PATIKARI POWER PVT LTD

2 X 8 MW

Mandi District, Himachal Pradesh

Annual O&M Report

FY 2014-15

Contents

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) Aquaducts 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

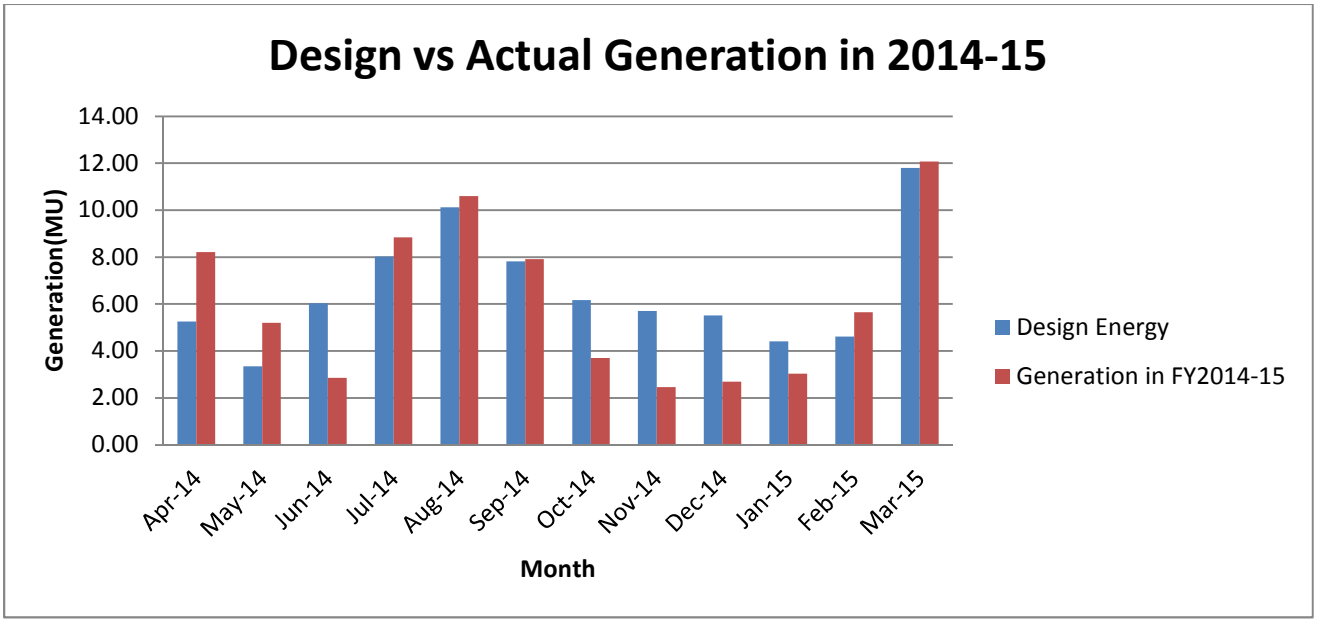
2.1 Generation Data during the Year:

Month wise Design Energy and corresponding actual generation from the Project during 2014-15 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-14	5.26	8.213	156.14	
May-14	3.35	5.208	155.46	
Jun-14	6.03	2.854	47.33	Due to Low Discharge
Jul-14	8.02	8.840	110.22	
Aug-14	10.12	10.598	104.72	
Sep-14	7.82	7.909	101.14	
Oct-14	6.17	3.703	60.02	Due to Low Discharge
Nov-14	5.70	2.459	43.14	
Dec-14	5.51	2.690	48.82	
Jan-15	4.41	3.031	68.73	
Feb-15	4.62	5.647	122.23	
Mar-15	11.80	12.070	102.29	

Total	78.81	73.222	92.91	Due to Low Discharge

As evident from above, against Design Energy of 78.81 MU based on 90% Dependable Year Discharges, Project generated 73.222 MU during the financial year 2014-15. The Generation during financial year 2014-15 was thus 92.91 % of the Design Energy. It is the second highest generation after FY 2013-14(75.63MU) since commissioning of the Plant.



