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Afghanistan Clean Energy Program

Thawak Mission Report (May 9, 2010)



This report was prepared by International Resources Group (an L-3 Company) for review by the United States Government for International Development (USAID).

Field Evaluation of the THAWAK MICRO HYDRO (PANJSHIR)
Afghanistan Clean Energy Program (ACEP)
May 2010

A field assessment was conducted of the 50 kW Thawak micro hydro project in Panjshir province. The power plant was installed by the Asian Development Bank (ADB) in 2006 but remained unutilized because of tribal disputes regarding sharing of electric power. The installation of the power plant was intended to show that with proper equipment and sound engineering, micro hydro power has tremendous potential for power generation wherever the resource is available. ACEP undertook the trip to inspect the condition of the plant and verify the work items quoted by ACEP's subcontractor. Findings are outlined below.

1. FINDINGS AND FURTHER WORKS NEEDED

(a) Background

- The project was initially intended to electrify some 350 households of Thawak village, with power availability per household of about 150 watts, and later, another 350 households of the nearby village, Anoba. All in all, the Thawak MHP would be supplying electricity to a total of 700 households with a population of approximately 4,000.
- Due to the later addition of the Anoba village, the power availability per household will decrease to about 70 watts per household. This might soon be insufficient as the population and the number of households grows.
- Procurement work on this project began in 2005 under the assistance from ADB. The equipment was installed and test-run in 2007 to produce 50kW under a gross head of about 14m. The distribution line, approximately 4km in total, was completed only in 2008 and canal upgrading was reportedly completed in 2009.
- However, due to acts of vandalism, which reportedly resulted from conflict between villagers, some of the equipment inside the powerhouse was damaged. This vandalism occurred sometime in early 2009, and the plant has since remained idle and in need of rehabilitation.

(b) The works that were carried out by villagers and development agencies that was not completed at the time when the machines were first installed and test-run in the powerhouse include:

- Cement-lining of the canal at the beginning of the headrace (about 200m), which was prone to damage/clogging with debris during times of high flow. The cement lining should reduce the period maintenance/cost on the canal and increase the reliability of water supply.
- The capacity of the whole length of canal (including the initial cement lined part and the remaining earth canal) appears to have been increased. This should allow for more water to be carried, resulting in less concern by farmers regarding irrigation requirements for their land located downstream of the MHP intake.
- Construction of a spillway and installation of sluice gates to control flow into MHP forebay.

Spillway gate

Main gate to control
flow to forebay and
d/s irrigation



- Construction of a by-pass at the forebay for irrigation water, and installation of sluice gates to control flow into forebay and or irrigation by-pass. One of the sluice gates requires minor maintenance (installing nut/bolt).



Fore bay

By-pass for irrigation

- An operator's room right next to the powerhouse. This should provide for better monitoring of the power plant by operators once the plant is put back into operation. However, the glass window glass panes are all missing and some damage has been inflicted to the main door. These need to be repaired or replaced.

New operator house



- (c) The powerhouse was especially vandalized. The main components of the generating equipment inside the powerhouse were purchased from IREM Spa, Italy, which is said to produce one of the most reliable electronic load regulator models on the market.
- (d) The powerhouse and its equipment were inspected in detail. The list below explains the works that are needed in order bring the plant back into normal condition. The photographs presented below illustrate the type and condition of various components.
- As per the suppliers' information sheet, the turbine is a cross-flow type made of Inox steel. The set includes a butterfly type inlet valve with a manual hand wheel used to operate the valve through a gear-mechanism. The turbine as a whole and the valve set appear to be in good condition with the exception of the inspection cover, which needs to be replaced. Some damage has been caused to two of the runner blades; it appears that they were stuck by a boulder from the tailrace pit. As the damage appears minor (bending of two blades at a certain location probably accounts for negligible area compared to the whole area through which water would flow) and IREM (the principle supplier) has not suggested any action, it is suggested to leave the blades in the present condition. Should there be any noticeable effect of this on the plant's performance (unusual noise or reduction in power), a corrective measure should then be taken. It was not possible to rotate the turbine shaft by hand. After looking through the inspection cover, it was revealed that a large piece of cloth has been stuck to the side of the turbine rotor. This needs to be removed as part of the rehabilitation work.



