare taxa of conservational and economic significance
- Identification of hot spots for conservation and sustainable exploitation
- Land-use and vegetation mapping including forest cover
- Biological sensitivity analysis of ecosystems/areas where developmental projects are proposed
- Identification of potential areas for eco-tourism
- Identification of potential biological resources for economic welfare of local population and industrial use

The Lower Teesta Basin CCS, completed in 2015, provided a fuller assessment of the cumulative impacts of hydropower projects on migratory fish, and a study of effectiveness of the fish passage at the Teesta Low Dam projects is planned. Whilst neither of these CCS studies specifically addressed cumulative impacts relating to Teesta-V, they provide important contextual information that informs consideration of risks and opportunities relevant to Teesta-V as well as other projects in the Teesta River cascade.

Most recently, NHPC is implementing a post-construction EIA for Teesta-V. The scope includes evaluation of the impact of reservoir creation on the water quality, biodiversity (terrestrial and aquatic), migratory species with respect to both upstream and downstream migration, and risk of invasive species. This study will also evaluate the post-construction downstream impact up to the next lower project, which includes the impacts of the project on the downstream ecology and socio-economy. Methods relating to biodiversity include:

- Evaluation of the effects of the operating project on animals and plants, especially rare and endangered flora and fauna
- Investigation of the efficiency of measures for plant protection, and identification of further protective steps to be taken
- Collection of pre-project information on terrestrial and aquatic ecological aspects for flora and fauna from EIA/EMP reports and existing and published literature, followed by primary data collection using the same framework
- Assessment of the vulnerability of certain species or impacts on them due to the project, with special attention on rare, endangered, threatened and endemic species
- Analysis of the impact of the dam and reservoir on aquatic life, with a focus on the effects on fishes. This aspect will assess the effects of the project on the planktonic animals and plants, benthic organisms, higher aquatic plants, fishes and other aquatic animals etc.; evaluate the impact on rare aquatic life; analyse the effects of the project on habitats for fish spawning; discuss the efficiency of conservation measures for aquatic life; and propose further protection measures.

Despite these many assessment processes and activities, there are shortfalls in the biodiversity assessment relating to fish impacts and the fish hatchery as the key fish mitigation measure, resulting in a **significant gap** against proven best practice. The contribution of the Teesta-V fish hatchery to mitigating the impacts of the Teesta-V dam on fish, and the fit of this mitigation within a suite of project-level mitigation measures aimed at addressing aquatic ecosystem impacts (e.g. such as environmental flows), have never been properly evaluated. The contribution of fish hatcheries as an effective mitigation measure is not well understood from the perspective of cumulative impacts on fish from the dams in the Teesta basin, and no dedicated analysis has been done of the implications of the introduction of exotic fish on aquatic biodiversity. Issues relating to hatcheries as a fish mitigation measure include low viability of hatchery stocks, loss of genetic integrity over time, impacts on natural fish populations, and in this case increased introductions of exotic fish. There has not been an assessment of capacities to manage and deliver on the objectives for the fish hatchery, and a lack of follow-up has resulted in shortfalls in outcomes (addressed under the Outcomes criterion).

Criteria met: No

15.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified biodiversity issues.*

The main focus of environmental management attention at Teesta-V has been on terrestrial biodiversity, with a particular focus on the forest environment. The power station and neighbouring land was devoid of dense vegetation pre-project development, although some trees were present in the submergence area which were removed before filling of the reservoir. Eight of the nine management plans in the EMP provided activities that contributed to the vegetation cover in the Teesta basin and around the project areas: the Green Belt around the Project Area; the Compensatory Afforestation Plan; the CAT Plan; the Reservoir Rim Treatment Plan; the Free Fuel Provision; the Landscape Plan; the Restoration Plan for Spoil Tip (dump sites); and the Restoration Plan for Quarry Sites and Borrow Pits. Additionally, the project developed a Wildlife Management Plan and a Fishery Management Plan.

A summary of the main measures taken by the project to manage the identified biodiversity issues are as follows.

- **Compensatory afforestation:** 250 ha of degraded forestland in the East, North, and South districts of Sikkim were afforested, in compensation for the loss of 147 ha of forest land by the project, including 25 ha of underground land. More than 400,000 saplings were planted, followed by 3 years of maintenance. Additionally, efforts were made to minimise tree cutting and to maintain the quality of the forests in the area of the project.
- **Catchment Area Treatment:** Numerous areas in the Teesta-V catchment received engineering and biological treatments in order to minimise erosion risks (see topic O-16), but with the added benefit of improving the quality of the vegetative cover in the catchment and hence the habitat areas.
- **Protection of forest in the project area:** NHPC fenced vulnerable forest areas, cleared fire trails, and employed surveillance staff. This included provision of subsidised fuel and electricity to workers during the construction period, to avoid cutting of trees for fuel wood.
- **Green belt development and landscaping:** NHPC planted various tree species in many of the empty spaces in the project area and also along the access roads to the powerhouse and dam sites, and protected these with fencing and guards. NHPC also used available spaces for parks and gardens to help manage erosion and improve ecological quality. This included a herbal park at the power station to preserve endangered and rare herbal species found in Sikkim.
- **Butterfly park:** A butterfly park was established in association with the FEWMD, and is operated by the FEWMD. The WII study recommended three butterfly rearing parks in Sirwani, Amdara and old Dikchu. NHPC reached an agreement with the FEWMD to consolidate the resources into one park, located

upstream of the Teesta-V reservoir on the left bank of the Teesta River. Teesta-V contributed to the gate, balcony, paths and staircase.

- **Fish hatchery:** A fish hatchery was built at Makha, near Adit III halfway between the Teesta-V dam and powerhouse, by the GoS Fisheries Department with funding provided by NHPC. The intent of the hatchery, according to the six-monthly compliance reports to the MoEFCC, was to rear fingerlings for their release into the project reservoir and into the Teesta River, and to develop fisheries in the area. At present this is not functional due to problems with the water supply, which are being addressed (see Conformance/Compliance and Outcomes criteria).

No invasive species issues were identified in the EIA, so no management measures were required. No issues have become apparent since operation has commenced. The relatively colder water in the Teesta River is thought to limit problems with invasive species that are being experienced elsewhere in India, such as with water hyacinth.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Processes are evident with respect to responding to emerging risks and opportunities, in particular with follow-up once the problems with the fish hatchery were discovered. Anticipation of these issues was not evident leading up to 2017, but more recent follow-up processes appear more robust. The linkage of further work on the Teesta-V fish hatchery with commitments in the Environmental Management Plan for Teesta-IV appears like a workable solution for ensuring more successful functionality of this hatchery going forwards.

Criteria met: Yes

15.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage biodiversity issues have been and are on track to be met with no significant non-compliances or non-conformances, and biodiversity related commitments have been or are on track to be met.*

NHPC fully delivered on all of its Environmental Clearance requirements, and has met all of its biodiversity-related commitments. The one issue that was outstanding at the time of this assessment was the full delivery of a functional fish hatchery, but as far as NHPC was required, it delivered the funding for this in line with the Fishery Management Plan, and the fish hatchery was built.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances identified regarding Teesta-V.

Criteria met: Yes

15.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative biodiversity impacts arising from activities of the operating facility are avoided, minimised, mitigated, and compensated with no significant gaps.*

Negative biodiversity impacts arising from activities of the operating facility appear to be well avoided, minimised, mitigated and compensated with respect to terrestrial flora. It will not be possible to derive a conclusion regarding terrestrial wildlife until the results of the post-construction EIA are provided, but given the attention to protection of habitat areas it is considered that this was reasonably well-managed.

The butterfly reserve was a significant mitigation measure implemented in recognition of the importance of butterflies and their conservation in Sikkim. Following its initial development using funding from the Teesta-V project, it has been managed by the FEWMD and has experienced deterioration over the past ten years. Recently, Japan International Cooperation Agency (JICA) funding has contributed to putting in many new plants, building a café, and promoting the park for tourism; there are also plans for the Teesta-IV project to further contribute to this park.

There is no evidence that the environmental flow release out of the dam has lessened the impacts of the project on the aquatic ecology of the river. Some information on this should be forthcoming from the post-construction EIA. An important aspect will be to understand the contribution of seepage and leakage from the dam and local inflows to the river flow in the diverted reach. Based on information from recent policy developments in India for environmental flows, it is likely that the flows are less than those targeted for newer projects (see topic O-19).

The impacts of gravel and rock extraction from the Teesta River on the instream habitat for aquatic biota is unknown. The WII study recommended that removal of boulders from the river bed should be prohibited. It is unknown what impacts to the instream habitats are occurring from the very active gravel and rock extraction activities throughout the river reaches dewatered by the Teesta-V project, but some of these operations are large-scale, include crusher plants, and have been ongoing for many years.

The fish hatchery was constructed in 2012 after several years of delay in agreeing on the details. Reportedly this was functional after being stocked with fish in September 2012 (10,000 fry and 700 yearlings of chocolate Mahseer, *Neolissochilus hexagonolepis*, and 12,000 fry and 450 yearlings of Grass Carp, *Ctenopharyngodon Idella*, and so basic good practice is considered met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are healthy, functional and viable aquatic and terrestrial ecosystems in the area affected by the hydropower facility that are sustained over the long-term; or the facility has contributed or is on track to contribute to addressing biodiversity issues beyond those impacts caused by the operating hydropower facility.*

There is no evidence to demonstrate that the Teesta-V fish hatchery is an effective mitigation measure for addressing Teesta-V impacts on fish, resulting in a **significant gap** at proven best practice. Whilst data is available to show that the hatchery received fish seedlings in 2012, and there were some mature fish observed when inspections were undertaken in and since 2017, there is no evidence relating to return of any fish to the river or reservoir. Deterioration of the hatchery due to the water supply and other problems, and the need for a significant injection of funds and works into this facility through the Teesta-IV EMP, further indicate the unsatisfactory outcomes for this facility at the time of this assessment.

Criteria met: No

15.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps in basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are shortfalls in the biodiversity assessment relating to fish impacts and the fish hatchery as the key fish mitigation measure.

There is a lack of evidence to demonstrate that the Teesta-V fish hatchery is an effective mitigation measure for addressing Teesta-V impacts on fish.

2 or more significant gaps

15.3 Scoring Summary

NHPC developed and operates the Teesta-V project with a high awareness of and sensitivity to the globally recognised environmental and biodiversity values of the state of Sikkim. Assessment processes and management plans during project development strongly addressed terrestrial ecosystem values and issues, and were supplemented by further studies of catchment carrying capacity and more detailed biodiversity assessments. Numerous mitigation measures have been fully implemented, notably with respect to catchment area treatment, reforestation, greenbelt development, and development of a butterfly reserve. Aquatic ecosystems and biodiversity have received a lesser degree of attention, and it cannot be concluded that there are healthy, functional and viable aquatic ecosystems in the areas affected by the project that are sustainable over the long-term. A fish hatchery was part of the commitments of the project and was developed with funding from NHPC, but the assessment and the outcomes relating to this mitigation measure fall short of proven best practice, leading to two significant gaps at this level and a score of 3.

Topic Score: 3

15.4 Relevant Evidence

Interview:	2, 18, 25, 40, 43, 47, 49
Document:	31-37, 40, 41, 46, 56, 60, 81, 66, 68, 192-199, 223
Photo:	2-4, 25, 97

16 Erosion and Sedimentation (O-16)

This topic addresses the management of erosion and sedimentation issues associated with the operating hydropower facility. The intent is that erosion and sedimentation caused by the operating hydropower facility is managed responsibly and does not present problems with respect to other social, environmental and economic objectives; that external erosion or sedimentation occurrences which may have impacts on the operating hydropower facility are recognised and managed; and that commitments to implement measures to address erosion and sedimentation are fulfilled.

16.1 Background Information

Teesta-V captures run-off from the very young and active Himalaya mountains, running in an WNW-ESE arc for approximately 2,400 km and containing more than 50 mountains higher than 7,200 m in elevation. The Himalayas were formed by the collision between two continental tectonic plates, and continue to uplift by as much as 10 cm/year from the pressure of the Indian plate being subducted under the Eurasian plate. Sikkim lies within the lesser Himalayas, Central Himalayas, and the Tethys Himalayas. The geology is variable across the state, with some regions having hard massive gneissose rocks which can resist the denudation and others with comparatively soft, thin slaty and half schistose rocks that denude very easily.

Weathering and erosion are highly active processes in the Himalayas generally, and very much so in the Teesta River catchment. More than 59% of the Teesta River catchment area lies above 3,000 m and is characterised by steep (>27°) to very steep (>65°) slopes. The mountains are characterised by folds and faults, and the region is highly tectonically active. The basin experiences extreme and even catastrophic meteorological events during the monsoon season, resulting in large quantities of silt and aggraded materials being deposited in the river channels and/or transported downstream. High rainfall over the steeper slopes (~2,300 mm/year) leads to run-off and soil erosion, slope failures, landslips and landslides.

Hydrology of the basin is addressed in topic O-4. Seismicity of the region, and the implications of erosion and sedimentation for dam safety, are addressed in topic O-6.

16.2 Detailed Topic Evaluation

16.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging erosion and sedimentation issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

The EIA for Teesta-V included evaluation of the sediment profile, geology, soil characteristics, weather, climate and catchment profile for the project. Based on this evaluation, and given that Teesta-V was a run-of-river project with an extremely high sediment inflow rate, the reservoir was anticipated to fill up during the monsoon months with sediments. Erosion and abrasion of the turbines due to sediments was also identified as a significant management issue.

Based on the studies and analyses in the EIA assessment and the Detailed Project Report, mitigation and management measures were built into the project design, operating rules and environmental management plans (see the Management criterion below). Monitoring has been and continues to be undertaken to assess if management measures are effective. The monitoring mechanisms include:

- Suspended sediment data collection. Samples are taken daily at the gauging station upstream of the reservoir and at one of the turbine draft tubes in the power station, and sometimes at the intake or

spillway at the dam. Samples are taken hourly during the monsoon season. A downstream sample is taken downstream when the gates are open. Data is analysed at a lab on site, and used to inform timing and duration of reservoir sediment flushing operations and operations of the desilting chambers. Daily readings for 2018 for inflows to the reservoir ranged from a low of 180 parts per million (ppm) in January to a high of 2,946 ppm in July.

- Reservoir survey cross-sections. These are taken using an echo sounder, before and after the monsoon season each year, at intervals of 100 m at the upstream end and then 250 m intervals. The data is used to inform the amount of sediment infilling in the reservoir, and the effectiveness of reservoir sediment flushing.
- Visual inspections of the reservoir rim and the local area for any destabilisation or landslip activity.
- Visual inspections of the long-term stability of rehabilitated areas of land disturbed by construction activities, including muck, spoil and waste dumps.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging erosion and sedimentation issues takes into account both risks and opportunities.*

There are a number of activities that demonstrate that Teesta-V identifies ongoing or emerging erosion and sedimentation management issues.

NHPC maintains close communication between the dam and powerhouse regarding the sediment monitoring results and the sediment management activities.

NHPC has also liaised with Teesta-III regarding coordination of reservoir sediment flushing activities, in conjunction with the ERLDC, and this is reflected in reservoir operating rules for both power stations.

Landslide management is an ongoing issue that is routinely monitored. Landslides of concern were specifically mapped during the project feasibility and EIA studies, and old and new landslides are monitored. The first resettlement colony had to be abandoned due to land slippage (see topic O-10). Risks of seismic events, major new landslides, and GLOFs, have assessment processes described in topic O-6.

The Central Government Disaster Management Team liaised with NHPC about a major landslide that occurred in August 2016 near the Teesta-IV HPP location. The landslide was 790 m long and 530 m wide at its midpoint, and blocked the flow of the Kanaka River/Tolung Chu (a main tributary to the Teesta River) resulting in a 2.2 km long and 209 m wide artificial lake. The water volume in the lake was estimated at 2.16 million m³, and concerns were that a sudden flood could occur if the debris dam breached. The management measure being discussed was, if a breach occurred, to draw down the Teesta-V reservoir so that the water release could be contained. This did not prove to be necessary given that seepage is gradually lessening the volume of water backed up by this landslide.

An issue which NHPC is aware of, but has not needed to apply any active management to, is the practice of sand and gravel extraction from the Teesta River in proximity to the project sites. The FEWMD is responsible for regulating this activity in the rivers, and issues permits. There are an estimated 70 river mining sites around Sikkim, and numerous sites of differing scales were observed during this assessment. NHPC had a dam safety specialist review the implications of these activities with respect to any risks to Teesta-V infrastructure, and concluded that there were no major risks.

The post construction EIA, presently being implemented for Teesta-V, will include in its scope to evaluate satellite imagery to analyse pre-project, during construction and post construction changes in land use and land cover patterns as well as the erosion intensity of the catchment and project area. This study will evaluate effectiveness of all management plans implemented for Teesta-V, and make recommendations that will influence further management activities.

Whilst there have been basin scale studies in the 2008 CCS, it is observed that there has been no basin-wide evaluation of sediment loads to establish a sediment budget and the implications of the hydropower reservoirs. Also, the 2019 DSPR inspection noted that there was a potential to further optimize sediment flushing patterns, and recommended mathematical modelling. These are not considered significant gaps, but are noted as observations.

Criteria met: Yes

16.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified erosion and sedimentation issues.*

The following measures have been and are implemented to manage erosion and sedimentation issues.

The CAT Plan had as one of its objectives to reduce soil erosion in the catchment to minimise build-up of sediments in the reservoir. A total of 10,710 hectares of land in the Teesta-V catchment were treated progressively over a period of ten years according to an agreed schedule. The land treatment was predominantly on forest land, but also addressed some agricultural land, using biological and engineering treatments. Focal areas were agreed with the FEWMD.

The Reservoir Rim Treatment plan had as its objectives to prevent land degradation and soil erosion, to prevent structures and settlements from subsidence and provide stability, to augment the life of the reservoir by reducing siltation, to prevent loss of agricultural land by local villagers, and to stabilise landslides and landslip zones around the reservoir. Focal areas for treatment works included identified structures in the village of Dikchu (a small township of around 50 houses about 2 km upstream of the dam), 3 landslides on the right bank (at around 700 m, 1.5 km and 2.5 km upstream of the dam), 2 landslides on the left bank (at around 30 m and 130 m upstream of the dam), and a number of minor landslides in the 1 km reach of the Dikchu River upstream of where it meets the Teesta-V reservoir.

Compensatory Afforestation was implemented to compensate the loss of 147 ha of forest acquired for the Teesta-V project. Afforestation was implemented over an area of degraded forest land in East, North and South districts of Sikkim, totalling 250 ha, in accordance with the directions of the Forestry Department. The plan involved creation of nurseries, engineering and biological treatments of the land, planting of more than 400,000 saplings, and maintenance over a 3-year period.

A detailed plan for minimisation of muck dumps and rehabilitation of the muck dumping areas was implemented to ensure their long-term stability. The excavation for project development unearthed an estimated 4.2 million m³ of excavated material (“muck”). 2.5 million m³ was used for road widening, development of working areas, concreting, and construction of coffer dams. The remaining 1.7 million m³ was dumped in accordance with the agreed plans. Seven muck dumping sites were designated, and prepared using engineering protection measures. Muck was levelled and compacted during the dumping process. Protection measures were implemented such as wire crate structures and dry walls. Finally, the sites were levelled and planted, and in some cases landscaped to create gardens and playgrounds.

