

PATIKARI POWER PVT LTD

2 X 8 MW **Mandi District, Himachal Pradesh**



Annual O&M Report
FY 2015-16

Contents

1. Introduction.....	3
2. Plant Performance	4
2.1 Generation Data during the Year:	4
2.2 Generation during Eight years of Operation since commissioning:	5
2.3 Discharge actually observed in the Bakhli Khad after commissioning:	8
2.4 Revenue Generation / Realization.....	9
3. Technical Audit	10
4. Preventive Maintenance.....	10
5. Annual Maintenance and Overhauling Works	19
6. Unit-II : Breakdown due to Rotor Earth fault.....	20
6.1 Fault reporting.....	20
6.2 Repair Works.....	22
7. Loss of Generation - Causes and Corrective steps	23
8. Inventory Management.....	25
9. Safety Measures	25
10. Employees Welfare Measures	25

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.

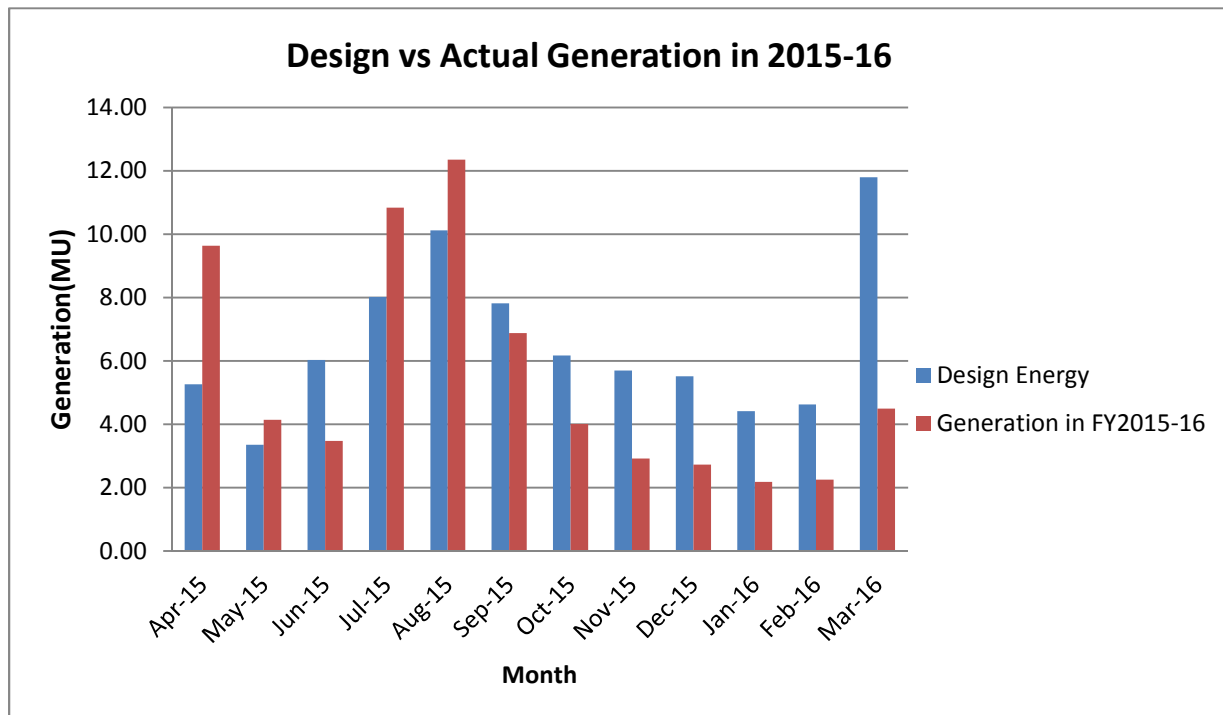
2. Plant Performance

2.1 Generation Data during the Year:

Month wise Design Energy and corresponding actual generation from the Project during 2015-16 and 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-15	5.26	9.64	183.19	
May-15	3.35	4.14	123.67	
Jun-15	6.03	3.48	57.66	Due to low discharge
Jul-15	8.02	10.84	135.10	
Aug-15	10.12	12.36	122.08	
Sep-15	7.82	6.88	87.97	Due to low discharge
Oct-15	6.17	4.01	64.96	
Nov-15	5.70	2.92	51.14	
Dec-15	5.51	2.73	49.53	
Jan-16	4.41	2.18	49.34	
Feb-16	4.62	2.25	48.77	
Mar-16	11.80	4.49	38.07	
Total	78.81	65.90	83.62	