Missing pressure gauge
Missing Inspection cover



Damaged runner blades

- The generator is a 4 pole, 1,500 rpm 230/400 V synchronous generator with brushless type and compound excitation. Physical inspection showed the generator to be in good condition. It was not possible to rotate the generator without completely removing the belt as the turbine on the other end of the belt was jammed with debris/cloth.



Cogged belt drive

Generator inspected after removing top cover

- The 1,500 rpm generator is coupled to the slow rpm turbine through a cogged-belt drive system. Physical inspection showed the belt to be worn out and possibly not suitable for transferring 50kW of power. As a result, the belt needs to be replaced. Reportedly, one set of belts is in stock and is being

held by locals). A new set should be procured to maintain the stock. Since the belt set was kept in tight condition for long without rotating, there is a possibility that the bearing of the generator may need to be replaced. The cogged pulleys on the turbine and generator shafts appeared to be in good condition.

- The main power cable connecting the generator to the main control panel also appeared to be in good condition.

Damaged main control and instrumentation panel. Circuit breaker seems to be OK.

Power cable from the generator to the control panel seems to be OK.



- The main control panel's instruments and wiring was found damaged. The power circuit breaker appeared to be in good condition. Nevertheless, it is suggested that a new control panel set be purchased and that any usable components in the old one, such as the circuit breaker be kept as spares for future use.
- The main power cable connection between the control panel and distribution board was found to be cut and will need to be replaced.



Damaged distribution board

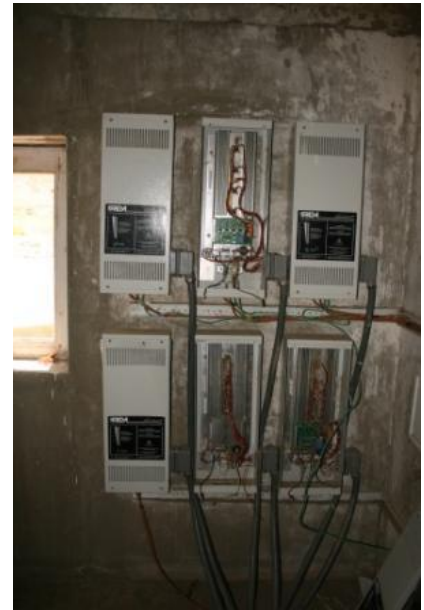
Cut power cable

- The distribution board (DB) with a set miniature circuit breaker (MCB) was destroyed and will need to be replaced. The DB individually controls the power supply to Thawak and Anoba villages.
- There are six sets of load regulating boxes, two for each phase. These keep the speed and voltage of the turbine-generator constant by regulating power to and from ballast heaters in the tailrace

based on the demand in the village. Whereas the top three regulators were found to be in good shape, the bottom two were destroyed and the third in bottom row had a slight indent on the front cover. It is suggested to buy three sets as replacement and keep one as a spare if not used (plus there is already one in stock).

Top three load controllers appear to be OK (we removed the middle cover for inspection)

Bottom two located on the right are clearly damaged



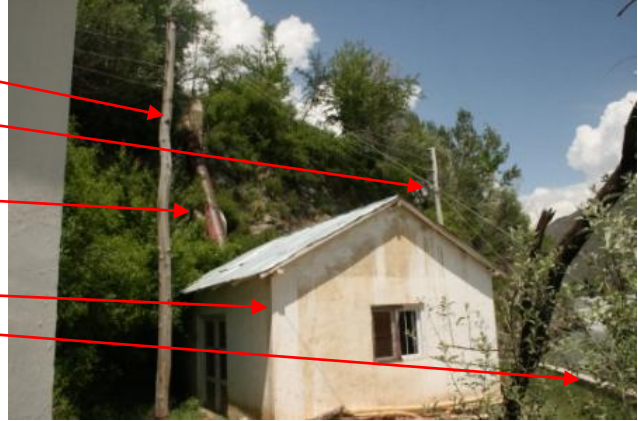
- The six ballast heaters installed in the tailrace are each connected to one of the load regulators. There are clear signs of damage on two of them while the rest may be usable. These heaters are relatively inexpensive; it is suggested to buy a whole new set. There is also one spare set with the villagers.



Some heater connection box and cables are damaged. Heaters protruding into the tailrace are mostly bent and later straightened.

- The main power cables connecting the DB to the first pole to Thawak and the first pole to Anoba have both been stolen. These need to be supplied and installed. The penstock pipe looks fine but needs to be repainted with a coat of anti-corrosion paint.

