

PATIKARI POWER PVT LTD

2 X 8 MW

Mandi District, Himachal Pradesh



Annual O&M Report

FY 2016-17

Contents

1.	<i>Introduction.....</i>	<i>3</i>
2.	<i>Plant Performance</i>	<i>4</i>
2.1	<i>Generation Data during the Year:.....</i>	<i>4</i>
2.2	<i>Generation during Nine years of Operation since commissioning:.....</i>	<i>7</i>
2.3	<i>Discharge actually observed in the Bakhli Khad since commissioning:</i>	<i>9</i>
2.4	<i>Revenue Generation / Realization</i>	<i>10</i>
3.	<i>Technical Audit.....</i>	<i>11</i>
3.1	<i>Technical Audit follow up of the financial year 2015-16:.....</i>	<i>11</i>
3.2	<i>Technical Audit of the financial year 2016-17:</i>	<i>11</i>
4.	<i>Preventive Maintenance.....</i>	<i>12</i>
4.1	<i>General</i>	<i>12</i>
4.2	<i>Restoration of Automation system.....</i>	<i>13</i>
4.3	<i>Restoration works of Electrical system.....</i>	<i>13</i>
4.4	<i>Painting works.....</i>	<i>13</i>
4.5	<i>Plantation at weir site and Muck disposal site.....</i>	<i>15</i>
4.6	<i>Restoration of Fire alarm system in Control Room and 11KV switchgear Room.....</i>	<i>15</i>
4.7	<i>Shifting of transmission line on newly erected pole</i>	<i>16</i>
5.	<i>Annual Maintenance and Overhauling Works.....</i>	<i>16</i>
6.	<i>A major landslide</i>	<i>18</i>
7.	<i>ISO 9001: 2015 Certification.....</i>	<i>19</i>
8.	<i>Loss of Generation - Causes and Corrective steps.....</i>	<i>20</i>
8.1	<i>Generation Loss data during the Financial year 2016-17.....</i>	<i>20</i>
8.2	<i>Various factors responsible for losses in Generation and their corrective steps</i>	<i>21</i>
9.	<i>Inventory Management.....</i>	<i>23</i>
10.	<i>Safety Measures</i>	<i>23</i>
11.	<i>Employees Welfare Measures.....</i>	<i>23</i>

1. Introduction

16 MW Patikari Project, implemented by Patikari Power Private Limited, is a run of the river hydro power project developed on Bakhli Khad, a tributary of Beas River and is located in Mandi district of Himachal Pradesh, India. Two (2) generating Units driven by horizontal shaft Pelton Turbines, each having a rated output of 8.0 MW (having 15% CMR), are installed in the Power Station. The Design Energy of the Power Plant is 78.81 million KWh of electrical energy based on the 90% Dependable Discharge and rated output of 16 MW.

Patikari HE Project harnesses energy of the water in Bakhli Khad River diverted through a Diversion Weir and led to Desilting Tanks. After flushing the silt, if any, clean water is then fed to the Water Conductor System comprising of 3.6 km Head Race Tunnel including two (2) Aqueducts enroute, followed by Surface Steel Surge Shaft and 715 m long Penstock feeding water under pressure for driving two (2) hydro-generating Units in the Power House. After passing through the Turbines, water is led back to Bakhli Khad through Tail Race Channel.

Each of the two (2) Generating Units in Patikari Hydropower station comprises horizontal Pelton Turbine to which synchronous Generator is directly coupled, generating rated power of 8.0 MW at 11kV. Besides appropriate Unit and Station Auxiliaries, state of the art Control and Monitoring System (SCADA) has been installed in the Power Station to ensure optimum generation there from.

Power so generated is then being stepped up to 33kV through two (2) 11MVA Step-up Transformers and evacuated through one (1) double circuit 11km long 33kV Transmission Line terminating at the other end in 33kV Substation of HPSEB at Pandoh which is part of the HPSEB network. Patikari Power Private Limited have entered into a long term Power Purchase Agreement dated 5th July 2004 with HPSEB envisaging delivery of power from the Project at 33kV Substation of the Board at Pandoh in Mandi district of Himachal Pradesh. Tariff for the electricity to be supplied by the Project to the Board at this Delivery Point is Rs. 2.25 per kWh (fixed).

Design Energy of the project, based on the 90% Dependable year Discharge as adopted in the Detailed Project Report and without taking into account mandatory release of 15% discharge during

lean discharge period, is 78.81 MU. However, discharge trend in Bakhli Khad as actually observed since commissioning of the project, does not match with above said Design discharges especially during eight lean discharge months even in years with normal monsoon rains. As a result, actual annual energy generation from the Project till date has been less than that of the Design Energy even during years with normal monsoon rains and in spite of both the units having been run at around 15% overload during monsoon months.