Three desilting chambers, each 20 m wide, 22.5 m high, and 315 m in length, were included in the project design. They remove the relatively coarser sediments in suspension, those that are larger than 0.2 mm in diameter. During the monsoon season when the intake gates are open and inflows are greater or equal to 350 m³/s, the desilting chambers are continuously flushed. In the pre- and post-monsoon seasons, silt flushing is intermittent to rare. The time periods, corresponding inflow levels, and pattern of flushing of the desilting chambers are all specified clearly in the Reservoir Operation and Silt Flushing Guidelines manual.

Reservoir sediment flushing is implemented at a minimum of four times during the monsoon season, according to rules set out in the Reservoir Operation and Silt Flushing Guidelines. The procedure involves closing the

powerhouse, intake and tailrace tunnel gates, then slowly opening the spillway gates until they are fully open and the reservoir water level is down to a minimum. Free flow is allowed over the spillway crest for a minimum of 12 hours, and until the silt concentration in the reservoir upstream of the dam equals the silt concentration downstream of the dam. The drawn down reservoir effectively acts as a river to mobilise the stored sediments.

River protection works have been built on the banks of the Teesta River downstream of the dam and at the power station, and are often damaged. The Teesta-V spillway is also regularly damaged by boulders. These areas of boulder damage are repaired each year after the monsoon, as required.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The close monitoring of erosion and sedimentation ensures that emerging risks and opportunities can be identified and responding to. NHPC's ability to conduct national level research programs and partner with leading research institutions have enabled it to develop and apply solutions that have successfully helped address practical issues with the impacts of sediments on its assets and operations. NHPC has invested considerable R&D efforts and practical simulations into design and management to minimise sedimentation issues, with benefits for Teesta-V and learnings for and from other hydropower projects.

During the Teesta-V feasibility studies, the location and angle of the Teesta-V intake gates was based on analyses with a purpose-built physical model at the Central Water and Power Research Station at Pune, resulting in a design that minimises the intake of sediments into the power station.

Continued R&D efforts and practical simulations by NHPC have been focussed on reducing the damage caused by sediment erosion and abrasion on the hydropower plant. One approach successfully applied at Teesta-V involves application of a surface coating on underwater parts. The thermal spray coating process extends equipment life by significantly increasing the resistance of the parts to erosion and wear, and protecting against corrosion. The High Velocity Oxygen Fuel (HVOF) coating is applied to the runner, guide vanes, cheek plates, etc and has demonstrably improved the longevity of the underwater parts.

Major R&D focal areas for NHPC during 2012-2018 relating to sediments have included:

- Development of silt-resistant materials for hydropower turbines
- Development of material having high abrasive strength for spillways
- Integrated 1D and 3D mathematical model studies for reservoir sedimentation

Ongoing R&D activities for NHPC relating to sediments include:

- Evaluating the abrasion resistance of repair mortars
- Monitoring of hydro abrasive erosion and suspended sediments for optimising hydropower operations
- Remote sensing-based sedimentation studies

The uses of directly abstracted river water can be limited, especially during the monsoon season, due to the siltation. For example, the fire-fighting system at the power station uses river water. There are considerations to build an off-river storage that allows the sediments to settle, so that this storage can be drawn on for water if needed to fight fires.

Criteria met: Yes

16.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: Processes and objectives in place to manage erosion and sedimentation issues have been and are on track to be met with no significant non-compliances or non-conformances, and erosion and sedimentation related commitments have been or are on track to be met.

There are no identified non-compliances regarding any of the Environmental Clearance requirements. All erosion and sedimentation related commitments appear to have been met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, there are no non-compliances or non-conformances.

As stated above, there are no non-compliances or non-conformances.

Criteria met: Yes

16.2.4 Outcomes

Analysis against basic good practice

Scoring statement: Erosion and sedimentation issues are avoided, minimised and mitigated with no significant gaps.

The various types of erosion and sedimentation issues are being actively managed, and to various degrees the issues are avoided, minimised and mitigated.

Suspended sediment ingress into the power station is minimised through the functions of the desilting chambers. Regular maintenance ensures these function as well as possible.

The erosion and abrasion of sediments on machinery is minimised with the application of turbine coatings. Regular maintenance ensures that the machine parts are able to function as well as possible.

The land disturbances and dump sites from the project construction have been rehabilitated and appear to be stable. Initial findings of the post-construction EIA are that the seven muck dumping sites that were used for disposal of excavated muck generated from construction activities were all restored through appropriate biological and engineering measures. The dumping site near the Surge Shaft was developed as a playground, and a park / community ground was developed at the site known as Dung Dung. A greenbelt, playground and a park have been developed along the left bank of the Teesta River near the powerhouse which have stabilised the site.

The CAT is considered highly successful by the FEWMD. The post-construction EIA will add some systematic data to support this conclusion, by evaluating the effectiveness of the CAT on land stability and soil erosion.

The treatment of landslips as part of the reservoir rim treatment plan has been partially successful. The 3 landslips on the very steep right bank of the reservoir were extensively treated but have since slipped. It has been agreed with the FEWMD that these will not be treated again, given the very steep slopes.

Reservoir sedimentation is progressing as predicted. This affects mainly the dead or inactive storage, and the live or active storage to a lesser extent. Effectiveness of reservoir sediment flushing can be seen in the suspended sediment concentrations before, during and after flushing takes place. The Gross Storage up to the Full Reservoir Level (FRL) at time of commissioning was 13.25 million m³, and was 8.7 million m³ post monsoon 2017, 5.3 million m³ of which are active storage.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, erosion and sedimentation associated with operating facility do not present ongoing problems for environmental, social and economic objectives of the facility or the project affected areas.*

Whilst there are many erosion and sedimentation challenges, this is an area that has received a very high degree of management attention at all stages of the project cycle. The issues and challenges that are presented appear to be well-managed.

Criteria met: Yes

16.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

16.3 Scoring Summary

NHPC has numerous and significant challenges regarding assessment and management of erosion and sedimentation issues at Teesta-V, given its location in the seismically-active Himalayas and the very pervasive processes of landscape weathering, catchment erosion, landslides and large riverine sediment loads. Erosion and sedimentation risks to the project were well assessed during the project development stage, and a number of management measures built into the project design and operations, including desilting chambers, regular sediment flushing, and extensive monitoring. A number of aspects of best practice are demonstrated, including research and development towards design features and asset maintenance (e.g. coatings of underwater parts), and coordinated sediment flushing rules with the upstream Teesta-III project. There are no significant gaps, resulting in a score of 5.

Topic Score: 5

16.4 Relevant Evidence

Interview:	18, 21, 25, 32, 39
Document:	31, 32, 35, 36, 40, 41, 45, 46, 56, 60, 61, 66, 68, 192-199
Photo:	1, 2, 5-7, 10, 15, 16, 21, 26, 39, 41, 47, 48, 88, 95

17 Water Quality (O-17)

This topic addresses the management of water quality issues associated with the operating hydropower facility. The intent is that water quality in the vicinity of the operating hydropower facility is not adversely impacted by activities of the operator; that ongoing or emerging water quality issues are identified and addressed as required; and commitments to implement measures to address water quality are fulfilled.

17.1 Background Information

The Teesta Basin CCS completed in 2008 included study of physical and chemical characteristics of the Teesta River water. Parameters evaluated were river current velocity, river water temperature, pH, turbidity, total dissolved solids, conductivity, dissolved oxygen, alkalinity, total hardness, and nutrients. The CCS showed that waters of the Teesta basin were generally healthy with respect to water quality and biodiversity. Some of the lower reaches of a few streams, such as the Rani Khola and Rangpo Chhu (at Rangpo), were observed to have relatively deteriorated water quality and poor biodiversity due to heavy anthropogenic activities in their vicinities.

Sources of potential water quality impact to the Teesta River in the vicinity of Teesta-V include, but are not limited to:

- Seepage and spills from chemicals, fuels and other liquids, and drainage from waste collection areas, at the Teesta-V colonies
- Untreated or poorly treated sewage and drainage from villages and townships
- Poor quality of run-off from construction sites, including other dam projects but also in relation to roads and other infrastructure
- Turbidity, oil and fuel from sand and gravel mining activities, especially from truck movements and crushing plants
- Diffuse run-off of agricultural inputs from surrounding farmland (however, Sikkim is aiming for exclusively organic agriculture)

Topic O-16 is closely related to this topic, and addresses suspended sediment sampling and transport. Topic O-19 addresses downstream flow regimes which influence water quality concentrations and transport. Topic O-20 addresses climate change including water quality related considerations.

17.2 Detailed Topic Evaluation

17.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging water quality issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Water quality issues were evaluated in the EIA studies. Analysis of the samples was carried out following the Standard Methods for Analysis of Water by APHA, 1992, looking at selected physico-chemical parameters. Samples were taken for the EIA at six locations for surface water quality, as well as four spring water samples. Samples were tested for physical parameters, inorganic, nutrients and organics, and heavy metals. No water quality issues were identified from the EIA samples taken.

Water quality sampling is undertaken during operations, in accordance with the Consent to Operate from the SPCB, for river water quality and drinking water quality.

River water quality monitoring is undertaken quarterly at four locations: upstream of the dam, downstream of the dam, at Makha (near Adit III, approximately halfway between the dam and the powerhouse), and at the powerhouse. The parameters analysed are pH, temperature, iron (Fe), arsenic (As), conductivity, biochemical oxygen demand (BOD), dissolved oxygen (d.o.), cadmium (Cd), calcium (Ca), chemical oxygen demand (COD), chlorine (Cl), lead (Pb), magnesium (Mg), mercury (Hg), nitrate, selenium (Se), sulphate (SO₄), fluoride (F), cyanide (CN), phosphate (PO₄), total dissolved solids (TDS), total hardness (Ca CO₃), total suspended solids (TSS), turbidity, zinc (Zn), total coliform bacteria, and faecal coliforms. No significant water quality issues have been reported.

Drinking water quality is assessed quarterly at three locations: the dam, the powerhouse right bank, and the powerhouse left bank. These samples are tested for pH, aluminium (Al), odour, colour, iron (Fe), total alkalinity (CaCO₃), arsenic (As), phenolic compounds (C₆H₅OH), taste, silver (Ag), barium (Ba), boron (B), cadmium (Cd), calcium (Ca), chloride (Cl), copper (Cu), lead (Pb), manganese (Mn), magnesium (Mg), mercury (Hg), nickel (Ni), nitrate, selenium (Se), sulphate (SO₄), fluoride (F), cyanide (CN), anionic detergent (MBAS), total chromium (Cr), total dissolved solids (TDS), total hardness (CaCO₃), turbidity, zinc (Zn), E. coli, total coliform bacteria, mineral oil, ammonia, sulphide (H₂S), and molybdenum (Mo). All results meet the Indian Standards (IS) with the exception of iron (Fe), which can be elevated at times. This does not represent a public health issue, but may affect taste.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging water quality issues takes into account both risks and opportunities.*

Water quality risks relate to ecosystem impacts and impacts in human uses and needs. The broad range of parameters measured ensures that the risks relating to water quality can be identified. For example, mercury is monitored, as are significant nutrients. Methodologies appear to be best practice.

The present monitoring programme, however, is not strongly linked to the array of potential water quality risks. It is unlikely to identify emerging issues that may be of short term or infrequent nature. The water quality monitoring is undertaken quarterly only, and there are no continuously-recording water quality probes being employed. Water quality trends are not analysed alongside trends in biodiversity, erosion and sedimentation, and flow, nor do they consider water quality risks from other activities and potential cumulative impacts. The absence of an underlying environmental risk framework, and the limited ability of the water quality monitoring program to identify or understand emerging issues or cumulative impacts, represents a **significant gap** against proven best practice.

The post-construction EIA plans to collect samples that will help evaluate the environmental impacts of water quality. These samples and analyses will mainly focus on changes of water quality in the reservoir, eutrophication trends, pollutant enrichment in bottom sediments, and water quality of the outflows from the reservoir and downstream. Standard methodologies will be used wherever required for surveys and analysis. This study will provide a more current view of water quality related risks, and the outcome of this may be a recommendation for a more risk-based and comprehensive approach to water quality monitoring and data analysis.

Criteria met: No

17.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified water quality issues.*

The Teesta-V EMP had no specific requirements regarding water quality, and neither did the Environmental Clearance, except to maintain the good water quality that was documented in the EIA.

The Infrastructure (Civil) division are responsible for the quality of drinking water in the project. This water is sourced from 5 groundwater bores that meet all water needs of the powerhouse colony. There is a main storage tank on the left bank of 500 ML, divided into two chambers. One chamber of 375 ML is treated, and the other chamber delivers the water supply to the first chamber. After treatment, the drinking water is distributed to a storage tank on the right bank. The treatment uses a bleaching powder only, typically 2 kg put in at night. During the monsoon there is a chance of higher bacterial levels, so 2.5 kg of bleaching powder is used.

Every domestic building at the powerhouse colony has a potable water treatment plant, with reverse osmosis. One reverse osmosis unit provides for ¼ of a standard apartment building. The administration building has a bigger size unit.

Wastewater is treated in septic tanks for the buildings at the colony. Sludge is cleared at 2-year intervals. The Central Municipal Corporation (CMC) of Sikkim collects the sludge from the septic tanks, and treats at their premises. If the tanks show any leakage or damage, this is reported by the service contractor who looks after the day-to-day maintenance.

There is a Sewage Treatment Plant (STP) in the powerhouse. Sewage goes to a 15,000 L tank, to which is added salt, alum and lime. It then goes to a bioreactor tank, then through an activated carbon filter in two chambers, and then is reused to water the colony's left bank gardens. Other than during the monsoon season, there are no discharges to the river from the powerhouse STP, as it is fully recycled. The STP water is tested after treatment by the EDM division, and compared to the prescribed limit at the outlet. During the monsoon season, between May and October, the treated STP effluent is discharged to the river. There is a pit for the sludge, which the CMC clears when they do the septic tanks. Other discharges to the river are not treated, such as from the sump pumps from the powerhouse. River monitoring is done downstream of the discharge point, 3x per year, by the EDM division and has not raised any issues requiring management interventions.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The presence of the EDM staff at the Teesta-V site, and the regular sampling data and liaison with the SPCB, mean that some risks and opportunities relating to water quality may be identified and responded to. Water quality reports are submitted as a set of data to the SPCB. The results of all the tested environmental parameters are compared with the standards and if any deviation is found, the concerned divisions are requested to resolve the issue.

Criteria met: Yes

17.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage water quality issues have been and are on track to be met with no significant non-compliances or non-conformances, and water quality related commitments have been or are on track to be met.*

There are no specific requirements regarding water quality in the EMP or in the Environmental Clearance. The requirements of the SPCB appear to be regularly met with respect to sample collection, analyses and reporting. No issues were raised by the regulators interviewed for this assessment, although this did not include the SPCB.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances were identified regarding Teesta-V water quality requirements.

Criteria met: Yes

17.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative water quality impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

No significant negative water quality impacts arising from activities of Teesta-V during its operations stage have been identified.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, water quality in the area affected by the operating hydropower facility is of a high quality; or the facility has contributed or is on track to contribute to addressing water quality issues beyond those impacts caused by the operating hydropower facility.*

Water quality in the area of Teesta-V is considered to be of high quality, but this is based on a very limited monitoring approach and data analysis (noted as a significant gap under the Assessment and Management criteria). Teesta V has contributed to addressing water quality issues beyond those impacts caused by the operating facility, through improvements in drinking water and sanitation in surrounding villages with its CSR program (see topic O-8).

Criteria met: Yes

17.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The water quality monitoring program is not underpinned by an environmental risk framework, and is limited in its ability to identify or understand emerging issues or cumulative impacts.

1 significant gap

17.3 Scoring Summary

Water quality upstream of Teesta-V was shown during the project preparation stage to be of a relatively high quality, and no significant issues associated with the operating hydropower facility were identified as requiring dedicated management plans. During the operations stage, there is ongoing monitoring of drinking water and river water quality at several locations in line with the requirements of the State Pollution Control Board. There are a number of potential sources of water quality issues, and river water quality may be influenced by the effects of Teesta-V on river flows. There is no overarching evaluation of these aspects of risk and potential cumulative impact, and the present monitoring program is unlikely to identify short-term or intermittent water quality issues. This is a significant gap against proven best practice, resulting in a score of 4.

Topic Score: 4

17.4 Relevant Evidence

Interview:	18, 25, 31
Document:	31, 32, 36, 40, 41, 46, 55, 64, 206-208, 226
Photo:	22, 45, 63, 84

18 Reservoir Management (O-18)

This topic addresses management of environmental, social and economic issues within the reservoir area during hydropower facility operation. The intent is that the reservoir is well managed taking into account power generation operations, environmental and social management requirements, and multi-purpose uses where relevant.

18.1 Background Information

Teesta-V is the first of four hydropower projects in the upper Teesta cascade. Of the projects further upstream, the 1,200 MW Teesta-III is operating, and the 500 MW Teesta-IV, which will have its power station immediately upstream of the Teesta-V reservoir, is going through the approvals process. Also upstream of Teesta-V and discharging into the reservoir is the 96 MW Dikchu hydropower project, completed in 2016, on the Dikchu River which enters the Teesta-V reservoir at the town of Dikchu.

The Teesta-V dam is a concrete gravity dam that is 96.45 m high from its foundations and 50 m high from the river bed. The dam is 182.50 m long, and at an elevation of EL 583.20 m, at its top. The Full Reservoir Level (FRL) is at EL 579.00 m, the Maximum Reservoir Level (MRL) is at EL 580.72 m, and the Minimum Draw Down Level (MDDL) is at EL 568.0 m. The Teesta-V reservoir area at full supply level is 68 ha in area, of which 32 ha was original river bed.

The catchment to the Teesta-V reservoir is 4,307 km². Inflows are variable year-to-year, but generally follow a monsoonal climate cycle.

Inflows to the Teesta-V reservoir are addressed in topic O-4, and outflows in topic O-19. Infrastructure safety in relation to dam safety, safety around the reservoir and downstream is addressed in topic O-6. Sediment accumulation and flushing are addressed in topic O-16. Greenhouse gas (GHG) emissions associated with the Teesta-V reservoir are addressed in topic O-20.

18.2 Detailed Topic Evaluation

18.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging reservoir management issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Issues identified in the Teesta-V EIA regarding the reservoir were with respect to reservoir sediment infilling and loss of storage capacity over time, landslips and destabilisation of land and structures around the reservoir rim, loss of flora and fauna due to the area submerged, and displacement of locals. Possible impacts were flagged as water quality changes, aquatic weed growth, algal blooms and lower reaeration. Benefits were considered to include protection against floods, improved power generation, and domestic uses of water.