As evident from above, against Design Energy of 78.81 MU based on 90% Dependable Year Discharges, Project generated 65.92 MU during the financial year 2015-16. The Generation during financial year 2015-16 was thus 83.62 % of the Design Energy.



2.2 Generation during Eight years of Operation since commissioning:

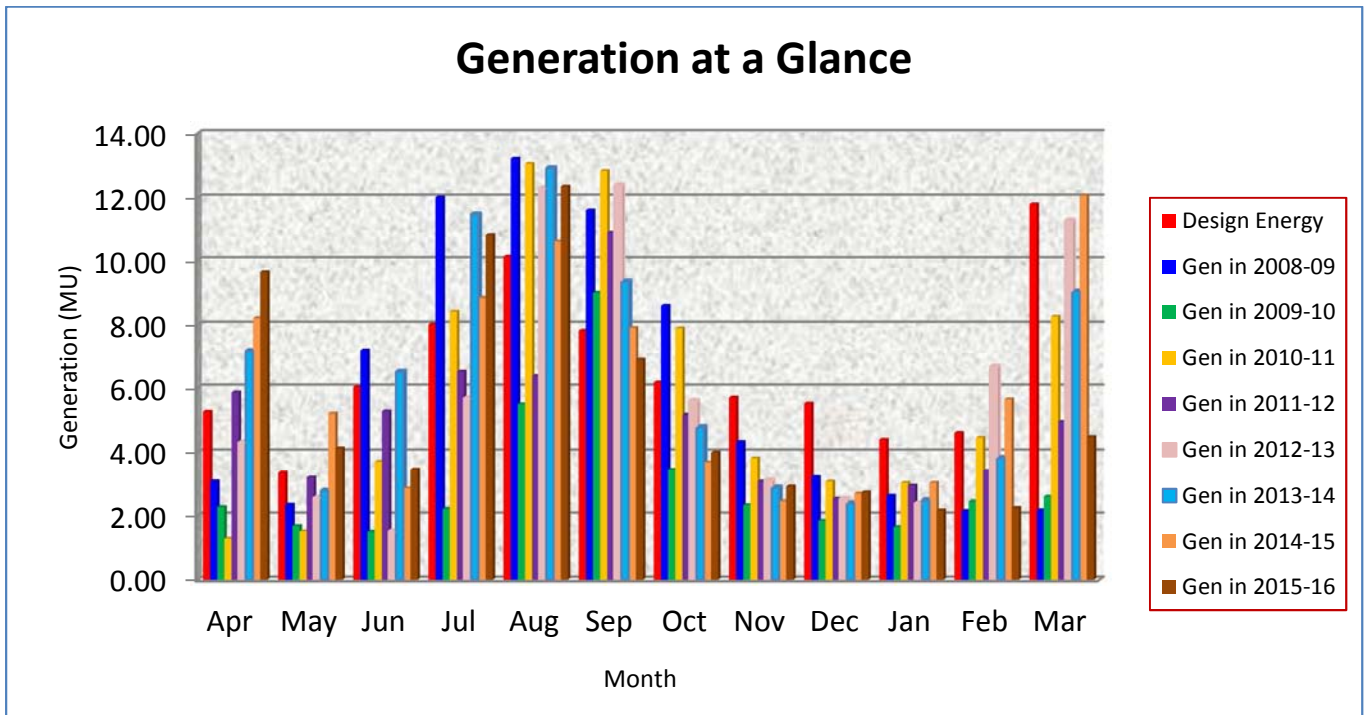
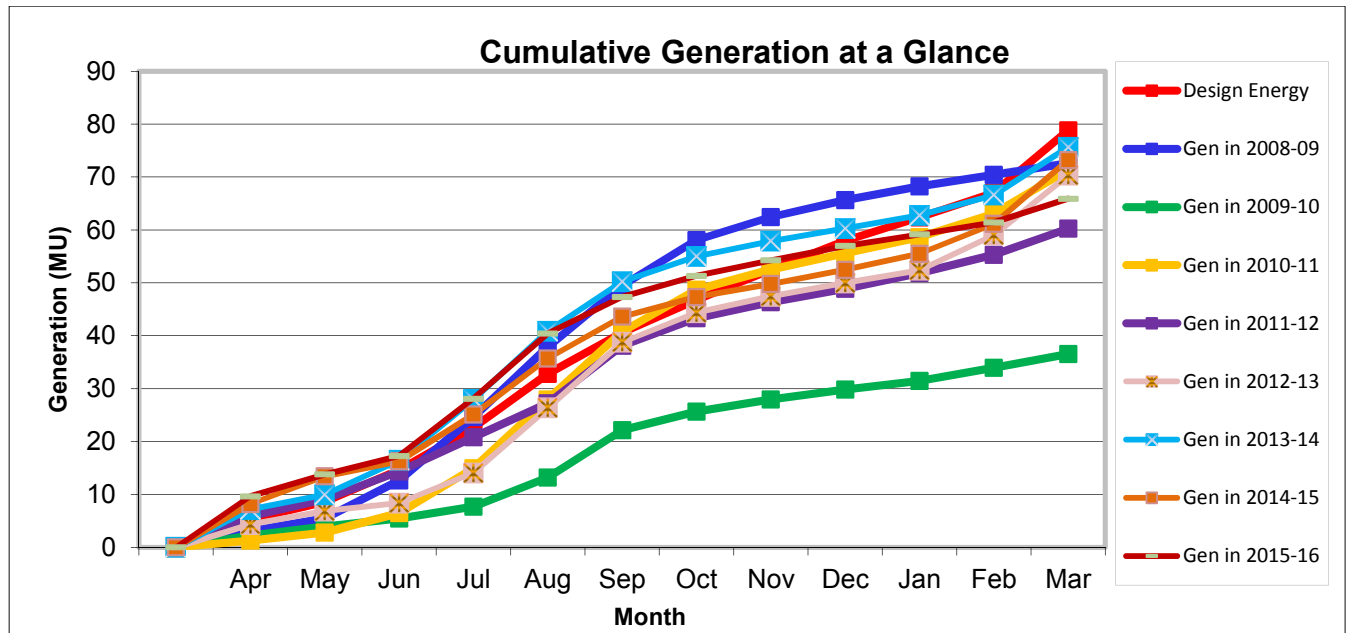
Month	Design Energy (90% Dependable Year in MUs)	Actual Generation (MUs) during 2008-09	Actual Generation (MUs) during 2009-10	Actual Generation (MUs) during 2010-11	Actual Generation (MUs) during 2011-12	Actual Generation (MUs) during 2012-13	Actual Generation (MUs) during 2013-14	Actual Generation (MUs) during 2014-15	Actual Generation (MUs) during 2015-16
Apr	5.26	3.08	2.28	1.29	5.86	4.32	7.18	8.21	9.64
May	3.35	2.36	1.68	1.51	3.20	2.56	2.78	5.21	4.14
Jun	6.03	7.20	1.50	3.72	5.27	1.52	6.50	2.85	3.48
Jul	8.02	12.02	2.22	8.42	6.51	5.68	11.48	8.84	10.84