2. Plant Performance

2.1 Generation Data during the Year:

Month wise analysis of the Design Energy and corresponding actual generation of the Project during the financial year 2016-17 along with the reasons for variations between the two are tabulated hereunder:

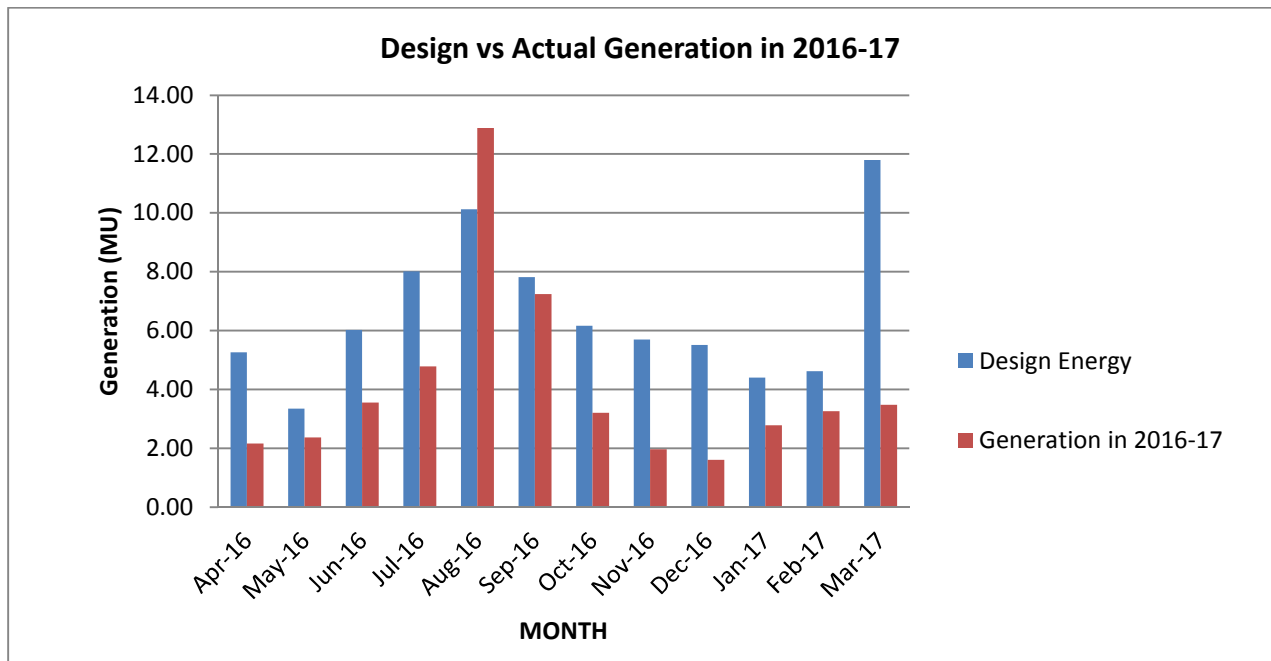
Month	Design Energy (90% Dependable Year in MUs)	Actual Energy Generated (MUs)	Actual Vs Design Energy %	Remarks
Apr-16	5.26	2.17	41.22	Low river Discharge
May-16	3.35	2.38	70.99	
Jun-16	6.03	3.55	58.94	
Jul-16	8.02	4.79	59.74	
Aug-16	10.12	12.89	127.37	
Sep-16	7.82	7.25	92.67	Low river Discharge
Oct-16	6.17	3.22	52.11	
Nov-16	5.70	1.97	34.51	
Dec-16	5.51	1.61	29.26	
Jan-17	4.41	2.78	63.08	
Feb-17	4.62	3.26	70.56	
Mar-17	11.80	3.48	29.47	
Total	78.81	49.34	62.61	

Table 2.1 Generation Data during the year 2016-17

As evident from Table 2.1,

- i) The actual generation of the project during the financial year 2016-17 was 49.34MU against the Design Energy of 78.81 MU based on 90% Dependable Year Discharges.
- ii) The Generation during financial year 2016-17 was thus 62.61% of the Design Energy.

Month wise comparison of Actual Generation and Design Energy during the financial year 2016-17 is plotted hereunder:



As evident from the above graph,

- i) The maximum generation during financial year 2016-17 was recorded in the month of August.
- ii) The minimum generation during financial year 2016-17 was recorded in the month of December.

