TEESTA CANAL FALL HYDEL PROJECT

W.B.S.E.D.C.L
VIDYUT BHAWAN

A WATER PROOFING OF BUILDINGS & HYDRO ELECTRIC PROJECT REPORT

ACKNOWLEDGEMENT

I am very grateful to the authority of WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED to give me an opportunity to take a vocational training at the power project TEESTA CANAL FALL HYDEL POWER PROJECT.

During this vocational training, I have come across with the engineers and workers who help me whole-heartedly. With kind co-operation of the employers, I have learned about the use of app, water proofing & hydro power and its utility. I am very thankful to Mr. Anand Kumar Passy, Assistant Engineer (Civil); Mr. Leksang Chochen Bhutia, Junior Engineer (Civil); Mr. Bappa Mandal, Junior Engineer (Civil) who has supervise and guide us during the vocational ttraining I hope that the experience that I have achieved during the vocational training will help me in my future professional life.

Thanking from,

PREFACE

I am , a student of B.Tech (civil engineering) in Siliguri Institute of Technology. I have taken a vocational training at P.S.-I, P.S.-II, P.S.III & Township in T.C.F.H.P under the supervision of Mr. Anand Kumar Passy, Assistant Engineer (Civil); Mr. Leksang Chochen Bhutia, Junior Engineer (Civil); Mr. Bappa Mandal, Junior Engineer (Civil) . This training was associated with hydro power and equipment related with it. Hydro electric power is the most versatile, efficient, economic, renewable energy development. Testa Canal Fall Power Development Scheme is linked with Testa barrage project which is under implementation by the I &W Department of West Bengal . The discharge from Testa River has been diverted by a link canal to Mahananda River where barrage has been constructed to raise the water level and diverted to Mahananda main canal. The generation of the power is envisaged by utilizing the head of the canal fall structures and then discharging the water by tail race canal back to the Mahananda canal. The scheme envisages construction 3 no. power stations each having install capacity of 22.5 MW, total 67.5 MW (7.5×3X3). The power stations are located at distance of 5.503 KM, 21.275 KM &31.5 KM on the Mahananda main canal. The project was sanctioned in September 1985 and the zero date of the project reckoned as at January 1988.

INDEX

Page No.

Water Proofing of Buildings

This part of the report covers water proofing methods in new as well as old building constructions. Repair of damaged structure due to seeping water is a very costly affair. Hence proper waterproofing of building at construction stage is essential. It also covers the system of roof overhangs and extending part of roof as parapet wall. Besides this modern water proofing methods including the use of nano technology and construction chemicals has also been incorporated in the report.

A building may be a house, office or service building is an important asset involving large investment. The water seeping into any building structure is really detrimental and one should take necessary precautions at construction stage to ensure minimal or no damage at all. It is very costly to repair if a building structure is damaged by water. Hence waterproofing of building at construction stage will not only prevent damage caused by the water but also add value to it over the period of time through reduced maintenance cost. It is absolutely essential that roofs are provided with adequate slope to ensure effective drainage. The slope of roof should be such that the water gets drained off quickly by achieving adequate velocity under influence of gravity. Even areas with light rainfall will require adequate slope as continuous light drizzling without dry spell will induce roof leakage problem badly. A slope of 1 in 100 or steeper, depending upon the type of roof, is required for effective drainage. Due to inadequate workmanship/ poor material quality, dampness from roofs may be seen at the later stage. Water proofing system on the roof get deteriorated due to weathering effect and may become ineffective due to development of cracks/de-bonding/ disintegration of water proofing material etc. stagnation of water due to undulation in roof surface, provision of less number of drainage pipes or choking of same and improper detailing at junction of parapet and roof etc., are other major contributors in making the roof leaky.

Water Proofing Treatment with APP (Atactic Polypropylene Polymeric) Membrane:

Water proofing treatment of roofs with APP modified polymeric membrane shall be either five course, seven course as specified in the item. In selecting the combinations of layers of APP membrane, consideration shall be given to the type and construction of buildings, climate and atmospheric conditions and the degree of permanence required. Five course treatment is a normal treatment suitable to moderate rainfall conditions (less than 50 cm.) and seven course treatment is suitable for heavy rainfall (50 cm and above). Seven course treatment with APP modified polymeric membrane 2.00 mm thick and weight 3.00 kg./sqm. to suitable for very heavy conditions of rainfall (more than 150 cm.).

APP Modified Membrane: It is a polymeric water proofing membrane manufactured to high standards. It is five layered APP modified polymeric membrane with centre core as 20 micron HMHDPE/100 micron HMHDPE High Molecular High Density Polythylene Film, is the heart of the membrane and protects against water and moisture. The centre core is sandwiched on both sides by high quality polymeric mix with properties of high softening point, high heat resistance and cold resistively to make it ideal for all water proofing treatment. The polymeric mix is protected on both sides with 20 micron HMHDPE film. The membrane is available in variable thickness and weights. Usual width is 1.0 m.

