Bhutan Electricity Authority

Thimphu Bhutan

REPORT
ON
HYDROPOWER PROJECT COST OVERRUN

December 2017

EXECUTIVE SUMMARY

Cost overrun in mega hydropower projects is a common news headline around the world. Millions of Ngultrum and months of delays are experienced for the bigger project. Study on international assessment of construction cost overruns for electricity infrastructure had seen an average cost escalation of **70.6%** for **61 hydropower projects**, with cost escalation as high as **513%**. Similar study had been conducted by World Commission on Dams and noted a relatively lower average cost overrun of **21%.** The average cost overrun according to the report for sub-region of Latin America, Central and **South Asia** are 53%, 108% and **138%** respectively.

For ongoing hydropower projects in Bhutan, the cost overruns are as in the table below:

Hydropower project	Installed Capacity (MW)	Cost overrun (%)
Mangdechhu Hydroelectric Project Authority	720	39.92
Punatsangchhu Hydroelectric Project Authority I	1200	166
Punatsangchhu Hydroelectric Project Authority II	1020	93

The explanations for the cost overruns and delays for hydropower projects are largely on account of inflation being not considered in the initial cost estimates to get project pass through, geological surprises, design changes, increase in installed capacity and construction of additional infrastructures.

The report also highlights the roles and responsibilities of Bhutan Electricity Authority (BEA) and regulatory agencies of six other countries pertaining to construction of hydroelectric projects. The regulatory agency has limited or no role if it is a de-licensed activity. However, if it is a licensed activity, the hydroelectric projects has to adhere to the license terms and conditions or to any other relevant legal documents. The project specific cost overrun issues are discussed in the case study and most of the cost overrun are incurred due to poor estimate, corrupt practices and handover problems etc.

TABLE OF CONTENTS

1. INTRODUCTION

The report on hydropower project cost overrun is prepared as per the directives of the BEA Commission during the 58th Commission meeting held on 19th July 2016 to study the ongoing practices followed in and outside the region.

The report presents research findings on the overview of cost overrun trends in hydropower projects across the globe, case studies, hydropower construction license application procedures and status of cost overruns for ongoing hydropower projects in our country.

Moreover, the commission during the 60th Commission meeting held on 23rd November 2016 directed to conduct a study on the roles and responsibilities of the regulatory agencies of countries in and around the region and BEA with regard to cost overrun roles and responsibilities. There are different means of handling the roles and responsibilities on cost overrun issues and largely depends on the rules and regulations in place. Some regulatory agency do not issue license and left for market forces to take care of it. In some country cost overrun issues are taken hold of through Power Purchase Agreements.

2. RESEARCH METHODS

The primary source of information presented in this report about the cost escalation is data base that are compiled from authentic sources to the extent possible. The information related to cost escalation were collected from online sources and newspapers. Since the information have been gathered from available national papers, research articles and special reports, the contents were not corrected example like percentage escalated cost etc. from the involved party(s).

It was very arduous to congregate the desired information about the cost overrun aspects of hydropower project of other countries through this desktop research. It was also impossible to obtain very explicit information with regard to fixing accountability for incurrence of cost overruns in building hydropower plants mainly because of paucity of information made in public domain. Considering the objective of the research and reliability of the sources, online available information pertaining to the cost overrun issues of few countries which were made available in the public domain were studied and presented.

3. GLOBAL SCENARIO OF COST OVERRUN IN HYDROPOWER PROJECTS

An international comparative assessment of construction cost overrun had been carried out in 2014 for sixty one (61) hydroelectric projects across the globe for project costs worth about USD 271.50 billion, constituting of 113.77GW of installed capacity. It was found out that these projects experienced collective cost overruns of USD 148.60 billion which translated to average cost escalation of 70.6%. The hydroelectric projects with cost overruns exceeding 100% are as given below:

Year	Name of the project	Installed Capacity (MW)	Country	Cost overrun (%)
2006	Sardar Sarovar dam	1450	India	513
2011	Bakun Hydroelectric Project	2400	Malaysia	417
2012	Three Gorges Dam	22,500	China	402
1978	Sayano-Shushenskaya	6400	Russia	353
1979	La Grande 2	2106	Canada	246
1976	Nurek	3015	Tajikistan	200
1950	Vinstra	1360	Norway	190
1977	Kabira Stage 2	1626	Zimbabwe	177
1981	Robert-Bourassa	5616	Canada	143
1986	Chixoy	300	Guatemala	136
2009	Longtan dam	6426	China	113
1986	Guri (Raul Leoni)	10,235	Venezuela	101

Source: An International Comparative Assessment of Construction Cost Overruns for Electricity Infrastructure.

The World Commission on Dams (WCD) had conducted similar studies. As per the report published by WCD in 2000, the average cost overrun for hydropower dams was about 21%. However, it was noted that performance in sub-region of Latin America, Central and South Asia with cost overruns averaging 53%, 108% and 138% respectively. In the report of WCD the cause of cost variations are categorized as follows:

i) Poor development of technical and cost estimates and supervision by sponsors.
ii) Technical problem that arose during construction.
iii) Poor implementation by suppliers and contractors.
iv) Change in external conditions (economic and regulatory).

The WCD also reported that part of the developing accurate projections for the construction costs of large dams is that the geotechnical conditions at the site (quality of undercover conditions). Further, discovery during construction are less favorable site conditions than those estimated in the engineering designs and construction plans can be a significant contributor to cost overruns and time delays of the projects.

As highlighted in the report 'Managing the Cost Overrun Risks of Hydroelectric Dams', the political influence could be the cause of the cost overruns. When the interest of the politician was involved the project cost were strategically kept low to go ahead with project and avoid criticism.

4. CASE STUDY REPORT ON ISSUES REGARDING COST VARIATIONS

4.1 Sawra Kuddu Hydroelectric Project (India)

The 111MW Sawra Kuddu hydroelectric project in Himachal Pradesh, India was a state-run project with the grant from ADB. Total cost of the project has been estimated at Rs. 5.58 billion (DPR cost of March 2003 price level) including interest during construction (IDC). Cost of generation has been worked out as Rs. 2.52 per unit at powerhouse bus bar after taking into account IDC.

Cause of the cost overruns: As per the report of the Comptroller and Auditor General, India there was slow progress by the contractors (slow progress of HRT lining), inadequate provisioning of some works in the detailed project report, subsequent change in design, poor geology in HRT and late handing over the sites to contractors. Treatment of entire grant amount as a loan amount to the power corporation by charging 10% p.a. Favoring the contractor, Aban Coastal Joint venture for construction of headrace tunnel (HRT), where Aban failed to execute the work properly from the initial stage.