- iii) The only instance when Actual generation was more than the Design energy was recorded in the month of August.

Quarter wise performance of the Plant during the financial year 20\16-17 is tabulated hereunder:

Quarter	Design Energy (MUs)	Actual Energy Generated (MUs)	Actual /Design Energy %
1st Quarter(April 16 to June 16)	14.64	8.100	55.32
2nd Quarter(July 16 to Sep 16)	25.96	24.928	96.02
3rd Quarter(Oct 16 to Dec 16)	17.38	6.794	39.1
4th Quarter(Jan 17 to Mar17)	20.83	9.520	45.7
Total	78.81	49.34	62.61

Table 2.2 Quarter wise performance of the plant

As is evident from above Table 2.2,

- i) Actual Generation during all the four quarters was lower than the Design Energy.
- ii) In the 3rd quarter, the generation was the lowest for this financial year due to low river discharge.

2.2 Generation during Nine years of Operation since commissioning:

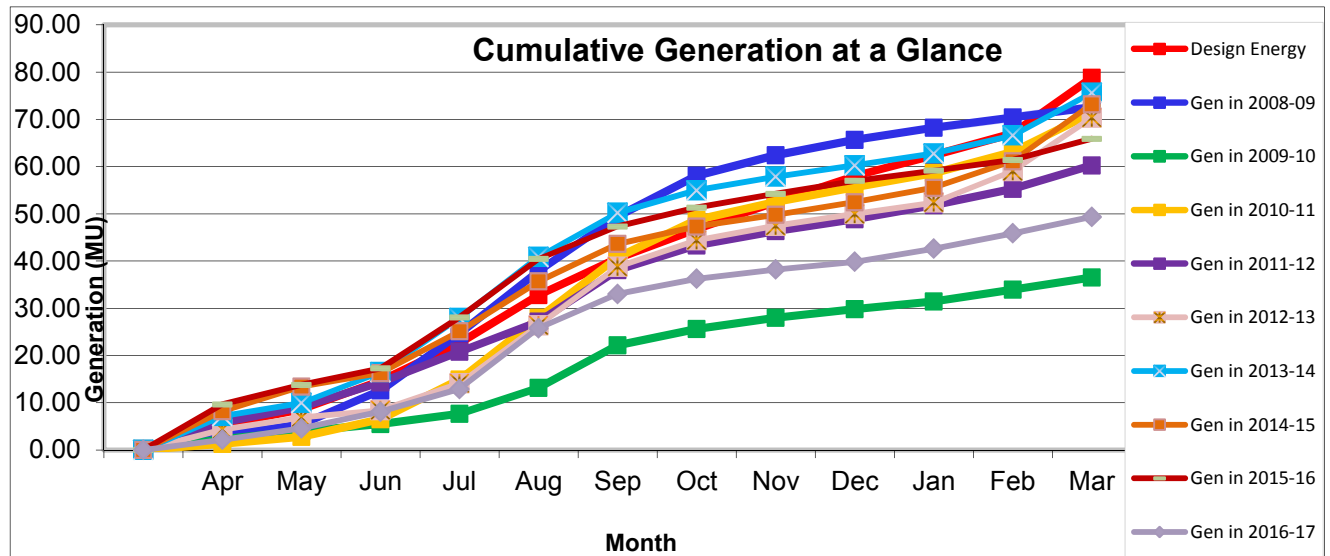
Month	Design Energy (90% Dependable Year in MUs)	Actual Generation (MUs) during 2008-09	Actual Generation (MUs) during 2009-10	Actual Generation (MUs) during 2010-11	Actual Generation (MUs) during 2011-12	Actual Generation (MUs) during 2012-13	Actual Generation (MUs) during 2013-14	Actual Generation (MUs) during 2014-15	Actual Generation (MUs) during 2015-16	Actual Generation (MUs) during 2016-17
Apr	5.26	3.08	2.28	1.29	5.86	4.32	7.18	8.21	9.64	2.17
May	3.35	2.36	1.68	1.51	3.20	2.56	2.78	5.21	4.14	2.38
Jun	6.03	7.20	1.50	3.72	5.27	1.52	6.50	2.85	3.48	3.55
Jul	8.02	12.02	2.22	8.42	6.51	5.68	11.48	8.84	10.84	4.79
Aug	10.12	13.21	5.49	13.05	6.37	12.30	12.91	10.60	12.36	12.89
Sep	7.82	11.61	8.99	12.82	10.91	12.39	9.35	7.91	6.88	7.25
Oct	6.17	8.60	3.47	7.90	5.17	5.60	4.80	3.70	4.01	3.22
Nov	5.70	4.34	2.34	3.83	3.08	3.10	2.88	2.46	2.92	1.97
Dec	5.51	3.22	1.84	3.07	2.53	2.52	2.40	2.69	2.73	1.61
Jan	4.41	2.62	1.65	3.03	2.94	2.40	2.48	3.03	2.18	2.78
Feb	4.62	2.16	2.46	4.47	3.43	6.66	3.84	5.65	2.25	3.26
Mar	11.80	2.18	2.59	8.26	4.96	11.29	9.03	12.07	4.49	3.48
Total	78.81	72.60	36.52	71.36	60.23	70.33	75.63	73.22	65.90	49.34

