SJVN LTD.

(A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HIMACHAL PRADESH)

JANGI THOPAN POWARI

HYDRO ELECTRIC PROJECT

PRELIMINARY GENERAL LAYOUT

CHAPTER (AUGUST 2020)

CONTENTS

1.0 INTRODUCTION

1.1 TYPE OF PROJECT

Jangi Thopan Powari HEP is a run of the river type development proposed to harness the hydel potential of river Satluj. The project envisages construction of a concrete gravity dam of ±88 m high above deepest foundation level across river Satluj near Jangi village and underground power house on the right bank upstream of Tehsil boundary (Kashang Nallah).

1.2 LOCATION OF PROJECT

The project is situated on Satluj River having its dam site near Jangi Village in Kinnaur power house on the right bank upstream of Tehsil boundary (Kashang Nallah). The dam is located at Longitude 78°25'55.17"E and Latitude 31°37'34.55"N. At the downstream of this project there is Shontong Karcham project having installed capacity of 450 MW. The location map of Jangi Thopan Powari Project has been shown below in Figure-1.

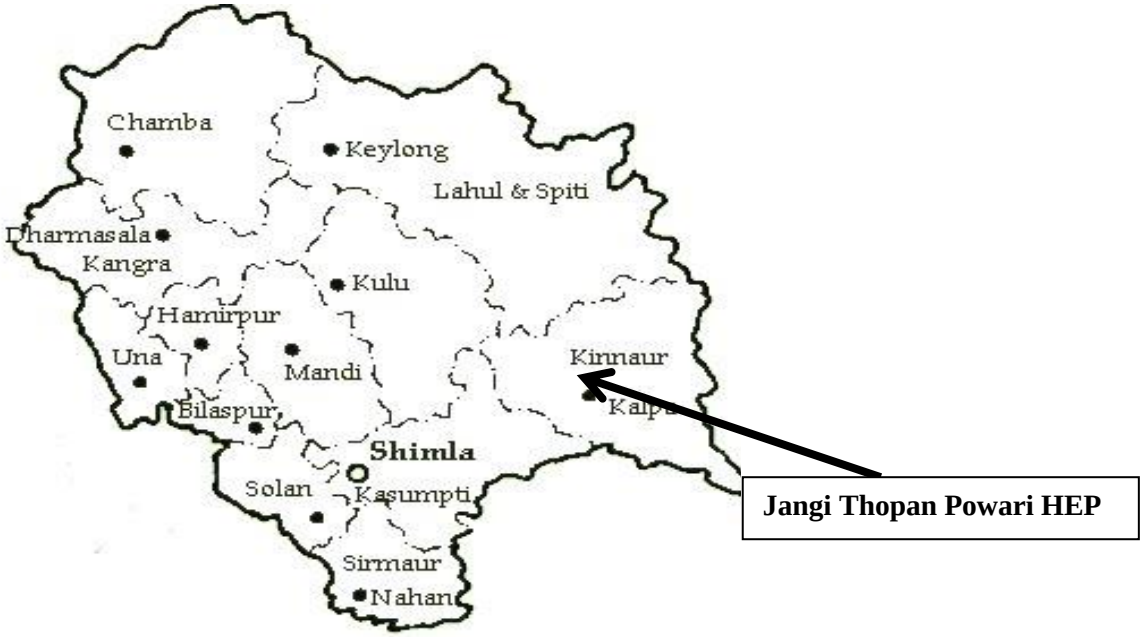

Fig. 1: Location map of Jangi Thopan Powari HEP.

1.3 ACCESS TO PROJECT AREA

The project can be approached by NH-05 via. Shimla, Narkanda, Rampur Bushar and Wangtoo.

The project site is located at about 320 km from the nearest railhead at Kalka in Haryana. The nearest airport is at Jubbar hatti (Shimla) about 260 km from project site. The nearest International airport is located at Chandigarh at a distance of 350 km from the project site.