Result: Project delayed by more than five years (January 2012 to June 2017). The project incurred Rs 1.00 billion for the change in design for the diversion barrage. The treatment of the grant amount to loan added Rs 1.26 billion on the project cost. Taking such aspects resulted in a cost increase from **Rs 5.58 billion** to **Rs. 11.81 billion** of 2012 price level (**increase of 111 %**). The contract with Aban terminated in 2014 due to dismal performance. As per the latest report the project will be completed in stipulated time by January, 2019 (of around 96 months delay) in-spite of all adverse conditions.

4.2 Neelum-Jhelum Hydropower Project (Pakistan)

The 969MW Neelum–Jhelum hydropower Plant (NJHP) in Pakistan was intended to begin in 2002 and to be completed in 2008, but the project could not be started due to lack of upfront funds. However, the funds were made available in 2007 and contract for the work was awarded to Chinese consortium CGGC-CMEC in the same year. The estimated cost of the project was Rs. 90.94 billion (2007 price level). The duration to complete the project is 9 years from 2008 to 2016.

Cause of the cost overruns: Design changes, and corrupt practices involved in purchasing the tunnel boring machine as pointed out by Transparency International Pakistan (NGO).

Result: No action was taken by the National Accountability Bureau, Pakistan and Pakistan government against the finding report submitted by the Transparency International Pakistan. The new estimated project cost after the fourth increase is **Rs 500.00 billion** which will be **491.7%** more than the initial estimated cost of **Rs. 84.55 billion** (price level of 2002). The project is expected to bring its first unit to operations at the end of February 2018 and full capacity by May 2018.

4.3 Parbati II Plant (India)

The 800MW Parbati II hydropower plant in Himachal Pradesh, India was a state-run project under the charge of National Hydro Power Corporation (NHPC). The investment cost approval for the proposed 800MW Parbati II project was Rs. 39.19 billion (DPR cost of December 2001 price level).

Cause of the cost overruns: As per the report of the Comptroller and Auditor General, India the work was awarded to ineligible contractor by relaxing the pre-qualification criteria and ignoring the non-fulfillment of eligibility conditions. Delay in revised forest clearance, out-off condition of tunnel boring machine in 2006, slide in power house area in April 2004 and flash flood in 2004, 2005, 2010 & 2011. Conflict of interest, the Chairman of the project committee was also the member on the board of directors of Nagarjuna Construction Company who was one of the partners to the sole project contractor called HJV.

Result: The project is still in progress (for more than 14 years) and the latest estimated investment cost is **Rs 83.98 billion** of 2015 price level **(increase of 114%)**.

4.4 Muskrat Falls Hydroelectric (Canada)

The Muskrat Falls hydroelectric of 842MW in Newfoundland and Labrador (N&L), Canada was constructed at Muskart falls on the lower Churchill River. The facility consist two power houses and it will be the second largest hydropower facility in the province once constructed.

Cause of overruns: The Ernst & Young (EY) LLP (government hired agent to review the assessment of Nalcor Energy's the planner, designer and contractor of the project cost, management and execution) highlighted that the estimation of cost and timeline were unreasonable and lapses in management for execution of the project by the contractor.

Result: Cost increase to **USD 12.7 billion** from **USD 6.20 billion (104% increase)** and delayed by several months which is expected to complete by 2019. The president and CEO of the Nalcor Energy along with the entire board quitted mentioning it had lost the government's confidence.

4.5 Gilgel Gibe II Power Station (Ethiopia)

The 420MW Gilgel hydropower plant is located in south of Ethiopia. The contract was awarded to Salini Costruttori, Italy in 2005 and was expected to be completed by late 2007. The total cost of project was estimated to be around **Euro 382.00 million** (2004 price level).

Cause of the cost overruns: The contract was awarded without competitive bidding, without a feasibility study and construction started without the legally requirement of environmental permit. Poor geological studies had overlooked sandy soils and other unexpected problem and therefore had to redesign the tunnel path.

Result: The project got delayed by three years. 15 meters of the 26KM long tunnel collapsed 10 days after commissioning the project on January 2010 and was repaired on December, 2010. Completion cost was **Euro 493.00 million** which is **29.05%** increase from the estimated project cost.

5. GENERAL TREND FOR CAUSES OF COST OVERRUN

Causes of cost overruns in hydropower projects are broadly classified into following categories based on the information gathered from several studies carried out across the globe.

a) **Inadequate prefeasibility studies:** A good detailed project report would lead to smooth implementation of a project. A poor prefeasibility study is characterized by one or more of the following:

   i) Poor project cost estimates.
   ii) Flaws in technical designs.
   iii) Lack of detailed study on geological aspects.

b) **Causes associated in the implementation phase:** Some prominent causes of cost overruns in the project implementation phase are:

   i) Lack of adequate supervision.
   ii) Inexperienced contractors.
   iii) Inefficient project management team.
   iv) Geological surprises.
   v) Design changes.
   vi) Political interference/Corrupt practices.

c) **Changes in external conditions:** In rare cases, the changes in external conditions such as significant change in economy of a country or regulatory aspects also contribute to cost overruns.

