

**NHPC LIMITED**  
**(A Government of India Enterprise)**



**HEAD REGULATOR AND INDO-NEPAL LINK CANAL  
FROM TANAKPUR BARRAGE**



**PROPOSAL**

**FARIDABAD**

**SEPTEMBER 2017**

## **1.0 SUMMARY**

### **1.1 Introduction**

NHPC Ltd. has constructed Tanakpur Power Station (94.2 MW) in the state of Uttarakhand which is being maintained and operated since its commissioning in the year 1992. It is a run of the river scheme for hydropower generation on Sharda (Mahakali) River, a boundary river between India & Nepal.

In year 1996, Govt. of Nepal and Govt. of India have entered into a bilateral agreement called 'Mahakali Treaty'. As per this treaty, Govt. of India is to supply 70MU per annum of energy generated from Tanakpur Power Station and construct a head regulator & 1.2 km long Indo-Nepal irrigation canal taking off from Tanakpur Barrage for release of 28.35 m<sup>3</sup>/s (1000 cusecs) of water in monsoon season (15<sup>th</sup> May to 15<sup>th</sup> October) & 8.5 m<sup>3</sup>/s (300 cusecs) in dry season (16<sup>th</sup> October to 14<sup>th</sup> May). It is to be noted that there was no provision of constructing proposed canal in the DPR of Tanakpur HE Project approved by Govt. of India.

As per direction of MOP, a Project Report for construction of Head Regulator with sill level at EL245.00m and 1.2 km long Indo-Nepal canal at Tanakpur Barrage was submitted by NHPC vide letter no. NH/PD/PC/TP/1704 dated 25<sup>th</sup> August 2009 with an estimated cost of Rs. 39.72 Crores at June 2009 price level. The cost estimate was forwarded to MOP, Govt. of India for obtaining sanction and release of funds by MEA/MoWR.

Meanwhile, in the 4<sup>th</sup> meeting of Indo-Nepal Joint Standing Technical Committee (JSTC) held on 12<sup>th</sup>/13<sup>th</sup> Sept. 2013, it has been decided to lower the sill level of the head regulator by 0.75m to EL 244.25m.

The 5<sup>th</sup> meeting of India – Nepal Joint Standing Technical Committee (JSTC) was held on 26.05.2016 at New Delhi. In the meeting, it was intimated that the Indian side has carried out preliminary design of Head Regulator structure of Tanakpur Barrage for canal corresponding to sill level of EL 244.25m. As requested by the Nepalese side efforts would be made by the Indian side to complete the final design at the earliest possible. In view of the above it was decided to update the Project Report.

The Sharda (Kali) River which form the boundary with Nepal in upper reaches up to Brahmadeo, run entirely in Indian Territory up to Banabssa, where a barrage

was constructed in 1928 by U.P. Irrigation department for utilizing the river flow of Sharda for multipurpose scheme and the left side irrigation canal for use of Nepal.

The Indo-Nepal Link Canal project comprise of constructing a Head Regulator on the left bank of existing Tanakpur Barrage and diverting its water into irrigation canal to Nepal. The irrigation Canal is R.C.C lined and a Cross drainage has been proposed at RD 941.1m to RD 966.6 m to pass flood water from the existing nallah crossing the canal alignment. The proposed Indo Nepal Link canal envisages construction of 1.2 km long irrigation canal originating from Tanakpur barrage and runs on the left bank of the river at almost perpendicular to Sharda River. It eventually connects to Nepal Canal after crossing Indian Territory.

The area of project lies entirely in Indian Territory. An agreement was entered between the Govt. of India and His Majesty's Govt. of Nepal for sharing of water at Tanakpur Barrage. In this Treaty the Govt. of India and His Majesty's Govt. of Nepal have agreed as follows:

'A supply of  $28.35 \text{ m}^3/\text{s}$  ( 1000 cusecs ) of water in the wet season ( i.e. from 15<sup>th</sup> May to 15<sup>th</sup> October ) and  $8.5 \text{ m}^3/\text{s}$  ( 300 cusecs ) in the dry season ( i.e. from 16<sup>th</sup> October to 14<sup>th</sup> May ) from the date of the entry into force of this Treaty. For this purpose India shall construct the head regulator near the left under sluice of the Tanakpur Barrage and also the water ways of required capacity up to the Nepal - India border . Such waterways and head regulator shall be operated jointly.'