2.0 NEED FOR THE PROJECT

Himachal Pradesh is blessed with vast hydroelectric power potential in its five major rivers. Gurgling rivers and their tributaries with steep gradient continue to challenge planners and engineers for optimal exploitation of hydropower potential. Numbers of hydroelectric projects are under execution in the state by central, state, joint and private sector developers. The only strategy followed in Himachal Pradesh for exploitation of hydroelectric power resources is to produce as much energy as possible, as fast as possible, with minimum cost and with minimum environmental negative impacts. The speedy exploitation of hydroelectric power potential will definitely improve the economic health of the State with free power plus other benefits on all new installations will increase the resources of the state to a significant extent. The need for the project also arises from the need to fulfil a steady increase in peak electricity demand and the growing energy deficit in the Northern Region.

3.0 ALTERNATIVE STUDIES FOR VARIOUS MAJOR COMPONENTS

- **Dam site & u/s area**: A concrete gravity dam of approximately 88 m height from deepest foundation level and 48 m from river bed level is proposed at Jangi village where width of river is about 150m. The site has already been explored by four drifts in the area having two exploratory drifts one each for the dam abutments on left and right bank. The GoHP has allotted domain elevation for this project to SJVN from El ±2320 m to El ±1965 m. However, the FRL is proposed at El ±2305 m for avoiding submergence of Spillo town. The reservoir length of the project shall be about 10.6 km.

- **Head Race Tunnel**: Proposal of conventional Drill & Blast Method of tunnelling is facing opposition from people in the project area. Therefore, it is proposed to excavate HRT with TBM.

- **Power House Site:** The downstream project under construction Shongtong Karcham HEP is having FRL of El ±1956m. In the present study the normal TWL of El ±2000

m has been proposed to ensure mandatory free flow condition as per MoEF guidelines and keeping in view the IR issues and R&R issues.

Keeping in view Geological, Topographical, Anthropological and Social issues the following alternative studies were carried out to explore the selection of Power House site:

Alternative-1: Dam at Jangi and PH on left bank d/s of Purbani with TWL ± 1965.0 m

This alternative comprises of dam at Jangi and approximately 14 km long HRT crossing from right bank to left near Kharo Bridge. Starting from intake about 8km HRT will be on right bank and remaining 6 km will be on left bank. Underground Power House complex is proposed d/s of Purbani village. Tail race tunnel will discharge water in river Satluj with TWL± 1965.0 m.

Alternative-2: Dam at Jangi and PH on left bank u/s of Purbani village with TWL±1995 m.

This alternative comprises of dam at Jangi and approximately 12 km long HRT crossing from right bank to left near Kharo Bridge. Starting from intake about 8 km HRT will be on right bank and remaining 4 km will be on left bank. Underground Power House complex is proposed u/s of Purbani village. Tail race tunnel will discharge water in river Satluj with TWL ± 1995.0 m. Although, there is unutilized head of 30m in comparison with alternative-1, however, passing of HRT below Purbani village is avoided in this alternative which is major IR and R&R concern in the area.

Alternative-3: Dam at Jangi and Power House Complex on right bank d/s of Kashang HEP with TWL ±1965 m.

This alternative comprises of dam at Jangi and approximately 14 km long HRT along the right bank. Underground Power House complex is proposed d/s of Kashang HEP near village Pangi. Tail race tunnel will discharge water in river Satluj with TWL± 1965.0 m**.**

In this option HRT will pass beside the Kashang HEP whose underground components like HRT, power house have been constructed with DBM and it has been observed that few construction issues have been encountered by developer i.e HPPCL and issues of neraby panchayats especially Pangi panchayat have not been resolved

yet. In this option HRT crossing has been avoided. However, the maximum vertical covers on HRT is about 2000 m in a reach of about 1.5 to 2 km. The issues related to environment, R&R and FRA are prominent in this alternative.

Alternative-4: Dam at Jangi and PH complex on right bank u/s of Kashang HEP with TWL ±1990 m.