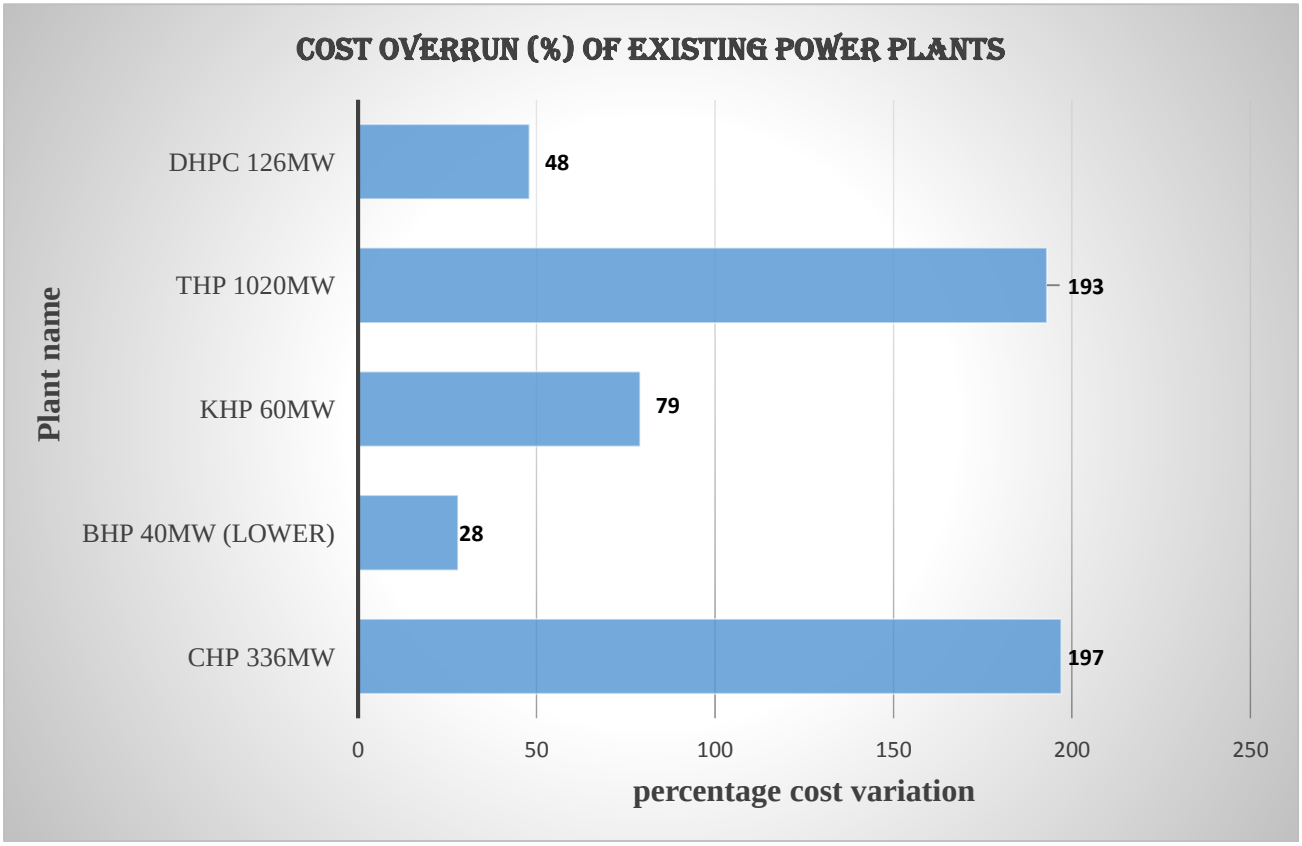
6. HYDROPOWER PLANTS IN BHUTAN

6.1 Established Hydropower Plants

The cost variations for the existing hydropower plants commissioned between the year 1988 and 2015 are as in the Table below. All costs are in million ngultrums.

Particulars	CHP (336MW)	BHP Upper (24MW)	BHP Lower (40MW)	KHP (60MW)	THP (1020MW)	DHP (126MW)
Project Period	1974-1988	1997-2001	2002-2004	1995-2002	1997-2007	2009-2015
DPR Cost	831.00	1,446.00	1,422.00	3,130.00	14,080.00	8,208.00
Actual Cost	2,465.00	1,440.00	1,821.00	5,600.00	41,258.00	12,516.00
Cost Variation	1,634.00	(6.00)	399.00	2,470.00	27,178.00	3,944.00
%Variation	197	(0.41)	28	79	193	48

Source: *Interim report to the 15th National Council Session on Review of Sustainable Hydropower Development Policy.*



6.2 Hydropower Projects Authority Under Construction

6.2.1 Mangdechhu Hydroelectric Project Authority, 720MW

As per the DPR prepared by M/s NHPCL the estimated cost of the project was Nu. 28.96 billion (March 2008 price level) without IDC. BEA issued the license to construct 720MW (4X180) hydroelectric plant on 24th April 2012 and is valid till 23rd April 2019. The revised cost estimate of the project vetted by CEA/CWC of Nu. 40.21 billion (March 2014 price level) was approved by GOI on 23rd March 2016.
The project has received Nu. 40.52 billion as of June 2017. (increase of 39.92%).

KUENSEL dated 23/Aug/2017

Mangdechhu project targets commissioning by June 2018

From Pg.1

All hydro-mechanical components of the work are expected to complete by April next year.

The progress report stated that the quality control and quality assurance division of the project has conducted 8,116 suitability tests during this quarter on different construction materials. "These tests signify that all necessary tests as per the quality assurance programme have been conducted and the use of specified materials has been assured."

It also stated that in addition to this, 53 advanced tests (chemical and mechanical which cannot be conducted in-house) were conducted at laboratories outside.

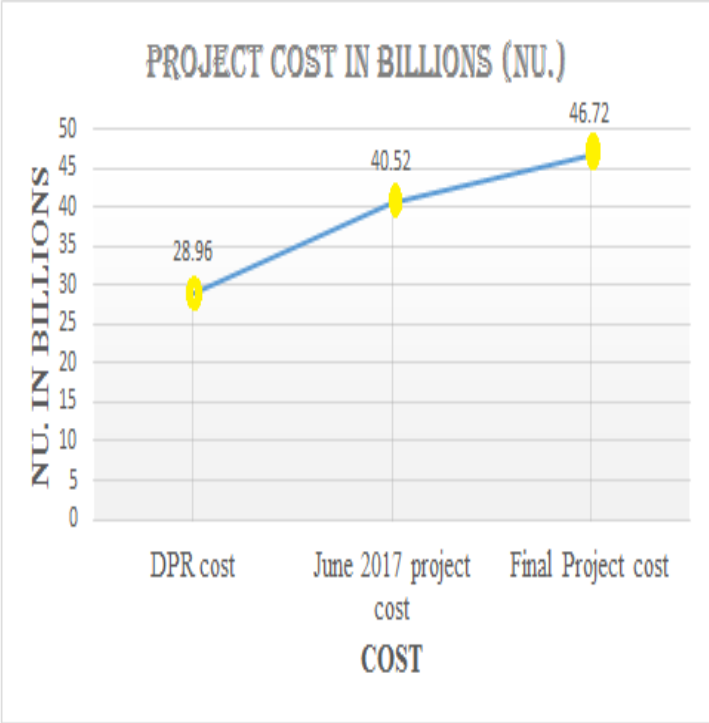
The managing director said that the cost per MW comes to around Nu 65M including the transmission lines.