### **Characteristics of River Basin**

River Sharda / Kali originating in higher reaches of the Himalayas, near the Indo – Tibetan border, the Sharda river emerges from the Zaskara Glacier, at about EL5250 m. In the upper reaches, in the hills, it is called Mahakali. The river is formed by two streams. Kuthiyankti and Kalapani near Indo – Tibet border at an elevation of about 5250 meters and flows in south western direction forming Indo Nepal boundary. Along the course the river is met by many tributaries from India as well as Nepal side. The important tributaries meeting from India side are Dhauliganga at Khela, Goriganga at Chuka, Sarju near Pancheshwar and Ladhiya at Shim. After traversing 300 Km downstream, the river meet the plains at Brahmadeo. The river bed at Bramdeo is about EL 250m. Average slope of Sharda river ranges from 40 m. per Km. near Darchula, to about 13 m per Km upstream of

Brahmadeo. The proposed head regulator is located about 130m (Approx.) upstream of Tanakpur Barrage axis.

The Sharda river known by different names in various reaches. Up to confluence with river Sarju , it is know as Kali, downstream upto Tanakpur where it emerges on to plains it is called Mahakali and thereafter Sharda.

### **Tanakpur Power Station**

Tanakpur Power Station of 94.2MW capacity is the first hydel project commissioned, in the Sharda Valley, by NHPC in the year of 1992-93. Power from this project is now also being supplied to neighboring country Nepal as per Mahakali treaty.

Tanakpur Power Station is a run of the river scheme. The main component of the Power Station include 475m long barrage with 22 bays and 78.45m long head regulator with 6 bays, 6.4 Km long power channel with a capacity of 566 m<sup>3</sup>/s, a surface power house consisting of 3 unit of 31.4 MW each.

The Barrage has been constructed 2 Km. south of Tanakpur Town and 6 Km. upstream of Banabssa Barrage to divert the water of Sharda River into power channel for power generation.

### **Accessibility**

The project site has meter gauge rail and road connections. Tanakpur town, 2 Km upstream of barrage, is the terminus of N.E. railway connecting it to Pilibhit, Bareilly & Lucknow. Tanakpur is a base station for a large transport system that feeds the Indo – Nepal and Indo - Tibet border areas in Pithoragarh district, Tanakpur Barrage and canal area fall in to Champawat district. Nearest broad gauge railheads are at Bareilly (110 Km) & Rudrapur (90 Km). Nearest civilian Airport is at Pantnagar 80 Km away.

### **Physical Features**

The project area is located, in “ bhabhar “ area of district Champawat, south of the Tehsil town of Tanakpur. Tanakpur is at the foothill of the mountains The river stream starts braiding in tails reach, and the river bed slope flattens to 3 m. per Km. The river bed is bouldery, sand and shingle.

## **Weather**

The site lies in the foothills of Kumaon hills in Uttarakhand in Terai Bhabar area. Monsoons are heavy, and cover the months of July to October, winter extend up to February, and summer from March to June. The maximum and minimum temperature are  $40^{\circ}\text{C}$  &  $10^{\circ}\text{C}$  Average rainfall is 1900 mm, relative humidity in Terai areas range from 42 % in April to 81 % in August. Water Table lies about 8 m. below ground in January, and comes up in monsoon.

## **1.2 Component of Civil & Hydro- Mechanical Works**

### **Inlet**

An Inlet of canal head regulator was constructed during construction of left afflux bund of Tanakpur Barrage. The crest width is 11.25 m and its sill level is kept at EL.245.00m. The same shall be dismantled and Inlet shall be constructed with sill at EL.244.25m and width of 11.25m as per the decision taken during the 4<sup>th</sup> JSTC meeting.

### **Approach Channel**

The approach channel consists of two bays varying from 4.875m width to 4.0m. The width of each bay from trash rack (31 m u/s of axis) to Road Bridge (17.5 m u/s of axis) is 4.875m. The bay width then reduces gradually from 4.875m at bridge to 4.0m at head regulator axis. The lengths of the bays are 31m with bed level at EL 244.25 m leading water to head regulator. A trash rack has also been provided at the entry of the approach channel.