Table 2.3 Generation during nine years of operation since commissioning

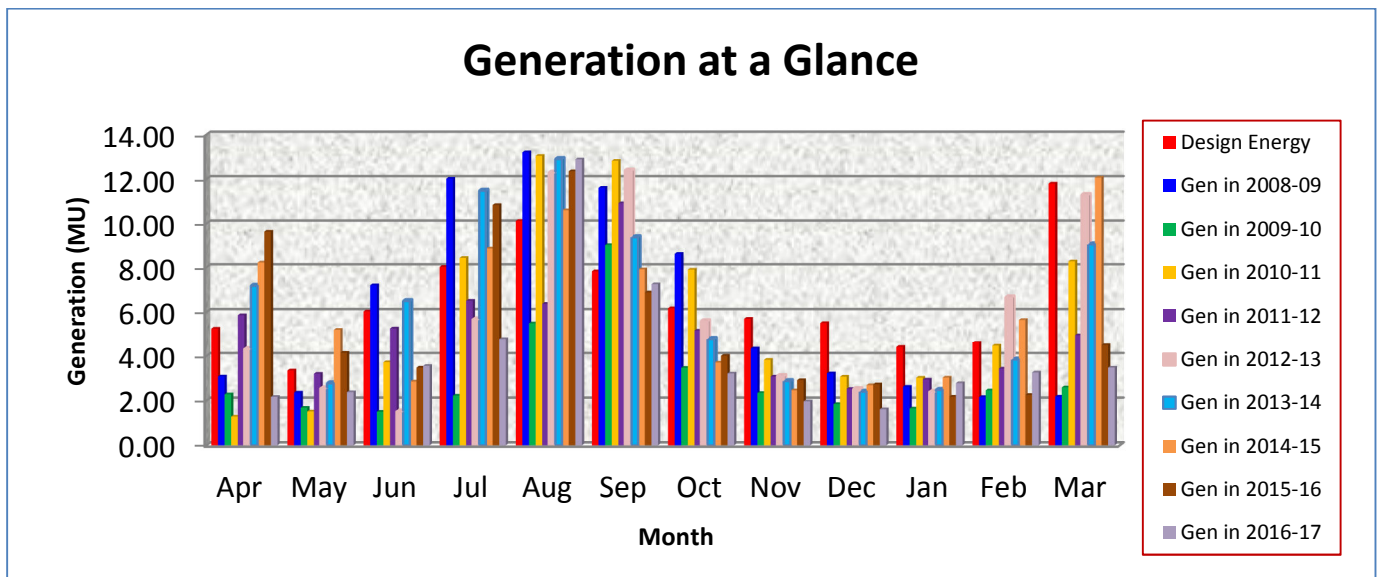
As evident from Table 2.3,

- i) Generation during the months of October, November and December 2016 is the lowest recorded for these corresponding months so far since the commissioning of the project.
- ii) The overall generation during the financial year 2016-17 is the second lowest annual generation since commissioning.

The Cumulative generation of the Plant for the past nine years since commissioning is graphically presented below:



The Actual generation of the Plant for the past nine years since commissioning is graphically presented below:



2.3 Discharge actually observed in the Bakhli Khad since commissioning:

Discharges actually observed in Bakhli Khad during lean discharge months after commissioning of the Project are much lower than the corresponding Design Discharges and many a times even less than the lowest monthly discharges recorded before commissioning as per DPR. A comparison of discharges actually observed in Bakhli Khad after commissioning of the Project along with the Design and earlier lowest recorded monthly discharges from 1984-85 to 1995-96 taken into account in the DPR is given below.