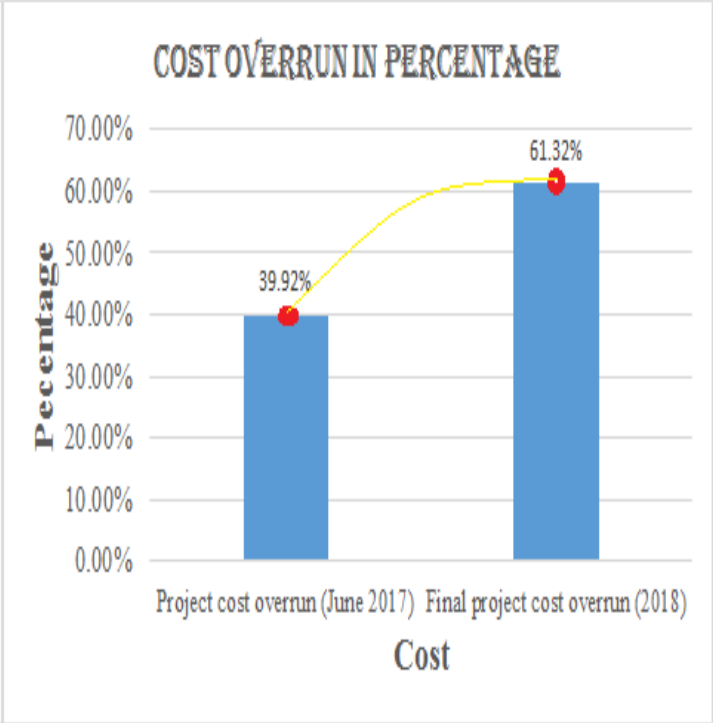
MHPA has built up manpower strength of 509, of which 471 (92.53 percent) are Bhutanese and 38 (7.47 percent) are Indian nationals.

The project cost as per the detailed project report (DPR) was around Nu 28.9B at 2008 price level, which was later revised to Nu 40.20B. The final cost which is yet to be approved (Nu 46.72B) is expected to be the final project cost.

As of June 30 this year, the project received Nu 40.52B, of which Nu 37.75B has been exhausted.

The bilateral agreement to execute the project was signed between the governments of India and Bhutan on April 30, 2010 with GoI funding of 30 percent grant and 70 percent loan at 10 percent annual interest to be paid back in thirty equated semi-annual installments.





Reasons for the cost escalation:

i) Inflation (Initial cost prepared without considering inflation).
ii) Additional construction of transmission line to Jigmeling substation, Gelegphu.

Source: MHPA website- **Dam and intake from upstream** **Dam from downstream**

Project cost details as per DPR and revised estimated cost of the project vetted by CEA/CWC at 2014 price level:

Sl. No.	Description	DPR Estimated Cost (A)	Revised estimate (B)	% Increase [(B-A)/A]*100
		(Million Nu.)		
1	Civil Works	15,794.46	19,013.90	28.38
2	Electro-Mechanical works	6,032.84	8,912.50	47.73
3	Transmission line	2,850.00	6,317.80	121.67
4	Others	4,285.50	5,962.10	39.12
Total		**28,962.80**	**40,206.30**	**38.82**

6.2.2 Punatsangchhu I- Hydroelectric Project Authority, 1200MW

As per the project cost (DPR prepared by WAPCOS ltd.) was Nu. 35.14 billion (March 2006 price level) without IDC. BEA issued license to construct 1095MW on 11th November 2008 and was vaild till 10th November 2015. The BEA further approved the extension of the license till 31st July 2019 (11 years). The project cost was Nu. 93.75 billion as of July 2015 (increase of 166%)

10 The Bhutanese

05-08-2017

Additional delay and costs in Punatsangchu I and II after NGI report

In the case of the P I project a major never development is that the NGI report has asked PIIPA to excavate large amounts of soil and rocks from a much higher place of 150 to 200 meters from the current point of excavation and stabilization.

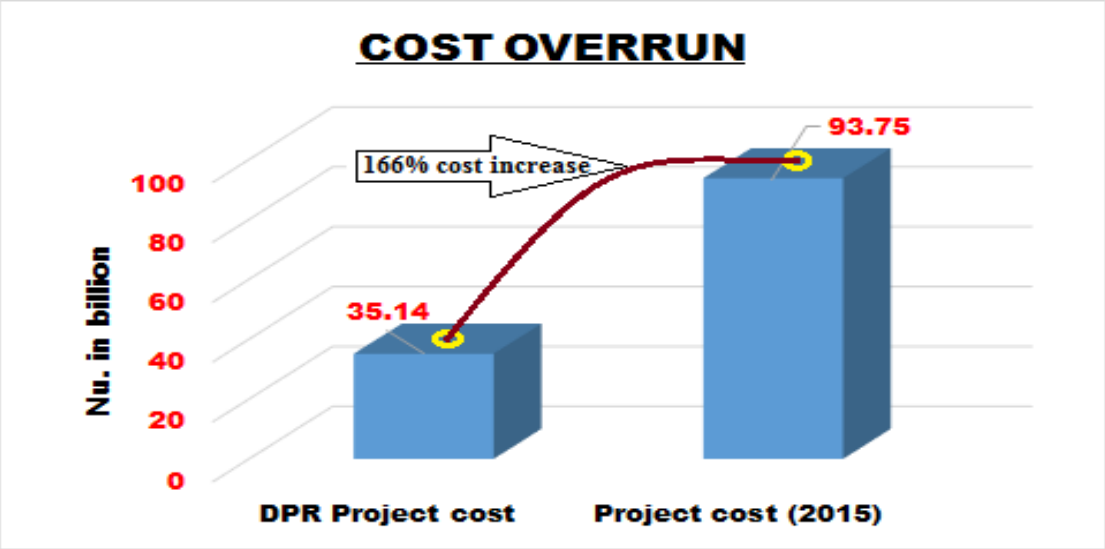
This would lead to less pressure on the slope from above but would also lead to a gentler slope. To achieve this benches of steps will have to be created at around 30 meters height along with cement grouting and 325 mm 'dia piling'.

P I in July 2013 saw a slide happening on its right bank and since then the CWC has done works to stabilize the slope in three phases with significant cost. The approach has been to do some work and then observe for slides. There was a Nu 3.5 bn price tag attached at the time for the rectification measures. However, even after the third phase of the rectification measures by CWC the machines detected a slide of 5 to 10 mm a month. This was the final push that got the Bhutanese side to recommend NGI for third party advice on the issue.

Given that the project was originally supposed to be completed by November 2016 this would mean around a six year delay. The last approved project cost of the project in July 2015 was around Nu 93.75 bn. The P I project has been plagued by delays and cost escalation on account of its dam relocation and the subsequent right bank slide.

Reasons for cost escalation are:

i) Inflation (Initial Project cost estimate prepared without considering inflation).
ii) Shifting dam location.
iii) Increase of capacity from 1095MW to 1200MW (additional of 105MW).
iv) Geological surprises (Sliding of right bank in 2013).
v) Dam related design changes (diversion tunnel, coffer dam, headrace tunnel, surge shaft, tail race tunnel, cable tunnel and addition of butterfly valves).