### **Head Regulator**

The Head regulator consists of two bays of 4.0 m width, with crest at EL 244.25m and a pier of 1.5m thickness. The flow is regulated with vertical gates of height 2.75m. The head regulator is designed for a discharge of  $28.35 \text{ m}^3/\text{s}$  (1000 cusecs) which can be passed with a gate opening of 1 m at FRL at EL.246.70m. The discharge can be reduced to  $8.5 \text{ m}^3/\text{s}$  (300 cusecs) by suitable gate operation.

### **Road Bridge over the Head Regulator:**

A bridge is required to cross the head regulator so as to serve connection between inspection road over left afflux bund and that over left embankment of the canal. To facilitate the same, a two span 7.0m wide carriage way simply supported precast-RCC bridge with footpaths has been proposed.

### **Canal**

The irrigation Canal of about 1144.50 m length (excluding Head regulator portion) is R.C.C lined, having carrying capacity of 28.35cumec (1000 Cusecs). The lining is 100mm thick with reinforcement @ 1.2% (including reinforcement in both directions by volume). The bed width is 4.0 m and full supply depth is 2.12 m at the start of Canal just downstream of Head regulator & Stilling Basin.

At the Indo Nepal border the R.C.C lined canal joins with unlined canal of 12 m bed width being constructed by Nepal.

### **Cross Drainage works**

A Cross drainage for a water way of 23.00 m width has been proposed at RD 941.1m to RD 966.6m to pass flood water from the existing nallah crossing the canal alignment. It consists of R.C.C box culvert with 9 barrels of size 2.0m (w) x 2.5m (h).

### **Hydro-Mechanical Components of Head regulator**

As per planning & layout of civil structures, following hydro-mechanical equipments are proposed for Canal Head regulator system

- a) Gates and Rope Drum Hoists
- b) Upstream Bulkhead Gate and Monorail Hoist
- c) Trash Rack
- d) Downstream Bulkhead Gate and Monorail Hoist

### **1.3 Construction Methodology**

The present scheme of construction of head regulator and canal is being proposed for supplying 1000 cusecs water to Nepal from Tanakpur Barrage.

Construction methodology and selection of equipment has been planned with the aim to commission this scheme in a total period of 24 months (including temporary infrastructure works). Major construction works shall start from 9<sup>th</sup> month after necessary initial mobilization and the same shall be completed in 24<sup>th</sup> months.

Equipment planning for construction of head regulator and canal for supplying 1000 cusecs water to Nepal from Tanakpur Barrage has been carried out and optimization studies conducted as if the work is to be executed under single package of Contract. Two months shutdown of Tanakpur Power Station would be required to construct upstream part of head regulator structure.

## **1.4 Project Cost**

### **General**

Cost of the scheme has been estimated at July 2016 PL. Summary of the present day cost in the form of major heads of expenditure is provided in the abstract of cost. Abstract of cost is inclusive of civil works as well as Hydro-mechanical works. Interest during construction of the scheme has not been accounted for due to unavailability of source of funding. **Total cost of project works out to Rs.7501.69 Lakhs at July' 2016 P.L.**

A brief description of provisions under various heads is given below;

### **I-works**

Under this heading, provision has been made for various components of the Project as detailed hereunder.

#### **A-Preliminary**

Under this heading, provision has been made for surveys and investigations to be conducted to arrive at the optimum design of the project components.

#### **B-Land**

Provision under this head is covered as NPV under head X-environment & Ecology.

#### **D-Regulator**

The cost of regulator is Rs.1458.59 lakhs (including hydro-mechanical works).

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## **F- Cross Drainage Works**

The cost of cross drainage works is Rs.372.26 lakhs.

## **L-Canal**

The cost of canal works is Rs.2649.91 lakhs.

A provision of 5% has been made for contingencies and the work charged establishment under head D, F & L

The unit rates for various items are based on Central Water Commission norms and worked out at July 2016 PL. The details of items and the supporting analysis are enclosed.

## **K-Buildings**

It is proposed to hire residential and nonresidential building for the purpose of accommodation and other uses as offices & store etc. on lease/rental basis for the construction period of two years.

Provision for utilization of existing facilities of Tanakpur power station like hospital, ambulance, bank, community center, post office, telephone exchange, fire station, officers and staff club etc. has been kept for 24 months.