Issues of greatest concern were addressed through a range of management plans, notably the catchment area treatment, compensatory afforestation, reservoir rim treatment, and resettlement and rehabilitation plans, which are now considered completed. Monitoring has been undertaken with respect to implementation and effectiveness of these plans, as described under topic O-3. Some water quality monitoring has been conducted in accordance with compliance obligations, but not oriented towards risks in the reservoir, as identified above (and noted as a significant gap against proven best practice under topic O-17).

During the operations stage, inflows, outflows and reservoir water level monitoring is one of the most fundamental forms of assessment undertaken for management of the Teesta-V reservoir. Monitoring sites are installed at:

- The Teesta-V dam site – an automatic water level sensor at the gauge wall of the dam, that can be read digitally in the control room at the top of the dam
- A gauge and discharge site upstream of the tail end of the reservoir
- A gauge and discharge site around 100 m downstream of the dam

Teesta-V's hydrological model is based on inflows, water level fluctuations, and outflows. To better support this model, NHPC is going to install 3 continuous recording flow stations, which at the time of this assessment had been put out to tender. These will be upstream of the reservoir, downstream of the dam (see topic O-19), and at the tailrace. The Reservoir Operation and Silt Flushing Guidelines for Teesta-V specify requirements for monitoring frequency and communications on inflows, reservoir water levels, and gate operations during the regular season and the flood season, ensuring that close coordination is maintained between the dam and the powerhouse.

The other main issue that requires considerable reservoir management attention is erosion and sedimentation. Monitoring in relation to erosion and sedimentation is addressed under topic O-15.

Visual inspections are undertaken in relation to the effectiveness of reservoir rim treatments, public safety, log and debris management, and any other issues arising.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging reservoir management issues takes into account both risks and opportunities.*

The Teesta-V reservoir is not a multi-purpose reservoir. It has a diurnal water level fluctuation during the dry season to provide peak load power. The reservoir storage is relatively small, and the power station operates in run-of-river (RoR) mode. As a RoR station, the load must be dispatched. Teesta-V typically operates in the morning and evening to provide peak power, and three hours of operation at full capacity will empty the reservoir's active storage. Therefore there is a risk that the daily capability statement submitted to the ERLDC for generation from Teesta-V, which is based on historical generation (trend for last 10-15 days), rainfall in the catchment area, and design discharge, does not allow for sudden changes in inflows. The Reservoir Operations and Silt Flushing Guidelines outline that the gauges should be checked every half hour during the monsoon season, and that gauge and discharge stations should be connected by wireless communications to the dam control room. If a sudden change in inflow occurs, NHPC can update availability in real time to the dispatcher; typically, the reservoir can absorb an increased inflow and use it the next day.

Risks of landslides directly into the reservoir, or upstream causing major sediment or inflow flushes to the reservoir, are monitored through processes described in topics O-6 and O-16. These risks are not only in relation to sediment filling, but also to shoreline and infrastructure stability and public safety.

Reservoir infilling through ongoing sediment accumulation is a major risk that NHPC is closely monitoring. Methods of monitoring are described in topic O-16. The EIA anticipated and calculated that the reservoir would gradually fill with sediments, and that sediment flushing would be essential to maintain a viable storage capacity. NHPC regularly surveys the reservoir, and the trends in storage capacity are in line with expectations.

NHPC is keeping a close involvement with the development of the Teesta River hydropower cascade, and considering what kinds of issues will require new or changed management approaches. An example is cited under the Management criterion (proven best practice) relating to coordination of reservoir sediment flushing.

There has been no evidence of an assessment of the reservoir with respect to its ability to deliver on any benefits other than power generation. Potential benefits noted in the EIA also included protection against floods, and domestic uses of water. Other opportunities could relate to aquaculture, fish stocking, tourism, public use, recreation and cultural uses. The absence of any assessment of opportunities for the reservoir beyond power generation is a **significant gap** against proven best practice.

Criteria met: No

18.2.2 Management

Analysis against basic good practice

Scoring statement: Measures are in place to manage identified issues.

NHPC has fully implemented four management plans that were directly relevant to the reservoir impacts:

- The R&R Plan (see topic O-10)
- The Compensatory Afforestation Plan (see topic O-15)
- The CAT Plan (see topic O-16)
- The Reservoir Rim Treatment Plan (see topic O-16)

In terms of ongoing management of the reservoir, Teesta-V reservoir operations are guided by the detailed Reservoir Operation and Silt Flushing Guidelines, the current version being Revision 3 dated 13 June 2017. Objectives for reservoir operation are to:

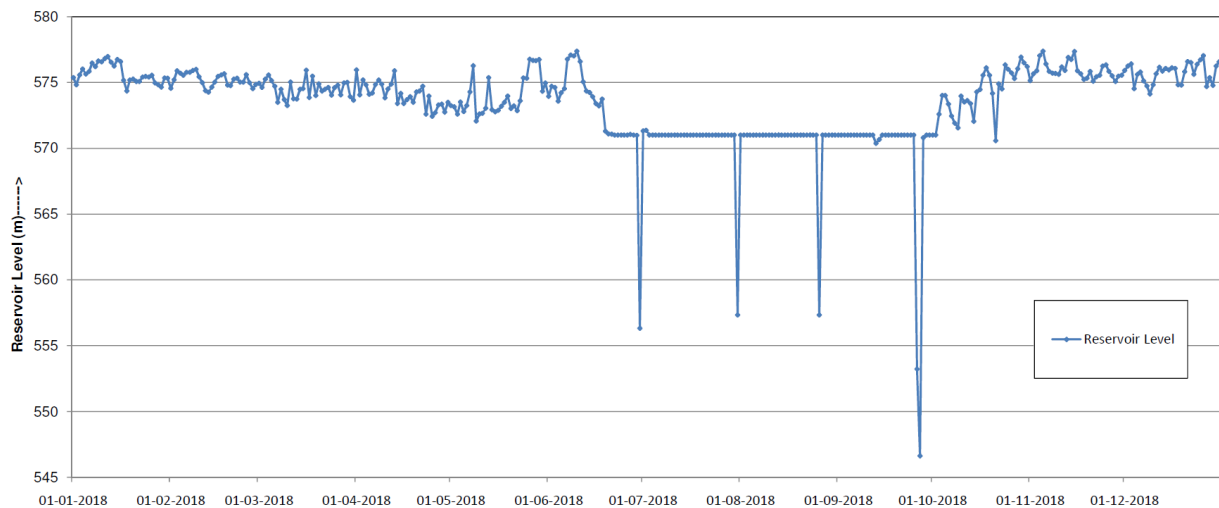
- Ensure the smooth running of the project by maintaining the reservoir level between MDDL and FRL
- Pass the flood safely during monsoons
- Ensure the life of the reservoir against sedimentation

Reservoir management requirements are provided for by a team at the dam site, supplemented with an additional staff during the monsoon season (officially from the 1st of May to the 31st of October). Annual maintenance is conducted during the lean season, typically over a 44-day period during December and January.

The Reservoir Operation and Silt Flushing Guidelines specify in detail the water level management, the gate operations, monitoring and communications at different thresholds of inflows to the reservoir: <500 m³/s, between 500 to 1,500 m³/s, between 1,500 to 5,000 m³/s, and greater than 5,000 m³/s.

The figure below with Teesta-V daily reservoir levels in 2018 illustrates the typical annual reservoir management for water levels and sediment flushing. The reservoir is maintained at or close to FRL (EL 579) from October to May, until the monsoon season. The reservoir is drawn down at or close to MDDL (EL 568) during the monsoon season. Reservoir sediment flushing is done at least four times during the monsoon season, on a monthly basis, involving opening of the spillway gates for a period of at least 12 hours (see topic O-16).

Figure 5. Average Daily Reservoir Levels 2018



Management of human uses of the reservoir does not appear to be required. Whilst fishing is allowed in the reservoir, no one appears to do this, and there is no boating or tourism. No one has approached NHPC asking for more uses of the reservoir.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Processes are in place to anticipate and respond to emerging risks and opportunities regarding the reservoir. Examples of reservoir management issues arising, and their management response, that were highlighted during this assessment include the following.

- A huge landslide occurred in an upstream tributary stream in August 2016 causing a temporary dam-like blockage of water. A Central Government Disaster Management Team discussed drawing down and using the Teesta-V reservoir as a potential management strategy if there was a sudden outburst from this debris blockage, although this was not required and further explored (see topics O-6 and O-16).
- Three landslides that were treated on the right bank of the reservoir as part of the Reservoir Rim Treatment plan failed. The slopes on the right bank are extremely steep, and it has been concluded that it would not be cost-effective to try to treat them again.
- During the first few years of operations, management of logs brought down during the monsoon season were a big issue. These logs have diminished significantly in number, and get flushed through the gates without causing any problems.
- The 2012-2013 monsoon caused a number of damages on the left bank of the reservoir, which had to be repaired. This is understood as likely to be required every few years.

An identified emerging opportunity is to coordinate reservoir operations throughout the cascade, particularly with respect to sediment flushing operations. A meeting was held with the ERLDC, Teesta-III and Teesta-V during 2016 to discuss the state of knowledge and operational rules, and it was agreed to trial a coordinated flushing approach, monitor this, and refine the operating rules for both reservoirs based on the experience gained. This is described in the Teesta-V Reservoir Operation and Silt Flushing Guidelines, which will be updated as learnings from coordination efforts are realised.

Criteria met: Yes

18.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: Processes and objectives in place for reservoir management have been and are on track to be met with no significant non-compliances or non-conformances, and reservoir management related commitments have been or are on track to be met.

The EMP management plans, and the Reservoir Operation and Silt Flushing Guidelines, set out requirements and commitments for management of the reservoir. No significant non-compliances or non-conformances have been identified. The national and state level environmental regulators have confirmed delivery of all EMP related commitments (see topic O-3).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, there are no non-compliances or non-conformances.

As stated above, there are no non-compliances or non-conformances.

Criteria met: Yes

18.2.4 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

Despite identification of potential benefits of the Teesta-V reservoir in the EIA, and other potential opportunities, there has been no assessment of opportunities for the reservoir beyond power generation.

1 significant gap

18.3 Scoring Summary

The Teesta-V reservoir is a fairly small reservoir in a very confined valley. Reservoir levels fluctuate in support of daily peak power generation, and to manage monsoon floods and reservoir sediment flushing operations. There are few social issues requiring management, other than protection of infrastructure relating to the road on the left bank and assets of the village of Dikchu at the tail end of the reservoir. The main environmental issues requiring management relate to sediments, and are addressed through catchment area treatment, landslip treatment, sediment flushing and intensive sediment monitoring. Within the constraints of its small size, NHPC could respond to some emerging reservoir management issues, as was demonstrated in discussions with national disaster management authorities about drawdown if a temporary upstream backwater from a major landslide suddenly breached. There is one significant gap against proven best practice, which is the absence of any assessment of the potential for further benefits from the reservoir beyond power generation, resulting in a score of 4.

Topic Score: 4

18.4 Relevant Evidence

Interview:	18, 21, 25, 38, 39
Document:	73, 110, 111, 202, 209
Photo:	7-9

19 Downstream Flow Regime (O-19)

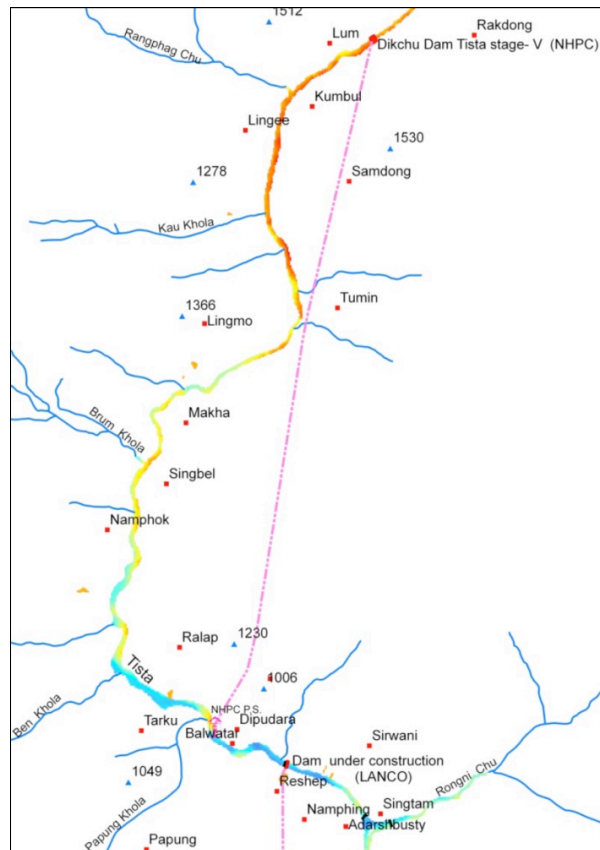
This topic addresses the flow regimes downstream of the operating hydropower facility infrastructure in relation to environmental, social and economic objectives. The intent is that issues with respect to the operating hydropower facility's downstream flow regimes are identified and addressed, and commitments with respect to downstream flow regimes are fulfilled.

19.1 Background Information

The following two figures illustrate the area of river flow changes of Teesta-V and other Teesta River hydropower developments.

Figure 6, which is a crop from Sharma et al (2013)³, shows the 23 km stretch of the Teesta River from which flow is diverted from the Teesta-V dam to the powerhouse. It shows the diversion tunnel (the pink line), with Teesta-VI (the former Lanco project) immediately downstream of the Teesta-V tailrace. Also shown are the numerous villages along this river reach, a number of which have agricultural lands extending to the river, and the numerous tributaries flowing into the Teesta River downstream of the Teesta-V dam.

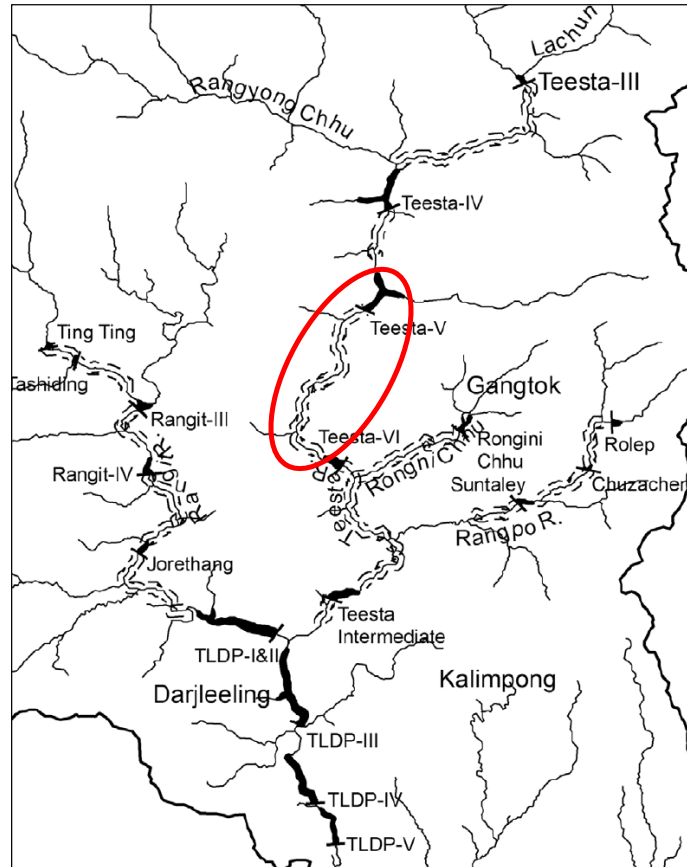
Figure 6. Teesta River from the Teesta-V Dam at Dikchu down to the Rongni River



³ Ghanashyam Sharma, Durga P. Sharma and D.R. Dahal (2013) "Water conflicts and benefits related to hydropower projects: A case study from Sikkim". Downloaded 1 March 2019 from https://www.indiawaterportal.org/sites/indiawaterportal.org/files/water_conflicts_and_benefits_related_to_hydropower_projects_a_case_study_from_sikkim.pdf

Figure 7, which is a crop from Bhatt et al (2017)⁴, shows the overall footprint of the hydropower developments on the Teesta River. The solid fill indicates the river reaches converted to reservoir by the existing and planned Teesta River hydropower projects, and the hashed lines show the river diversion reaches, where part of the flow is diverted through a tunnel to the power station for that project. The Teesta-V diversion reach from the reservoir to below the powerhouse is indicated with a red circle (added for emphasis).

Figure 7. Teesta River between the Teesta-III and Teesta Low Dam V Projects



Topic O-4 addresses the inflows to the Teesta-V reservoir and how these are used for generation operations during the wet and dry season. Topic O-16 addresses management of suspended sediments and flushing operations. Topic O-18 addresses reservoir management.

19.2 Detailed Topic Evaluation

19.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging issues relating to the operating hydropower facility's downstream flow regimes have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Potential issues relating to Teesta-V's downstream flow regimes include:

⁴ Jay P. Bhatt, Sudha Tiwari and Maharaj K. Pandit (2017) "Environmental impact assessment of river valley projects in upper Teesta basin of Eastern Himalaya with special reference to fish conservation: a review". Impact Assessment and Project Appraisal, Vol. 35, No. 4, 340–350. International Association for Impact Assessment.

- Public safety impacts, due to water level fluctuations with peaking discharges from the power station, releases through the spillway gates during floods, and sediment flushing operations (an 11-year old girl drowned due to a sudden release from Teesta-V in April 2014, and an ensuing court case against NHPC resulted in orders to introduce a number of public safety measures)
- Increased sand and gravel mining activities, due to increased accessibility in the dewatered reach
- Aquatic habitat and biodiversity impacts, due to a decrease in area, velocity and riparian areas in the dewatered reaches and intermittent discharges from the power station
- River channel erosion, due to intermittent flow releases from the power station
- Water quality deterioration, due to lack of dilution in the dewatered reach, pulse effects downstream of the power station, and cumulative impacts from other activities
- Sediment transport impacts, given changes to the flow regime
- Impacts to army rafting operations upstream of Melli
- Recreational and commercial impacts, such as on the viability of downstream tourist rafting businesses
- Cultural impacts, such as to cremation sites along the river, and to the culturally-significant site at the sand delta located at the confluence of the Teesta and Rangit rivers

No comprehensive study has been done regarding the range of potential issues and the implications of the changes to flows in various river reaches due to Teesta-V. No environmental flow studies were conducted in the EIA for Teesta-V, as the Terms of Reference for the EIA did not mention environmental flows.

The Environmental Clearance certificate for Teesta-V highlighted that the flow in the 23 km reach between the dam and the powerhouse would be much reduced. The requirement to NHPC in this clearance was to conduct an aquatic ecology study within the first six months (by July 1999) “to know the impact of reduced water flow on aquatic ecology”. NHPC commissioned a study called the “Ecological Assessment of Teesta-V Hydro-Electric Project, Sikkim”, undertaken by the Wildlife Institute of India and completed in March 2000. The main outcome of this compliance requirement, reported in NHPC’s six-monthly reports to the MoEFCC, was a Fishery Management Plan for “setting up of a fish farm at Makha for rearing fingerlings for their release into the reservoir of the project as well as in the Teesta River and to develop fisheries in the area” (see topic O-15). The MoEFCC accepted that this Ecological Assessment study met the requirements of the Environmental Clearance certificate, and no further requirements were made regarding downstream flow impact assessments.