Where proprietary brands Atactic Polyproplene modified polymeric membrane is proposed to be used by the contractor, they shall conform in all respect to the specification in the preceding paras and manufactured by a company of repute.

Bonding Material: This shall consist of blown type bitumen conforming to IS 702 or residual bitumen 85/25 conforming to IS 73 heated to the correct working temperature of 180°C. The penetration of the bitumen shall not be more than 40 when tested in accordance with IS 1203, unless otherwise specified each coat of bonding material shall be of blown type bitumen of grade 85/25 heated to a working temperature of 180 degree C and applied @ 1.20 kg. per square metre of the surface area.

Surface Finish: Surface finish shall be with brick tiles of class designation 100 grouted with cement mortar 1:3 (1 cement : 3 fine sand) with 2% integral water

proofing compound by weight of cement over a 12 mm thick layer of cement mortar 1:3 (1 cement: 3 fine sand) and finished neat.

Preparation of Surface:

- The surface to be treated shall have a minimum slope of 1 to 120.

- This grading shall be carried out with cement concrete or cement plaster with coarse sand, as desired, to the average thickness required and finished smooth.
- Junctions between the roof and vertical faces of parapet walls, chimneys etc. shall be chased by running triangular fillets 7.5 x 7.5 cm. size, cement concrete.
- At the drain mouths, the fillets shall be suitably cut back and rounded off for easy application of water proofing treatment and easy flow of water.

- Cement concrete where shall be 1:2:4 mix (1 Cement: 2 Coarse sand: 4 Graded stone aggregate 20 mm nominal size). The provision of fillets shall be deemed to be covered by the item of water proofing and shall not be measured or paid for separately.

- In existing roof where gola and drip course are provided at the junction of roof and vertical face of parapet wall, chimney stacks, etc. These shall be dressed suitably and finished smooth so as to ensure an easy and gradual turning of the flashing.

- Any dismantlement or forming and finishing smooth the junction for forming the base of the flashing shall not be measured or paid for separately and shall be deemed to form part of the preparation of the surface.

- While the grading of roof surface is being done, it shall be ensured that the outlet drain pipe have been fixed and mouth at the entrance have been eased and rounded off properly for easy flow of water.

- When any pipe passes through the roof to be treated, angular fillet shall be built around it for the water proofing treatment to be taken over it. These fillets shall not be measured or paid for separately.

- For carrying over and tucking in the water proofing felts into the parapet walls, chimneys stacks etc. a horizontal groove 6.5 cm. deep, 7.5 cm. wide section with its lower edge at not less than 15 cm. above the graded roof surface shall be left on the inner face of the same; during construction if possible.

- When such groove has not been left, the same shall be cut out neatly and the base at rear of the groove shall be finished smooth with cement plaster 1:4 (1 cement: 4 coarse sand).

- Such cutting of the groove and its finishing smooth shall be part of the water proofing or paid for separately.

- No deduction shall be made either for not making the groove or when the latter has already been left in the masonry by the construction agency.

- Tucking in the water proofing felt will be required where the parapet wall exceeds 45 cm. in the height from the graded surface.

- Where the height is 45 cm. or less, no groove will be required as the water proofing treatment will be carried over the top of the parapet wall to its full thickness.

- In the case of low dividing walls of height 30 cm. or less, outlets therein shall be cut open for full height and the bottom and sides shall be rendered smooth and corners rounded and such treatment shall not be measured and paid for separately.

- Where expansion joints are left in the slab the provision of dwarf walls and/or RCC slabs for covering them and finishing the surface smooth shall be the responsibility of the construction agency, which had laid the roof slab and will not be included in the operation of water proofing.

- The graded surface of the roof and concrete fillets and the faces of walls shall be thoroughly cleaned with wire brushed and all loose scales etc. removed. The surface shall then be dusted off.

- Any crack in the roof shall be cut to V section, cleaned and filled up flush with cement mortar slurry 1:4 (1 cement : 4 coarse sand) or blown type petroleum bitumen of IS grade 85/25, or approved quality conforming to IS 702. Such cleaning of the surface or treating the cracks shall not be paid for separately.

Treatment:

The water treatment shall be of five or seven course as specified. In seven course treatment, the first four courses shall be the same as for five course treatment. The fifth course shall be a layer of APP modified polymeric membrane. The sixth course shall be a coat of bonding material and the top most seventh course shall be of specified surface finish.

Laying:

(a) First course shall be a coat of bitumen primer @ 0.40 kg per sq mt followed by subsequent course as per treatment required.

(b) Drain outlets shall be given a four or six course treatment as specified for the roof in the description of the item in the manner specified for the flat roof surface. Water proofing treatment shall be carried into the drain pipe or outlets by at least 10 cm. The water proofing treatment laid on the roof surface shall overlap the upper edge of the water proofing treatment in the drain outlets by at least 10 cm.