2.2 Generation during seven 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
Apr	5.26	3.08	2.28	1.29	5.859	4.319	7.178	8.213
May	3.35	2.36	1.68	1.51	3.203	2.556	2.775	5.208
Jun	6.03	7.20	1.50	3.72	5.269	1.517	6.498	2.854
Jul	8.02	12.02	2.22	8.42	6.506	5.678	11.482	8.840
Aug	10.12	13.21	5.49	13.05	6.369	12.296	12.909	10.598
Sep	7.82	11.61	8.99	12.82	10.913	12.392	9.345	7.909
Oct	6.17	8.60	3.47	7.90	5.172	5.598	4.802	3.703
Nov	5.70	4.34	2.34	3.83	3.075	3.104	2.879	2.459
Dec	5.51	3.22	1.84	3.07	2.526	2.516	2.403	2.690

Jan	4.41	2.62	1.65	3.03	2.942	2.399	2.482	3.031
Feb	4.62	2.16	2.46	4.47	3.434	6.660	3.844	5.647
Mar	11.80	2.18	2.59	8.26	4.963	11.292	9.028	12.070
Total	**78.81**	**72.60**	**36.52**	**71.36**	**60.23**	**70.327**	**75.625**	**73.222**

Generation during the months of April-2014, May-2014, Jan-2015 and March-2015 were the highest recorded for these four months so far since commissioning of the Project.

Quarter wise performance of the Plant during the year is tabulated hereunder:**Quater**	**Design Energy (MUs)**	**Actual Energy Generated (MUs)**	**Actual /Design Energy %**
1st Quarter(April 14 to June 14)	14.64	16.28	111.20
2nd Quarter(July 14 to Sep 14)	25.96	27.35	105.35
3rd Quarter(Oct 14 to Dec 14)	17.38	8.85	50.92
4th Quarter(Jan 15 to Mar15)	20.83	20.75	99.62
Total for the year 2014-15	**78.81**	**73.23**	**92.92**