NHPC has a gauge and discharge station downstream of the Teesta-V dam that is manually read. Maintenance inspections for the dam, and readings from this gauge, confirm that the two environmental flow pipes are continuously releasing 1 m³/s of water from the Teesta-V dam.

The SPCB has requested for NHPC to install a downstream flow meter for continuously recorded flow data downstream of the dam. NHPC is in the process of tendering for three new gauge and discharge stations, which will be located upstream of the Teesta-V reservoir, just downstream of the dam, and just downstream of the power station tailrace. NHPC plans to install similar flow meters downstream of all of its hydropower dams, and to have a centralised database where real time data can be viewed.

The National Hydrological Program, an extensive project being carried out by the Ministry of Water Resources funded by the World Bank, is in the process of buying and installing rain gauges, gauge and discharge stations, and Acoustic Doppler Current Profiler instrumentation for Sikkim state. These stations will be in addition to those already installed by the CWC, and in addition to any installed by the hydropower project owners. New gauge and discharge stations to be installed on the Teesta River downstream of the Teesta-V HPP will be under the Makha Bridge and at the Singtam Bridge.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, issues identification takes into account both risks and opportunities. In the case of a need to address downstream flow regimes, an assessment has been undertaken that includes identification*

of the flow ranges and variability to achieve different environmental, social and economic objectives based on field studies as well as relevant scientific and other information.

NHPC has not formally been advised that it needs to “address downstream flow regimes”, but it is monitoring closely the emerging policy regarding environmental flow requirements in India, already applying this at other hydropower stations, and positioning itself so that it would be better placed to undertake more formal studies in the Teesta River if required.

In 2015 the MoEFCC released an updated “Standard ToR for EIA/EMP Report for Projects/Activities Requiring Environment Clearance under EIA Notification, 2006”. This standard ToR contains a section for Hydropower Projects that make reference to environmental flow requirements, under the header Water Environment and Hydrology (p.57). This section states that the minimum environmental flow shall be 20% of the flow of four consecutive lean months of 90% dependable year, 30% of the average monsoon flow. The flow for remaining months shall be in between 20-30%, depending on the site-specific requirements. A site-specific study shall be carried out by an expert organization.

The National Green Tribunal in an August 2017 order gave the direction “that all the rivers in the Country shall maintain minimum 15 % to 20% of the average lean season flow of that river”, unless otherwise directed by MoEFCC.

There are a number of questions that these recent policy developments give rise to, which NHPC is closely following and considering its position with existing power stations. For example, it is not clear if these percentage targets can be met by inflows from tributaries, seepage etc. rather than delivered from the dam itself, and it is not clear if these requirements would apply to existing projects.

NHPC has several actions in progress that will help it be better positioned regarding downstream flows at Teesta-V, as the national environmental flow policy requirements emerge and are clarified:

- Keeping the NHPC executive and Board informed about these developments and potential implications
- Installation of the new gauge and discharge stations, which will include locations downstream of the Teesta dam and the power station tailrace
- Consideration of technical options at the dam for delivery of an increased environmental flow (at very early stages, no specific studies or analyses at this point in time)
- Implementation of the post-construction EIA (described in topic O-3), which while not explicitly including an environmental flows study, will include evaluation of the impacts of changes in the hydraulic regime and downstream flow, the impact on fish migration and habitat degradation due to change in flow of water, and the impact of project on socio-economic status of project affected families and local population.

The scope of the post-construction EIA states that it will address the post-construction downstream impact up to the next lower project, which includes impact on ecology and socio-economic change of the downstream population. Given the delays in Teesta-VI development this raises a lack of clarity on how far downstream, and it would be preferable to express this to be as far downstream as flow alterations from Teesta-V can be detected. There was no documentary information available to this assessment about downstream water level fluctuations or travel times. The assessors heard from local community representatives that river levels fluctuate for some distance downstream of the powerhouse on a daily basis in the dry season. For example, a rafting company at Melli, some 40 km downstream of the Teesta powerhouse, informed the assessors that water levels typically rise 1 m at around 10 am and drop again at around 4 pm during the rafting season. The assessors also heard from operators of the Teesta Low Dams that inflows vary depending on Teesta-V operations. This is not listed as a significant gap given that the post-construction EIA researchers have said they will be evaluating impacts of changes in the hydraulic regime and downstream flow, so there is scope for the evaluation to go as far downstream as necessary.

Criteria met: Yes

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes, measures are in place to address identified downstream flow issues; and where formal commitments have been made, these are publicly disclosed.*

Concerns about the diversion of flow out of the Teesta River downstream of the dam were strongly expressed during the evaluation of the Teesta-V project. The Environmental Clearance responded to this concern with a compliance requirement to prevent mosquito breeding through pooling of water downstream of the dam. It stated that two approaches could be adopted to address this risk: “(a) The rate of flow of water should be more than 60 cm/sec; and (b) This part of the river should be properly channelised so that no small pools and poodles are allowed to be formed.”

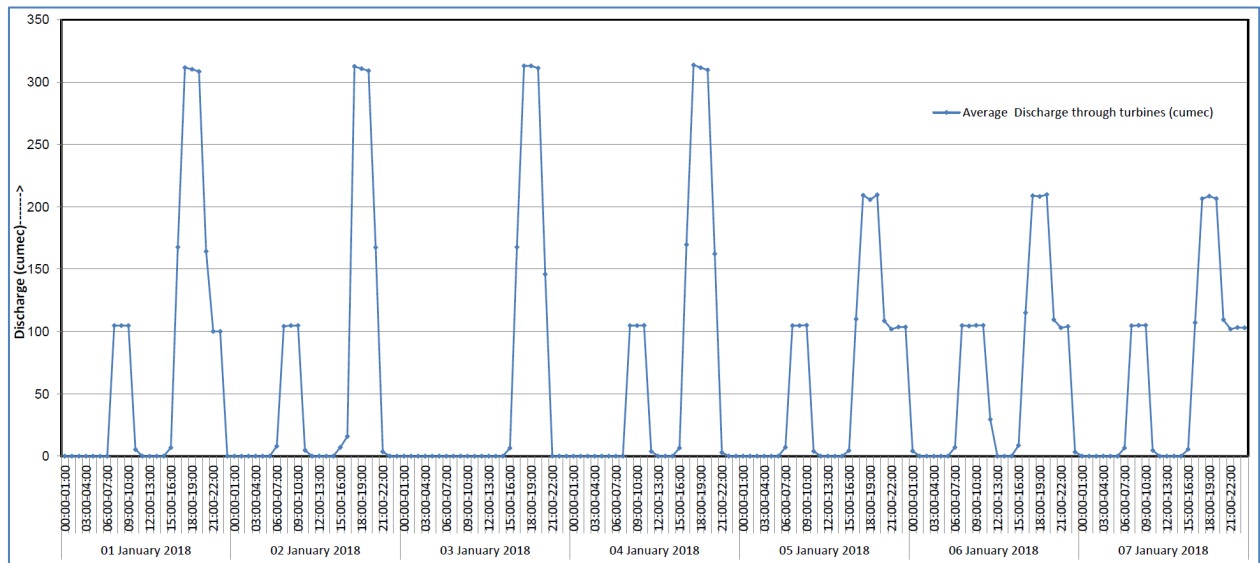
In response to this requirement, NHPC installed two pipes each of 1 foot in diameter in to the dam structure, for continuous release of an environmental flow from the dam. Although there was no stipulation for an environmental flow release in the Environmental Clearance (and the requirement for a flow greater than 60 cm/sec was unclear given that flow rates are expressed in m³/sec), NHPC has continuously maintained a minimum flow of 1 m³/s downstream of the dam from these two pipes. This commitment is publicly disclosed in the six-monthly compliance reports to the MoEFCC, available on the MoEFCC website and the most recent one on the NHPC website. In this report, NHPC advises that this environmental flow is for the sustenance of aquatic ecology.

In addition to the 1 m³/s of continuous flow released through the two environmental flow pipes at the dam, additional flow comes from leakage and seepage, which is estimated to be between 4-8 m³/s based on manual readings from the gauging station ~100 m downstream of the dam. Each year the Dam (Civil) division changes the seals around the gates to reduce seepage, which cannot be fully eliminated. A number of streams flow into the 23 km reach of the Teesta River between the Teesta-V dam and powerhouse, particularly on the right bank, as indicated in the left-hand map in the Background section of this topic.

The impacts of the flow releases downstream of the power station have not received much attention. The Teesta-V powerhouse design discharge is 292.37 m³/s for the 3 units. Discharges are intermittent, typically twice a day in the morning and evening to deliver peak power during the non-monsoon season, but with some variability to this. An example of hourly outflow data during a week in the lean season is shown in Figure 8.

NHPC advised that as more wind and solar energy is developed, and there is an increased need for balancing energy, the releases from the Teesta-V power station may become more irregular. Releases from the power station are “ramped” in accordance with rules issued by the ERLDC, meaning that the machines are not turned fully on or off instantly but are stepped up and down with some hold points. These rules take into account factors influencing the energy system needs, such as demand and transmission. The ramping of power station releases is for the purposes of grid stability and not downstream public safety. NHPC does implement a 5-minute “hold point” when first starting up the power station, at about 35-40 MW, which in combination with downstream siren alerts is for the purposes of warning any downstream parties that the water level is about to rise.

Figure 8. Hourly outflow data from the Teesta-V powerhouse between 1-7 January 2018



Public safety due to downstream releases is taken into consideration in management actions, through placement and utilisation of sirens (see topic O-6). The extent of distance downstream for sirens relating to powerhouse releases only goes to the Sikkim state border, and is not based on any evaluation of water level fluctuations and risk.

NHPC has responded to the needs identified at the time of project approval regarding downstream flow releases, and formally disclosed these commitments, and so this basic good practice criterion is considered met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities. In the case of a need to address downstream flow regimes, in addition commitments are made in relation to downstream flow regimes that include the flow objectives; the magnitude, range and variability of the flow regimes; the locations at which flows will be verified; and ongoing monitoring.*

Based on the activities of NHPC already mentioned, processes are in place to anticipate and respond to emerging risks and opportunities regarding downstream flows at Teesta-V.

However, commitments made by NHPC regarding Teesta-V downstream flow regimes are significantly less than what would be expressed at the level of proven best practice. There is a **significant gap** at the level of proven best practice due to unclear environmental flow objectives, and an absence of ongoing monitoring with respect to effectiveness of meeting objectives.

The Environmental Clearance certificate says that the environmental flow release is to prevent mosquito breeding and increase in risk of malaria; however, the Teesta-V Health Centre staff advised that this is not an area of risk for malaria. Even if it were a malaria risk area, the benefits of a 1 m³/s flow release were not linked to evaluation of this risk and what flow was required to minimise this.

In the six-monthly report for the Environmental Clearance, NHPC says the 1 m³/s flow release is to sustain aquatic ecology, but there is no evidence of any forms of assessment and monitoring in relation to such an objective.

NHPC has identified that a downstream flow meter will be installed below the Teesta-V dam, but has advised that the exact location will be determined by the dam department. This location should be very well-considered, as it should ultimately inform long-term conformance with commitments that should be made in relation to objectives for the downstream flow releases.

Criteria met: No

19.2.3 Stakeholder Engagement

Analysis against basic good practice

Stakeholder engagement is not assessed at level 3.

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes, in addition the assessment and management process for downstream flow regimes has involved appropriately timed and two-way engagement with directly affected stakeholders, and ongoing processes are in place for stakeholders to raise issues with downstream flow regimes and get feedback.*

There has not been any, nor are there any plans for, dedicated stakeholder engagement process for Teesta-V with respect to downstream flow regimes, which is a **significant gap** with respect to proven best practice. The post-construction EIA methodology does include interviews with project-affected communities, but does not include a process of stakeholder engagement specifically with respect to downstream flows.

Criteria met: No

19.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes, processes and objectives in place to manage downstream flows have been and are on track to be met with no significant non-compliances or non-conformances, and downstream flow related commitments have been or are on track to be met.*

NHPC is compliant with its legal obligations regarding downstream flows, and has met its commitments. Public safety improvements such as signage and sirens following the April 2014 drowning appear to have been fully implemented.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes, in addition there are no non-compliances or non-conformances.*

As above, there are no non-compliances or non-conformances at Teesta-V regarding downstream flow regimes.

Criteria met: Yes

19.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes and commitments to downstream flow regimes have been made, these take into account environmental, social and economic objectives, and where relevant, agreed transboundary objectives.*

The commitment that has been made and is being delivered for minimum downstream flow releases from the Teesta-V dam, 1 m³/s continuous release supplemented by any leakage, seepage or local run-off, is in keeping with the requirements at the time of project development. It is very clear that requirements in the Indian policy arena are evolving rapidly, and expectations have changed. Whilst NHPC has not committed to a dedicated environmental flows study at Teesta-V, taking into account environmental, social and economic objectives, the

post-construction EIA study will provide a number of inputs that would then be able to be drawn on when considering any update to the present environmental flows. For this reason, the basic good practice criterion is considered met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes and commitments to downstream flow regimes have been made, in addition these represent an optimal fit amongst environmental, social and economic objectives within practical constraints of the present circumstances.*

Downstream flow regimes at Teesta-V, below the dam and below the power station, are not demonstrated to represent an optimal fit amongst environmental, social and economic objectives, which is a **significant gap** against proven best practice. Whilst there are practical constraints in the present circumstances, no analysis has been undertaken to document what these are, to elicit and document environmental, social and economic objectives taking into account stakeholder views, and to consider these alongside each other taking into account scenarios and trade-offs to inform an optimal commitment.

Criteria met: No

19.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are unclear environmental flow objectives, and an absence of ongoing monitoring with respect to effectiveness of meeting objectives.

There have been no, nor are there any plans for, dedicated stakeholder engagement processes with respect to downstream flow regimes.

Downstream flow regimes below the dam and below the power station, are not demonstrated to represent an optimal fit amongst environmental, social and economic objectives.

2 or more significant gaps

19.3 Scoring Summary

An environmental flow of 1 m³/s is released from the Teesta-V dam, through two permanent pipes in the dam, which is accepted by the regulator as meeting the compliance requirements in the Environmental Clearance. No environmental flow assessment was required, or undertaken, for the Teesta-V EIA, and the objectives for and benefits from this 1 m³/s release are unclear. There is no requirement for dedicated flow management measures downstream of the power house. Whilst further information on the impacts of changed flow regimes on social and environmental values will be part of the scope of the present post-construction EIA, this does not provide a comprehensive environmental flow assessment, it is not clear how far downstream of the powerhouse that it will extend, and it does not include dedicated stakeholder engagement about downstream flow values, issues and objectives. The present minimum flow cannot be demonstrated to provide an optimal fit between environmental, social and economic objectives. These limitations represent 3 significant gaps against proven best practice, resulting in a score of 3.

Topic Score: 3

19.4 Relevant Evidence

Interview:	18, 24, 25, 32, 39, 45, 47, 48, 50
Document:	31, 33, 36, 40-42, 68, 70, 72, 73, 76, 96, 144, 186, 210-213
Photo:	10, 11, 22, 24, 26, 38, 89-94, 96, 98

20 Climate Change Mitigation and Resilience

(O-20)

This topic addresses the estimation and management of the project's greenhouse gas (GHG) emissions, analysis and management of the risks of climate change for the project, and the project's role in climate change adaptation. The intent is that the project's GHG emissions are consistent with low carbon power generation, the project is resilient to the effects of climate change, and the project contributes to wider adaptation to climate change.

20.1 Background Information

Environmental and forest clearances for the Teesta-V project were issued in 1999 under the Environment Protection Act 1986 and Forest Conservation Act 1980 respectively. At the time, none of these acts required a project to include GHG emissions estimation, monitoring of these gases, or management of risks associated with climate change.

The National Electricity Plan 2018 (NEP 2018) of India reiterates the government's previous commitment to significantly reduce its dependency on fossil fuels for power generation by retaining its target of 275 GW of renewable energy by 2027. The NEP 2018 also includes a new target for closure of 48.3 GW of end-of-life coal plants. India has also submitted its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC), which includes a commitment to reduce the emissions intensity of its GDP by 33-35% by 2030 from the 2005 level, and to achieve an installed electricity generation capacity of about 40 percent from non-fossil fuel-based energy resources by 2030. India is rapidly moving towards expanding renewables generation.

20.2 Detailed Topic Evaluation

20.2.1 Assessment

Analysis against basic good practice

Scoring statement: For climate mitigation: power density has been calculated; if power density is below 5 W/m², estimates of net GHG emissions (gCO₂^e) of electricity generation are calculated and independently verified, and periodically updated; if power density is below 5 W/m² and estimated emissions are above 100 gCO₂^e/kWh, a site-specific assessment of GHG emissions is undertaken and periodically updated.

For climate resilience: an assessment of the project's resilience to climate change is undertaken and periodically updated; this assessment of project resilience incorporates an assessment of plausible climate change, identifies a range of resulting climatological and hydrological conditions at the project site, and applies these conditions in a documented risk assessment or stress test that encompasses dam safety, other infrastructural resilience, environmental and social risks, and power generation availability.

Teesta-V is a low carbon-emitting project with a very high power density of approximately 1,417 W/m², based on an active reservoir size of 68 hectares and a pre-impoundment area of approximately 32 hectares for the original Teesta River. The estimate was prepared as part of internal business reporting and has not been publicly disclosed. With a relatively small RoR reservoir, Teesta-V has a low potential for GHG emissions.

Because of its high power density, Teesta-V does not require either an estimation of GHG emissions or a site-specific assessment of GHG emissions. Nonetheless, NHPC has engaged RS EnviroLink to undertake an assessment of GHG emissions from the Teesta-V reservoir during various seasons, as part of the post-construction EIA for Teesta-V. This assessment is being carried out in accordance with the guidelines and methodology proposed by

the IHA and UNESCO's International Hydrological Programme in "GHG Measurement Guidelines for Freshwater Reservoirs". The study will also assess the impact of thermal stratification across the reservoir.

NHPC has completed a similar post-construction EIA study for the Dhaulti Ganga Power Station in Uttarakhand, which ranked the project as "Medium GHG Risk". Both model and field sampling indicated a rapid decrease in GHG emissions over time. Due to the similar reservoir size and similar water retention and discharge patterns, similar attenuation of GHG emissions over time is expected for the Teesta-V reservoir.

NHPC is evaluating variability in precipitation in the upper catchment and changes to the seasonal variability in river flow; and temperature change leading to GLOF events.

NHPC's Hydro-Meteorological Observation Manual (2018) provides methods for measuring climatic variables including precipitation, temperature, humidity, solar radiation and duration, wind, and evaporation. However, in practice, in the Teesta basin NHPC collects data from weather stations operated by CWC. Similarly, river discharge data is also collected from CWC river gauging stations located both upstream and downstream of the Teesta-V dam. A World Bank-funded project (National Hydrology Project) is currently installing a number of hydro-meteorological stations along the Teesta River. These stations, when operational, are likely to provide more data to the dam operators, that would give them the opportunity to change or update existing reservoir operational rules, taking climatic changes into consideration.