(c) The APP modified polymeric membrane shall be cut to the required length, brushed clean of dusting material and laid out flat on the roof to eliminate curls and subsequent stretching. The membrane shall normally be laid in length in the direction of the slope and laying shall be commenced at the lowest level and worked up to crest. The membrane shall not be laid in single piece of very long lengths as they are likely to shrink; 6 to 8 m are suitable lengths. The roof surface shall be cleaned and dry before starting the membrane treatment. Each length of membrane shall be laid in position and rolled up for a distance of half its length. The hot bonding material shall be poured on the roof across the full width of the rolled membrane as the latter is steadily rolled out and pressed down. The pouring shall be so regulated that the correct weight of bonding material per unit area is spread uniformly over the surface. Excess bonding material that gets squeezed out at the ends shall be levelled up as laying proceeds. When the first half of the strip of felt has been bonded to the roof, the other half shall be rolled up and then unrolled on the hot bonding material in the same way. Subsequent strips shall also be laid in the same manner. Each strip shall overlap the preceding one by at least 7.5 cm. at the longitudinal edges and 10 cm. at the ends. All overlaps shall be firmly bonded with a blow lamp and levelling down unevenness. The fourth layer of bonding material in the five course treatment shall be carried out in a similar manner after the flashing has been completed.

(d) In a seven course treatment the fifth layers of membrane shall be laid in the manner already described, taking care that laps in the membrane are staggered from those in the earlier layer. The sixth layer of bonding material shall be carried out after the flashing is done.

(e) High Parapet Walls, Chimney Stacks etc.: Membrane shall be laid as flashing wherever junctions of vertical and horizontal surfaces occur. Longitudinal laps shall be 10 cm. The lower layer of flashing membrane in a six course treatment shall overlap the roof water proofing by not less than 20 cm. while the upper layer shall overlap the roofing felt by 10 cm. The minimum overlap of the flashing membrane in five course treatment over the roofing membrane shall be 10 cm. The flashing shall consist of the same five or seven course treatment as for the roof except that the final course shall be replaced by an application of 12 mm thick cement plaster 1:3 on the vertical and sloping faces only, of the flashing. The overlap along the length of flashing shall stagger with those in the second layer of flashing membrane (in a seven course treatment and with the joints in the roof membrane). The upper edge of the finishing membrane shall be well tucked into the flashing grooves in the parapet, chimney stacks etc. to a depth of not less than 6.5 cm. Corresponding applications of bonding material shall also be made. The flashing treatment shall be firmly held in place in the grooves with wood edges at intervals and the grooves shall be filled up with cement mortar 1:4 (1 cement: 4 coarse sand) or cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) and surface finished smooth with the rest of the wall. The cement work shall be cured for 7 days. When dry, the exposed plaster joints of grooves shall be painted with bitumen and two coats of bituminous solution shall be applied on the vertical and sloping surface of flashing. After the top flashing membrane layer has been fixed, the penultimate layer of bonding material shall be applied over the roofing membrane and the horizontal overlaps and vertical and sloping surfaces of the flashing at the specified rate.

(f) Low Parapet Walls: Where parapet walls are of height 45 cm. or less, membrane flashings shall be provided in the same manner as for flashings in the case of high parapet walls except that the upper edge shall be carried upto the full height of the wall and taken right across the top of the parapet and down on the external vertical faces to a minimum distance of 5 cm.

(g) Low Dividing Walls: Where low dividing walls or inverted beams are met with, the same shall be covered with a four or six layer treatment as for the main roof, the latter bearing carried down both sides of the wall and overlapping the roofing treatment as in the case of flashing of high parapet walls. Drain outlets where formed in the low dividing walls, shall be given water proofing treatment of the same number of courses as specified for the flat roof surface. The bottom

and sides shall be so treated that all overlaps are in the direction of flow of drainage.

(h) Expansion Joints: Where the expansion joints are provided in the slabs, the joints and their cover slabs shall be suitably treated with water proofing. A typical sketch of an expansion joint with the RCC slabs on either side of the joint turned vertically up and dwarf walls by not less than 7.5 cm. and are provided with throatings on their underside along their length. The water proofing treatment shall be taken up the sloping junction fillets and the vertical faces of the walls to the underside of the cover slabs. The cover slabs are given the water proofing treatment like the roofs slabs, after the cross joints between adjacent cover slabs are first sealed with 15 cm width of roofing felt struck to them with bitumen. The water proofing treatment shall be carried down the sides of the cover slabs to their full thickness. Care shall be taken to see that overlaps if any in the roofing over the cover slabs stagger with the joints between cover slabs. The formation of the expansion joints and provision of the cover slabs shall be the responsibility of the construction agency. The formation of the junction fillets and the water proofing treatment of the joint and cover slabs shall be carried out by the water proofing agency. Nothing agency extra shall be paid for the sealing of the cross joints in the cover slab with 15 cm. width of bitumen strips.