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

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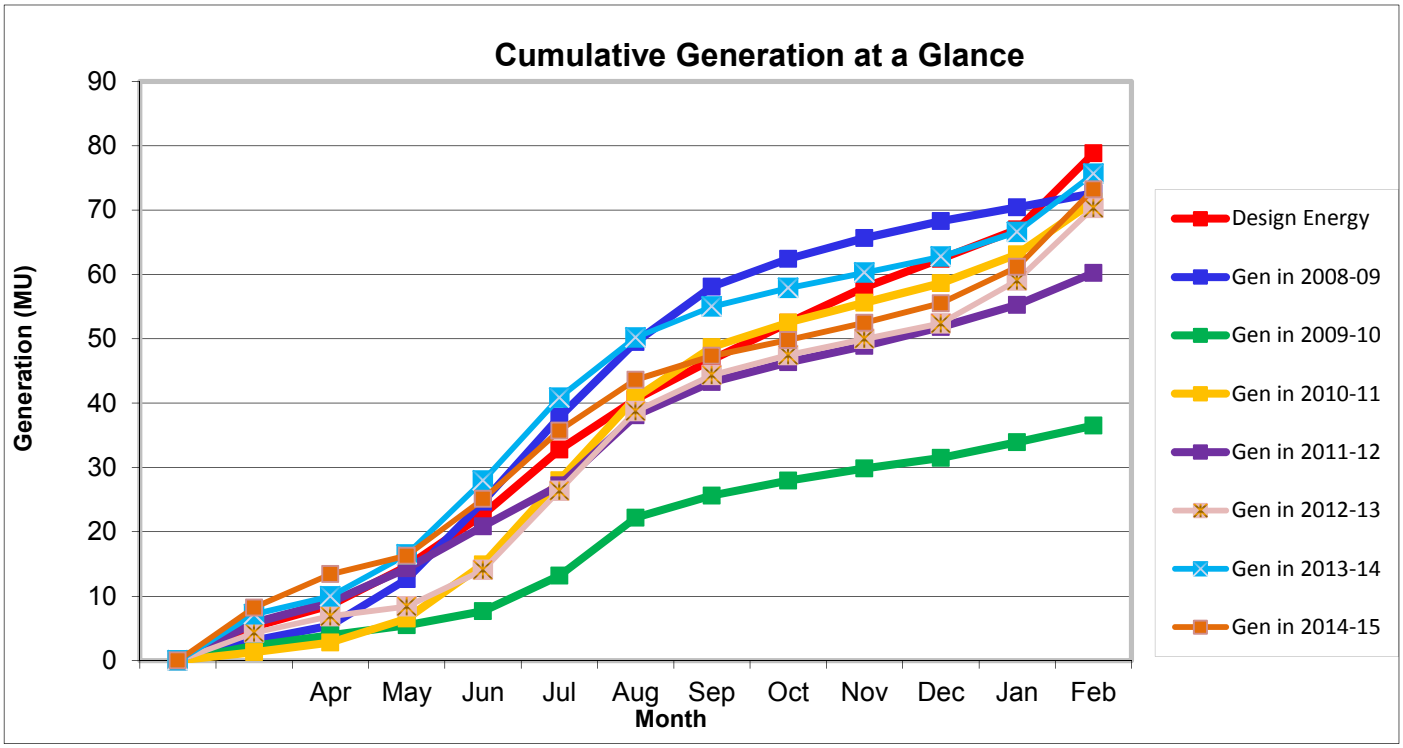
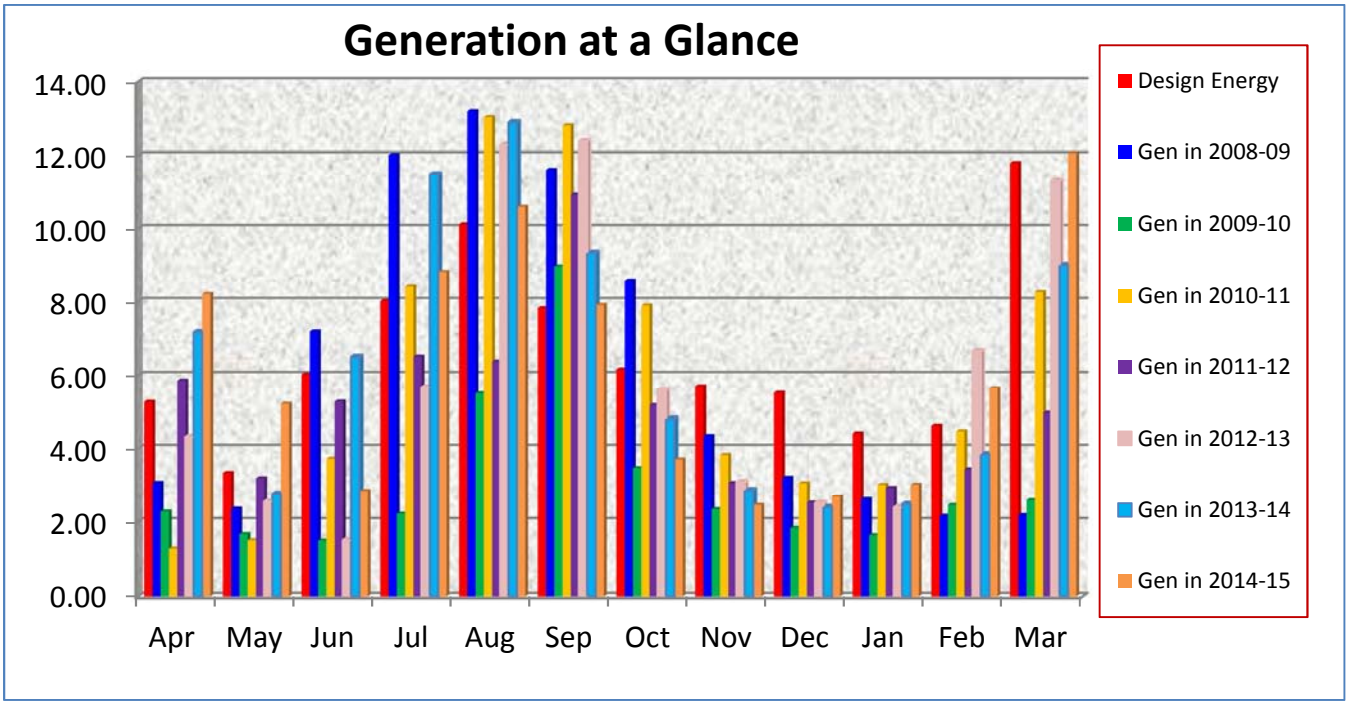

Cumulative Generation at a Glance
Generation (MU)
90
80
70
60
50
40
30
20
10
0
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Month
Design Energy
Gen in 2008-09
Gen in 2009-10
Gen in 2010-11
Gen in 2011-12
Gen in 2012-13
Gen in 2013-14
Gen in 2014-15