Month	90% Dependable Year Discharge	Lowest Monthly Discharge Observed from 1984-85 to 1995-96	Actual Discharge during 2008-09	Actual Discharge during 2009-10	Actual Discharge during 2010-11	Actual Discharge during 2011-12	Actual Discharge during 2012-13	Actual Discharge during 2013-14	Actual Discharge during 2014-15	Actual Discharge during 2015-16	Actual Discharge during 2016-17
Apr	2.45	1.79	1.80	1.12	0.69	2.87	2.29	3.46	4.09	5.35	1.11
May	1.52	1.29	1.03	0.76	0.76	1.60	1.25	1.48	2.44	2.05	1.48
Jun	2.81	1.23	4.84	0.74	2.40	3.52	0.78	6.09	1.81	1.71	2.91
July	6.15	3.47	5.98	1.02	5.34	6.73	2.95	14.24	6.94	8.82	2.25
Aug	4.56	4.56	8.01	3.03	12.55	10.05	15.12	13.76	8.63	19.38	9.96
Sep	3.65	3.65	5.90	6.32	9.44	6.65	7.84	4.62	4.10	3.38	3.55
Oct	2.79	2.70	3.72	1.54	3.67	2.43	2.62	2.27	1.76	1.89	1.54
Nov	2.66	1.77	2.08	1.15	1.87	1.55	1.58	1.52	1.23	1.44	1.02
Dec	2.49	1.43	1.48	0.88	1.49	1.25	1.31	1.19	1.37	1.33	0.85
Jan	1.99	1.16	1.25	0.82	1.48	1.53	1.25	1.24	1.48	1.05	1.53
Feb	2.26	0.89	1.15	1.28	2.44	1.78	3.74	3.74	4.16	1.19	1.77
Mar	6.46	1.79	1.07	1.18	3.87	2.44	5.57	5.57	6.81	2.23	1.74
Average Discharge	3.32		3.19	1.65	3.83	3.53	3.86	4.93	3.73	4.15	2.48

Table 2.4 Discharge observed in Bakhli Khad since commissioning

2.4 Revenue Generation / Realization

Project delivered 24,43,808 Units of electricity to HPSEB during financial year 2016-17 after accounting for 12% Free Power to the Home State. Against the energy supplied and billed for the year 2016-17 amounting to INR 9,54,98,568 HPSEB released payments amounting to INR 101,797,344 including the payment for February-16 & March-16 amounting to INR 1,31,27,400 released during April & May-16. Details about the monthly billings and receipts are tabulated hereunder:

Financial Year 2016-17				
Revenue Generation/Realization during Financial Yr 2016-17				
S.No.	Period	Total Saleable Energy (kWh)	Bill Raised (INR)	Amount Received (INR)
1	-----	-----	-----	4395600*
2	-----	-----	-----	8731800**
3	01/04/16 to 01/05/16	1,852,224	4,167,504	4,167,504
4	01/05/16 to 01/06/16	2,056,032	4,626,072	4,626,072
5	01/06/16 to 01/07/16	3,072,960	6,914,160	6,914,160
6	01/07/16 to 01/08/16	4,245,120	9,551,520	9,551,520
7	01/08/16 to 01/09/16	10,960,224	24,660,504	24,660,504
8	01/09/16 to 01/10/16	6,161,760	13,863,960	13,863,960
9	01/10/16 to 01/11/16	2,749,824	6,187,104	6,187,104
10	01/11/16 to 01/12/16	1,686,432	3,794,472	3,794,472
11	01/12/16 to 01/01/17	1,387,584	3,122,064	3,122,064
12	01/01/17 to 01/02/17	2,434,080	5,476,680	5,476,680
13	01/02/17 to 01/03/17	2,802,624	6,305,904	6,305,904
14	01/03/17 to 01/04/17	3,034,944	6,828,624	-----***
	Total	42,443,808	95,498,568	101,797,344

- * Payment against energy bill of Feb-16 (Rs. 43,95,600) was realized in April-16
- ** Payment against energy bill of Mar-16 (Rs.87, 318, 00) was realized in May -16.
- *** Payment against energy bill of March (Rs 6,828,214) was released in April, 2017

3. Technical Audit

3.1 *Technical Audit follow up of the financial year 2015-16:*

During the technical audit of financial year 2015-16, the observations pointed out by EIPL team were to be taken care of before the Board Meeting. To have an independent on spot assessment, EIPL team was once again deputed. During the visit, the team reviewed the status of the works against the observations made in the Audit report and confirmed readiness for all systems and subsystems. As evident from the EIPL final status report of the Technical Audit follow up, almost all the observations raised in the Technical Audit Report had been properly acted upon.

3.2 *Technical Audit of the financial year 2016-17:*

Technical audit was conducted by O&M advisory services M/s EIPL in two phases.