(i) Pipes: Where vertical pipe outlets are met with, 7.5 x 7.5 cm fillets of lime or cement concrete of the type shall be provided and flashing of four or six course treatment, same as for the roofing treatment shall be laid. The upper edge of the flashing shall be laid sloping down forward and butted against the pipe and annular depression so formed shall be filled with hot bitumen. A circular metal collar in the shape of an inverted truncated cone shall be fixed on the pipe to throw off the rain water clear of the flashing and this shall be paid for separately.

Product Catagory	**Name of Product**	**Description/ Area of Application**
APP Waterproofing membranes	Sika WP Shield 103 P/104 P / SikaBit T 130 PG / 140 PG Sika WP Shield 103PM / 104PM / SikaBit T 140 MG/ SikaBit T 130 MG SikaBit T 130 SG/140 SG Sika WP Shield 103F/102F	Plain finish polyester reinforced APP membrane Mineral finish polyester reinforced APP membrane Sand finish polyester reinforced APP membrane Sika WP Shield 103F/102F Plain finish fibre glass reinforced APP membrane
Expansion Joint Waterproofing Bonding agent Anti-Carbonation coating	SikadurCombiflex SG Sikadur 32, Sikadur 32LP, Sika Hibond Sikagard 550W Elastic, Sikagard 551S Primer, Sikagard 680 MY	Expansion Joint Treatment Bonding agent for new concrete to old concrete Protective coating for concrete exposed structures
Water stopper / Waterbar	Sika Swell A Profile Sika Swell S2 Sika Waterbar h	Acrylic based Hydro swelling Water stopper PU Based hydro swelling liquid PVC based Water stopper

SOLAR POWER PROJECT COMMISSIONED ON TEESTA CANAL:

A 10MW PV installation has been commissioned on the Teesta canal bank of West Bengal as part of the governments' scheme for canal-top and canal-bank projects. This project is the first canal-bank project to be commissioned under the new measure.

The project was inaugurated by the chief minister of West Bengal, Mamata Banerjee, on 23 August 2016 — while commercial operation began on 24 August 2016.

As part of the new program for canal-top and canal-bank projects, 100MW of PV capacity has been approved for installation across eight states. Aside from a 1MW project commissioned in Andhra Pradesh in early 2016, all other projects are in various stages of implementation.

The program — implemented by the Solar Energy Corporation of India — provides central financial assistance of up to 30% of project costs for installations located on top of canals or on available land adjacent to canals.

The 10MW installation, located between Mahananda Main Canal and Tailrace Channel of Teesta Canal Fall Hydroelectric Power Plant, is owned by the West Bengal State Electricity Distribution Company Limited (WBSEDCL).

-:INTRODUCTION: HYDRO-ELECTRIC PROJECT:-

RELATION BETWEEN CILIV ENGINEERING & GEOLOGY:

The application of geological knowledge in design &construction has become obligatory, particularly in the field of hydro-electric /river valley project. The layout of the hydel project generally includes a storage structure, water conductor system, a shaft or balancing reservoir, penstock &power house. Al this structure to be placed on good Foundation. A thorough knowledge of the same is therefore necessary to take care of any deficiency.

Lithology & rock deformation are the two most important geological parameter that control the character of the foundation material. Rock types, their mode of occurrence, grain size, colour & mineral constitute the lithology at a given locality. Foundation material may be soft fragile, incompetent or hard, compact, competent depending on the above.

POWER HOUSE : -

The foundation of a surface power is usually placed on fresh & hard rock after removal of the overburden. Rocks are grouted to make the foundation monolithic. Raft foundation is provided where the foundation rock has low load bearing capacity.

The design & of underground power is totally depend on geological condition. The orientation of long axis of capacity, stability of roof & the wall are determined from the geological study carried out though drafts &drill holes during investigation stage. Instrumentation data help in the interpretation of geological complexities. The design suitably modified during actual excavation though more data input. This process is continuous &has in construction of large underground cavities.

SLOPE STABILITY : -

Slope stability is another important factor in civil engineering construction, particularly in Himalayan terrain, where slope are in critical balance due to the natural mountain building &weathering process. The major factors contributing in slope failure are 1) high slope angle, 2) low cohesion of slope forming material, 3) high pour water pressure, 4) unfavourable joint or fracture planes. Land use pattern & heavy concentration precipitation also contribute to the slope failure.

Any interference of the slope already in critical condition in the way of excavation or leading trigger instability &affects civil engineering structure roads, building, surface power house, open channel etc. affected by slides in hydel project almost annually during monsoon.