This alternative comprises of dam at Jangi and approximately 12 km long HRT along the right bank. Underground Power House complex is proposed u/s of Kashang HEP. Tail race tunnel will discharge water in river Satluj with TWL ± 1990 m.

In this option HRT crossing has been avoided. However, the maximum vertical covers on HRT is about 1900 m in a reach of about 1.5 to 2 km. Although HRT crossing is avoided in this alternative but there will be unutilized head of 25m in comparison with alternatives-1&3.

Purbani is a big village and has lot of orchards and fertile land. The fear of damage to water sources, houses, orchards and fertile land due to blasting and construction activities was expressed and highlighted by local population during numerous meetings. There was a lot of resistance to proposal of constructing the project with HRT passing beneath the populated areas.

Alternative 5: Dam at Village Jangi and Power house/ surge shaft at village Thopan:

This alternate has been studied with sole objective of avoiding river crossing near village Rarang and avoiding any interference with Kashang Project. The Preliminary Feasibility Report (December 2003) of 480 MW Jangi Thopan HEP by HPSEB was also referred. As per PFR the location of Power House Complex is shown adjacent to Rarang village.

Alternative-6: Entirely on right bank with dam axis same as Alternative-2 and power house upstream of Alternative-4 with TRT Outfall upstream of Alternative-4 Outfall.

This alternative comprises of dam at Jangi and approximately 12 km long HRT entirely on right bank of river Satluj with dam axis same as Alternative-2 i.e. near Jangi Village. Underground Power House complex is proposed U/s of Tehsil

boundary (Kashang Nallah). Tail race tunnel will discharge water in river Satluj with TWL ± 2000.0 m.

Alternative-7: Diversion structure downstream after river bend with FRL± 2250m, keeping the location of power house same as Alternative-2 with components lying entirely on left bank.

This alternative comprises of dam/barrage at ±180m d/s of Tidong Nala & Tidong Power House site and approximately 14 km long HRT entirely on left bank of river Satluj. Underground Power House complex is proposed U/s of Purbani vllage (**same as Alternative-2**). Tailrace tunnel will discharge water in river Satluj with TWL ± 1995.0 m.

After detailed deliberation & considering mertis & demerits of all alternatives i.e. Alternative-1 to Alternative-7, It is concluded that the Alternative-6 proposed by CWC with Power House location Upstream of Tehsil boundary (Kashang Nallah) is better than Alternative-2 & Alternative-7. Therefore, Alternative-6 is proposed for further studies.

4.0 ENVIRONMENTAL RELEASE

The environmental discharge released from the dam will be as per Cumulative Environmental Impact Assessment (CEIA) study got conducted by MOEF&CC, which has been approved in the 29th & 30th EAC meeting held on 5 Dec., 2019 & 27 Jan., 2020. As per the CEIA study of Satluj basin, project falls in no fish zone and therefore, the recommended EFR values of 20% of mean lean season flow i.e. mean flow in the month of December, January & February for 90% dependable year have been considered to be released throughout the year.

The hydrological series for 27 years data (1992-93 to 2018-19) has been approved by CWC for preliminary project planning. The 90% dependable year worked out as 2001-02. The discharges in the year 2001-02 & e-flows to be released as per approved CEIA work out to 9.415 cumecs tabulated below:

Sr. No.	Discharges in 90% DY (2001-02)	E-Flows to be released (20% of mean flow in month of December, January & February) in all months (Cumecs)
June	164.25	9.415
	230.20	9.415
	205.02	9.415
July	281.24	9.415
	366.19	9.415

	375.44	9.415
August	330.65	9.415
	335.91	9.415
	259.65	9.415
September	193.31	9.415
	131.77	9.415
	92.70	9.415
October	95.12	9.415
	84.39	9.415
	78.04	9.415
November	74.32	9.415
	69.22	9.415
	62.28	9.415
December	55.87	9.415
	52.10	9.415
	49.74	9.415
January	47.00	9.415
	43.80	9.415
	42.60	9.415
February	43.35	9.415
	44.77	9.415
	44.45	9.415
March	49.66	9.415
	53.86	9.415
	58.43	9.415
April	59.31	9.415
	70.99	9.415
	93.33	9.415
May	133.57	9.415
	457.41	9.415
	272.39	9.415