## **O-Miscellaneous**

Under this head provision has been made to cover the cost of following miscellaneous works:-

- a) Capital cost of telecommunication and firefighting-equipments etc.
- b) Repair and maintenance of security arrangements, firefighting equipments, inspection vehicles, school, transport for labour and staff etc.
- c) Other services such as inauguration ceremony, social welfare, model exhibition, canteen facilities, photographic and cinematographic equipments and award of workers etc.

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### **P-Maintenance**

Under this head, provision has been made to cover the cost of maintenance of all civil works, i.e. D-Regulator, F-Cross drainage works, L-Canal, K-building & R-Communication during the construction. It is kept as 1% of heads D, F, L, K & R.

### **Q-Special T&P**

As all the major equipment shall be procured by main contractors at works, so Nil provision has been considered.

### **R-Communication**

Provision is kept for connecting road from existing barrage to canal, Road for construction of canal and improvement of existing connecting katcha road from Tanakpur barrage to quarry area.

### **X-Environment & Ecology**

The provision under this head covers the cost of compensatory afforestation, restoration, Landscaping & NPV etc.

### **Y-Losses on Stock**

Provision has been made under this head on lump sum basis @ 0.25% of heads D, F, L, K & R.

### **II-Establishment**

Provision for establishment has been made as per "*Guidelines for Formulation of Detailed Project Reports for Hydro Electric Schemes, their Acceptance and Examination for Concurrence*", New Delhi, January, 2015 (Revision 5.0).

### **III-Tools and Plants**

The provision under this head is Rs.8.0 lakhs only.

### **IV-Suspense**

No provision has been made under this head as all the outstanding suspense amount are expected to be cleared by adjustment to appropriate heads on completion of the scheme.

### **V-Receipt and Recoveries.**

Nothing is expected as receipt & recoveries.

### **Indirect charges-Audit & Account charges**

Provision under this head has been considered 0.5% of I – Works.

### **Revenue loss:**

Revenue loss due to shut down of Tanakpur Power Station for 2 months (during lean period) has been assessed as under:

Sl. no.	Parameters	Anticipated drop in parameters	Impact in terms of revenue (Rs. in Lacs)
i)	PAF	6%	670.00
ii)	Generation	38 MU	490.00
	Total Revenue Loss		1160.00

## **1.5 Environment and Ecological Aspects**

The proposed project site lies in the foothills of Kumaon hills in Terai Bhabar area of Uttarakhand State. The area observes sub-tropical climate. The catchment of the river Sharda essentially falls in geologically fragile environment. The rocks are characterized by many geological discontinuities and bears ample structural signatures of Himalayan orogeny. The natural vegetation in this area is predominantly sub-tropical type. Agriculture is one of the major occupations of the locals in the area.

The project will require about 38 ha of land, which falls in the river shoals/islands, known as Sharda Tapu under Reserve forest. No private land is proposed to be acquired. No major impact is anticipated on the land environment as the canal area is mostly in the valley and the land likely to be acquired is reserve forest land with sparse density of vegetation.

The quarry area is proposed below the Tanakpur barrage for which 26 ha of Reserve forest land is required besides 12 ha forest land required for construction of link canal. As Uttarakhand Forest Corporation allows lifting of construction material on royalty basis from the river channel, the State Forest Corporation may be approached to allow NHPC to lift the construction material on royalty basis from the deposits /shoals below the Tanakpur barrage which have been tested and found suitable for the construction material. By this, the area of 26 ha of Reserve Forest land proposed for diversion for quarry sites by the project could be avoided.

### **1.6 Geological Appraisal of Indo Nepal Link Canal**

The entire area falls under Bhabar Terai Zone. The area comprises of quaternary sediments consisting of boulders, gravels, pebbles, cobbles with silty sand in the top surface deposited by river Sharda. Seismically, the area falls under seismic zone IV of Seismic Zonation map of India.

### **1.7 Construction Materials**

For the construction of 1.2 km long canal the availability of construction materials were studied giving due cognizance to the impact of the same on the environment. Subsequently, to meet the requirement of coarse and fine aggregate, filter, boulders, earth fill & random material, three borrow areas have been identified and studied in details.

Detailed exploration of borrow areas were carried out, coarse and fine aggregate samples were tested for complete range of physical parameters as well as alkali-aggregate reactivity tests have been conducted to ascertain suitability as concrete aggregate as well as filter material for construction of canal.