- i. Technical Audit of Civil works**
- ii. Technical Audit of E&M and HM works**

Technical Audit of Civil works was successfully conducted by: Mr. Krupananda Rao M., Asst. Manager (Civil), the detailed report of which was submitted on May 30, 2017.

Technical Audit of E&M and HM works was successfully conducted by EIPL Audit team, the detailed report of which was submitted on July 13th, 2017. The Audit team for E&M and HM works comprised of:

- i. Mr. B. L Gulshan, Sr. Manager (HM)
- ii. Mr. Bhaskar Maraina, Senior Engineer (E&M)
- iii. Mr. Rajesh Pandey, Engineer (E&M)

During the audit all the systems were thoroughly checked with respect to the availability of the spares and proper functioning of the systems.

To ensure the uninterrupted generation, inspection of the civil structures, approach roads of power house as well as weir site and the foundations of the transmission line poles were also carried out.

To ensure the safety of the systems and personals, the fire fighting system and other related instruments were thoroughly inspected.

A detailed report was prepared regarding the non-conformances observed during the audit and required actions were also suggested against the non-conformances.

4. Preventive Maintenance

4.1 General

To minimize the plant outages and consequent avoidable generation loss of the project, periodic preventive maintenance schedules for all the equipment have been prepared and are being complied with. These periodic maintenance schedules are listed below.

- i) Daily maintenance schedule
- ii) Weekly maintenance schedule
- iii) Monthly maintenance schedule
- iv) Quarterly maintenance schedule
- v) Half-Yearly maintenance schedule
- vi) Yearly maintenance schedule

Following major inspections & repair works were carried out during the financial year

- i) Painting of the Left over portions of the Plant
- ii) Plantation at weir site
- iii) Restoration of Automation system
- iv) Restoration works of other electrical system i.e. Incomer breakers of SSB, 11KV switchgear
- v) Restoration of fire alarm system in the control room and 11KV switchgear room
- vi) Shifting of transmission line on newly erected Pole

4.2 *Restoration of Automation system*

During the visit of the respective teams of M/s EIPL and M/s RAS Automation at Patikari HEP site from March 18 to 21, 2017, the following restoration works regarding Automation system were carried out.

- i) The operational logics of SCADA of both the units were modified.
- ii) The complete sequence of Auto/Manual operations of both the units from SCADA were carried out to check and verify the working of the modified logics.
- iii) Audio based Alarm system was installed in the control room to warn the operating personnel against serious dangers.
- iv) Quick Heal Antivirus was installed in the computer system.
- v) A separate SCADA screen for the emergency trip signals and stop signals (which could cause complete shutdown of the plant) was implemented.
- vi) A detailed documentation regarding the steps of installation of the logic in the PLC, steps of downloading the logics from PLC and steps of installation of SCADA backup from any system was prepared.

4.3 *Restoration works of Electrical system*

During the visit of the respective teams of M/s EIPL and M/s RAS Automation at Patikari HEP site from March 18 to 21, 2017, restoration works regarding other Electrical system apart from SCADA were also carried out. The Auto/ Manual operations of the incoming feeders of SSB Panel were restored. Operations of the breakers of 11KV switchgear were checked and the problems regarding their improper mechanical alignment and problems of leakage (current/ voltage) were noted for further processing.

4.4 *Painting works*

The Painting works of the leftover portions of the Plant were carried out during the early part of the financial year.

- i) The Painting works of Machine Floor, Penstock, and weir site were completed.

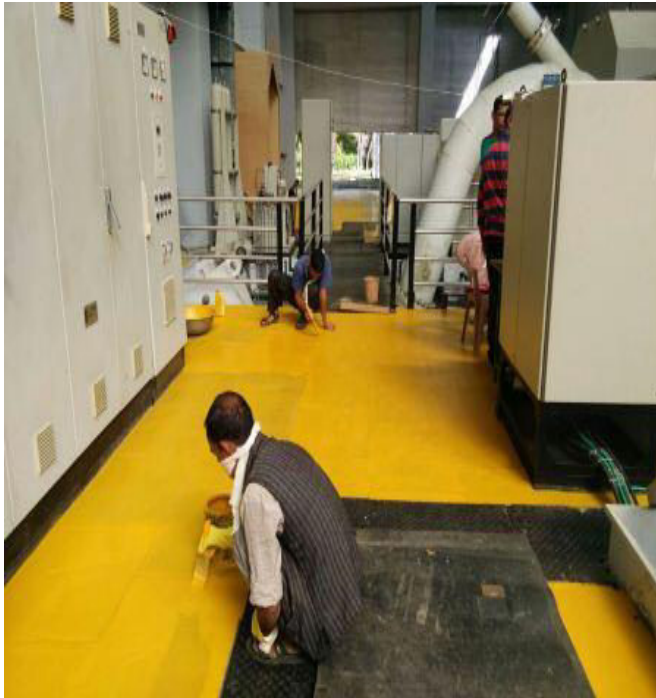


Fig. 4.1 Painting of Machine floor



Fig.4.2 Painting of Penstock

- i) The Painting works of Transmission line poles, and 33KV switchyard were also completed.