5.0 MAIN COMPONENTS OF THE PROJECT

5.1 RIVER DIVERSION WORKS

The diversion tunnel is proposed to be constructed in left bank of the river valley. 10 m dia, horse shoe shaped diversion tunnel is designed to pass diversion flood up to 695m^3/s. Upstream and downstream cofferdams of sufficient height will be constructed to facilitate the construction of dam and other appurtenant structures.

5.2 DAM

A ±88 m high, concrete gravity dam from deepest foundation level ±2220.0 m, with integral 5 nos. gated spillways having size of 7.5m (W) X 15.0m (H) have been proposed. Upper level spillway having width of 8.0m has been proposed in block no. 6 on left bank side. The spillway has been designed to pass assumed design flood

corresponding to Probable Maximum Flood of 6212 cumecs. The Full Reservoir Level has been kept at 2305.0 m and Minimum Draw Down Level at El. 2302.0 m. The dam would provide a gross pondage of about 27.45 MCM and live storage of about 4.17 MCM. The length of the dam at top shall be 189 m. The proposed dam is divided in 14 blocks as tabulated in Table below:

Table 2: Details of Dam Blocks

Sl. No.	Description	Total length (m)	No. of blocks	Block no.	Remarks
1.	NOF section on left bank	74.76	5	1 to 5	Total no. of Blocks = 14
2.	Over flow blocks (LLS + ULS)	75.5	6	6 to 11	
3.	NOF section on right bank	38.74	3	12 to 14	

5.3 INTAKE STRUCTURE

Intake structure is proposed on right bank for diverting the design discharge of 315 m^3/sec from the reservoir to the underground power house.

5.4 PRESSURE SHAFT

For flexibility of operation and maintenance, three pressure shafts have been proposed which shall further bifurcated into six to pass total discharge of 315 m^3/sec.

5.5 POWER HOUSE AND TRANSFORMER HALL

Underground power house having size of 165.0 m (L) x 22 m (W) x 50 m (H) shall be provided on right bank.

Water exiting from the turbines will be discharged through the draft tubes into the 1 no., 9.5m dia horse shoe shaped tail race tunnel. The TRT outfall gated structure after TRT has been proposed for discharging water from TRT to Satluj River.

5.6 ACCESS TUNNELS

The access tunnels to the machine hall and transformer hall have been proposed based on the size of the vehicles and equipment required to be transported through them will be kept as straight as possible for ease of manoeuvring large vehicles.

6.0 INTER STATE/INTERNATIONAL ASPECTS

The project lies in Satluj basin, which is a part of Indus Basin, and is to be governed by relevant provision of Indus water Treaty signed between India and Pakistan in 1960. Since Satluj is an Eastern flowing river of Indus Basin, hence India has exclusive right over its water sharing.

7.0 COST AND BENEFITS OF SCHEME

The project is estimated to cost ₹ 5708.35 Cr. including IDC and financing charges at March, 2020 price level. The breakdown of the cost estimates is given below:

Total Hard Cost at March'20	:	₹ 4960.05 Crores
Interest during Construction	:	₹ 728.32 Crores
Financial Charges	:	₹ 19.98 Crores
Total Basic Cost including IDC and FC	:	₹ 5708.35 Crores
The tariffs for the project are as below	:	
1st year Tariff	:	₹ 4.81/kWh
Levellised Tariff	:	₹ 4.38/kWh