TUNNELS:-

Tunnels of various dimensions are constructed at hydel project to serve as water conductor. The tunnels are generally placed at depth to provide sufficient fresh & sound vertical rock cover. Surface geological slopping constitutes the main basis of geological interpretation along with geophysical method &limited drilling.

The adverse condition in tunnelling can be broadly grouped as .1 Following ground 2. Squeezing round 3. Roof collapse & 4. Heavy water ingress zone. Flowing ground condition takes place in sheared granular rock surcharges with seepage water. The material flows into tunnel like mud &hinders tunnelling process. "Fore poling" method is adopted in tackling flowing.

Squeezing ground condition takes place in area having high stresses. The rock media squeezes after tunnel excavation & reduces the diameter of the tunnel. Roof collapse is common where joins fractures intersect each other & for wedges at the crown. Heavy water inflow takes place where water table gets punctured during tunnelling.

DAM & WEIR:-

The foundation of a dam or weir should be placed on fresh and hard rock after removal of overburden. The structure win be stable if the compressive strength of foundation rock is sufficient to withstand its load. The joints and fractures in rock should not be wide enough to allow significant seepage and crest there by uplift pressure. The faults should not include unequal settlement during dam loading.

Since deal condition is rarely available, the deficiencies should be identified and adequately treated. Grouting, selective deeper excavation, anchoring etc are some of the approved measures usually undertaken towards foundation treatment of dams. Another important consideration is the keying of abutments of a dam in sound rock. Drifts are exuviated of the purpose to estimate stippling.

SEISMICITY:-

Vulnerability of engineering structure to earthy quake shock is well known for which adequate safety factor is incorporated in the designed. This safety factor is determined by the Study of regional geology of are, history of past earth quake & their damage pattern, of recent activity, if any, along known faults. Geological input is therefore vital for understanding, seismic-tectonic setup of the area, where construction activity is under process. ISI has divided India sub-continent in five seismic zones 1 to 4. Each zone has been assigned different "seismic coefficient" for incorporation of the design, This coefficient is to be multiplied an "Important Factor" according to the type of engineering structure to be constructed.

HYDRO POWER:-

Hydro-electric Power is the most versatile, efficient, economic, renewable energy development. The huge momentum of flow of river water is used for generating hydro-electric power. Quantity of water & the and head or pressure are requirements to produce energy. The simplest form of hydro power development from river is achieved by constructing a dam across the river. The water is then diverted and routed through turbine to rotate the runner which in turn rotates the rotor of the generator to produce electricity.

Types of Hydro power development:-

There are hardly two types of hydropower development system

1. Storage scheme.

2. Run of the river scheme.

3. Mixed type scheme.

T.C.F.H.P. is mainly based upon canal fall development scheme

In an irrigation canal often falls are provided to match the ground level along its course.

ADVANTAGE OF HYDRO POWER:-

1. Very efficient
2. Pollution free
3. Renewable
4. Simple operation &maintenance
5. Small auxiliary consumption
6. Can accept &reject load quickly within frequency &voltage regulation limit
7. Unit can be put off &put on within a second as per load variation without any consequence
8. Machine can be designed to take high degree of load variation with normal effect on efficiency
9. Long time &can be renovated upgrade the frequency with reasonable cost
10. The cost per MW of installed capacity is same as that thermal but generation cost is lower & reduce with time.

DISADVANTAGE OF HYDRO POWER:-

1. High degree of sophistication, expertise, &innovative techniques is required during Construction to meet geological uncertainties.

2. Hydraulic structure &equipment is unique for each project &required detail study on construction facilities which have major effect on cost & time of construction.

3. Generation may effect if monsoon fails.

4. Each plant has unique features & designs.

5. Site is invariably located in difficult hilly area in hospitable climate condition without civic amenities/ facilities nearby.

6. Suffers uncertainties & hazard from geological & natural cause such as rock fall, tunnel collapse, floods, land slide etc during construction.

THE RUN OF THE RIVER SCHEME:-

As the name suggest, the run of the rive schemes are those which do not gave a large dams with reservoir to store entire monsoon water. There are mainly two types of ROR schemed.

1.To use the river water & its drop either In the fall or from in natural gradient.
2. Canal fall development: To use the intended drop provided in the canal.

In the former type the typical layout &the features would be as appended below:

1. A diversion structure

a. Barrage or diversion dam
b. Weir
c. Drop type or trench type

2. Intake structure:

To received diverted water from the river.

3.Desalting chamber:

To eliminate sand/silt particles which are harmful to turbine.

4. Water conductor system:

A. Pressure conduit:-

a. over ground duct.
b. Cut &cover duct.
c. Pipe - concrete or steel.
d. Tunnel or shaft with steel concrete lining
e. Surge tank or balancing reservoir
f. Pen stock

B. Open flow:-

a. over ground duct.
b. Cut & cover duct.
c. Pipe- concrete or steel.
d. Tunnel or shaft with steel/concrete lining.

e. Fore bay.

f. Pen stock.