First pole to Anoba village
 First pole to Thawak village
 Penstock pipe
 Panjsir river
 Flood retaining concrete wall



- The powerhouse building itself looks OK except for the damaged window panes. It is suggested that all the glass panes be replaced with new ones, and a metal door and windows be installed to deter forceful entrance into the powerhouse by unauthorized persons.



Powerhouse building
 Panjsir River
 Flood retaining wall
 Operator's house

- The distribution line poles from powerhouse to Anoba and power house to Thawak largely appear to be in good condition. However, there are some poles that are tilting beyond acceptable angle and need to be straightened and secured. It was also reported by SESA engineers (was not possible to walk the whole length of distribution line at the time of the visit) that the distribution wires have been cut at an unspecified number of locations. These need to be repaired and the poles brought back into an upright position. Some of the wooden poles will need to be replaced with steel/reinforced concrete poles along the distribution lines. These should be surveyed, quantified and installed.

Tilting pole in the Anoba bazar



2. FURTHER WORKS NEEDED

- Recommended works based on the findings of the inspection visit are listed below.
- As described in the beginning of this report, the power available per household is very limited, amounting to roughly 70 watts per household. Villagers will definitely want to hook on more load if there is possibility of by-passing the load limiting switches. Moreover, the population and households will have grown by now and are expected to grow in the future. The only solution would then be to shed part of the load in the evening. If the plant is run overloaded, this will result in under voltage/under speed operation of the generator, which in-turn might have adverse affects on the life of the appliances connected at the consumers' premises. This can also adversely affect the generator.
- Therefore, it is recommended that a new separate plant be developed to supply one of the two main villages as soon as possible.

Requirement for Thawak MHP Rehabilitation

Result of visit to site on May 9, 2010

S.N.	Particulars or works required	Quantity	Remarks	
A	General			
1	Maintenance of sluice gates at spillway and forebay	1 lot	Bolt to be installed	
2	Cleaning/maintenance of flushing pipe from forebay; cleaning forebay area	1 lot		
3	Red-oxide painting of penstock pipe	1 lot		
4	Installing metal door at main entrance to powerhouse	1 set		
5	Installing metal windows at powerhouse	3 sets		
6	Powerhouse wiring for lighting and power sockets	1 lot		
7	Wooden cover for tailrace and ballast heater pit	1.4x1m + 0.9x1.5m		
B	Electro-mechanical			
8	Supply/install pressure gauge and nipple	1 set	Pressure gauge from IREM	
9	Supply/install turbine inspection cover with bolts	1 set	From IREM	
10	Provide spare bearings for turbine and generator DE and NDE	1 each	Bearing number from IREM and buy from local market	
11	Provide spare belt	1 no.	From IREM	one in stock; belt has been loosened to avoid unnecessary tension for the bearings
12	Provide/install complete set of ballast heaters and connecting cables	6 sets	From IREM	1 in stock, any useful from those damaged can remain in stock
13	Supply/install electronic load regulators	3 sets	From IREM	2 regulators are badly damaged, 1 may be damaged, 3 appear OK, 1 in stock

14	Supply/install main control, switchgear and instrumentation panel	1 set	From IREM	Good components from existing one, including circuit breaker, may be kept as spares
15	Supply/install underground power cable main control panel to distribution board	1 lot		
16	Supply/install flexible power and grounding cable from main control panel to electronic load regulators in cable trays	1 lot		
17	Supply/install underground power cable from distribution board to first pole (Thawak line)	1 lot		
18	Supply/install power cable from distribution board to first pole (Anoba line)	1 lot		
19	Supply/install grounding copper wires/cable from generator to control panel to distribution board to nearest PH grounding rod outside	1 lot		
20	Disassembling turbine, cleaning turbine rotor and penstock end of mud, pebbles, cloths; replacing / re-greasing bearings	1 lot		A large piece of cloth seems to have become entangled at the side of the rotor and is jamming it. The rotor cannot be moved by hand
21	Installing stay/guy wires or supports to distribution line poles that are at bends and not adequately positioned	?		Some poles along the Anoba line could be seen tilted; total quantity needs to be assessed
22	Reconnecting any broken wires along the LT distribution lines	?		Quantity of work needs to be assessed
23	Cleaning, installing, testing, and putting into service	1 lot		
C	Others			
24	Meetings with community and local administration to prepare for handover	lot		
25	Training operators			
26	Taxes, duties, etc.	%		Importable items to be supplied through IRG, while payment through SESA