Generation at a Glance
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Design Energy
Gen in 2008-09
Gen in 2009-10
Gen in 2010-11
Gen in 2011-12
Gen in 2012-13
Gen in 2013-14
Gen in 2014-15

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 t0 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
	Discharge data is in cumecs								
Apr	2.45	1.79	1.80	1.12	0.69	2.87	2.29	3.46	4.09
May	1.52	1.29	1.03	0.76	0.76	1.60	1.25	1.48	2.44
Jun	2.81	1.23	4.84	0.74	2.40	3.52	0.78	6.09	1.81
July	6.15	3.47	5.98	1.02	5.34	6.73	2.95	14.24	6.94
Aug	4.56	4.56	8.01	3.03	12.55	10.05	15.12	13.76	8.63
Sep	3.65	3.65	5.90	6.32	9.44	6.65	7.84	4.62	4.10
Oct	2.79	2.70	3.72	1.54	3.67	2.43	2.62	2.27	1.76
Nov	2.66	1.77	2.08	1.15	1.87	1.55	1.58	1.52	1.23
Dec	2.49	1.43	1.48	0.88	1.49	1.25	1.31	1.19	1.37
Jan	1.99	1.16	1.25	0.82	1.48	1.53	1.25	1.24	1.48
Feb	2.26	0.89	1.15	1.28	2.44	1.78	3.74	3.74	4.16
Mar	6.46	1.79	1.07	1.18	3.87	2.44	5.57	5.57	6.81

2.4 *Revenue Generation / Realization*

Project delivered 6,28,54,176 Units of electricity to HPSEB during financial year 2014-15 after accounting for 12% Free Power to the Home State. Against the energy supplied and billed for the year 2014-15 amounting to INR 14,14,21,896/- HPSEB released payments amounting to INR 13,57,76,520/- including the payment for March-14 amounting to INR 1,76,32,296/- released during April-14. Details about the monthly billings and receipts are tabulated hereunder:

Financial Year 2014-15				
Revenue Generation/Realization during Financial Yr 2014-15				
S.No.	**Period**	**Total Saleable Energy (kWh)**	**Bill Raised (INR)**	**Amount Received (INR)**
1	----------	----------	----------	17,632,296*
2	01/04/14 to 01/05/14	6,971,712	15,686,352	15,686,352
3	01/05/14 to 01/06/14	4,457,376	10,029,096	10,029,096
4	01/06/14 to 01/07/14	2,512,224	5,652,504	5,652,504
5	01/07/14 to 01/08/14	7,648,608	17,209,368	17,209,368
6	01/08/14 to 01/09/14	8,993,952	20,236,392	20,236,392
7	01/09/14 to 01/10/14	6,745,728	15,177,888	15,177,888
8	01/10/14 to 01/11/14	3,179,616	7,154,136	7,154,136
9	01/11/14 to 01/12/14	2,118,336	4,766,256	4,766,256
10	01/12/14 to 01/01/15	2,326,368	5,234,328	5,234,328
11	01/01/15 to 01/02/15	2,628,384	5,913,864	5,913,864
12	01/02/15 to 01/03/15	4,926,240	11,084,040	11,084,040
13	01/03/15 to 01/04/15	10,345,632	23,277,672	**----------
	Total	**62,854,176**	**141,421,896**	**135,776,520**

- * Payment against Energy bill amounting to Rs. 1,76,32,296 raised for March-2014 was realized during April-2014.
- ** Payment against Energy bill amounting to Rs. 2,32,77,672 raised for March-2015 was realized during April-2015.

3. *Technical Audit*

Technical audit was conducted by O&M advisory services contactor (M/s EIPL) from 18th April to 24th April, 2014. The audit team comprised of two Electrical Engineers (for Electro-Mechanical works), one Mechanical Engineer (for Hydro-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 and proper functioning of the systems.

To insure the uninterrupted generation, 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 personnel, 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.