POWER HOUSE & TAIL RACE:-

1. Underground power house: - With tunnel & Surge shaft when there is no good site available forever ground P.H.

2. Overground power house: - In such run of the river project small poundage is provided either at Barrage/Weir/Diversion dam or at both to cater diurnal load variation during lean flow period.

CANAL FALL DEVELOPMENT:-

In an irrigation canal fall often falls are provided to match the ground level along its course. Such falls or drops are normally within 2 to 10 m. normally gates are provided just before main to keep the canal water at a constant level in different flow condition so that water from main canal to distributors can flow with gravity. The additional water not required for upstream of fall structure, will flow downstream. This water can be utilized to genera Power when it is allowed to flow through a Turbine in a power house.

In this type of development a By Pass channel is provided upstream of the fall, to divert the water from main irrigation canal. The power house is located on this by pass channel. The part of the channel is called Head Race Channel (HRC). The water from HRC will flow through the turbine installed in the power house to generate electricity. The water then flow through the Tail Race Channel (TRC) which would be in the same level as that of irrigation channel downstream of the fall structure. The TRC will finally discharge back the water in the downstream irrigation canal.

Obviously in such scheme there is no channel or poundage available in the canal even for daily load Variation. However in most of the cases there would be a reservoir scheme in the upstream of the river and regulated discharge of water from that reservoir to match the daily/ hourly load demand could be ensured without much difficulty.

-:SALIENT FEATURE FALL HYDEL PROJECT:-

MODERNISATION OF TEESTA CANAL FALL, HYDEL, PROJECT AND IMPLEMENTATION OF SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA) FOR PS-II AND III & INSTALLATION OF AUTOMATIC TRASH CLEANING MACHINE

INTRODUCTION

Teesta Canal Fall Power Development scheme is linked with Testa Barrage Project which is under implementation by the I & W Department, Govt. of West Bengal. The discharge from Testa River has been diverted by a link canal to Mahananda River at Fulbari where a barrage has been constructed to raise the water level and divert it into Mahananda Main Canal. There are three units in each Power Station having capacity of 7.5 MW each and the total installed capacity is 67.5 MW. This is a foreign aided Project under loan assistance scheme from J.B.I.C. (formerly O.E.C.F), Japan. The salient feature of the Project are as follows:

SALIENT FEATURE OF THE PROJECT

1.GENERAL :

Project Area : In Darjeeling Dist. & Uttar Dinajpur District, West Bengal.

Location : On Mahananda Main Canal of Testa Barrage Project.
At Canal drop of Mahananda Main Canal.

P.S.-I : 1" Fall Channel 5.503 KM to 5.903 KM in the district of Darjeeling.

P.S.-II : 2nd Fall Channel 21.213 KM , 3rd fall Channel 26.029 KM, In the district of Uttar Dinajpur.

P.S.-III : 4 Fall Channel 31.50 KM , In the district of Uttar Dinajpur.

Scope of Scheme : Power Generation by utilising discharge of Irrigation Canal.

Installed Capacity : 3x3x7.5 MW =67.5 MW

Generation stars in year of self Sufficiency : 6th year of construction.

Area to be served : In grid with other Generating Stations.

Total Annual Generation :

(PS-I - 109.9 Gwh) + (PS-II - 107.0 Gwh) + (PS-III - 103.0 Gwh) = 319.0 Gwh

2. HYDRALOGY :-

Minimum Discharge
90% Dependability P.S.-I -50.37 Cumecs

P.S.-II -49.75 Cumecs

P.S.-III -48.92 Cumecs

Maximum Discharge at
90% Dependability P.S.-I -331.53 Cumecs

P.S.-II -321.77 Cumecs

P.S.-III -309.26 Cumecs

3. DEPTH OF FALL:- P.S.-I -7.168 M

P.S.-II -9.29 M

P.S.-III -7.049 M

4.BY-PASS HYDEL CANAL :-

A) POWER STATION – I :

TYPE : Trapezoidal Section

LENGTH : 154 M (approx.)

BED WIDTH : 46.94 M

DEPTH : 5.16 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 3.658 M

SIDE SLOPE : 1.5 : 1

MAXIMUM WATER LEVEL : 105.428 M

B) POWER STATION - II:

TYPE : Trapezoidal Section

LENGTH : 246 M (approx.)

BED WIDTH : 26.822 M

DEPTH : 6..376 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 4.876M

SIDE SLOPE : 1.5 : 1

MAXIMUM WATER LEVEL : 94.254 M

C) POWERSTATION- III:

TYPE : Trapezoidal Section

LENGTH : 270 M (approx.)

BED WIDTH : 26.212 M

DEPTH : 6..376 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 4.876 M

SIDE SLOPE : 1.5 : 1

MAXIMUM WATER LEVEL : 82.73 M

5.TAILRACE CANAL :-

A) POWER STATION – I :

TYPE : Trapezoidal Section

LENGTH : 154 M (approx.)