There is a requirement of 17500 cum of coarse aggregate and 8750 cum of fine aggregate for construction of canal. Besides the above, 5000 cum of boulder, 5500 cum filter material and 262500 cum of earth & random fill material are also required for the construction of embankment. The total requirement of suitable construction material worked out for the project includes 36225 cum coarse & fine aggregate, 6900 cum boulders, 7590 cum of filter material and 362250 cum of earth

& random fill material. Against the above requirement the selected borrow areas contains 1145000 cum of suitable constriction material. (As per CWC guidelines 38% of quantity for coarse and fine aggregate and other material is to be added for wastage). This quantity is sufficient to fulfill the requirement for the construction of Tanakpur Indo Nepal link canal.

## **SALIENT FEATURES**

### **1 LOCATION**

State	: Uttarakhand
District	: Champawat
River	: Sharda River
Barrage	: 2 Km d/s of Tanakpur Town

### **2 INLET**

	: To be constructed at about $\pm 130$ m u/s of barrage on left bank afflux bund
Sill level	: EL 244.25 m
Clear water way	: 11.25 m

### **3 APPROACH CHANNEL**

Length	: 31.00 m
	2 bays of width varying from 4.875 m
Width	: each (at trash rack) to 4.0m from bridge end to head regulator axis.
Bed level	: EL 244.25 m
Top EL of side wall	EL 250.00 m

### **4 HEAD REGULATOR**

Total length	: 35.00 m
Crest level	: EL 244.25 m
No. of Bays	: 2 Nos.
Width of each Bay	: 4.0 m

Floor Level u/s of Head regulator	: EL 244.25 m
Cistern Level of Stilling Basin	: EL 241.10 m
Max /Minimum Discharge:	: 28.35 cumec (1000 cusec) / 8.5 cumec (300 cusec)
Full Reservoir Level	: EL 246.7m
Energy dissipation arrangement	: Stilling basin with end sill
Trash rack	: Two sets of vertical trash racks size 4.875 m wide x 5.25 m height.
Size and type of gates	: Two Nos. 4.0 m x 2.75 m fixed wheel type gates
Bulk head gates	: 1. Upstream Bulkhead Gate: One set of sliding type Bulkhead for opening size 4.0m x2.75m with two sets of embedded parts. 2. Downstream Bulkhead Gate: One set of sliding type Bulkhead for opening size 4.0m x 2.42m with two sets of embedded parts (SILL EL 241.99 m).
Sill level of the gates	: EL 244.25 m

## 5 BRIDGE

Type of bridge	: Precast-R.C.C. Bridge with foot path 70R loading
Effective span	: Two spans of 5.875m each
Carriage width	: 7.0 m clear