Studies indicate that sizes of glacier lakes in the eastern Himalayas, including Nepal, Bhutan, and Sikkim, are increasing due to a higher rate of glacier melt. This also increases the risk of GLOFs that may impact downstream dams including Teesta-V. The most recent GLOF occurred at Lemthang Tsho in western Bhutan in June 2015. A number of studies have been undertaken recently to assess the risk of GLOFs in the Eastern Himalayan region. CWC undertook a GLOF study in 2015 for the Teesta basin, which focused on the South Lhonak Glacial Lake and three other lakes in Sikkim, that have the potential for a sudden outburst that could greatly impact downstream communities and hydropower operations. Modelling was carried out to predict the increase in water levels and discharges, maximum velocities, and time for the peak flood under various lake outburst scenarios, including the worst-case scenario when all lakes burst at the same time. Results indicate that except for the worst-case scenario, the Teesta-V dam is likely to survive all other scenarios. The study did not suggest that any lake outburst was imminent.

The state government has access to an internationally run satellite-based glacier lake monitoring program and an automated lake water level monitoring program. Accessing this monitoring information would be helpful for Teesta-V in terms of taking emergency actions against any potential threats, as well as adopting long-term planning to enhance its resilience to climate change.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *For climate mitigation: in addition, if a site-specific assessment is required, it incorporates a broad range of scenarios, uncertainties and risks.*

For climate resilience: in addition, assessment of resilience incorporates sensitivity analysis, project specific hydrological modelling using recognized climate models, and the project's opportunities to provide adaptation services are considered on an ongoing basis.

Because GHG emissions of the Teesta-V project are consistent with low carbon power generation, they do not require a site-specific emissions assessment. There is an opportunity that would be consistent with proven best practice, for NHPC to estimate combined emissions from the entire Teesta-V project including emissions from vehicles and plants, incinerators, waste disposal sites, and the resettlement and colony areas.

There have been no assessments of resilience to, and opportunities to provide adaptation services under, different climatic scenarios (including extreme events), which is a **significant gap** against proven best practice. Hydrological modelling conducted for Teesta-V has considered variability in river flow, but climate models have

not been used to forecast hydrological changes. Instead long-term historical data series have been analysed and considered during the planning stage of the project. It is not evident that NHPC has any plan in place for Teesta-V to explore opportunities to provide adaptation services, nor is it evident what capacity this project would have to deliver such services.

Criteria met: No

20.2.2 Management

Analysis against basic good practice

Scoring statement: For climate mitigation: if GHG emissions estimates assume management measures, these measures are in place.

For climate resilience: measures are in place to avoid or reduce identified climate risks.

Whilst there are no concerns about the GHG emissions from the Teesta-V reservoir, there are some measures that have benefits in minimising emissions. As described under topics O-4 and O-18, depending on inflow and power generation targets, the reservoir is generally emptied annually during the monsoon season. This annual flushing along with the run-of-river operating mode minimises accumulation of organic debris, and so helps lower the risk of decomposition-related methane production. Teesta-V has also installed an 800 kWp solar PV project on the roof of the hospital, and has undertaken an energy audit of the power station.

Some management measures are in place to enhance Teesta-V's resilience to identified climate risks including variability in precipitation and river flow; excessive sedimentation at the reservoir and high silt content in water; and irregular and unusual flooding including GLOFs.

During the design phase of Teesta-V, long-term rainfall and river flow data were analysed and variability in these parameters were taken into account. Reservoir operation data including inflows/outflows and power generation indicate that Teesta-V is able to operate under a wide variation in flows. Regular dam safety inspection and dam maintenance works are carried out to increase the dam's resilience to extreme flooding events. To protect underwater equipment from sediment abrasion, particularly during the monsoon when sediment concentrations are high, and to maintain effective life of these equipment, NHPC implements mitigation measures including reservoir flushing, desilting chambers and application of surface coatings to underwater parts (e.g. HVOF coating consisting of tungsten carbide, cobalt and chromium) (see topic O-16).

NHPC also coordinates with the state government and other stakeholders to implement emergency management planning by raising community awareness and vigilance and minimising negative consequences in an emergency event (see topic O-6). NHPC maintains an online forum (i.e. a WhatsApp Group) among all dam operators in the Teesta basin and the state regulator to exchange dam operational and monitoring data, which can assist with the early identification of regular or unexpected changes in river hydrology and other natural events (such as earthquake, landslide, or GLOF) and allow the taking of appropriate mitigation measures to minimise risks to dam and other infrastructure as well as communities (see topic O-6).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: For climate mitigation: management measures are in place to respond to risks and opportunities including offsetting emissions; plans are in place to monitor parameters used in GHG emissions estimates or to monitor GHG stocks.

For climate resilience: in addition, measures take account of a broad range of risks and interrelationships, and processes are in place to respond to unanticipated climate change; and plans are in place to provide adaptation services if necessary.

The many environmental management measures relating to improving the quality and quantity of terrestrial vegetation described under topic O-15 (e.g. catchment area treatment, green belt development, compensatory afforestation, and reservoir rim treatment) create carbon sinks.

NHPC is currently pursuing opportunities to generate revenue through carbon financing. Since construction of Teesta-V commenced before January 1, 2000 it was not eligible for claiming any Clean Development Mechanism (CDM) benefits. However, NHPC registered Teesta-V under the Verified Carbon Standard (VCS). NHPC initially estimated that Teesta-V would avoid 2,037,867 tCO₂ annually, through which it would be able to generate an additional revenue of USD 8.74 million annually. About 8.05 million units were generated between April 2008 and May 2012, and NHPC sold 1.56 million units during financial years 2012-13, 2013-14 and 2014-15.

NHPC is currently undertaking a study to estimate GHG emissions for the reservoir, through the post-construction EIA. This is a one-off study and there are no plans for ongoing monitoring of GHG emissions from the project, but given the high power density, this is not considered a gap.

Given the absence of assessments of resilience to, and opportunities to provide adaptation services under, different climatic scenarios, there are also no comprehensive management plans to prepare for and respond to such scenarios, which is a **significant gap** against proven best practice, related to the gaps under Assessment, Stakeholder Engagement, and Outcomes.

Criteria met: No

20.2.3 Stakeholder Engagement

Analysis against basic good practice

For climate mitigation: power density calculations, estimated GHG emissions, and / or the results of a site-specific assessment are publicly disclosed.

For climate resilience: ongoing processes are in place for stakeholders to raise issues and get feedback on the management of climate risks.

The Teesta-V estimate of GHG emissions was prepared as part of internal NHPC business reporting and has not been published on the NHPC website or in any publicly available project reports. There has been limited disclosure of information pertinent to potential avoided GHG emissions through the NHPC website. In 2010 NHPC presented in a conference showing estimation of avoided emissions from 21 projects (planned and operational) including Teesta-V. Given the high power density, this is not considered a gap.

There is no evidence of stakeholder consultation specifically on climate risks, or any ledger of public comments or feedback. However there are general processes by which stakeholders can raise issues and get feedback, which may include concerns about management of climate risks, and are described under topic O-3.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the assessment of project resilience is publicly disclosed.*

Given the absence of an assessment of resilience to different climatic scenarios, no information on Teesta-V's resilience has been publicly disclosed, which is related to the **significant gap** noted under Assessment, Management and Outcomes.

Criteria met: No

20.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to climate change mitigation and resilience have been and are on track to be met with no significant non-compliances or non-conformances, and any mitigation-related and resilience-related commitments have been or are on track to be met.*

Despite the national commitments regarding renewable energy, the central government does not require any hydropower project to estimate and report GHG emissions from the reservoir or the plant. Also, there is no mandatory requirement for hydropower projects to reduce GHG emissions. Given this, Teesta-V is fully compliant with its legal obligations.

NHPC has voluntarily taken initiatives to assess GHG emissions from their project. The first detailed GHG assessment was carried out for the Dhauliganga project, Uttarakhand in 2018. Similar studies are ongoing for Teesta-V and Chamera I. NHPC is also looking into generating additional revenue through carbon credits. Similar to GHG emissions, there is no regulatory requirement for NHPC to assess resilience of a hydropower project against different climate change scenarios. All initiatives taken so far are on a voluntary, ad-hoc basis.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

20.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *For climate mitigation: the project's GHG emissions are demonstrated to be consistent with low carbon power generation.*

For climate resilience: findings of the climate change assessment indicate that the project is resilient to climate change.

Regarding mitigation, Teesta-V has low GHG emissions and partially displaces fossil-fuel based generation.

Regarding resilience, while there is no specific climate change resilience assessment, over the last 10 years, Teesta-V has been operating efficiently under different flow conditions ranging from low flow in the lean seasons to unusually high flow in the monsoon seasons without major financial or operational loss. Relevant management procedures are also in place to:

- address sediment loading in the reservoir due to landslides or excessive erosion in the catchment, to prevent any major loss of storage or damage to underwater power generation infrastructure (see topic O-16)
- maintain dam safety through monitoring, safety inspections, maintenance works, dam break analysis, early warning procedures, and Emergency Action and Disaster Management Plans (see topic O-6)
- ensure cost coverage through long-term PPAs, even under different hydrological scenarios, with sharing of hydrological risks (see topic O-7)

Therefore, at the basic good practice level the project is considered resilient.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: For climate mitigation: in addition, project net emissions are minimised or project operations facilitate system emissions reductions.

For climate resilience: in addition, the project is resilient under a broad range of scenarios; and the project will contribute to climate change adaptation at a local, regional or national levels.

Regarding mitigation, this low GHG emitting project is minimising net emissions further through developing solar generation capacity and implementing compensatory afforestation, forest protection measures and green belt development.

Regarding resilience, the resilience of Teesta-V under a broad range of climate change scenarios, and potential contributions of the project to adaptation to such scenarios, have not been assessed and therefore no conclusion can be made at this point in time; this was noted as a **significant gap** under Assessment, Management and Stakeholder Engagement.

Criteria met: No

20.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

No assessments have been carried out of the resilience of the project to different climatic scenarios, or of opportunities to provide adaptation services under different climatic scenarios. Therefore no comprehensive management approaches could be developed, no information on these aspects of the project publicly disclosed, and there is uncertainty regarding the resilience of the project under a broad range of scenarios, and its contribution to adaptation.

1 significant gap

20.3 Scoring Summary

Teesta-V is a low carbon-emitting project with a very high power density. NHPC is undertaking a GHG emissions assessment of Teesta-V as part of the post-construction EIA. Initiatives are also undertaken to identify some risks of climate change on Teesta-V (such as GLOF study and ongoing hydro-meteorological data collection). However, there have been no assessments of resilience to, and opportunities to provide adaptation services under, different climatic scenarios (including extreme events), which is a significant gap against proven best practice. This gap against proven best practice results in a score of 4.

Topic Score: 4

20.4 Relevant Evidence

Interview:	2, 8, 18, 39
Document:	37, 40-42, 72, 73, 74, 88, 89, 210, 214-219, 224
Photo:	69

Appendix A: Written Support of the Project Operator



एनएचपीसी लिमिटेड
(भारत सरकार का उद्यम)

NHPC Limited
(A Government of India Enterprise)

संदर्भ सं./Ref. No. NH/Env/214/4466

फोन/Phone : _____

दिनांक/Date : 4/6/2019

Dr Joerg Hartmann,
Sustainable Water and Energy Consultant,
1527 Devils Gulch Rd, Estes Park, CO 80517, USA.
Email: joerg.hartmann.water@gmail.com

Sub: "Assessment of Teesta-V Power Station (510MW), Sikkim through Sustainability Assessment Protocol of International Hydropower Association (IHA)".

Dear Dr. Hartmann,

This is in reference to your email dtd. 03.06.2019 regarding Appendix A of the report i.e. written support of the project operator for the ongoing sustainability assessment work of Teesta V.

In this regard, it is brought out that NHPC Limited always believes in conducting its business in environment friendly and socially responsive manner, which is also reflected in the vision and mission statements of the company. In this endeavour, NHPC participated voluntarily in the trialing of Hydropower Sustainability Assessment Protocol (HSAP) during its development stage. As a step forward, NHPC Limited has undertaken the assessment of Teesta-V Power Station through Section IV: Operation Stage tool of HSAP.

This letter confirms the full support of NHPC to your assessment team for carrying out a comprehensive assessment of Teesta-V Power Station through the Hydropower Sustainability Assessment Protocol (Stage IV: Operation Stage Tool) of IHA.

Thanking you.

Yours faithfully,

(A.K. Mishra)
Executive Director (EDM)

पंजीकृत कार्यालय : एन एच पी सी ऑफिस कॉम्प्लेक्स, सेक्टर-33, फरीदाबाद - 121 003, हरियाणा
Regd. Office : NHPC Office Complex, Sector-33, Faridabad - 121 003, Haryana
CIN : L40101HR1975GOI032564; Website : www.nhpcindia.com
E-mail : webmaster@nhpc.nic.in; EPABX No. : 0129-2588110/2588500
बिजली से संबंधित शिकायतों के लिए 1912 डायल करें। Dial 1912 for Complaints on Electricity

Appendix B: Verbal Evidence

No.	Name	Designation	Division of NHPC / Other Organization	Date	Time	Inter-viewer
1	Mr. R.K. Agrawal	GM	Safety	5.3.	09:40-11:00	JH, HL & ZK
	Mr. V.K. Sinha	GM	O&M			
	Ms. Anuradha Bajpayee	SM (Env)	EDM			
	Ms. Ritumala Gupta	SM (Env)	EDM			
	Mr. Ranjit Kumar	SM	O&M			
2	Dr. J.P. Bhatt	Researcher	CISMHE, University of Delhi	5.3.	11:00-13:00	JH & ZK
	Dr. Arun Bhaskar	Managing Director	RS Technologies			
3	Mr. Vipin Jain	Manager (Finance)	Company Secretariat	5.3.	11:00-13:00	HL
4	Mr. R.K. Agrawal	GM	Safety	5.3.	14:00-15:00	JH & ZK
	Mr. V.K. Sinha	GM	O&M			
	Mr. Ranjit Kumar	SM	O&M			
5	Mr. Sanat Kumar	SM (Civil)	Procurement	5.3.	14:00-15:00	HL
6	Mr. Kanchan Thakur	SM (I.E.)	CSR	5.3.	15:00-16:00	JH
7	Mr. Anuj Kapoor	GM	Treasury	6.3.	9:30-11:00	JH & ZK
	Mr. A.K. Nauriyal	GM	Planning			
	Mr. A.K. Pandey	GM	Commercial			
	Mr. Jay Kishore Prasad	SM	Commercial			
	Mr. Binay Kumar	DGM	IFC			
	Mr. Ashish Dutta	SM	Planning			
8	Dr. A.K. Tripathi Dr. Sujit Kumar Bajpayee Mr. Jaspreet Singh		EDM	6.3.	11:00-12:00	JH & ZK
9	Mr. Guru Dutt	DGM	Internal Audit	6.3.	11:00-12:00	HL
	Mr. Pallav	DGM	Vigilance			
11	Mr. I. Boral	GM	HR	6.3.	12:00-13:00	JH
	Mr. Manoranjan Behera	SM	HR			
	Mr. Abhay Kumar Singh	DGM	Corporate Communications			
12	Ms. Bharti Gupta	DGM	Hydrology	6.3.	14:00-15:00	JH & ZK
13	Mr. Manoranjan Behera Mr. R.K. Aggarwal Mr. Kamlesh Mali Mr. T.S. Chauhan Mr. RMA Khan Mr. Rajeev Saxena	SM (HR) GM (Safety) AM (Safety) AM (Mechanical) DGM (Civil) SM (Geology)	Medical Safety	6.3.	14:00-15:00	HL
15	Dr. A.K. Tripathi Dr. Sujit Kumar Bajpayee Mr. Jaspreet Singh		EDM (Social Impacts)	6.3.	15:00-16:00	JH

16	Ms. Bharti Gupta	DGM	D&E	6.3.	15:00-16:00	HL & ZK
17	Mr. Sahadev Khatua	GM (I/c)	HoP Secretariat	8.3.	10:00-10:45	JH, HL & ZK
18	Dr. Ajay Kumar Jha	Sr. Manager (Env)	Environment	8.3.	11:15-12:40	HL & ZK
19	Mr. Digvijay Singh	Sr. Manager (Tech.)	HoP Secretariat	8.3.	11:15-12:20	JH
20	Mr. Pravesh Kumar	DGM (HR)	HR Division	8.3.	12:20-13:30	JH
21	Mr. Rajappan K.	GM (Civil)	Dam (Civil)	8.3.	12:40-13:30	HL & ZK
22	Mr. Rajappan K.	GM (Civil)	Dam (Civil)	8.3.	14:20-15:40	JH
23	Mr. Pravesh Kumar	DGM (HR)	HR Division	8.3.	14:30-15:35	HL
24	Mr. Jitendra Kumar	GM (Elect.)	Power House	8.3.	16:00-18:00	JH, HL & ZK
25	Dr. Ajay Kumar Jha	SM (Env.)	Environment	9.3.	09:00-10:00	HL
26	Mr. Jitendra Kumar	AM (C)	IMS & Safety	9.3.	10:00-11:00	JH & ZK
27	Dr. Satarupa Bhattacharjee	DCMO	Medical	9.3.	10:00-11:00	HL
28	Mr. Jitendra Kumar	AM (C)	IMS & Safety	9.3.	11:00-12:00	HL
29	Mr. Chewan Narayan Regmi	Sc. Asstt./HR	Staff Representatives	9.3.	12:00-12:50	HL
	Mr. Kabiraj Sharma	Electrician/EMD				
	Ms. Yogita Tamang	Sc. Asstt./HR				
30	Mr. Zigme Yonzon	Sc. Asstt./Env.	Project Affected People	9.3.	12:50-13:30	JH & HL
	Mr. Santosh Kumar Adhikari	Sc. Asstt./PH (C)				
	Mr. Zigme Lepcha	Sc. Asstt./Teesta-IV HEP				
	Ms. Dil Maya Rai	Sc. Asstt./Dam (Civil)				
	Mr. Sonam Tamang	Sc. Asstt./GM (E) Office				
31	Mr. N.H. Mollick	SM (C)	Infra (Left Bank)	9.3.	14:30-15:30	HL & ZK
	Mr. Sanjeev Kumar Suman	SM (C)	Infra (Right Bank)			
32	Group of gravel miners near Teesta-VI site	--	Project Affected People	9.3.	15:30-16:30	JH & HL & ZK
33	Mr. Sharad Chandra	DGM (Finance)	Finance	9.03	16:30-17:30	JH & ZK
34	Mr. Shashi	SM	Procurement	9.03	16:30-17:30	HL
35	Mr. Passang Tamang	Resettlers	R&R Colony	10.3.	10:30-12:00	JH
	Mr. Kalu Tamang					
	Mr. Sonam Tamang					