Source: PHPA I website

HEAD RACE TUNNEL

Source:: PHPA I website

POWER HOUSE

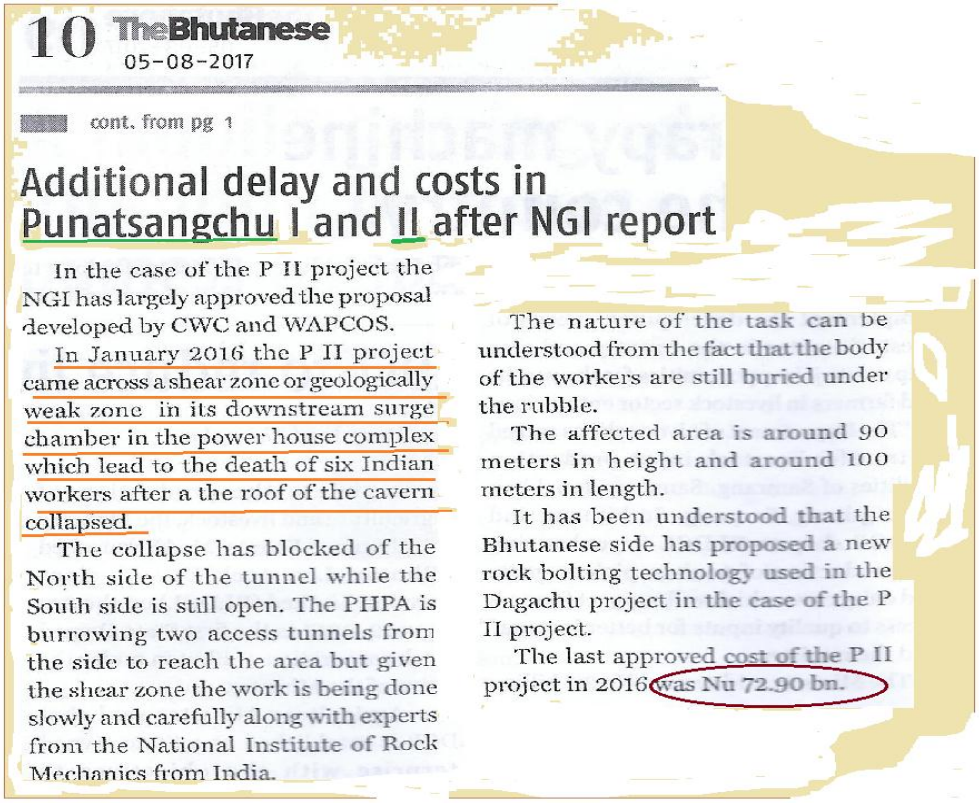
Project cost details as per DPR are as tabulated below:

Sl. No.	Descriptions	Cost Estimate (Nu. Million)
1	Civil works	20,498.20
2	Electro-Mechanical Works	10,576.70
3	Transmission line	4,073.20
Total		**35,148.10**

Further as per the report highlighted in the **TheBhutantese** dated 5th August 2017 the project completion date could move into mid-2022 or beyond (that is more than 14 years) due to the requirement of additional measures to strengthen the sliding right bank (excavate large amounts of soil and rocks from a much higher places of 150 to 200 meters from the current point excavation and stabilization) as per Norwegian Geological Institute recent study recommendation.

6.2.3 Punatsangchhu II Hydroelectric Project Authority, 1020MW

As per the DPR prepared by M/s WAPCOS ltd. the project cost was Nu. 37.77 billion (March 2009 price level). BEA issued license to construct 1020MW on 9th February 2012 and is valid till 8th February 2019. The revised project cost in 2016 was Nu. 72.90 billion (increase of 93%). The project is expected to be completed not before January 2020.



10 The Bhutanese
05-08-2017

cont. from pg 1

Additional delay and costs in Punatsangchu I and II after NGI report

In the case of the P II project the NGI has largely approved the proposal developed by CWC and WAPCOS.

In January 2016 the P II project came across a shear zone or geologically weak zone in its downstream surge chamber in the power house complex which lead to the death of six Indian workers after a the roof of the cavern collapsed.

The collapse has blocked of the North side of the tunnel while the South side is still open. The PHPA is burrowing two access tunnels from the side to reach the area but given the shear zone the work is being done slowly and carefully along with experts from the National Institute of Rock Mechanics from India.

The nature of the task can be understood from the fact that the body of the workers are still buried under the rubble.

The affected area is around 90 meters in height and around 100 meters in length.

It has been understood that the Bhutanese side has proposed a new rock bolting technology used in the Dagachu project in the case of the P II project.

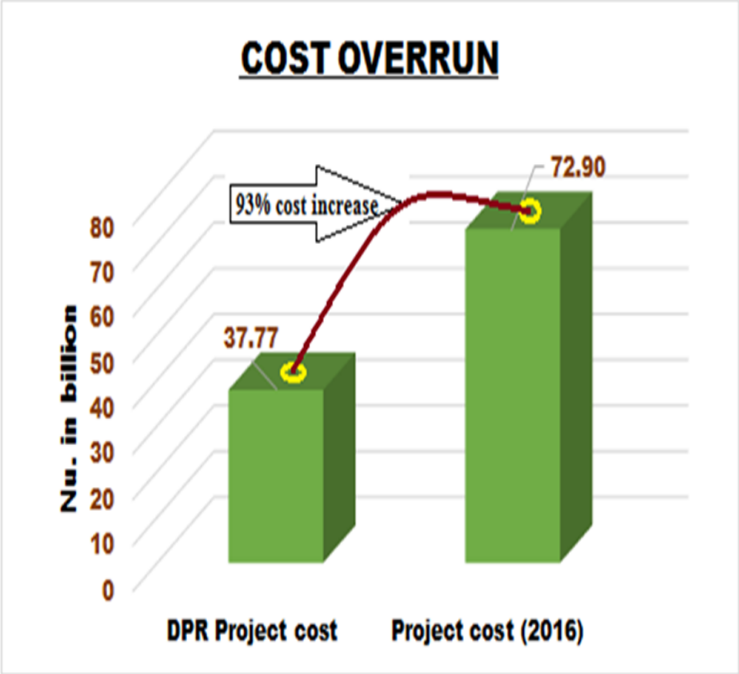
The last approved cost of the P II project in 2016 was Nu 72.90 bn.

Source:: PHPA website

Damsite

Reasons for cost escalation:

i) Inflation (initial cost prepared without considering inflation).
ii) Additional construction of 400 kV D/C transmission line from PHPA-II to Jigmeling, Gelegphu.
iii) Change from surface power house to underground power house.
iv) Requirement of additional reinforcement work in power house complex.
v) Increase in capacity from 990MW to 1020MW (additional of 30MW).
vi) Geological surprises.