BED WIDTH : 46.94 M

DEPTH : 5.16 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 3.658 M

SIDE SLOPE : 1.5 : 1

MAXIMUM T.W.L. : EL 98.205 M

MINIMUM T.W.L. : EL 95.640 M

B) POWER STATION - II:

TYPE : Trapezoidal Section

LENGTH : 246 M (approx.)

BED WIDTH : 26.822 M

DEPTH : 6..376 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 4.876M

SIDE SLOPE : 1.5 : 1

MAXIMUM T.W.L. : EL 84.989 M

MINIMUM T.W.L. : EL 83.10 M

C) POWERSTATION- III:

TYPE : Trapezoidal Section

LENGTH : 270 M (approx.)

BED WIDTH : 26.212 M

DEPTH : 6..376 M (Including 1.50 M Free Board.)

FULL SUPPLY DEPTH : 4.876 M

SIDE SLOPE : 1.5 : 1

MAXIMUM T.W.L. : EL 75.546 M

MINIMUM T.W.L. : EL 72.25 M

DISCUSSION & CONCLUSION

Specifications:-

(1) The power station each having installed capacity of 22.5 MW, total 67.5 MW (7.5×3×3 MW). Cost of this total project is 600cr in Rs. This amount is very huge in comparison with prevailing per MW installation lost.

(2) It is linked with an irrigation canal. And it is depended on this irrigation canal.

(3) Here use instrument, which parches from FUJI ELECTRIC COMPANY, JAPAN. If Indian company can manufactured this kind of important machines, then the financial cost of this project may be reduced considerably.

IMPLEMENTATION OF SCADA AND AUTOMATIC TRASH CLEANING MACHINES ALONG WITH ITS MERITS AND COST.

Justification for SCADA

The Testa Canal Fall Hydel Power Stations (7.5 MW x 3 Units x 3 Power Stations) are designed for tandem operation with all the three power stations on the same canal. With large volume of waler of 330 cumec. of peak discharge and 80 to 120 cumec. of lean discharge manual operation in all the three power stations turn out to be highly intricate and complicated. Constant communications between operators in all the three power stations is an absolute necessity for safety and optimum generation. With such a large volume of water lack of communication and / or co-ordination may cause serious generation loss. An unintentional maloperation and / or mal-functioning of any component may cause a disaster if prompt and appropriate safety device are not activated.

The SCADA system will not only eliminate chances of above loss but also will store all the important data and carry out trend analysis giving the Engineers / Operators the opportunity to take remedial measures in advance. This will increase efficiency and reliability of the units, reduce downtime and increase effective life of the machines.

Present Status

All present the Power Station-I is taken up as a pilot project to implement SCADA. The major cost of the scheme has been funded by JBIC, Japan. The scheme is under implementation and is in the final stage of commissioning.

General requirements:

The automation system shall be capable of carrying out the following functions automatically with a single push button / key board command at local /remote Power Houses respectively.

Automatic start / stop of the units and checking of the interlocks.

Automatic synchronising, loading / deloading of the units.

Parameter monitoring and data acquisition on read time basis.

Generating logs at specified intervals, on demand and after a tripping.

Display of trends

Sequence of events recording

Display of mimic on the station computer for effective man machine interaction.

In addition to above the system must support the following modes of operation:-

Step by step mode of operation, Manual operation from the control room and from local panels.

System self diagnostic function

The automation system have following self diagnostic features :

The automation system is capable of recognising errors inside and outside the system, localising them and making appropriate error reports.

External errors are recognised by means of live zero monitoring of analogue measurements from transmitters. The monitoring of approximately sensors is provided according to DIN 19234 (Namur),

Internal diagnostics contain test which run periodically in the background, such as memory tests, monitoring of all processors, functional tests of all converters (e.g. ADC) monitoring of all communication lines by corresponding monitoring messages. In the event of failure of a communication interface, the functional areas or functional islands which no longer communicate should continue to operation autonomously. Similarly, lower level processor boards should continue to work autonomously in the event of malfunctions in higher level processor boards or modules.

Internal monitoring performs independent diagnoses and reports error states via front panel displays and related diagnosis equipment.

Monitoring

The representation of power plant overview displays and process flow displays in various degrees of detail must be possible. The process flow displays must be dynamically provided with all the necessary process data, while the representation of process data in the form of figures, charts, trends, colour codes, text and symbols must be possible in every image.

In case of a fault, it should be possible to quickly access the process images, which are necessary for quick corrections and actions intended to eliminate the fault.