Fig. 4.3 Painting of Transmission line poles



Fig.4.4 Painting of 33KV Switchyard

4.5 *Plantation at weir site and Muck disposal site*

Plantation at weir site and Muck disposal sites were carried out during the financial year. The photographs of the plantation at the respective places are shown below



Fig. 4.5 Plantation at weir site



Fig. 4.6 Plantation at Muck disposal site.

4.6 *Restoration of Fire alarm system in Control Room and 11KV switchgear Room*

Restoration of fire alarm system in control room and 11KV Switchgear room were carried out.



Fig. 4.7 Fire Alarm system in Control room

4.7 Shifting of transmission line on newly erected pole

A new pole “Pole 51” was erected and shifting of transmission line on the newly erected pole was carried out.



Fig. 4.8 Shifting of transmission line over newly erected pole

5. Annual Maintenance and Overhauling Works

Equipment wise maintenance schedules viz. Generator, Turbine & MIV, Power Transformers, Switchyard equipment, weir site structures etc. have already been issued to the Project Management Team. These maintenance schedules are strictly adhered by the team on regular basis. Maintenance of the following equipment/structures was carried out as per the maintenance schedule.

- i) Generator
- ii) Generator Transformers & other Transformers
- iii) Turbine & MIV
- iv) Switchyard equipment
- v) EOT Crane
- vi) Weir site structures

Following Repair & Maintenance works of the Power Plant were carried out during the year:

- i) Replacement of the fault luminaires with LEDs
- ii) Servicing of mini compressor
- iii) Adjustment of needles
- iv) Installation of CCTV cameras in Plant premises
- v) Inspection of the runner of unit II.
- vi) Replacement of faulty multifunction meter in SST-2
- vii) Replacement of the damaged bearing of cooling water pump-3
- viii) Replacement of the coolant of the DG set
- ix) Replacement of faulty under voltage relay in SSB Panel
- x) Installation of lightening arrestor in switchyard
- xi) Re-commissioning of emulsifier system of step up transformer

Repair and Maintenance works which could not be taken up during the year under report for want of funds:

- i) Left over painting works in the Plant
- ii) Runner Repair with Hard Coating
- iii) Hardware requirement for auto synch of SCADA system with the protection relays
- iv) Repairs of Rotor Poles damaged during 2015-16
- v) Overhauling of 11kV as well as 33kV Breakers
- vi) Load and Pressure Testing of equipment in the Plant
- vii) Calibration of Energy Meters
- viii) Hard coating of one runner
- ix) Requirement of spare Runner

Estimated cost of execution of above said works including spares required for the same is around Rs.2.8 crores.

6. A major landslide

A major landslide occurred on 26th Jan-17 on the approach road to the Power House. The road was completely blocked due to the landslide. Restoration/repair works were carried out and were successfully completed by 2nd Feb-17.



Fig.6.1 The photographs of approach road to powerhouse after the landslide



Fig.6.2 Restorations works carrying out



Fig.6.4 After restoration works

7. ISO 9001: 2015 Certification

- i) ISO 9001 Stage 1 Audit: M/s Samarth Consultants was engaged for ISO 9001: 2015 Certification. A team of M/s Samarth Consultants along with an officer of URS (United Registrar systems) had conducted the first stage Audit of the project on August 05th & 06th, 2016 and pointed out some non-conformities regarding Calibration of all measuring instruments (i.e. Megger, multimeters etc) and load pressure testing of the equipment (i.e. EOT, OPU, Compressor) which were attended to by the project:
- ii) ISO 9001 Stage 2 Audit: The Final ISO 9001 Stage 2 Audit was successfully conducted on October 05th & 06th, 2016 by URS. Patikari HEP has now been accredited ISO 9001: 2015 certification and the final certification to this effect was issued on November 25th, 2016

8. Loss of Generation - Causes and Corrective steps

8.1 Generation Loss data during the Financial year 2016-17

Month wise analysis of Energy losses during the financial year 2016-17 is tabulated hereunder:

Energy Loss due to Outage(MU)					
Month	Grid Outage (> 20 Min)	Grid Outage (< 20 Min)	Back Down Instructio ns	Unit / Weir site Outage	Total Energy Loss
Apr-16	0.00000	0.00104	0.00000	0.00000	0.00104
May-16	0.01733	0.01094	0.00000	0.19639	0.24499
Jun-16	0.01908	0.02248	0.00000	0.01614	0.06989
Jul-16	0.00000	0.00682	0.00000	0.00000	0.00788
Aug-16	0.00000	0.09663	0.00000	0.02561	0.14006
Sep-16	0.01477	0.02015	0.00000	0.00141	0.04340
Oct-16	0.01252	0.00227	0.00000	0.00253	0.04846
Nov-16	0.00000	0.00000	0.00000	0.00000	0.00000
Dec-16	0.00000	0.00000	0.00000	0.00000	0.00000
Jan-17	0.00508	0.00000	0.00000	0.00000	0.00508
Feb-17	0.00441	0.01194	0.00000	0.00113	0.01800
Mar-17	0.00000	0.00068	0.00000	0.02896	0.03477
Total	0.07	0.17	0.00	0.27	0.61

Table 7.1 Energy loss data during the financial year 2016-17

As evident from Table 7.1,

- i) Total Energy losses during the financial year 2016-17 was equal to 0.61 MUs
- ii) These energy losses are calculated taking into consideration various factors viz. plant outages, back down instructions and weir site outages.
- iii) Generation loss of 0.24 MUs was attributable to the grid outages.

Month wise Analysis of No. of tripping from Pandoh/ Bijni Substation for the financial year 2016-17 is tabulated hereunder:

No. of Grid Failures		
Month	No. of tripping from Pandoh	No. of tripping from Bijni
Apr-16	7	13
May-16	8	5
Jun-16	2	11
Jul-16	13	14
Aug-16	17	15
Sep-16	3	7
Oct-16	9	8
Nov-16	11	7
Dec-16	0	13
Jan-17	2	16
Feb-17	6	10
Mar-17	6	18
Total	84	137

Table 7.2 No. Of tripping during 2016-17

8.2 *Various factors responsible for losses in Generation and their corrective steps*

Generally, there are two main factors responsible for the losses in generation which are mentioned hereunder::

- i) External Evacuation constraints: They comprise of the Grid outages in the HPSEB networks & back down instructions.
- ii) Plant Outages: They comprise of factors such as silt flushing duct choking, trash rack choking, cooling water filter choking, failure of 11/33kV breakers etc.

Silt flushing and trash rack arrangement: During the financial year 2016-17, to improve the silt flushing and trash removal arrangement M/s SediCon was put into consultation. M/s SediCon experts visited the weir site and reviewed the silt flushing and trash rack arrangement and submitted their proposals regarding the same amounting to 2 Crores and 65 lakhs respectively. However, taking techno-economic factors into consideration, the quoted prices were too high for the matter to be further processed.

As of now, to improve the situation, alternate plates covering the bottom channels of De-sanders were removed prior to preceding monsoon as recommended by EIPL Civil design team . This has substantially improved the evacuation of silt from de-sander tanks as compared to last year. As discussed and decided in a meeting held on 13th Jan-17 between M/s EIPL and M/s PPPL, the remaining plates are also now proposed to be removed which would further improve de-silting process.

Moreover, Silt flushing gated were kept partially/ fully open whenever the discharge was more than what is required for running both the units at full load.



Fig.7.1 Arrangement in De-sander in preceding Monsoon (2016-17)

9. Inventory Management

Adequate optimum stocks of spares are being maintained in the Plant stores to cater for any preventive as well as other maintenance requirements of the Power Station. The consumption of Electrical, Mechanical & General store material is being regularly reported and monitored on monthly basis.

10. Safety Measures

Safety Manual had been issued to the Plant & the Safety measures as per the manual had been strictly complied. Safety charts had been displayed in the power house area. Mock drills related to Fire Protection / Flood Protection / any other natural calamity Protection had been arranged annually in & around power house area to ensure preparedness for such exigencies.

11. Employees Welfare Measures

Various Employees Welfare measures being undertaken from time to time by the Company Management are as under:

- i. **Review of Annual wages** – Review of the annual wages of the O&M staff is carried out based on the performance of the employee & accordingly they are being compensated.
- ii. Employees are also appreciated with incentives on achievement of certain target of generation.
- iii. **Training of O&M Staff** – Various trainings related to operation & maintenance of small hydro plants & interpersonal relationships are being imparted to the employees from time to time.

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PVT. LTD**

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The End