	Mr. Lakpa Tamang					
36	Mr. Gyan Ongrup Lepcha	Lepcha Representatives	--	10.3.	14:00-15:30	JH
	Mr. Sonam K. R. Lepcha					
37	Mr. Kunal Rai	Senior Chief Reporter	Sikkim Express	10.3.	15:50-17:00	JH
	Mr. Pradeep Plizar	Reporter				
	Mr. Ganga Sharma	Media Person				
38	Villagers from Lum	--	Project Affected People	10.3.	12:00-12:30	HL & ZK
39	Mr. Sahadev Khatua	GM (I/c)	HoP Secretariat	10.3.	12:30-13:30	HL & ZK
	Mr. Rajappan K.	GM (Civil)	Dam (Civil)			
	Mr. Sanjay Kumar Sahu	SM (Mech.)	Dam (Hydro-mechanical)			
	Mr. Sonam Dadul Bhutia	SM (C)	Dam (Civil)			
40	Contract worker at Butterfly Reserve	--	Butterfly Reserve	10.3	15:00-15:30	HL & ZK
41	Mr. Sanjeev Kumar	SM (Elect.)	Safety & IMS	11.3.	8:30-9:00	JH, HL & ZK
42	Mr. Jigme Bhutia	Deputy Director	LR&DM Deptt. GoS	11.3.	11:00-12:30	JH & ZK
43	Mr. B. S. Siktel	CCF (Working Plan)	FEWM Deptt., GoS	11.3.	11:00-12:00	HL
44	Ms. Ambika Pradhan	Secretary	Cultural Affairs & Heritage Deptt., GoS	11.3.	13:00-14:00	JH
45	Mrs. Pema Donka	Superintending Engineer (Hydrology)	Irrigation & Flood Control Department, GoS	11.3.	13:00-14:00	ZK & HL
46	Mr. Rodhan Thapa	Principal Chief Engineer	Energy & Power Department, GoS	11.3.	15:00-16:00	JH & ZK
47	Mr. C.S. Rai	Joint Director	Directorate of Fisheries, GoS	11.3.	15:00-16:00	HL
48	Rafting guide near Melli	--	Project Affected People	12.3.	9:00-9:30	HL
49	Dr. S. Kerketta	Director	MoEFCC	13.3.	11:00-12:00	JH, HL & ZK
50	P.K. Sharma (Director, CWC); Abhinav Sharma (Dy Director, CWC); Deepak Sharma (Dy Director, CEA); Sandeep Malik (Director CEA); P.K. Gupta (Director CEA); M. Tripathi (Director CEA); Rakesh Goyal (Director CEA); S. Biswas (CE, CEA); P.C. Kunal (CE, CEA); I.S. Bawa (CE, CEA); P.K. Shukla (CE, CEA); P.C. Jiloha (CE, CEA); B. Kumar (Dy. Director, CEA)	--	CEA & CWC	13.3.	15:00-17:00	JH, HL & ZK

Appendix C: Documentary Evidence

Ref	Author / Organisation	Title	Year	Notes
1	NHPC Communication Department	Office Order – Authorized representative for interacting with stake holders, media, NGOs, Opinion Leaders etc.	2013	
2	NHPC Corporate Office	CSR & SD Communication Strategy	n.d.	http://www.nhpcindia.com/writereaddata/Images/pdf/csr_sd_comm_policy.pdf
3	NHPC	Corporate Identity Manual	2008	
4	NHPC	Main IMS Communication Procedures (Publicity, Media Relations and Printing, Sports and Culture)	2017	
5	NHPC	Procedures and Guidelines for Social Media Activities in NHPC	2018	
6	Various Sikkim newspapers	Examples for press articles about Teesta-V	2018	English, Hindi and Nepali
7	NHPC	From the CMD's Desk (6 last monthly internal newsletters)	2018-19	
8	NHPC	Risk Management Policy	2015	
9	NHPC	Integrated Management System Procedures and Manual, Teesta – V Power Station ISO 9001:2015, ISO 14001:2015 & OHSAS 18001:2007	2017	
10	NHPC	Teesta-V Power Station Quarterly Risk Report October-December	2018	
11	Gol, Ministry of Heavy Industries & Public Enterprises	Amendment to the public Procurement Policy for Micro & Small Enterprises (MSEs) Order, 2012	2018	
12	NHPC	Circular regarding Amendment to Public Procurement Policy for Micro & Small Enterprises (MSEs)	2018	
13	CEA	Techno-Economic Clearance	1999	
14	Comptroller and Auditor General of India	Report for the year ended 31 March 2017 Union Government (Commercial) Report No. 18 of 2018 General Purpose Financial Reports of Central Public Sector Enterprises (Compliance Audit)	2017	https://cag.gov.in/content/report-no18-2018-compliance-audit-general-purpose-financial-reports-central-public-sector
15	Comptroller and Auditor General of India	Report on Capacity Utilisation, Electricity Generation, Sale and Collection of Revenue including Disaster Management by Hydro Power CPSEs (NHPC Limited, SJVN Limited, THDC India Limited and NHDC Limited) No. 41 of 2015 (Performance Audit)	2015	https://cag.gov.in/content/report-no-41-2015-performance-audit-capacity-utilisation-electricity-generation-sale-and
16	NHPC	Telephone Directory of Teesta-V Power Station	2019	
17	NHPC	Corporate Environment Policy	2016	http://www.nhpcindia.com/EnvironmentPolicy.htm

18	NHPC	Corporate Social Responsibility & Sustainability Policy of NHPC (Revision-II)	2017	http://www.nhpcindia.com/csr-policy.htm
19	NHPC	Annual Report 2017-18	2018	http://www.nhpcindia.com/NHPC-annual-reports.htm
20	NHPC	Organization Structure	2019	http://www.nhpcindia.com/organisation-structure.htm
21	NHPC	Memorandum and Articles of Association	1975	http://www.nhpcindia.com/moa.htm
22	GoI, Ministry of Heavy Industries and Public Enterprises	Guidelines on Corporate Governance for Central Public Sector Enterprises (CPSEs)	2010	https://dpe.gov.in/publications/guidelines-corporate-governance-cpses-2010
23	NHPC	Codes of Business Conduct and Ethics (for Senior Management Personnel, for Board Members)	2014	http://www.nhpcindia.com/Default.aspx?id=170&lg=eng&
24	NHPC	Share Holding Pattern after Capital Restructuring as on 25.01.2019	2019	http://www.nhpcindia.com/shareholding-pattern.htm
25	NHPC	Standard procurement contract package	2019	
26	NHPC	IMS Circular: Internal Audit Schedule Teesta-V	2019	
27	NHPC	Teesta-V Power Station Non-Conformance Report IS/ISO 9001:2015, IS/ISO 14001:2015 & IS/ISO 45001:2018 Internal Audit from 04.02.19 to 06.02.19	2019	
28	NHPC	Examples for IMS Compliance report follow up by Auditee divisions	2018	
29	NHPC IA Wing, LO Kolkata	Internal Audit Report Teesta-V Power Station (for the period 01.03.2018 to 31.07.2018)	2018	
30	NHPC IA Wing, Corporate Office	Internal Audit Reports Estate Management Services, Planning, Arbitration, CSR, Security, Corporate Communications, E&M Store, Store EMS, Store IT, Training & HRD Divisions (for the period 01.02.2018 to 31.08.2018)	2018	
31	Environment and Pollution Control Division, GoS	Environmental Impact Assessment Report of 510 MW Teesta Hydroelectric Project Stage-V, Sikkim	n.d.	
32	Environment and Pollution Control Division, GoS	Details of Public Hearing and Environmental Management Plans for 510 MW Teesta Hydroelectric Project Stage-V, Sikkim	n.d.	
33	Wildlife Institute of India	Ecological Assessment of Teesta Hydroelectric Project Stage-V, Sikkim	2000	
34	GoS, Office of the Divisional Forest Officer	Estimates to NHPC for revegetation of Dikchu dam site (Bio-engineering)	2010, 2013	
35	Environment and Soil Conservation East and North Districts	Documentation of Bio-Engineering Works at Dam Site	2015	

36	NHPC	Implementation of Environmental Management Plans in Teesta-V Power Station_15.11.2017	2017	Presentation
37	Centre for Inter-Disciplinary Studies of Mountain & Hill Environment, University of Delhi	Environment Impact Assessment and Environmental Management Plan of Teesta Stage-IV H.E. Project, Sikkim	2014	
38	RS Envirolink Technologies	Post-Construction EIA Study of Dhauliganga Power Station (280 MW)	2018	
39	NHPC	Request for Proposals for Post-Construction EIA Study of Teesta-V Power Station (510 MW)	2018	
40	NHPC	Contract for Post-Construction EIA Study, NHPC	2018	
41	RS Envirolink Technologies	Post-Construction EIA Study of Teesta-V Power Station (510 MW) - Inception Report	2018	
42	Gol, Ministry of Environment, Forest and Climate Change	Standard terms of reference (TOR) for EIA/EMP report for projects/activities requiring environment clearance under EIA notification, 2006	2015	http://environmentclearance.nic.in/writereaddata/Online/TOR/10_Oct_2018_1701269306T9MQDWGTORforDistaleries.pdf
43	NHPC and MSTC	Agreement on e-waste and scrap disposal	2016	
44	NHPC	Confirmation regarding handling of biomedical waste	2019	
45	NHPC	Details of Muck Disposal Sites of Teesta-V HEP with Present Status	2019	
46	Centre for Inter-Disciplinary Studies of Mountain & Hill Environment, University of Delhi	Carrying Capacity Study of Teesta Basin in Sikkim (commissioned by Ministry of Environment and Forests, Gol) 10 volumes	n.d.	http://www.sikenvi.nic.in/Data base/Teesta_Basin_2964.aspx
47	NHPC	Swachhata Hi Seva Report (clean-up day at power station)	2018	
48	NHPC	Report to Deutsche Bank & Nexi (March 2018) on Implementation of Environmental Management Plans	2018	
49	Drs Tripathi and Bajpayee (NHPC)	Development of Teesta-V (510 MW) HE Project, Sikkim, India: Contribution to Three Pillars of Sustainable Development	2010	Hydropower 2010 Conference Paper
50	NHPC	Environment & Diversity Management Department: Roles & Responsibilities	n.d.	
51	LMS	Certificates of Compliance 2014-2017 for NHPC ISO 9001:2008, ISO 14001:2008, OHSAS 18001:2007	2014	
52	BSI	Certificate of Registration 2016-2019 for NHPC SA 8000:2014	2016	
53	URS	Certificates of Registration 2017-2020 for NHPC	2017	

		ISO 9001:2015, ISO 14001:2015, OHSAS 18001:2007		
54	NHPC	Integrated Management System Policy	2017	
55	NHPC-TÜV SÜD	Work order for testing of air emissions, noise levels and wastewater plant effluents at Teesta-V	2017	
56	Forest, Environment and Wildlife Management Department, GoS	A Detailed Report on Implementation of Catchment Area Treatment Plan of Teesta Stage-V HEPP	2007	http://www.sikkimforest.gov.in/Reports%20and%20Publications/CAT%20TSV.pdf
57	NHPC	Six-monthly progress reports on environmental aspects (March 2017, Sept. 2017, March 2018, Sept. 2018)	2017-18	http://www.nhpcindia.com/six-monthly-progress-report.htm
58	NHPC	Environment – Key Areas	2019	http://www.nhpcindia.com/Default.aspx?id=102&lg=eng&
59	NHPC	Report on Flower Show organised in Teesta-V Power Station	2019	
60	NHPC	Minutes of Ninth Meeting of Multi-Disciplinary Central Level Monitoring Committee for Teesta (Stage-V) Power Station held on 15 th July 2010	2010	
61	NHPC	Minutes of Tenth Meeting of Multi-Disciplinary Central Level Monitoring Committee for Teesta (Stage-V) Power Station held on 15 th November 2017	2017	
62	NHPC	Environment Statement Form – V for the Financial Year Ending 31st March, 2018	2018	
63	NHPC	Report on World Environment Day Celebration in Teesta-V Power Station	2018	
64	NHPC	Submission of duly filled-in Application Forms to the State Pollution Control Board for renewal of Consents / Authorizations for 2018-19	2018	
65	NHPC	Scope of Work – Running and Maintenance of Solid Waste Treatment Plant and Collection of Waste	2018	
66	Ministry of Environment and Forests, GoI	Environment Clearance Forest Clearance	1999	
67	Affected Citizens of Teesta (ACT)	Deficiencies at Teesta Stage V	n.d.	http://www.actsikkim.com/stagev.html
68	Menon & Vaghlikar	Environmental and Social Impacts of Teesta V Hydroelectric Project, Sikkim: An Investigation Report		static.esgindia.org/campaigns/moef-suno2005/Teesta%20%20Dam%20Sikkim.doc
69	Forest Department, GoS	Chapter 3: Water Resources	n.d.	http://www.sikkimforest.gov.in/soer/Water%20Resources.pdf
70	Kausila Timsina	Assessment of Changes in Hydrologic Regime of the Teesta River by Teesta-V HEPP	n.d.	https://swat.tamu.edu/media/115757/h1-3-timsina.pdf
71	NHPC	Daily inflow-outflow data	2018	
72	National Green Tribunal	Order on E-flow (August 09, 2017)	2017	http://www.indiaenvironmentportal.org.in/files/environmental

				%20flow%20of%20river%20India%20NGT%20Order.pdf
73	NHPC	Reservoir Operation and Silt Flushing Guidelines (Rev 3)	2017	
74	NHPC	Hydro-Meteorological Observation Manual	2018	
75	Forum of Load Despatchers / Power System Operation Corp. (POSOCO)	Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India	2017	https://posoco.in/download/fold-posoco-report-on-operational-analysis-for-optimization-of-hydro-resources/?wpdmdl=14168
76	NHPC	Discharge and gauging data, January –March	2019	
77	Central Electricity Authority	Review of Performance of Hydro Power Stations 2017-2018	2018	http://www.indiaenvironmentportal.org.in/content/460276/review-of-performance-of-hydro-power-stations-2017-18/
78	NHPC	Monthly Generation, Plant Availability, and Forced Outages Targets and Data 2008-2018	2018	
79	NHPC	Action Taken Report on Observations raised in Technical Inspections up to 20 th Technical Inspection dated 15.-16.3.2018	2019	
80	NHPC	Annual Maintenance Schedules for 3 Units 2008-2018	2019	
81	NHPC	Detailed Maintenance Schedule for Each Unit	2019	
82	NHPC	Letter of Award for Spillway Maintenance Work, 24.12.2018	2018	
83	NHPC	Summary and Detailed Reports on Regular Annual Maintenance 2018-2019	2019	
84	NHPC	Yearly Generation Report for NHPC Fleet, 2017-2018	2018	
85	NHPC	Power Generation Hourly Logbook	2019	
86	NHPC	Research and Development – New Initiatives	2019	http://www.nhpcindia.com/new-initiatives.htm
87	NHPC	IMS Procedures for Monitoring of Power Stations, Analysis of Tripping Reports Received from Power Stations, Coordination with External Agencies, Planning for Renovation & Modernisation of Power House Equipment, Technical Support/Assistance – Generating Unit Breakdown, Processing of Purchase Proposals Pertaining to Powerhouse Equipment, Technical Inspection, Maintenance Reports	2019	
88	National Institute of Hydrology	Dam Break Analysis for preparation of Emergency Action Plan and Inundation Map - Teesta-V Power Station Sikkim	2016	
89	NHPC	Assessment of Slope Degradation in Tolung Chu Valley	2008	
90	N.S. Parameshwaran, General Manager O&M, NHPC	Hydro abrasive erosion – Experience and Mitigation	n.d.	http://www.ahec.org.in/archives/Abrasive_erosion_workshop/presentations/first_session/Hydro_Abrasive_Erosion_ppt_NHPC.pdf
91	NHPC	Dam Instrumentation Data January 2019	2019	

92	Central Water Commission	Revised Design Floods	2011	
93	NHPC	Dam Safety Observations and Actions Teesta-V	2019	
94	Disaster Management Authority, East District Sikkim	Disaster Management Plan 2016-2017	2016	https://eastsikkim.nic.in/ddmae/
95	NHPC	Teesta-V Power Station (510 MW) Instrumentation	n.d.	
96	NHPC	The details of sirens and Mode of Operation; Siren Location Map	n.d.	
97	NHPC	Disaster Management Plan Teesta-V (Ed 1, Rev 1)	2019	
98	NHPC	Emergency Action Plan Teesta-V (Ed 3, Rev 1)	2019	
99	Central Water Commission	Advisory Sheet: Glacial Lake Outburst Flood – South Lhonak System in Teesta River Basin	2015	http://164.100.229.55/sites/default/files/admin/glof-south-lhonak-system-teesta-basin-final.pdf
100	Aggarwal et al	Glacial lake outburst flood risk assessment using combined approaches of remote sensing, GIS and dam break modelling	2016	Geomatics, Natural Hazards and Risk, 7:1, 18-36, DOI: 10.1080/19475705.2013.862573
101	Central Water Commission	Guidelines for Safety Inspection of Dams	2018	https://damsafety.in/ecm-includes/PDFs/Guidelines_for_Safety_Inspection_of_Dams.pdf
102	Mandal & Chakrabarty	Flash flood risk assessment for upper Teesta river basin: using the hydrological modelling system (HEC-HMS) software	2016	Model. Earth Syst. Environ. 2:59 DOI 10.1007/s40808-016-0110-1
103	Central Water and Power Research Station	Teesta Dam Spillway Stage-V, Sikkim	n.d.	http://cwprs.gov.in/WriteReadData/file/onepage%20-%20water%20resources/TEESTA%20%20DAM%20SPILLWAY%20STAGE%20%E2%80%93%20V,%20SIKKIM.pdf
104	NHPC	Post-Monsoon Dam Safety Inspection	2018	
105	NHPC	Pre-Monsoon Dam Safety Inspection	2018	
106	NHPC	Revised Standard Operation Procedure for Adopting Measures for Protection of People Living in Downstream Area for Emergency such as Sudden Release of Water from Dam	2016	
107	NHPC	Safety Manual (Rev 1)	2017	
108	NHPC	IMS Procedures for Safety Monitoring, Monthly Check List, Inspection, Investigation and Root Cause Analysis of Accident	2019	
109	NHPC	Safety Policy for Power Stations	n.d.	
110	Martha et al	Assessment of the Valley-Blocking ‘So Bhir’ Landslide Near Mantam Village, North Sikkim, India, Using Satellite Images	2017	Current Science, Vol. 113, No. 1228 7, 10 October 2017
111	Anupam Chakravartty	Sikkim High Court Issues Notice to State Government on Landslide Dam	2016	https://www.downtoearth.org.in/news/natural-disasters/sikkim-high-court-issues-notice-to-state-

				government-on-landslide-dam-55354
112	CERC	Petition No. 27/GT/2013 Approval of generation tariff of Teesta-V for period 1.4.2009 to 31.3.2014	2009	http://www.cercind.gov.in/2014/orders/SO27.pdf
113	CERC	Petition No. 234/GT/2014 Revision of tariff after truing-up exercise for the period 2009-14 and determination of tariff for 2014-19 in respect of Teesta-V Hydroelectric Project (510 MW)	2016	http://www.cercind.gov.in/2016/orders/234T.pdf
114	CERC	Tariff Regulations for 2019 to 2024	2019	http://www.cercind.gov.in/2019/regulation/Tariff%20Regulations-2019.pdf
115	ICRA	NHPC Ltd Rating, December 2018	2018	https://www.icra.in/Rationale/Index?CompanyName=NHPC%20Limited
116	NHPC	Teesta-V Power Station Budgets 2018-2019 and 2019-2020	2019	
117	NHPC / Ray & Ray Chartered Accountants	Audited Teesta-V Balance Sheet as at 31st March 2018 Audited Teesta-V Statement of Profit & Loss for the year ended 31st March 2018	2018	
118	Eastern Regional Power Committee	Revised Allocation of Power from Teesta-V	2008	
119	NHPC-GRIDCO	Power Purchase Agreement	2017	
120	New India Assurance Co.	Mega risk, standalone terrorism, third-party liability and comprehensive package policy (2018-19)	2019	
121	GoI, Ministry of Power	Note for Cabinet Committee on Economic Affairs on Teesta-V	1999	
122	NHPC	Memorandum for Public Investment Board on Approval of Teesta-V	1999	
123	NHPC	Memorandum for Public Investment Board on Completion Cost (Revised Cost Estimate) of Teesta-V	2011	
124	Kendriya Vidyalaya, NHPC Singtam	Class-X and Class-XII Exam Results	2018	
125	Various local entities	Requests for support from NHPC Teesta-V	2018-19	
126	GoS-NHPC	Memorandum of Understanding for support of the Industrial Training Centre, Chandey	2017	
127	Vimal Khawas (Department of Geography, Sikkim University)	Benefits Sharing in Hydropower Projects: The case of CSR in the Upper Tista Basin, Eastern Himalaya International Workshop on Benefit Sharing in Hydropower: Examples from Nepal and implications for other countries in the Hindu Kush Himalayas	2016	https://www.researchgate.net/publication/329060388_Benefits_Sharing_in_Hydropower_Projects_The_case_of_CSR_in_the_Upper_Tista_Basin_Eastern_Himalaya
128	NHPC	Free Power from NHPC Power Stations in Eastern Region (1992-93 up to Dec. 2018)	2018	
129	Energy & Power Department, GoS	Proceedings before Sikkim State Electricity Regulatory Commission	2018	http://sserc.in/sites/default/files/True%20Up%20%20for%20FY