Project cost details as per DPR

Sl. No.	Descriptions	Cost estimate (Nu. Million)
1	Civil works	27,620.95
2	Electro-Mechanical Works	9,957.06
3	Transmission line	200.00
Total		**37,778.01**

:

KUENSEL

THAT THE PEOPLE SHALL BE INFORMED

FRIDAY, AUGUST 18, 2017 • Nu 15

Roof collapsed portion

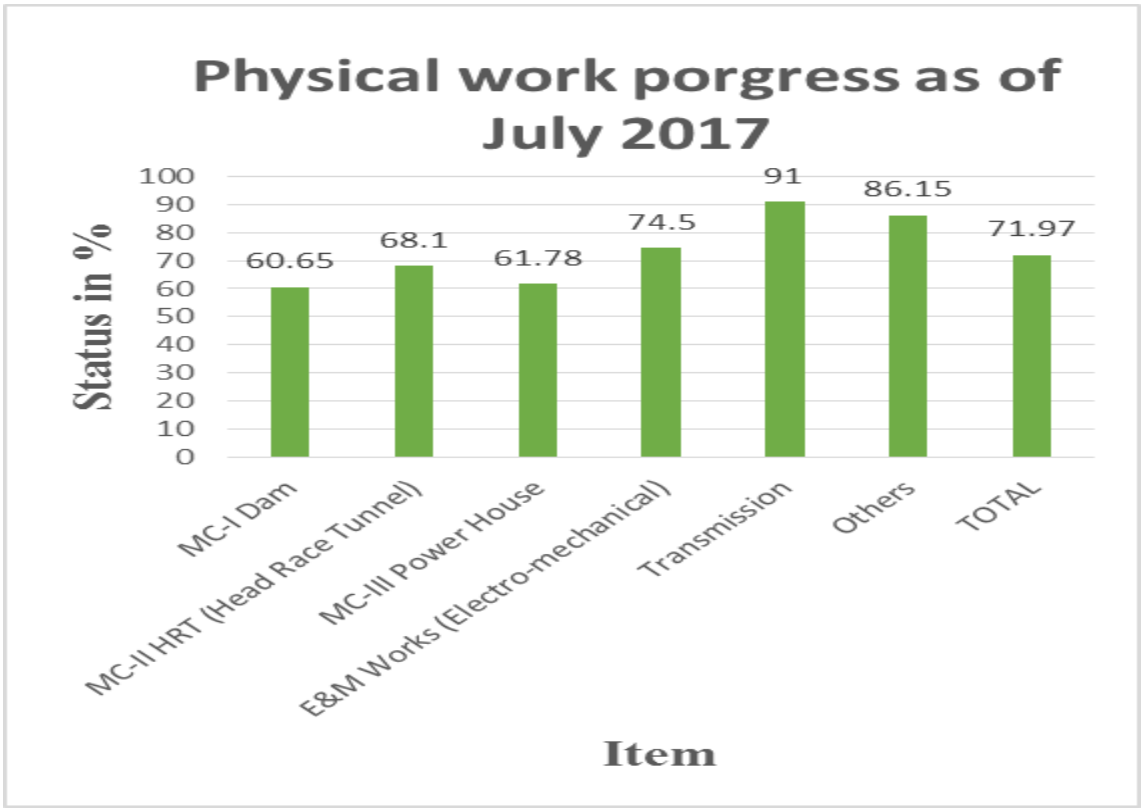
Work has stopped for more than a year at the downstream surge gallery of Punatsangchhu-II where the roof had collapsed and killed six people in March last year. Strengthening measures on the cavity above are yet to complete.

Briefly

Inside

HOME

» Yonphula Colleg
function independ
| PG.5




KUENSEL

THAT THE PEOPLE SHALL BE INFORMED

THURSDAY, AUGUST 24, 2017 • Nu 15

ke three months to clear the debris from the Punatsangchhu-II hydroelectric project dam in ephodrang

7 HYDROPOWER CONSTRUCTION AND INTERNATIONAL REGULATORY AGENCY

The roles/responsibilities of regulatory agencies of India, Norway, Uganda, Philippines, Sri Lanka, Pakistan and license enforcement aspects of the Energy Regulators Regional Association comprising of thirty (30) full member and six (6) associate members of regulatory agency were studied on the issue regarding cost overrun and time delay for the construction of hydropower projects. The study mainly referred the Electricity Acts and few available licensee conditions in the public domain of the respective regulatory agencies to know-how on the roles/onus in the event on project delays and cost overruns. The practically executed roles and responsibilities by the regulators on cost overruns and project delays issues/documents were not accessible through this desktop online research of the respective regulators website and also in other relevant sources. The Secretariat tried to gather some information through personal contacts during SAARC Council of Experts of Energy Regulators (Electricity) meeting held in Thimphu on 12th and 13th December 2016 and email correspondence on how such issues were tackled as per the prevailing laws and rules of their countries.

7.1 India

In India any generating company may establish, operate and maintain a generating station without obtaining a license as per the Electricity Act, if it complies with the technical standards relating to connectivity with the grid. So there is no direct role for the regulatory agency in the aspect of cost overrun and project delay.

7.2 Sri Lanka

As per the Electricity Act a license must be obtained for generating electricity from the Public Utility Commission of Sri Lanka (PUCSL). The Electricity Act has provisioned that license terms and conditions need to be developed for each generating plants where it may include to have effect or cease to have effect at such times and in such circumstances as may be specified in the license; conditions relating to the optimum utilization of funds and assets of the licensee; in order to ensure that a most economical and efficient service is provided to its customers; compelling the licensee to adhere to any decision, order, direction or determination given by the Commission as to such matters as are specified in the license; compelling the licensee to enter into agreements with other persons etc. The Electricity Act has the provision for revocations of license and impose penalty, if any licensed person contravenes any provision of the Act or any regulation or rules. The PUCSL has a license conditions for generating license which includes term of the license, revocation of the license, extension of license, other agreements (PPAs) etc.

It was informed to BEA Secretariat official during the informal discussion with the Deputy Director General, PUCSL during the 1st SAARC Council of Experts of Energy Regulators

(Electricity) meeting held in the Thimphu on second week of December 2016, that cost overrun and time delay will be automatically taken care by PPAs since the licensee shall have to enter into agreements with other persons as directed to by the Commission, including tariff and connection agreements with the relevant licensees as required by the Electricity Act. However, it was informed that since the establishment of the electricity regulatory (PUCSL) no new hydropower projects have applied or under construction, so they have not come across such cost overrun and time delay issues.

7.3 Pakistan

As per the Electric Power Act no person shall, except under the authority of a license issued by the Authority and subject to the conditions specified in the Act and as may be imposed by the Authority, construct, own or operate a generation facility. The Licensing (Generation) Rules empowers the Authority to suspend or revoke the generation license upon the persistent failure of the licensee to comply with the terms and conditions of the license. The revocation or suspension could be executed depending upon the fact and circumstances, the degree of recurrence of specific breach of any terms and conditions of the generation license or no measures for rectification were taken thereof by the generation license and abandonment by the licensee of the construction of the generation facilities or the operation or management of generation business or any part thereof.