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:

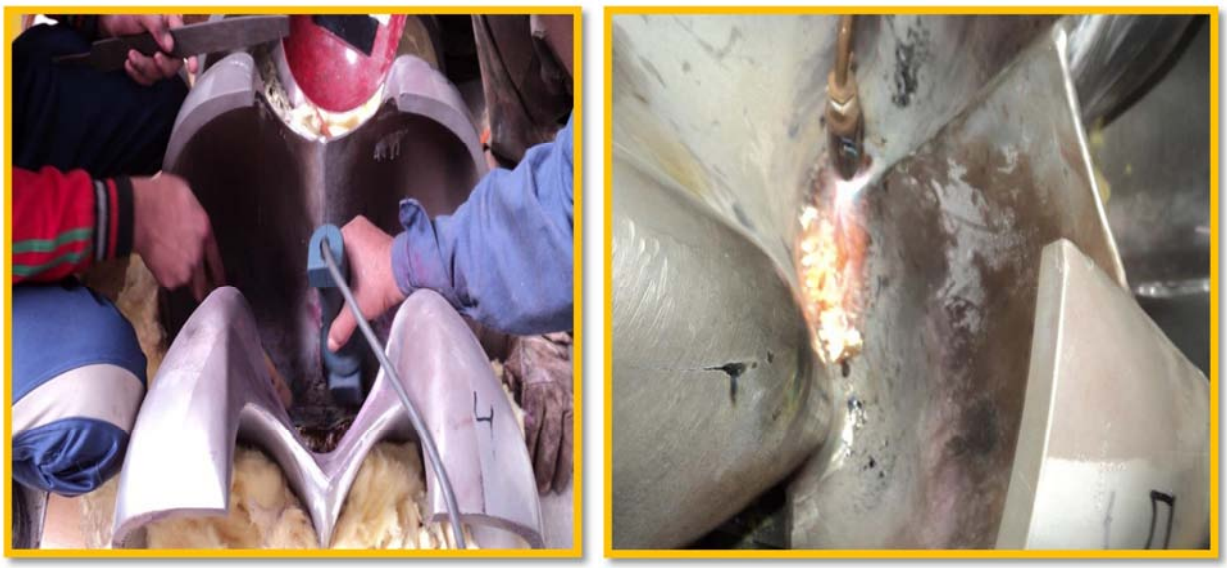
- ✓ Repair of the stator winding
- ✓ Replacement & Repair of the runners
- ✓ Repair of the maintenance seal and service seal
- ✓ Hard coating of Runner, needle tips & mouth rings of nozzle
- ✓ Repair of the maintenance seal and service seal
- ✓ Cleaning of Cooling Water pit, CW filter, MIV filter, Generator 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

5.1 Replacement & Repair of the runners

Inspection of the runner of both the units was carried out. During the DPT of Unit-II Runner, a crack was observed in the bucket no. 5. The Runner repair works of Unit-II was carried out by gouging, grinding & welding etc.

The photographs of the inspection and repair works carried out on runner of Unit-II