		True-up for the FY 2017-18, Review for the FY 2018-19 & ARR & Tariff Proposal for the FY 2019-20		%202017-18%2C%20APR%20for%20FY%202018-19%20%26%20Tariff%20Proposal%20for%20FY%202019-20.pdf
130	NHPC	Scholarship Award Scheme	n.d.	
131	National Skill Development Corp.	NHPC CSR Skill Development Project	2018	
132	NHPC	Teesta-V 2013-2018 CSR Budgets	2019	
133	NHPC	Teesta-V 2015-2018 CSR Reports, February 2019 Progress Report	2019	
134	NHPC-University of Sikkim	Impact assessment study of CSR & SD activities for Teesta-V, Teesta-IV, Rangit Power Stations	2019	
135	NHPC	Internal email on CSR activities in Lum and Rakdong villages	2017	
136	Lum Village	Letter with Requests to General Manager, Teesta-V	2019	
137	Ministry of Corporate Affairs, GoI	General Circular: FAQs with regard to Corporate Social Responsibility under section 135 of the Companies Act, 2013	2016	
138	GoI	The Land Acquisition Act	1894	https://www.prsindia.org/uploads/media/Land%20Acquisition/bill167_20080311167_The_Land_Acquisition_Act__1894.pdf
139	GoI	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act	2013	http://www.legislative.gov.in/sites/default/files/A2013-30.pdf
140	GoS	Sikkim Human Development Reports	2001, 2014	http://hdr.undp.org/en/content/sikkim-human-development-report https://www.sikkim.gov.in/stateportal/Link/Sikkim%20Human%20Developent%20Report%202014.pdf
141	GoS	Sikkim: A Statistical Journal (Draft)	2013	https://www.sikkim.gov.in/stateportal/UsefulLinks/Sikkim%20A%20Statistical%20Journal%202013%20(DRAFT).pdf
142	OECD	Fiscal Decentralisation and Inclusive Growth. Chapter 4: The effects of central-government transfers to states in India	2017	http://www.oecd.org/tax/federalism/fiscal-decentralisation-and-inclusive-growth.pdf
143	NHPC	Project Layout Plan with Boundaries of Acquired Plots	n.d.	
144	Sharma et al	Water conflicts and benefits related to hydropower projects: A case study from Sikkim	2019	https://www.google.com/search?q=Water+conflicts+and+benefits+related+to+hydropower+projects%3A+A+case+study+from+Sikkim&rlz=1C1CHBF_enAU741AU741&oq=Water+conflicts+and+benefits+related+to+hydropower+projects%3A+A+case+study

				+from+Sikkim&aqs=chrome..69i57.2238j0j8&sourceid=chrome&ie=UTF-8
145	Lum village resident	Letter to Minister, Department of Power, GoS, regarding employment in project	2010	
146	Subba	Impact of Hydropower on the Economy of Sikkim	2015	http://14.139.206.50:8080/jspui/bitstream/1/3154/1/Anita%20Subba.pdf
147	Chandy et al	Impacts of Hydropower Development on Rural Livelihood Sustainability in Sikkim, India: Community Perceptions	2012	Mountain Research and Development, Vol. 32, No. 2, pp. 117-125 https://www.jstor.org/stable/mounresedeve.32.2.117
148	Land Revenue and Disaster Management Department, GoS	Title Deeds of land acquired by NHPC under Lum-Gor-Sanqtok and Tanqyek Blocks, North Sikkim	2018	
149	Ministry of Rural Development, GoI	National Rehabilitation and Resettlement Policy	2007	https://dolr.gov.in/sites/default/files/National%20Rehabilitation%20%26%20Resettlement%20Policy%2C%202007.pdf
150	NHPC	Rehabilitation and Resettlement Plan for Oustees of Teesta Stage-V HEP	n.d.	
151	Power Department, GoS	Approved Rehabilitation and Resettlement Plan under Teesta Stage-V HEP	2003	
152	NHPC	Minutes of Meetings regarding Follow up action for the implementation of Rehabilitation & Resettlement Plan for the Project Affected Families	2006	
153	NHPC	R & R Initiatives	2019	http://www.nhpcindia.com/r-and-r-initiative.htm
154	NHPC	Teesta-V Data on Land Acquisition, Resettlement and Implementation of R&R Plan	2019	
155	NHPC	Letter to Mr Tamang, regarding allocation of plot Nr. 3 at R&R colony	2008	
156	Ministry of Power, GoI	Press Release: NHPC Fulfilling its Social Obligation in the Rangit and Teesta Stage-V Projects	2012	http://pib.nic.in/newsite/PrintRelease.aspx?relid=90577
157	NHPC	List of land oustees in job and training	2019	
158	NHPC	List of Scheduled Tribe employees of NHPC in Sikkim and in Teesta-V	2019	
159	Ministry of Tribal Affairs, GoI	Statistical Profile of Scheduled Tribes in India	2013	https://tribal.nic.in/ST/StatisticalProfileofSTs2013.pdf
160	Centre for Environment, Water and Power Consultancy Services	Ethnographic Study: Impact of Teesta-V HEP Sikkim on the tribal communities with special reference to Lepchas and Bhutias	1999	
161	Prasad Chetri	Tribal Population and Development Policies in the Himalayan state of Sikkim: A Critical Analysis	2013	International Journal of Humanities and Social Science Invention www.ijhssi.org

				Volume 2 Issue 5, May 2013, pp.08-18
162	Subrata	Hydro Power Development and the Lepchas: A case study of the Dzongu in Sikkim, India	2013	International Research Journal of Social Sciences, Vol. 2(8), 19-24, August
163	Lum village	Letter with Requests to General Manager, Teesta-V	2017	
164	Indigenous Lepcha Tribal Association	Letter to The Chief Minister, GoS: Appeal to protect Dzongu, the holy Land of Lepchas	2007	
165	NHPC	Conduct, Discipline and Appeals Rules	1979	
166	NHPC	Office Order: Introduction of New Grade W-0 in the Workmen Category	2002	
167	NHPC	List of awareness raising sessions participated in by the medical team during 2018 regarding OHS issues	2019	
168	NHPC	Pay scale W-0 grade and wages for contract labour	2019	
169	NHPC	Mock drills in year 2018 & Mock drill Plan 2019	2019	
170	NHPC	Monthly Labour Report to Joint Labour Commissioner, GoS for March 2019	2019	
171	BIS	Teesta-V Licence for the OH&S Management Systems Certification 2016-2019	2016	
172	NHPC	Constitution of Committee for Ensuring Statutory Compliance w.r.t. Contractor's Employees	2018	
173	NHPC	Circular on Mode of Payment to Contract Labour	2014	
174	NHPC	Circular on Compliance with Labour Laws	2014	
175	NHPC	Fraud Prevention and Detection Policy (revised)	2016	http://www.nhpcindia.com/writereaddata/images/pdf/NHPCFraudPrevention-Detectionpolicy-may16.pdf
176	NHPC	Whistle Blower Policy	2012	http://www.nhpcindia.com/writereaddata/images/pdf/wbp.pdf
177	NHPC	Medical Attendance Rules, modified 2018	1979	
178	NHPC	Health statistic in project area of Teesta V power station	n.d.	
179	NHPC	Grievance Policy and Procedure	1979	
180	NHPC	Grievance Redressal Authority Reconstitution	2016	
181	NHPC	Teesta-V Manpower Sanctioned and Proposed	2019	
182	NHPC	List of Contract Workers	n.d.	
183	NHPC	Mock Drill Report on Emergency Exercise on Vehicle Accident	2018	
184	Cultural Affairs & Heritage Department, GoS	Cultural Resource Mapping, 4 Vols.	n.d.	
185	Archaeological Survey of India	List of Ancient Monuments and Archaeological Sites and Remains of Sikkim	n.d.	http://asi.nic.in/asi_monu_alphalist_sikkim.asp

186	Forest, Environment and Wildlife Management Department, GoS	Sacred Groves of Sikkim	2011	http://www.sikkimforest.gov.in/Reports%20and%20Publications/SacredGroves/Sacred%20Grooves%20of%20Sikkim%202011%20Edition%20FEWMD.pdf
187	Sikkim Bhutia Lepcha Apex Committee (SIBLAC)	Ancient Laws	2019	http://www.siblac.org/laws.html
188	Ministry of Health and Family Welfare, GoI	National Family Health Survey (NFHS-4) 2015-16 India Fact Sheet, Sikkim Fact Sheet, North Sikkim Fact Sheet, East Sikkim Fact Sheet, South Sikkim Fact Sheet	2016	http://rchiips.org/nfhs/factsheet_nfhs-4.shtml
189	NHPC	Monthly Report Medical Wing Teesta-V (February)	2019	
190	NHPC	Monthly Statement Communicable Diseases (January)	2019	
191	GoS	State Health Information and Statistics (infrastructure, HIV/Aids, etc)	2019	http://sikkimhealth.gov.in/
192	GoS	Biodiversity of Sikkim: Exploring and Conserving a Global Hotspot	2011	https://www.researchgate.net/publication/319836796_Biodiversity_of_Sikkim_Exploring_and_Conserving_a_Global_Hotspot
193	GoS	Bio-Diversity Statistics of Sikkim	2016	http://www.sikenvis.nic.in/Data base/Biodiversity_776.aspx
194	Toppo et al	Fish Biodiversity as an Indicator of Riverine Status of Sikkim	n.d.	http://sikkimforest.gov.in/Reports%20and%20Publications/Biodiversity-of-Sikkim/12%20Fish_221-232%20web.pdf
195	Bhatt et al	Environmental impact assessment of river valley projects in upper Teesta basin of Eastern Himalaya with special reference to fish conservation: a review	2017	Impact Assessment and Project Appraisal, 35:4, 340-350 http://dx.doi.org/10.1080/14615517.2017.1354642
196	Allen et al (IUCN)	The Status and Distribution of Freshwater Biodiversity in the Eastern Himalaya	2010	https://www.iucn.org/content/status-and-distribution-freshwater-biodiversity-eastern-himalaya
197	NHPC and Forest, Environment & Wildlife Management Department, GoS	Documentation regarding implementation of Wildlife Management Plan, including Butterfly Park	2004-12	
198	NHPC and Directorate of Fisheries, GoS	Documentation regarding implementation of Fisheries Management Plan	2010-18	
199	NHPC	Documentation regarding fisheries management in Teesta Lower Dam III and IV projects, including fish passage effectiveness study	2017	
200	NHPC	Daily/hourly weather, suspended sediment, and water level data	2018	

201	NHPC	Flushing data for June, August, September	2018	
202	NHPC	Annual post-monsoon reservoir cross-section data Comparison of reservoir elevation, area and capacity	2009-17	
203	NHPC	Standard technical specifications for HP-HVOF coating of underwater parts	2011	
204	NHPC and Forest, Environment & Wildlife Management Department, GoS	Correspondence relating to breaking of boulders near Teesta-V tailrace	2018-19	
205	Ojha	Sediment Management at Teesta III - A Case Study	2014	International Journal for Technological Research in Engineering, Vol 2, Issue 3, November
206	TÜV-SÜD	Test Reports River Water, Drinking Water, Ambient Air Quality – Teesta-V	2019	
207	Archana Tiwari	Water quality and quantity analysis in Sikkim, North Eastern Himalaya	2012	Current Science, Vol. 103, No. 1, 10 July 2012
208	Wiejaczka et al	Reservoir's Impact on the Water Chemistry of the Teesta River Mountain Course (Darjeeling Himalaya)	2018	Ecol Chem Eng S. 2018; 25(1):73-88
209	The Pioneer	Utilise storage in NHPC project to minimise Sikkim flood: CWC	2016	https://www.dailypioneer.com/2016/india/utilise-storage-in-nhpc-project-to-minimise-sikkim-flood-cwc.html
210	NHPC	Proposal for installing real time online e-flow measurement devices at dams/barrages of all NHPC projects/power stations and setting up a centralised e-flow monitoring centre at the corporate office	2018	
211	NHPC	Teesta-V procurement requisition for continuous flow measurement and data logging system	2019	
212	National Institute of Hydrology, Roorkee	Study Report on Environmental Flows from Proposed Dam of Teesta Stage-IV Project	n.d.	
213	Syed et al	The Teesta Basin: Enough water for power and agriculture for all? HI-AWARE Working Paper 12	2017	https://www.researchgate.net/publication/322634708_The_Teesta_Basin_Enough_water_for_power_and_agriculture_for_all
214	Central Electricity Authority	The National Electricity Plan 2018	2018	http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf
215	Srivastava & Khan (NHPC)	NHPC's Hydropower Projects - A Stride Towards Carbon Trading	2010	Hydropower 2010 Conference Paper
216	VCS	Teesta-V APX VCS Registry Project status	2019	
217	Arrawatia & Tambe (eds.)	Climate Change in Sikkim: Patterns, Impacts and Initiatives	2012	http://www.sikkimforest.gov.in/climate-change-in-sikkim/climate%20change%20in%20sikkim%20-

				%20patterns%20impacts%20and%20initiatives.htm
218	IRENA	Renewable Energy Prospects for India	2017	https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/May/IRENA_REmap_India_paper_2017.pdf
219	Wester et al (ICIMOD)	The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People	2019	https://www.researchgate.net/publication/330157745_The_Hindu_Kush_Himalaya_Assessment_Mountains_Climate_Change_Sustainability_and_People
220	NHPC	Photographs of Existing Water Supply Scheme at Teesta-V R&R Colony, Khamdong and of Assessment of Water Supply Restoration work at R&R Colony, Report on Assessment for Restoration of Water Supply (Annexes I and II to Comments on Draft Report)	2019	
221	NHPC	Circular: Environmental and Social Performance Review and Monitoring in NHPC's Projects/Power Stations (Annex IIa to Comments on Draft Report)	2019	
222	NHPC/Rural Development Department, GoS/North District Sikkim	Minutes of the Meeting of Grievances of Project-Affected Area People with NHPC, 30.4.2005; Minutes of the Meeting held on 22.8.2003 in the Chamber of H.M. Rural Development Department, Regarding NHPC Financial Support for Model Villages (Annex III to Comments on Draft Report)	2003 , 2005	
223	NHPC	Teesta-V Makha Fish farm Development- Chronology of Events; Letter NHPC to Directorate of Fisheries GoS regarding River Ranching of Golden Mahseer in Teesta-V reservoir and awareness programme on riverine fisheries conservation; photographs of Water Supply Restoration at Fish Farm at Makha-Teesta-V PS; Teesta-IV Fishery Management Plan (Annexes IV, V and VI to Comments on Draft Report)	2019	
224	NHPC	Annex VII to Comments on Draft Report: Topics O-4 and O-20	2019	
225	NHPC	Annex VIII to Comments on Draft Report: Topic O-14	2019	
226	TÜV-SÜD	Annex IX to Comments on Draft Report: Topic O-17 (additional drinking water test results)	2019	
227	NHPC	Annex X to Comments on Draft Report: Topic O-12	2019	
228	Dam Safety Review Panel	Inspection Report of Teesta-V Dam, East Sikkim	2019	

Appendix D: Visual Evidence



Photo 1: Planned Upstream Teesta-IV Dam Site



Photo 2: Vegetation Growth at a Catchment Area Treatment Location



Photo 3: Works in Progress at Butterfly Reserve



Photo 4: Works in Progress at Butterfly Reserve 2



Photo 5: Landslides on Right Bank of Reservoir



Photo 6: Landslide on Right Bank of Reservoir



Photo 7: Reservoir at Dikchu Showing very high Suspended Sediments



Photo 8: Debris in Reservoir at Dam



Photo 9: Reservoir at Dikchu Showing Temple



Photo 10: Dam Showing Multiple Water Discharge Points, with Road Stabilization Works in Foreground