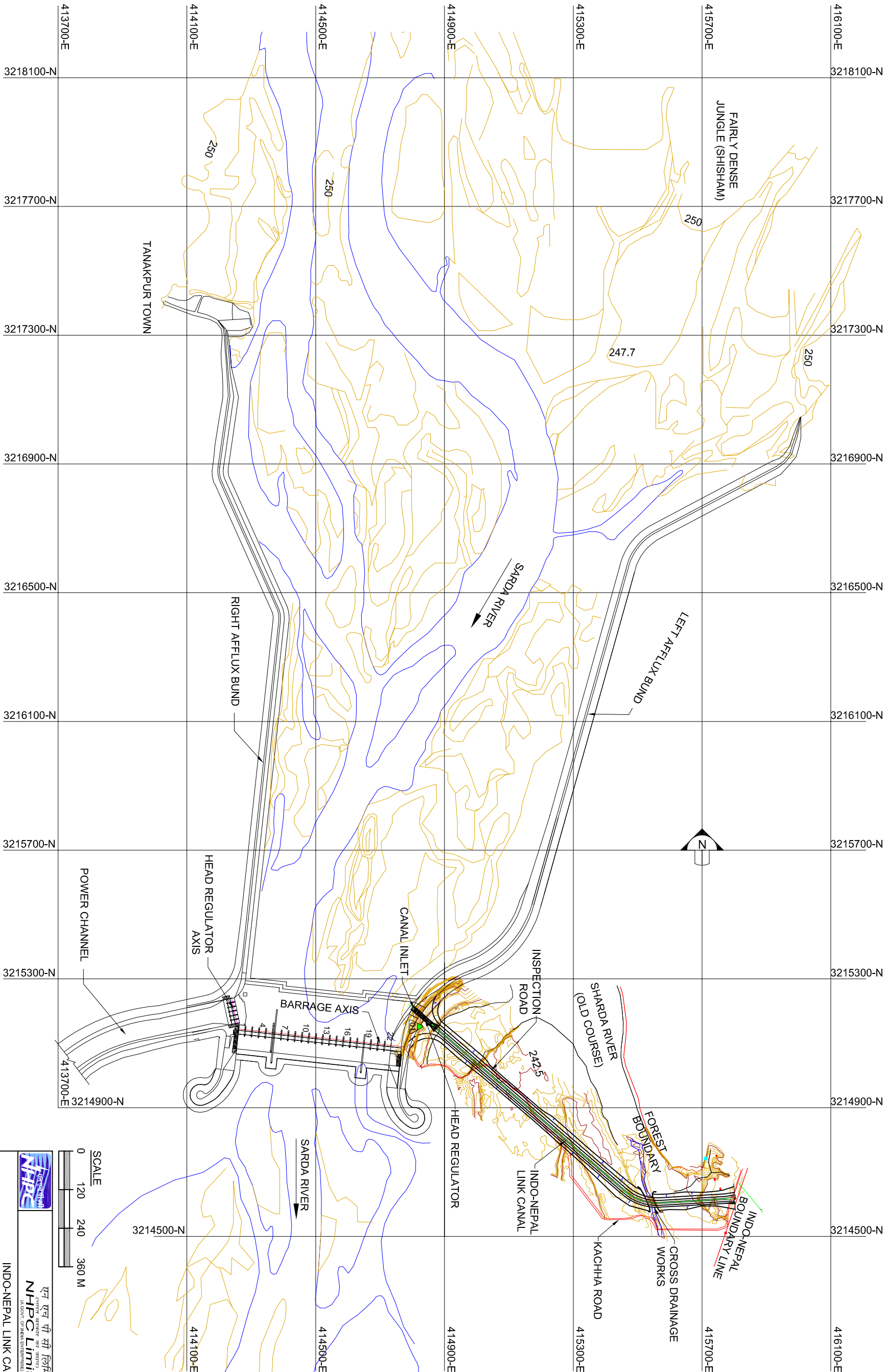
## 6 CANAL

Length	: 1144.50 m
Bed Level of the Canal	: EL 241.99 m at the beginning EL 241.232 m at the Indo Nepal Junction.
Full Supply Level (FSL) of the Canal	: EL 244.11 m at the beginning EL 243.352 m at the Indo Nepal Junction.
Full Supply Depth	: 2.12 m
Bed width	: 4.00 m
Shape & side slope	: Trapezoidal; 1.75 H : 1 V
Bed slope	: 1:1460 up to start of d/s transition & 1:5556 in the transition portion of 30 m
Type of lining	: R.C.C lined 100 mm thick (Cast-in-situ).
Design discharge	: 28.35 Cumecs (1000 Cusecs)

## 7 CROSS DRAINAGE WORK

Type	: Box culvert
No of bays / barrels	: 9 nos. of 2.0 m (w) x 2.5 m (h)
Width of waterway	: 23.00 m

<b>8 Project Capital Cost (July 2016 PL)</b>	<b>Rs. 7501.69 Lakhs</b>
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NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES.
2. THIS DRAWING HAS BEEN PREPARED BASED ON DRAWING OF BARRAGE AREA LAYOUT PLAN & TOPOGRAPHICAL MAP SUPPLIED BY CGIP DIVISION VIDE DRG. NO - NH-CGIP-TANAKPUR-01, DATED 03-03-09.

DATE		NO.	REVISION OR ISSUES	BY	CH APP	DATE	SEPT .2016	DRG. NO.	NHTA	D	41	GA	02	00
DESIGN NO.		1601412FD01-0												
NAV.		01	WIDTH OF WATERWAY & RAFT											
DATE		2017	THICKNESS REDUCED											
DESIGNER		RAJINDER KUMAR	SUBMITTED	RECOMMENDED										
DATE		SEPT .2016	APPROVED											

BARRAGE & CANAL  
GENERAL LAYOUT

(SHEET 1 OF 2)

INDO-NEPAL LINK CANAL  
TANAKPUR POWER STATION