DPT of the runner of Unit-II

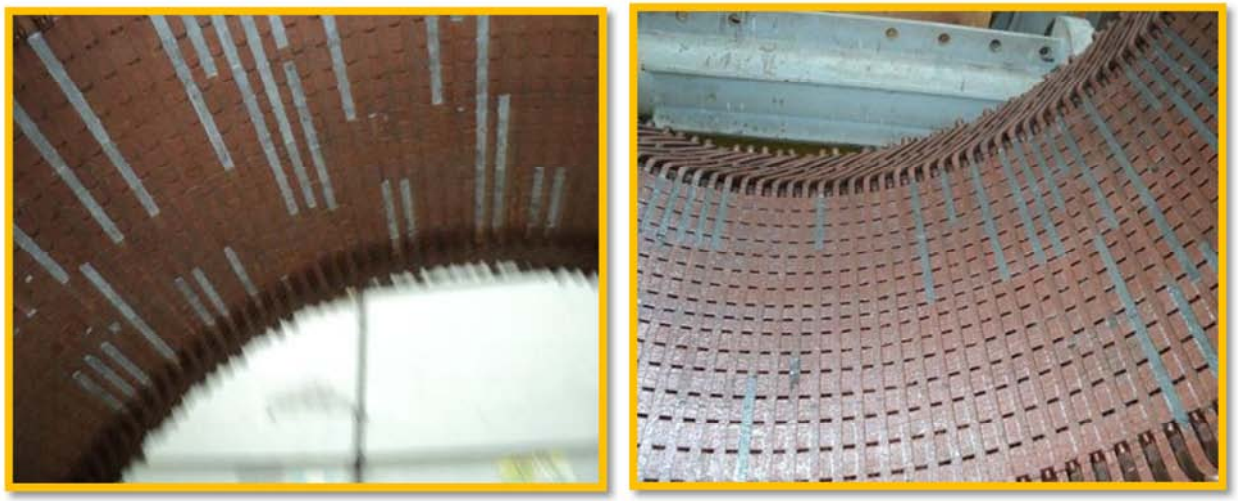


Repair work on the runner of Unit-II

Runner of Unit-I was also replaced with the available spare Runner during the overhauling of MIVs. Unit-I Runner thus taken out, has been sent to M/s IPM, Ghaziabad for repairs and hard coating.

5.2 Repair of Stator winding

During inspection of the stator, it was found that some wedges in the winding of unit-I were misplaced. The misplaced wedges were replaced by the M/s EMCO Electrodyne Pvt. Ltd. The photographs of the stator winding of Unit-I before repair works and after repair works are below.



Photograph of the stator winding with misplaced wedges

Photograph of the stator winding after restoration of wedges

5.3 Repair works on maintenance and service seal

Since commissioning of the project, first time MIV was taken out for the replacement of the service seal and maintenance seal. To avoid generation loss, bulk head (dummy) was placed at the penstock to facilitate the running of other unit. Replacement and repair works on the maintenance and service seal were carried out, related photographs are as below.

Dismantling of the MIV

Dismantling of the seals

Maintenance seal and service seal

5.4 Civil Structures – Inspections & Restoration Works

Some damages to the approach roads to the Power House & Weir site had taken place due to heavy rains. Repair & restoration works on the damaged portions were carried out.

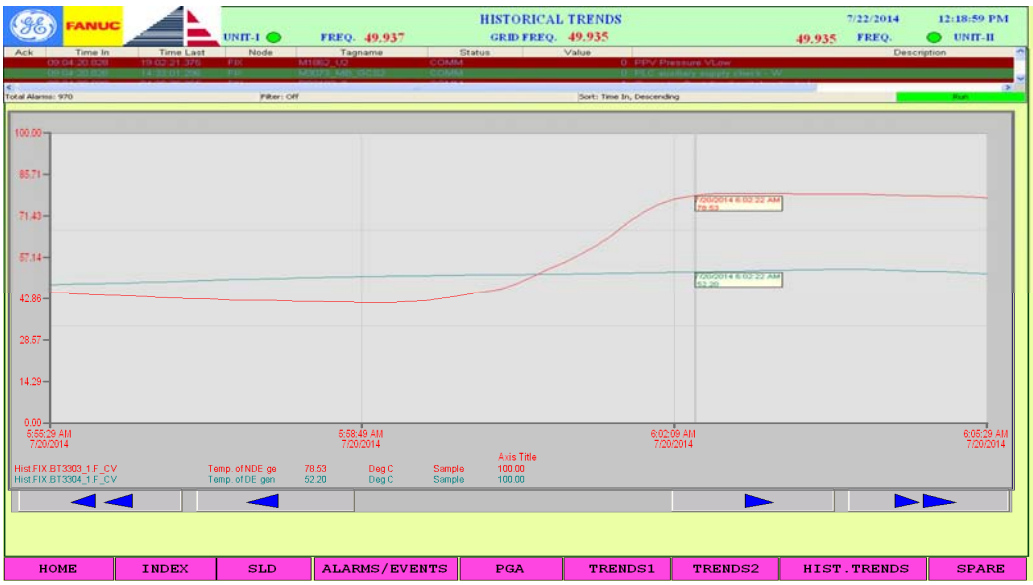
6. Bearing Failure & Restoration

On 20th July-14 at 5: 58 AM, when both the units were running smoothly at overload 9.2MW each, Unit-I was suddenly tripped in emergency condition (Class A tripped) due to very high temperature of the DE bearing. After the inspection of the bearing, it was found that the DE bearing was completely damaged. Photograph of the spare DE bearing is as below.

Photograph of the spare DE bearing

Cause of the failure was interrogated through detailed review of the event list of the SCADA system, in which it was observed that the failure was due to the choking of the lube oil filter.

The screenshot of the SCADA system taken during the tripping due to temperature rise is as below.