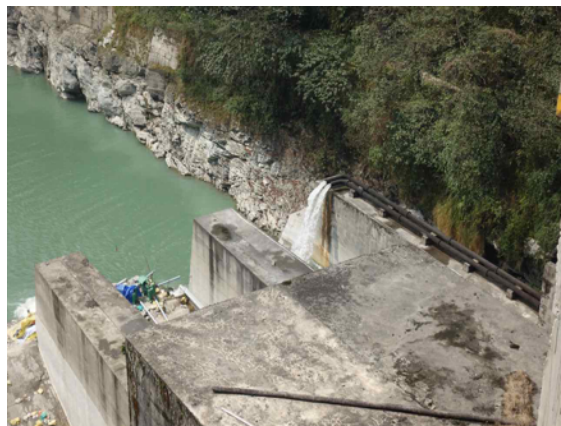


Photo 11: Environmental Flow Discharge Pipes



Photo 12: PPE and Safety Equipment at Dam

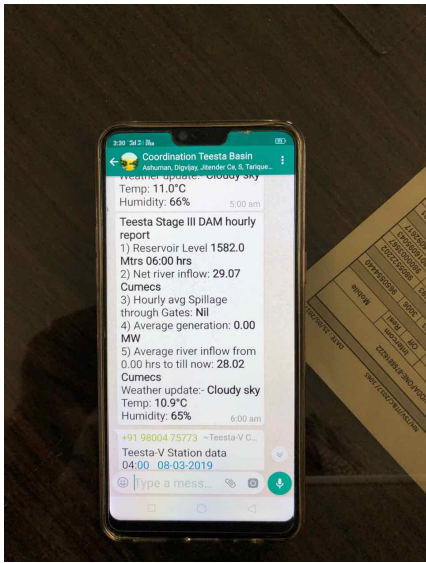


Photo 13: WhatsApp Coordination Group for Teesta basin

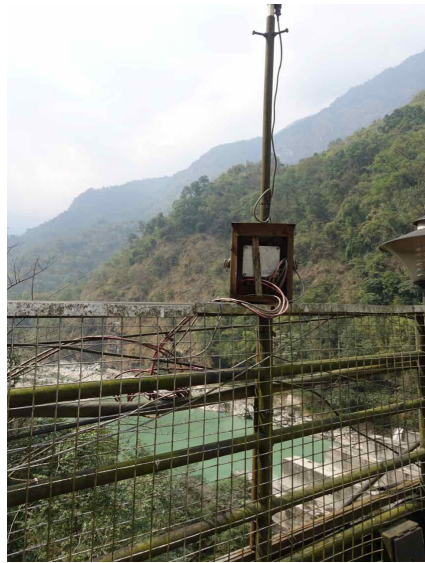


Photo 14: Exposed Electrical Wires at Dam



Photo 15: Spillway Maintenance



Photo 16: Spillway Maintenance 2



Photo 17: Dam Emergency Exit Plan Signage



Photo 18: Gas Bottles near Intake at Dam Site



Photo 19: Downstream View from Dam Showing Road on Right Bank to Lum Village



Photo 20: Meeting Lum villagers with Teesta-V Management and Assessors



Photo 21: Steep Slopes and Landslide on Right Bank between Dam and Powerhouse



Photo 22: Water Quality Sampling Location near Adit III



Photo 23: Rehabilitated Muck Dump at Dung Dung Village used by Local Community



Photo 24: Teesta River near Fish Hatchery



Photo 25: Fish Hatchery Ponds



Photo 26: Boulders and Cremation Site near Makha Bridge and Adit III between Dam and Powerhouse



Photo 27: Lower Samdong Village



Photo 28: Signs for Electrification Campaign and for CSR Livelihoods Training at Dam Colony

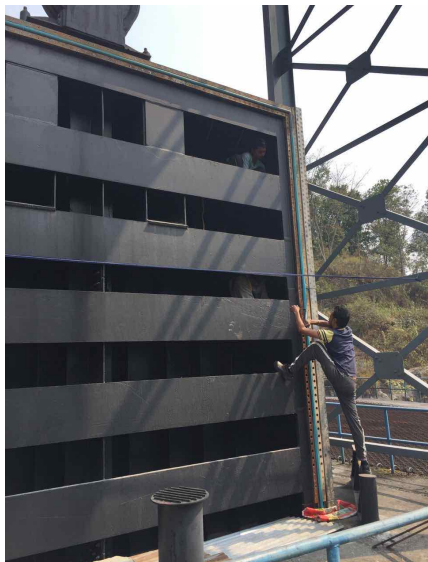


Photo 29: Repairs at Surge Shaft Gates



Photo 30: Monitoring of Cracks at Surge Shaft

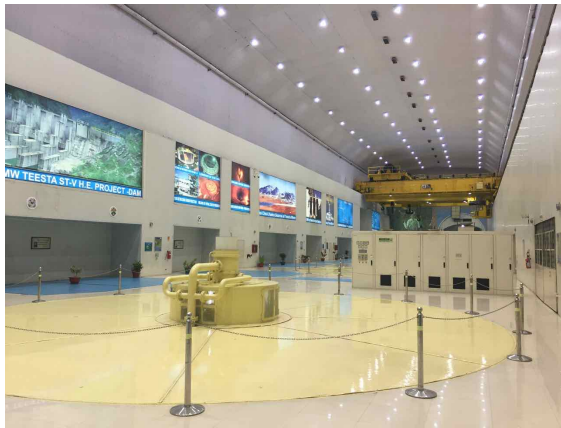


Photo 31: Powerhouse Interior

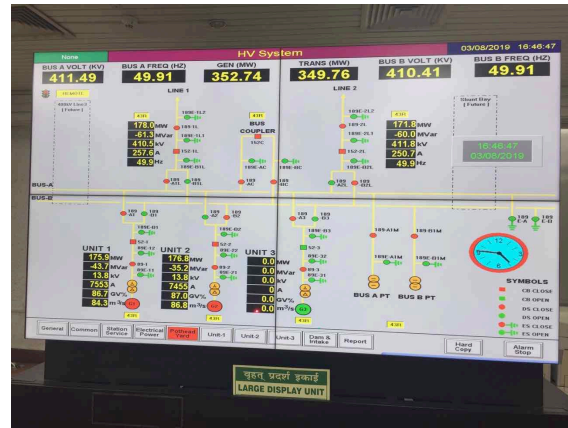


Photo 32: Control Room Displays



Photo 33: Safety Rules Signage at Powerhouse

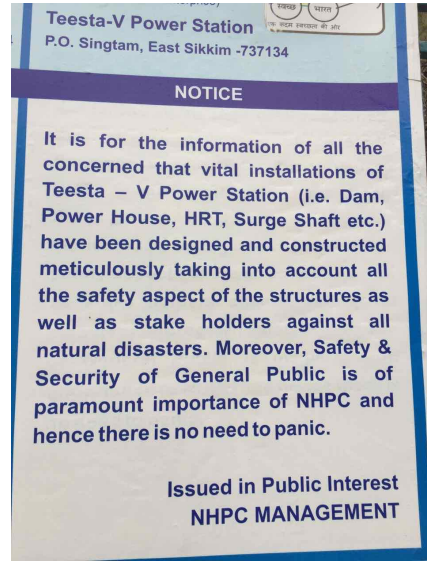


Photo 34: Public Safety Signage at Powerhouse



Photo 35: Fire Hazard



Photo 36: Fire Assembly Point Signage



Photo 37: Fire Station at Powerhouse

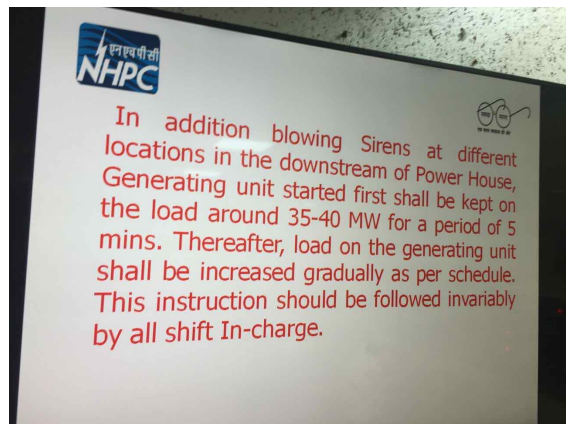


Photo 38: Safety Reminder in Control Room



Photo 39: Erosion Damage to Runner

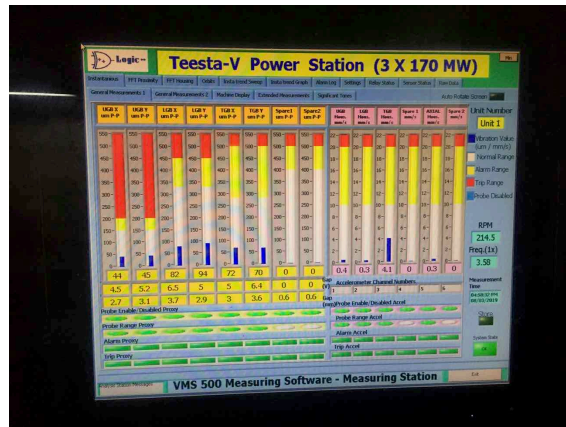


Photo 40: Vibration Monitoring Display



Photo 41: Teesta River at Powerhouse Showing Right Bank Protection Damaged by Boulders



Photo 42: Repairs at Tailrace

Hydro Declaration - Declaration Details Tables

Date: 08-03-2019 Published Time: 08-03-2019 07:19:24

Hydro Moderation Spillage: 5 = 3351.00

Time Block	Time Desc	DC	Injection Schedule
64	15:45-16:00	0	0
65	16:00-16:15	0	0
66	16:15-16:30	0	0
67	16:30-16:45	168	168
68	16:45-17:00	168	296
69	17:00-17:15	336	336
70	17:15-17:30	336	336
71	17:30-17:45	529	504
72	17:45-18:00	529	504
73	18:00-18:15	529	504
74	18:15-18:30	529	504
75	18:30-18:45	529	504
76	18:45-19:00	529	504

Photo 43: Generation Schedule as Proposed to and Confirmed by ERLDC

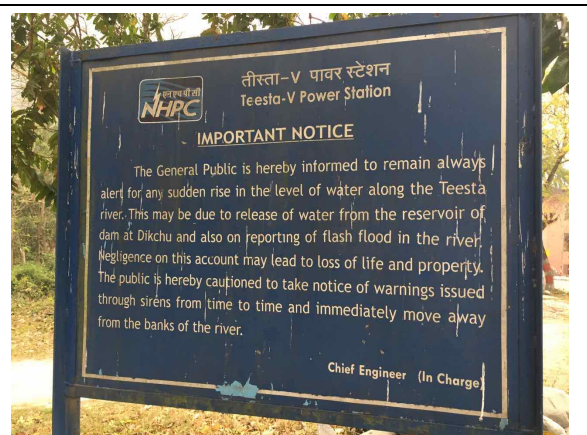


Photo 44: Safety Signage in Powerhouse Colony



Photo 45: Temporary Storage of Turbine Oil in Powerhouse



Photo 46: Spare Parts in Central Store



Photo 47: Gravel Extractors Opposite Tailrace



Photo 48: Private Quarry Opposite the Powerhouse



Photo 49: Powerhouse Colony with Neighbouring Village and Industries



Photo 50: Conditions in Village next to Powerhouse Colony



Photo 51: Drainage and Water Supply in Village next to Powerhouse Colony



Photo 52: Rehabilitated Land Converted to Playing Field



Photo 53: Farm House next to Powerhouse Colony



Photo 54: Farm Terraces next to Powerhouse Colony



Photo 55: Housing in Powerhouse Colony



Photo 56: Housing in Powerhouse Colony 2



Photo 57: Litter at Powerhouse Colony



Photo 58: Environmental Awareness in Sikkim



Photo 59: Solid Waste Separation & Composting Plant



Photo 60: Solid Waste Stockpile Waiting Separation



Photo 61: Waste Separation in Central Store



Photo 62: Waste Separation in Central Store 2



Photo 63: Unbundled Fuel Storage at Substation



Photo 64: Emergency Preparedness Plan

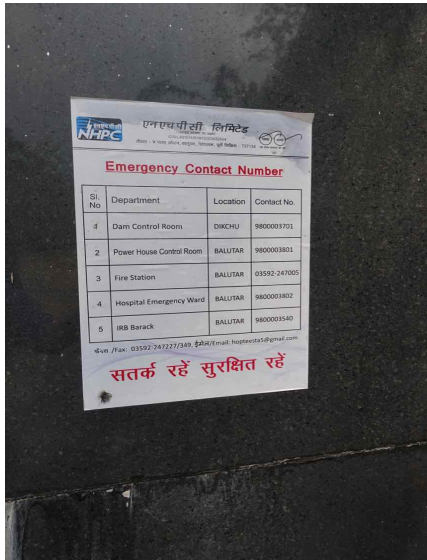


Photo 65: Emergency Contact Numbers signage



Photo 66: Award for Best NHPCL Power Station



Photo 67: Filing System Deficiencies

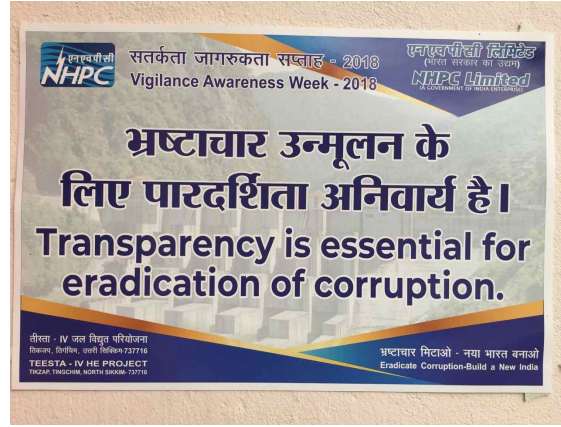


Photo 68: Vigilance Awareness Week Sign



Photo 69: 800 kW Solar Project on Powerhouse Colony Hospital



Photo 70: Evacuation Plan Signage

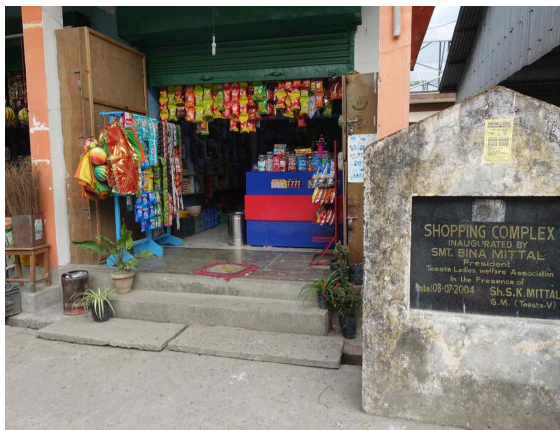


Photo 71: Shops at Powerhouse Colony



Photo 72: Electrical Safety Risk



Photo 73: Temple in Powerhouse Colony

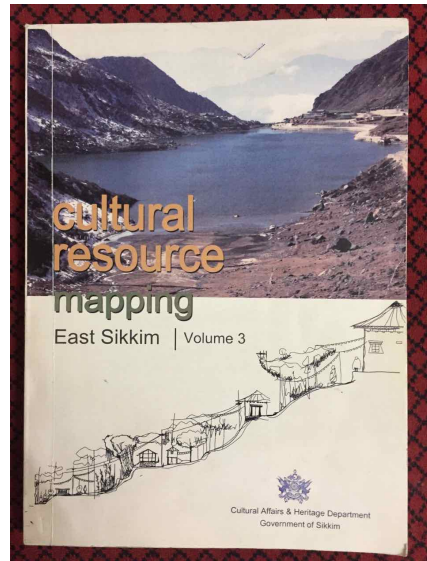


Photo 74: State Government Cultural Heritage Mapping



Photo 75: Recognition from State Government



Photo 76: First Aid Equipment with Missing Information



Photo 77: Resettlement Colony Gate



Photo 78: Overview Resettlement Colony



Photo 79: Meeting with Resettled Families Employed by NHPC

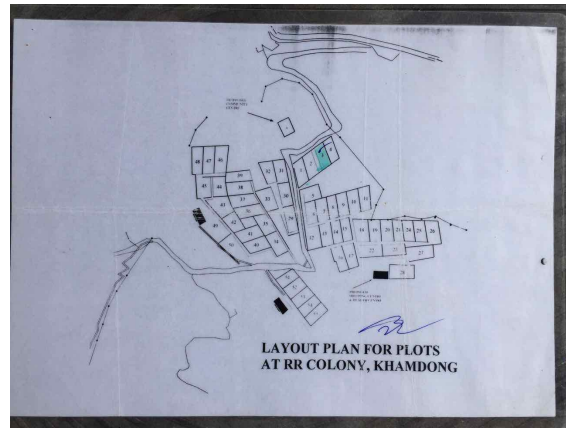


Photo 80: Allotment of Plots in Resettlement Colony



Photo 81: Disused Dispensary and Shops at Resettlement Colony



Photo 82: Waste Disposal at Resettlement Colony

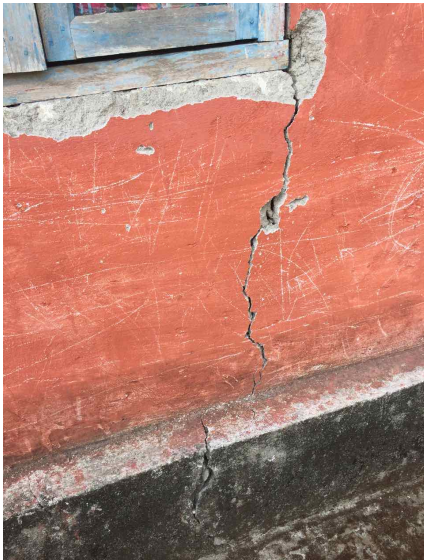


Photo 83: 2011 Earthquake Cracks in Resettlement Home

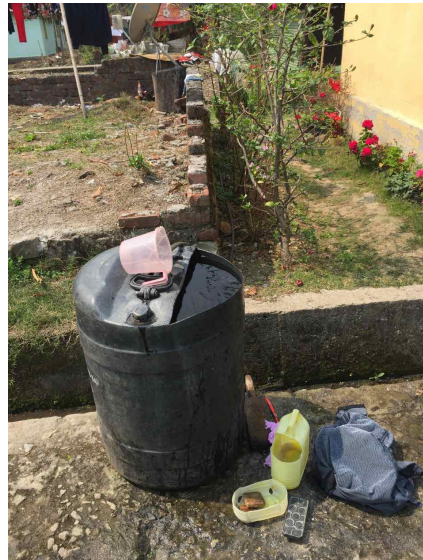


Photo 84: Privately Organised Water Supply at Resettlement Colony

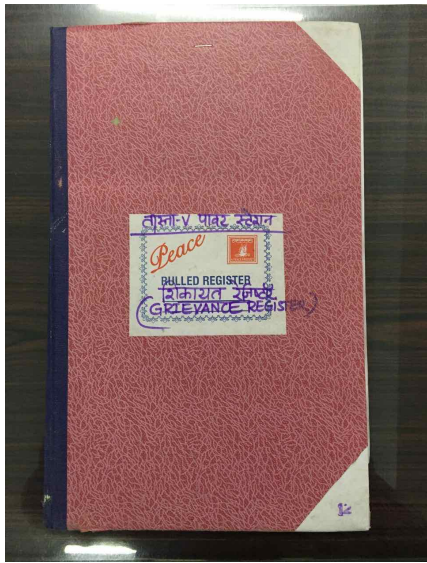


Photo 85: Grievance Register



Photo 86: Home of Resettled NHPC Employee



Photo 87: Informal Interview Downstream near Teesta-VI Dam



Photo 88: Gravel Mining near Teesta-VI Dam



Photo 89: Downstream Teesta-VI Dam with Algae Growth Indicating Water Level Fluctuations during Dry Season



Photo 90: Downstream Urban Development at Singtam



Photo 91: Red Cloth Showing Dry Season Water Level Fluctuation Range at Melli



Photo 92: Recreation Activities at Confluence of Teesta and Rangit



Photo 93: Whitewater Rafting Business at Melli



Photo 94: Whitewater Rafting Sign at Melli



Photo 95: Landslide near Rangit and Teesta Confluence



Photo 96: Downstream Reservoir of Teesta Low Dam III



Photo 97: Fish Passage on Teesta Low Dam IV



Photo 98: Teesta River entering the Plains at Sevoke