On the cost overrun aspects of the generation license it was informed during informal discussion with the Registrar, National Electric Power Regulatory Authority during the 1st SAARC Council of Experts of Energy Regulators (Electricity) meeting held in Thimphu on second week of December 2016, that generation license shall charge only tariff as may be approved by the Authority in pursuant to **power acquisition contract** entered into between Licensee and the national grid company, distribution company or transmission company. The Authority may also approve tariff in advance of generation license, on the request of the applicant or in its discretion either decline to determine or determine only one or more components of the tariff and at a later stage to file petition to the Authority for approval or modification of the tariff according to prevailing circumstances and conditions as per the Tariff Standard and Procedure Rules.

7.4 The Philippines

The Electric Power Industry Reform Act of 2001 (Act) states that generation shall not be considered a public utility operation. For this purpose, any person engaged or intending to engage in generation of electricity shall not be required to secure a national franchise, but no person may engage in the generation of electricity as a new Generation Company unless such person has received a Certificate of Compliance (COC) from the Energy Regulatory Commission (ERC) to operate facilities used in the Generation of Electricity. If a generation company fails to comply with any rules and sections of the Act, and terms and conditions of the COC, shall be subject to

fines and penalties as may be imposed by the ERC. There are cases where ERC has imposed fines and penalties for non-compliance with the terms and conditions of the COC and failure to renew the COC within the prescribed period. The Secretariat could not study the treatment of cost overrun aspects since no information are available in the website.

7.5 Norway

Norway do not issue license for generating company(s). In Norway hydropower generation are subject for competition and the prices are not regulated and thus generation company is accountability for any cost overrun, and such cost overrun and time delay will result in a less profitable project.

7.6 Uganda

The Electricity Act empowers the Electricity Regulatory Authority to issue, modify or revoke licenses. As per the Electricity Act they issue license for interested applicant(s) and where the Authority, in the public interest, identifies a need for a project under the Act. The Authority may invite applications and award licenses through a fair, open and competitive process. The responsibilities of the Authority is same as that of the BEA as enshrined in their Electricity Act. The Authority may revoke a license where it is satisfied that the licensee is not operating in accordance with the terms and conditions of the license or provisions of the Act or any regulations, codes or standards made under the Act if the breach - (a) inflicts significant damage on public or private interests affected by the breach; (b) lasts for a considerable period of time; (c) takes place repeatedly; or (d) causes the authority to have strong reasons to believe that the licensee may not be able to fulfill his or her obligations under the license or the Act. The License Conditions is not available in their website and further no information pertaining to cost overrun and project delay issues were reported.

7.7 Energy Regulators Regional Association

The Energy Regulators Regional Association (ERRA) has its secretariat office located in Budapest, Hungary. ERRA consists of regulatory agencies of thirty (30) full members and six (6) associate members. Since BEA is also one of the full fledge member of the ERRA, the BEA Secretariat has requested Dr Gabor Szorenyi, General Secretary, ERRA to share the experience of ERRA members on the responsibilities with regard to cost overrun and project delay of construction of hydropower projects. It was informed that for the license the regulators generally determine mile-stones for establishment of the power plant and time period for construction based on the information provided by the license applicant. In case the license holder does not start the construction work of the power plant in the scheduled time (e.g. delay more than 2-3 years with the start of the building activity) the regulator could withdraw the establishment license (in case this potential regulatory action was mentioned among the license conditions with strong legal

background). For the license holder who have already spent a lot of money for the building and construction works and its project got delayed, withdrawing the license is not a feasible solution for the regulator. It is the duty of the established license holder to provide sound reasons and seek consent of the regulator for the project delay. In case if there are no strong reasons for the deviation from the planned schedule, regulator could penalize the license holder for breaching the license conditions.

In the case of any construction cost related figures, regulator does not set in the license conditions, and it is the responsibilities of the owner of the project and or the investor or the bank providing loan for the establishment. However, if it is declared in the license conditions or in the price setting regulation, the regulator could determine the tariff with the recognized/accepted cost elements and not necessary to include all the cost elements incurred during the construction.

8 ROLE OF BEA IN HYDROPOWER CONSTRUCTION

8.1 Licensing of Hydropower Construction

As per the Electricity Act of Bhutan 2001 (EAB), no person or an entity shall engage in construction, generation, transmission, system operation, distribution sale, export or import of electricity without a license. In this regard, when an applicant applies for license, the applicant is expected to submit set of reports containing information as per section 22 of the EAB. The license application shall be accompanied by the application fee as per the Regulatory Fees Regulation of BEA. After the receipt of the license application, the BEA conducts review of an application as per section 22 of the EAB.

During the review the BEA may request for additional information if the application is found incomplete or else confirm to the applicant in writing that the application is complete. Thereafter, as per section 23 of the EAB, the application is advertised in Kuensel and BBS informing the general public on the availability of license application for inspection, and inviting the affected parties and local authorities for any objection in granting license within the deadline (generally more than a month from the date of advertisement). If no objection is received for the issuance of the license, then BEA further reviews the license application considering the factors provided in section 25 of the EAB.

The section 25.1 (v) and (x) of EAB, the BEA while granting the applications has to take into consideration, as far as adequate for the project applied for the cost of the project and price or tariff offered by the applicant.

After the review, the complete assessment report is submitted to BEA Commission for the decision. Based on the assessment report, the BEA Commission may approve or reject the license and subsequently Statement of Reasons as per section 26 of the EAB has to be produced and issued to the applicant.

8.2 Modification of License

As per section 29.1 the BEA may modify the terms and conditions of the license in accordance with the procedures specified in the license conditions and by agreement between the BEA and the Licensee. The section 29.5 of the EAB, the BEA has the authority to modify the license terms and conditions if the benefits of such modification for public interest significantly exceed the disadvantages of the licensee. The licensee in line with section 30.1 of the EAB, may apply to the BEA for modification of the license issued earlier under following circumstances.

i) If the conditions of the license have become unduly onerous.

ii) The conditions of license is affecting on his ability to full fill his obligations under the license.

8.3 License Conditions

The section 34 of the Act empowers the BEA to issue license conditions with license to the licensees. As per the license terms and conditions, the licensee is mandated to perform those activities listed in the license and any other additional or change of existing facilities which may impact the cost of supply shall be carried out with the prior approval from the Authority.

The license term for construction states that the licensee shall complete constructing the project within the prescribed period or its commercial operation date, whichever is earlier. However, there is exceptional clause where the Authority shall extend the construction period under following circumstances:

i) Adverse geological conditions.

ii) Adverse hydrological conditions. or

iii) Force majeure events.