Aug	10.12	13.21	5.49	13.05	6.37	12.30	12.91	10.60	12.36
Sep	7.82	11.61	8.99	12.82	10.91	12.39	9.35	7.91	6.88
Oct	6.17	8.60	3.47	7.90	5.17	5.60	4.80	3.70	4.01
Nov	5.70	4.34	2.34	3.83	3.08	3.10	2.88	2.46	2.92
Dec	5.51	3.22	1.84	3.07	2.53	2.52	2.40	2.69	2.73
Jan	4.41	2.62	1.65	3.03	2.94	2.40	2.48	3.03	2.18
Feb	4.62	2.16	2.46	4.47	3.43	6.66	3.84	5.65	2.25
Mar	11.80	2.18	2.59	8.26	4.96	11.29	9.03	12.07	4.49
Total	78.81	72.60	36.52	71.36	60.23	70.33	75.63	73.22	65.90

Generation during the month of April-2015 was the highest recorded for this month and generation during the month of September-2015 was the lowest for this month so far since commissioning of the Project.

Quarter wise performance of the Plant during the year is tabulated hereunder: Quarter	Design Energy (MUs)	Actual Energy Generated (MUs)	Actual /Design Energy %
1st Quarter(April 15 to June 15)	14.64	17.256	117.87
2nd Quarter(July 15 to Sep 15)	25.96	30.069	115.83
3rd Quarter(Oct 15 to Dec 15)	17.38	9.652	55.54
4th Quarter(Jan 16 to Mar16)	20.83	8.921	42.83
Total for the year 2015-16	78.81	65.90	83.62

As is evident from above table, generation during 1st and 2nd quarters was above Design Energy but the generation during 3rd and 4th quarter was very less because of poor river discharges during corresponding months.



2.3 *Discharge actually observed in the Bakhli Khad after 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 vis-a vis 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
Discharge data is in cumecs										
Apr	2.45	1.79	1.80	1.12	0.69	2.87	2.29	3.46	4.09	5.35
May	1.52	1.29	1.03	0.76	0.76	1.60	1.25	1.48	2.44	2.05
Jun	2.81	1.23	4.84	0.74	2.40	3.52	0.78	6.09	1.81	1.71
July	6.15	3.47	5.98	1.02	5.34	6.73	2.95	14.24	6.94	8.82
Aug	4.56	4.56	8.01	3.03	12.55	10.05	15.12	13.76	8.63	19.38
Sep	3.65	3.65	5.90	6.32	9.44	6.65	7.84	4.62	4.10	3.38
Oct	2.79	2.70	3.72	1.54	3.67	2.43	2.62	2.27	1.76	1.89
Nov	2.66	1.77	2.08	1.15	1.87	1.55	1.58	1.52	1.23	1.44
Dec	2.49	1.43	1.48	0.88	1.49	1.25	1.31	1.19	1.37	1.33
Jan	1.99	1.16	1.25	0.82	1.48	1.53	1.25	1.24	1.48	1.05

Feb	2.26	0.89	1.15	1.28	2.44	1.78	3.74	3.74	4.16	1.19
Mar	6.46	1.79	1.07	1.18	3.87	2.44	5.57	5.57	6.81	2.23

2.4 Revenue Generation / Realization

Project delivered 56,478,049 Units of electricity to HPSEB during financial year 2015-16 after accounting for 12% Free Power to the Home State. Against the energy supplied and billed for the year 2015-16 amounting to INR 12,70,75,610/- HPSEB released payments amounting to INR 15,06,56,820/- including the payment for February & March-15 amounting to INR 3,43,61,712/- released during April & May-15 and payment for liquidated damages amounting to INR 25,44,000. Details about the monthly billings and receipts are tabulated hereunder:

Financial Year 2015-16				
Revenue Realization during Financial Yr 2015-16				
S.No.	Period	Total Saleable Energy (kWh)	Bill Raised (INR)	Amount Received (INR)
2	-----	-----	-----	3,43,61,712*
3	01/04/15 to 01/05/15	81,68,161	1,83,78,362	1,83,75,660
4	01/05/15 to 01/06/15	35,72,448	80,38,008	80,38,008
5	01/06/15 to 01/07/15	29,85,312	67,16,952	67,16,952
6	01/07/15 to 01/08/15	93,77,280	2,10,98,880	2,10,98,880
7	01/08/15 to 01/09/15	1,04,82,912	2,35,86,552	2,35,86,552
8	01/09/15 to 01/10/15	58,60,800	1,31,86,800	1,31,86,800
9	01/10/15 to 01/11/15	34,44,672	77,50,512	77,50,512
10	01/11/15 to 01/12/15	25,16,448	56,62,008	56,62,008
11	01/12/15 to 01/01/16	23,53,824	52,96,104	52,96,104
12	01/01/16 to 01/02/16	18,81,792	42,34,032	42,34,032
13	01/02/16 to 01/03/16	19,53,600	43,95,600	-----**
14	01/03/16 to 01/04/16	38,80,800	87,31,800	-----**
15		LD Refund	25,44,000	23,49,600***
	Total	5,64,78,049	12,96,19,610	15,06,56,820

- * Payment against energy bill of Feb-15 & Mar-15 (Rs. 3, 43, 61,712) was realized in April-15 & May- 15.

- ** Payment against energy bill of Feb-16 (Rs. 43, 95,600) & Mar-16 (Rs.87, 318, 00) was realized in April-16 & May -16 respectively.
- *** Liquidated Damages refund

3. Technical Audit

Technical audit was conducted by O&M advisory services contactor (M/s EIPL) from 4th November to 7th November, 2015. The audit team comprised of two Electrical Engineers (for Electro-Mechanical works) and one civil engineer (for civil works).

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

To insure the uninterrupted generation due to any cause, inspection of the civil structure, approach roads of power house as well as weir site and foundation of the transmission line poles were also carried out.

To insure the safety of the systems and personals, the firefighting 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 equipments have been prepared & are being complied with. These periodic maintenance schedules are listed below.

- Daily maintenance schedule
- Weekly maintenance schedule

- Monthly maintenance schedule
- Quarterly maintenance schedule
- Half-Yearly maintenance schedule
- Yearly maintenance schedule

Apart from the above schedules, cleaning of both desanders at weir site & cooling water pit in power house prior to, during and after monsoons is being carried out.

4.2 Inspection of Runner

Runners of both the units have been inspected before the monsoon months, to assure the readiness of the machine during monsoon. One bucket of Runner of Unit-II was found in the damaged condition. The Photographs of Runner Buckets as taken during Dye Penetration Tests (DPT) and repairing work on the damaged bucket are shown below.



DP test



Repairing work in bucket

4.3 Inspection of Transmission line

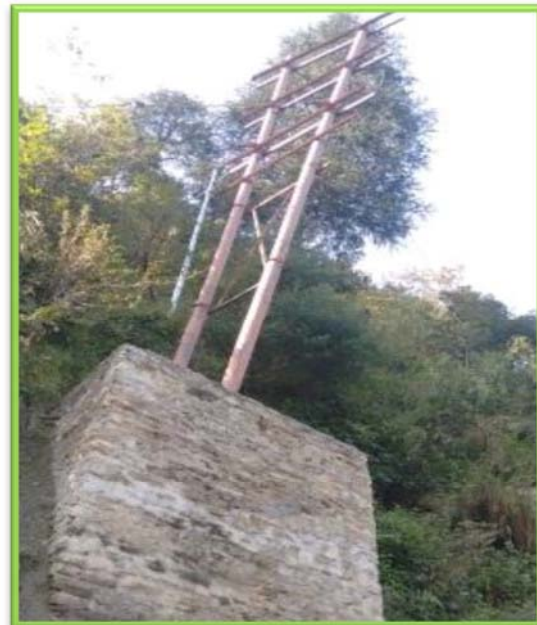
To ensure the availability of transmission line during monsoon, patrolling of the transmission line was carried out. During patrolling, some cracks were observed in the foundation of pole-51 and pole was also found in tilted position. Any further damages in the foundation could have caused complete outage of the transmission line. Therefore, the shifting of the foundation of that pole was done on the priority basis. The proposed and selected position for the shifting of the pole is depicted in the below photograph.