Display construction

A convenient graphics package will be available for construction of the display. This package will permit the construction of displays using graphic elements and symbols. It should be possible to combine several elements and symbols to form objects for the purpose of configuring similar system areas by simply copying and renaming these types of representations. Displays and partial displays, whether altered or not, can be used repeatedly for the construction of new displays. It should be possible to link the display and process trough inputting of the text address (Data point designation).

Process operation

The following functions are available as part of process operation.

Remote control, including adjusting commands.

Correction to a set point of equipment which is not operated by remote control. It should be possible to operate the system by means of mouse / trackball along. The cursor is used to select a display object (c.g. a switch or a valve), which then opens a window. The complete technological description of the object will be provided in clear text (text address or long text). The window's design depends on the display object and function. Therefore, the representation of any superfluous information is avoided and dependable process operation and process management is ensured. Function and information fields should alleys be located at the same spot in the windows so that the operator will not have to reorient him or herself in every new window.

Carrying out barring and locking checks before a command to change the set points is executed.

It should be possible to monitor command status. Every step of operation will receive an answer immediately. The system should react lo incorrect operations with specific messages (e.g. forbidden switching command or command initiation blocked).

Data Processing

The following functions must be possible for all types of information:

1) It should be possible to create the data points through parameterization and integrate them into the system, even if the signals for the same are not available e.g. sensors not yet connected.
2) Faulty data points can be switched to a default value or default status manually or automatically.
3) Measurements and binary information, which has not been transmitted, can be generated and made available for further processing.
4) When changes in the status occurs (e.g. Limit Violations), an even can be generated and made available for further processing.
5) All events can be subjected to alarm treatment. Forced acknowledgement can be assigned to each events status.

DIAGNOSIS

i) Fault recognition

Effective and swift recognition of faults is an essential features of an automation system. A hardware watchdog and monitoring of each processor are minimum requirements.

Each function area should monitor itself and communication with the other devices.

In addition to the recognition of faults, the diagnosis concept comprises two parts.

Indication of faults for swift localisation and elimination of errors throughout the process control system.

Recognition of faults for the purpose of marking process variables, which allows the operator to immediately recognise which areas of his or her system are fully available and which are affected by the fault.

ii) Fault indication

The following diagnosis information should be displayed :

Diagnosis information which has been found by in ternal components, i.e. internal errors, external errors and communication errors.

Component failure (watchdog process)

Diagnosis information on the rest of the system i.e. external errors communication errors.

In addition to fault identification and indication, the operator shall receive precise information concerning areas affected by faults. This will ensure that the operator can determine the urgency of elimination of the error and request suitable service personal or decide whether the process should continue by remote control or on site and manually.

LOGGING

The layout and content of logs can be configured via a log generator (instruction list). New logs can be created and activated on line without interrupting operation. Following log types must be available.

Chronological logs.

Operational data logs.

Spontaneous images.

Actualisation logs.

8.COST INVOLVEMENT : - Rs. 2.00Crores (approx.)

The benefit of this capital investment will be available after almost 2(two) years by way of reduction in O & M cost and increase in revenue due to higher level of generation and reduction of unit down time for close monitoring and optimisation of generation capacity.

PROPOSED MECHANICAL, AUTO-TRASH CLEANING DEVICE

i) Introduction

Since commissioning of project the Mahananda Main Canal is carrying large volume of trash which eventually clog the trash racks within a short period. Manual trash cleaning has been resorted round the clock in three shifts but with little effect. The trash volume is so large that often water flow has to be restricted or even have to take forced shutdown, spilling partial or entire water causing serious generation loss.

ii) The Proposal

Mechanical Auto-Trash cleaning device has been proposed which will be fully mechanised system with a movable machine operated through a boom and "drag line" type device by which the trash are lied from the trash rack and directly discharged to the track mounted trolley for final disposal. The operator sits in an elevated cabin and can operate conveniently even in inclement weather condition. The efficiency of the system is much higher than the manual system and will save the revenue loss.

iii) Justification on cost vis-a-vis revenue

Present average generation per month / power house with one unit in operation is up to 4200 MWH due to non-availability of sufficient water in HRC and loss of head for Trash rack package. The generation could have been increased to average S040 MWH per month in each power station with one unit in operation at an average load of 7.0 MW. This increased generation in tum, will pay back the capital investment of Rs. 1.00 crore within a year considering average cost of power as Rs. 1.00/unit.

RECOMMENDATION:

On the above score WBSEB propose for

(i) Implementation of the SCADA system at its other 2(two) Power Stations viz. II & III for better efficiency, higher reliability, less down time and long life of the units.

(ii) Implementation of Mechanical auto trash cleaning machine at HRC of each Power Station which will eliminate head loss in trash racks and avoid spilling of water which are causing serious recurring revenue loss.

REFERENCE:

CPWD Specification (Vol. – I & II).
Literature available on internet.

Resisting Garbage and sludge at Power Station- I

A model of Teesta Canal Fall Hydel Project

Application of Atactic Polypropylene Polymeric