Trend of the temp during bearing failure

Trend of lube oil flow during bearing failure

As spare parts of the damaged bearing was available at site, so that the restoration work was carried out at the earliest, and unit was successfully restored within 24 hrs of the failure by the maintenance team and put the unit under operation at 6:06 AM on 21 July-2016.

7. *Loss of Generation - Causes and Corrective steps*

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 **2.78 MU** out of which Generation loss of **2.14 MU** was attributable to the forced grid outages.

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

- External Evacuation Constraints
- Plant Outages

7.1 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 2014-15 was to the tune of 2.14 MU. This is on a higher side as compared to preceding year generation loss of 1.15 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.

7.2 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.

To avoid choking of silt flushing duct, Civil Design wing had suggested modifying the existing holes as per design requirement for improving the efficiency of the De-silting arrangement and also suggested to make some arrangements for the agitation of the deposited silt on the holes. For agitation, a compressed air injection arrangement was suggested. The size of holes on the plates was increased, but the said arrangement of compressed air injection was not implemented due to lack of the availability of the desired nozzle.

Floating Drums arrangement for diversion of drift wood towards open Weir had earlier been provided at the intake to avoid the clogging of the trash racks to the maximum extent possible. Continuous clearing of Trash Racks manually during monsoon months had also being implemented during monsoons.

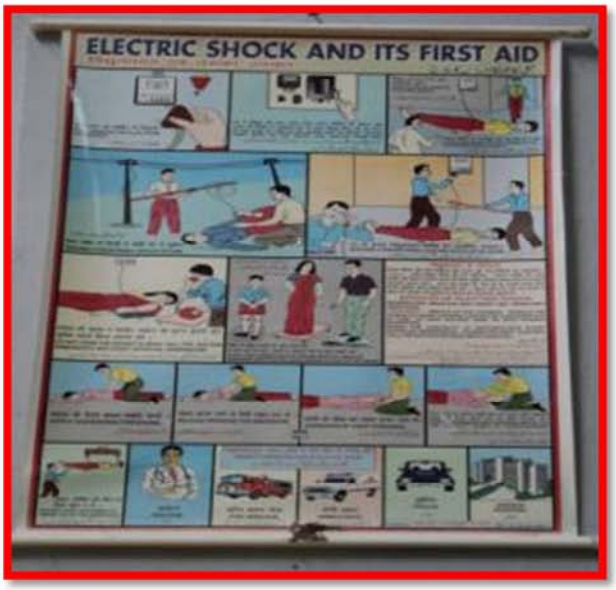
The overhauling of the 11kV as well as 33kV circuit breakers were carried out to avoid further failure of the breakers, during that mechanical alignment as well as electrical system of the breakers were thoroughly checked, after overhauling circuit breaker is working properly.

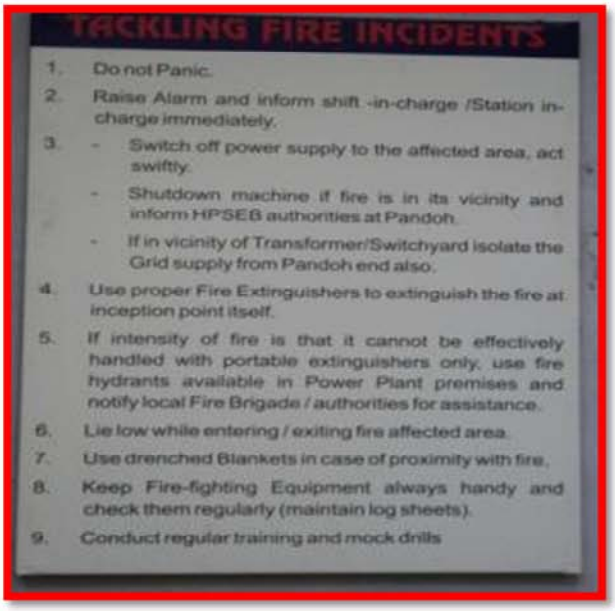
8. *Inventory Management*

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. Since the plant is in operation for more than seven (7) years now, some equipment / parts viz. valves, seals etc need to be replaced in the coming lean season for the uninterrupted operation of the plant. These equipments / parts are being listed & are proposed to be procured before the lean season of the next financial year.

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 issues related to Employees Welfare which are under consideration of 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