Tilted pole due to slide of foundation



proposed space for new foundation



Newly constructed foundation

4.4 Weir Site & Approach Roads

Due to heavy rains in the preceding monsoon some damages have taken place to the approach roads to the Power House & Weir site. The repair works as carried on the damaged portion of the roads as shown in the below photographs.





A cave-in had taken place in the power house approach road on 26th Feb which restricted the access of powerhouse. Restoration works was carried out on the damaged portion of the road.



Photograph blocked road & during repair works

4.5 Painting works

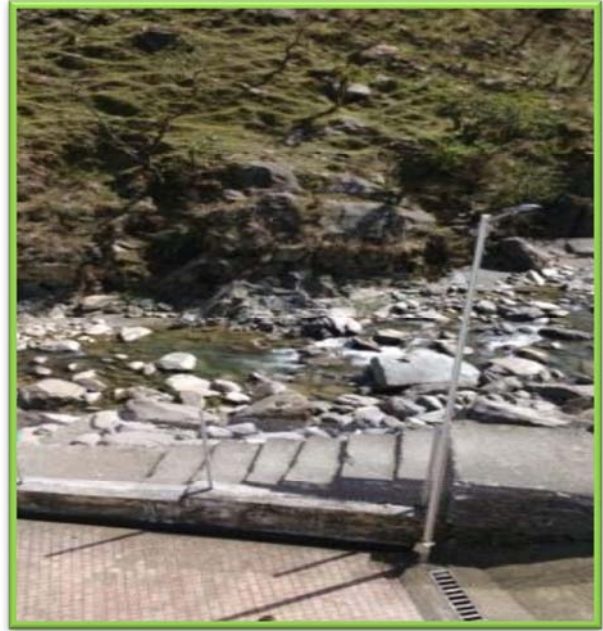
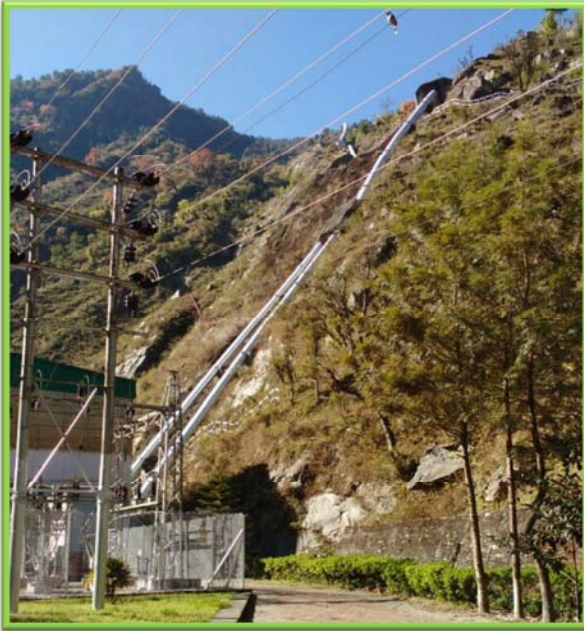
Since the commissioning of the project painting work of the powerhouse premises and weir site structures were not carried out. The painting of the power house premises, penstock, weir site structures as well as machinery including switchyard structure & transmission poles were carried out. The photographs of the painted structures and buildings are depicted as below.



Painting works in Switchyard and Transmission poles



Painting works in Power house premises



Painting of Penstock and illumination poles



Painting works at weir site

4.6 Installation of Vibration Monitors & Sensors

The vibration sensors installed on the bearing of generators were not working properly. To ensure the healthiness of the machine, the vibration sensors & monitors were replaced with Masibus make instead of OME make. The functioning of the newly installed vibration sensors & monitors were checked and found working properly. The photographs of the newly installed sensors and monitors are as below:



Vibration Sensor



Vibration Monitor

5. Annual Maintenance and Overhauling Works

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

- Generator
- Generator Transformers & other Transformers

- Turbine & MIV
- Switchyard equipments
- EOT Crane
- Weir site structures

Following major Annual Maintenance and restoration works of the Power Plant were carried out during the year:

- ✓ Repair of the stator winding
- ✓ Replacement & Repair of the runners
- ✓ Repair of the maintenance seal and service seal
- ✓ Hard coating of Runner, needle tips & mouth rings of nozzle
- ✓ Repair of the maintenance seal and service seal
- ✓ Cleaning of Cooling Water pit, CW filter, MIV filter, Generator cooler filter
- ✓ Cleaning of cooling water Filters of both the Units.
- ✓ Cleaning of Back Flushing Filters of both the Units.
- ✓ Repair of approach road of power house

6. Unit-II : Breakdown due to Rotor Earth fault

6.1 Fault reporting

On April 18, 2015 at 10:15 AM, Unit II tripped with abnormal sound. The machine was electrically isolated as the Generator Circuit Breaker tripped by the Electrical Protection (Rotor Earth Fault). The operator initiated the emergency command through emergency push button on governor panel to stop the Turbine. Subsequently the unit was opened up by the Operating team of PPPL and inspected to locate the fault.

Upon opening of the generator rotor, two poles were found to have faulted and insulation damage was seen on the poles. The insulation resistance test revealed insulation failure of the poles. Damages were observed at inter turn area and connecting terminals of the respective poles. The photographs of the damages are shown below.



The photograph on the right shows fault at the connecting terminals and the photograph on the left shows fault in the winding inter turn area.



Scratches were observed on the stator which would have come from the rotating rotor during the fault. The stator was later checked for insulation resistance and was reported to be OK.



Photograph showing Scratches observed on stator of unit 2

6.2 Repair Works

The poles were replaced by the spare poles available at site by M/s EMCO Electrodyne and the unit was put back into operation on dated 24/04/2015 at 12:30 PM.



IR check of spare poles

7. Loss of Generation - Causes and Corrective steps

7.1 Loss of Generation due to various reasons viz. plant outages, forced Grid outages & repair works during the year under report was to the tune of **1.37 MU** out of which, Generation loss of **0.5 MU** was attributable to the forced grid outages.

There are following two main factors responsible for the loss of generation from the Project in general:

- External Evacuation Constraints
- Plant Outages

7.2 External Evacuation Constraints

External constraints mainly comprise of the Grid outages in the HPSEB networks & back down instructions. Generation loss due to grid/HPSEB transmission lines tripping incidents during financial year 2015-16 was to the tune of 0.5 MU. This is on a lower side as compared to preceding year generation loss of 2.15 MU due to grid/HPSEB transmission lines tripping incidents.

This issue of grid/HPSEB transmission lines tripping incidents had been persistently followed up with the Board to eliminate such outages to the maximum extent possible and remove all evacuation constraints being faced by the project.

7.3 Plant Outages

The factors such as silt flushing duct choking, trash rack choking, cooling water filter choking, failure of 11/33kV breakers etc. were major cause for the plant outage. The matter of choking of silt flushing ducts was referred to civil design wing for their suggestions on the further improvements in the existing de-silting arrangements to obviate the problems of choking.



Completely choked silt flushing duct

To avoid choking, Civil Design wing had suggested removal of every third Chequered plate from the cut out of the silt flushing duct for improving the efficiency of the De-silting arrangement because the hole size in the plate was not sufficient to cater such huge amount of silt . These suggestions in the Desander had been taken up. And success of the implemented scheme was monitored in the monsoon and found that the problem of the silt deposition was not resolved. At this time the silt flushing duct was completely choked due to huge amount of silt flow from the duct. The photograph of the completely choked duct is shown above.

The below photographs depict the implemented suggestion of the civil wing.



Removal of plates from alternate holes

The overhauling of the 11kV as well as 33kV circuit breakers were carried out to avoid further failure of the breakers, during that mechanical alignment as well as electrical system of the breakers were thoroughly checked, after overhauling circuit breaker is working properly.

8. 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.

9. 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.

10. Employees Welfare Measures

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

- ✓ **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.
- ✓ Employees are also appreciated with incentives on achievement of certain target of generation.
- ✓ **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.

The End