8.0 CONSTRUCTION PERIOD

Jangi Thopan Powari HEP is proposed to be completed in 60 months

9.0 SALIENT FEATURES

I) Location	
State	Himachal Pradesh
District	Kinnaur
River	Satluj
Nearest Village (Dam Site)	Jangi
Rail Head	Kalka (Haryana), 320 km
Latitude of Dam Site	31°37'34.55"N
Longitude of Dam site	78°25'55.17"E
II) Hydrology	
Catchment Area at Diversion Site	45925 km^2
90% dependable year	2001-02
Flood discharge for river diversion	695 m^3/sec
Design flood	6212 m^3/sec
III) Reservoir	
Full Reservoir Level (FRL)	EL 2305.00 m
Minimum Draw Down Level (MDDL)	EL 2302.00 m
Tentative River Bed Level	El 2260.0 m
Gross Storage at FRL	27.45 X 10^6 m^3 approx.
Live Storage at FRL	4.17 X 10^6 m^3 approx.
Length of Reservoir	10.6 km approx.
Desilting Basin	Reservoir will act as Desilting basin
IV) Dam	
Type of Dam	Concrete Gravity
Top of the Dam	EL 2308.00 m
Dam Height from deepest foundation level	± 88.00 m
Length of Dam at Top	189.00 m
Top Width of Dam	8.00 m
Length of Overflow Blocks	75.5 m
Length of Non-Overflow Blocks	113.50 m
V) Spillway	
Design Flood (PMF)	6212 cumecs
Type of Spillway	Low Level Spillway (LLS) (sluice spillway)

Energy Dissipation System	Stilling Basin
Low Level Spillway (LLS) (Under sluice Spillway)	
Type	Sluice type
No. of Bays	Five (05) (Block No 7 to 11)
Size of opening	7.5 m (W) X 15.0m (H)
Type & No. of gate	Radial, Five (05)
Width of block	67.5 m
Upper Level Spillway (ULS) (Overflow Spillway)	
Type	Ogee with open crest overflow
No of Bays	One (01) (Block No. 6)
Type and No of gates	Flap Gate, One (01)
VI) River Diversion	
River Diversion Discharge (1 in 25 years)	695 m^3/sec
Diversion Scheme	Through Diversion Tunnel (DT) and coffer dams
Location of Diversion Tunnel	Left Bank
No. of Tunnel	One (01)
Diameter and shape of DT	10 m, Horse Shoe Shaped
VII) Power Intake	
Number of Intake	Two (04)
VIII) Pressure Shaft (Main Units)	
Number of Pressure Shaft	Three (03) further bifurcated into six (06)
IX) Head Race Tunnel	
Number	One (01)
Size of Tunnel	9.4 m Diameter, Circular Shaped
Length	12 Km (Approx.)
X) Surge Shaft	
Type & Number	Underground, Restricted Orifice, Vertical, One (01)
Size	24m Dia. (Finished), 170m deep including Connecting Shaft
XI) Power House (Main Units)	
Type	Underground
Location	Right Bank
Size of machine Hall	165.0 m (L) X 22 m (W) X 50 m (H)

Normal Tail Water Level	EL 2000 m
Gross Head	304m
Net Head	281 m
Turbine Type	Francis
No of Unit	Six (06)
Design Discharge	315 Cumecs
Installed Capacity	804 MW (134 MW x 6)
XII) Tail Race Tunnel	
Number	One (01)
Size of Tunnel	9.5m dia, Horse Shoe Shaped
XIII) Power Generation	
Annual Energy	2777.56 MU
XIV) Estimated Cost	
Total Hard Cost at March'20 Price Level	₹ 4960.05 Crores
Interest During Construction	₹ 728.32 Crores
Financial Charges	₹ 19.98 Crores
Total Project Cost	₹ 5708.35 Crores
XV) Financial Aspects	
1st year tariff at Power House bus bars (including IDC) during 90% dependable year as per CERC guidelines	₹ 4.81 /kWh
Levellised tariff at Power House bus bars (including IDC) during 90% dependable year as per CERC guidelines	₹ 4.38 /kWh
XVI) Construction Period	
Total construction period	60 months