Under the **force majeure events**, following circumstances are considered:

i) Strike, lockout, war, invasion, armed conflict, blockade, revolution, riot, insurrection or civil commotion, terrorism, sabotage, fire, explosion or criminal damage.

ii) Lightning, cyclone, typhoon, flood, famine, hurricane, droughts, earthquake, landslide, epidemic or similar cataclysmic event and such other extreme weather or environmental situations.
iii) Change of applicable laws, enactments, rules, applicable orders or regulations including under the electricity act of Bhutan 2001.

If the license activities are affected by the above factors, the BEA shall extend the construction duration. While extending the construction period, the cost associated will also increases which would mean lawful as it is approved by the Authority.

The license conditions further stressed that the licensee shall not make any changes to the approved plans, which have impact on cost of supply or environment. Any activities which impacts the cost of supply, mandates the BEA's approval and failing which shall lead to sanctions and penalties as it is breach of license conditions. Under license conditions, the BEA has empowered to limit certain activities of the licensees.

9 CONCLUSION

The study suggests that the bigger the project, the more likely the project will experience cost overruns. This report presents the research findings of international trends and case study based analysis of cost overruns in hydropower projects. Following important conclusion can be drawn from this research:

i) The prominent factors that contribute to the cost overruns in hydropower projects are change/error in design mostly civil works due to geological problems, engagement of ineligible contractors, strong political interference in the construction of hydropower projects and corrupt practices.

ii) Case studies capturing the cost overruns reports reported by the competent and independent agency has clearly mentioned the party(s) responsible and causes of the cost overruns, but nothing was indicated with regard to accountability of such act.

iii) Different countries follow different methods. Some countries do not regulate the generation tariff and left to the market forces while some adopts PPA and other forms of agreements.

iv) The regulators' roles in cases of cost overrun or delays are limited as their roles are not specifically specified of events.

On the BEA's roles and accountability with regard to cost overrun, there are no provisions either in EAB and licenses conditions explicitly mentioning on cost aspects. However, BEA seems to have implied responsibilities to control the cost of projects through some sections and provisions of EAB and License Conditions. If modification of license is granted after the review by the BEA, the cost associated will also deem to be approved by the BEA. This also means the BEA has implied role on project cost overruns. In the current state most of the mega hydropower projects in the country are executed through Inter Government (IG) mode and thus for such setup, the BEA has no/very limited roles when it comes to the hydropower cost components. Further as per section 11.1 (b) of EAB it is outside the purview of the BEA for tariff setting when it is governed through Power Purchase Agreement.

REFERENCES

1. Auditor Slams Himachal Pradesh over ADB-funded Hydel project, retrieved from www.business-standard.com.

2. Benjamin K. Sovacool, (2014) Alex Gilbert and Daniel Nugent, An International Comparative Assessment of Construction Cost Overruns for Electricity Infrastructure, 2014, Institute for Energy and the Environment, Vermont Law School, USA.

3. Cabinet approval of first RCE of Mangdechhu HE project, retrieved from www.mhpa.gov.bt dated 31st August 2016.

4. Cost of 969MW Neelum-Jhelum Hydropower Project increased to Rs 500 billion, retrieved from https://www.pakistantoday.com.pk/2017/03/09.

5. Cost of Muskrat Falls hydro project rises by another billion, CEO says, retrieved from www.ctvnews.ca/.../cost-of-muskrat-falls-hydro-project-rises-by-another-billion-ceo-say

6. CAG reports losses worth Rs. 200 cr in Himachal power plant, retrieved from www.firstpost.com › India News.

7. Electricity Act of Bhutan 2001.

8. Electricity Act, 2003, India, retrieved from www.cercind.gov.in.

9. Electric Power Industry Reform Act, 2001, Philippine, retrieved from www.erc.gov.ph

10. Electricity Act (1999), Uganda, retrieved from www.era.or.ug.

11. Ethiopia: Dam critics won't go away, retrieved from http://www.ipsnews.net.

12. Ethiopian-dam-suffers-tunnel-collapse-days-after inauguration, retrieved from https://www.internationalrivers.org.

13. Final Report Ex-post evaluation of the Italian Development Cooperation initiative in Ethiopia, named "Gilgel Gibe II Hydro-electric Project", retrieved from https://www.oecd.org/.../Ex-post-evaluation-of-the-Gilgel-Gibe-II-Hydroelectric-Project.

14. Government release EY's Interim Report on the Muskrat Falls Project, retrieved from www.releases.gov.nl.ca.

15. Interim report to the 15th National Council Session on Review of Sustainable Hydropower Development Policy.

16. Journal of Construction in Developing Countries, 2016/vol21_2_2016, (Early View), Impact of Variation Orders on Time & Cost in Mega Hydropower Projects of Pakistan.

17. Kuensel issue dated August 24, 2017

18. Kuensel issue dated 23, 2017.

19. Kuensel issue dated 18, 2017.

20. Kuensel issue dated July 18, 2016.

21. License Conditions of Hydropower Constructions Project Authority, BEA.

22. License application submitted to BEA - Executive summary of MHPA.

23. License application submitted to BEA - Executive summary of PHPA I.

24. License application submitted to BEA - Executive summary of PHPA II.

25. License Enforcement Issue Paper (1998), Energy Regulators Regional Association (ERRA).

26. Mangdechhu's cost escalates by more than 25 percent, retrieved from https://www.drukgreen.bt/.../news/...news/228-mangdechhu-s-cost-escalates.

27. Matti Siemiatycki, Cost Overruns on Infrastructure Projects: Patterns, Causes, and Cures Institute of Municipal Finance & Governance, 2015.pdf.

28. Progress of on-going hydroelectric projects (In fulfilment of CEA's obligation under Electricity Act, 2003) QUARTERLY REVIEW NO. 85 (Apr - June, 2016), retrieved from www.cea.nic.in/reports/others/hydro/hpm/qly85.pdf.

29. Project 8556 : 111 MW Sawra Kuddu Hydro Electric Power Project in Himachal Pradesh, retrieved from http://cdm.unfccc.int/Projects/DB/RWTUV1354641854.75/view.

30. Regulation of Generation, Transmission and Distribution of electric Power Act, 1997, retrieved from www.nepra.org.pk.

31. TheBhutanese issue dated August 5, 2017.

32. World Commission on Dams, Dams and Development, 2000, Earthscan Publication Ltd., London and Sterling, VA.

33. www.nve.no.

34. www.phpa.gov.bt.

35. www.pucsl.gov.lk.

DISCLAIMER

Bhutan Electricity Authority assumes no responsibility for inaccuracy, incompleteness, errors or omissions in this report. The content of the report is for general information purpose only. In no event shall Bhutan Electricity Authority be liable for incidental damages or any damages whatsoever, arising due to use of information presented in this report.