टीएचडीसी इंडिया लिमिटेड
THDC INDIA LIMITED

International Conference On

HYDROPOWER AND DAMS DEVELOPMENT FOR WATER AND ENERGY SECURITY – UNDER CHANGING CLIMATE

New Delhi
Central Board of Irrigation & Power

INCOLD
Indian National Committee on Large Dams

Role of Tehri Dam in absorbing the Flood during the Uttarakhand Disaster - 2013

Outline

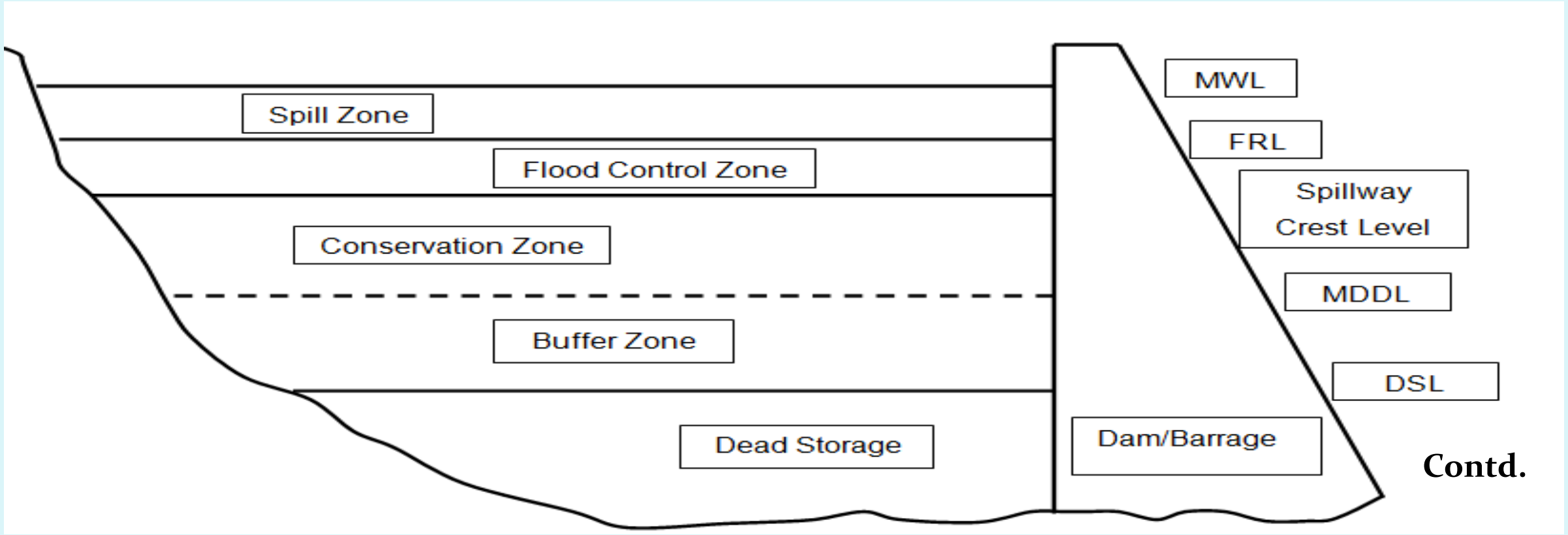
1. Significance of storage dams in management of river flows;
2. Tehri dam project- *A Brief Introduction;*
3. Role of Tehri dam in flood mitigation and control in the context of Uttarakhand Flood Disater-2013;
4. Conclusion.

Significance of Storage Dams in Management of River Flows

- Reservoirs are the most important component of a water resources development scheme as –
  - they can regulate natural stream-flow thereby modifying the temporal and spatial availability of water through out the year.
  - they can store flood water to moderate flood peaks and protection of downstream areas from flood damages.
  - the water stored during monsoon can be used for irrigation, domestic and industrial needs along with hydro power generation etc.
  - Reservoirs also provide pool for navigation, habitat for aquatic life and facilities for recreation and sports.

Zones of Reservoir

In general five basic zones of reservoir space may be used in operating a reservoir for various functions. Typical storage allocations for various uses are indicated in the figure below:



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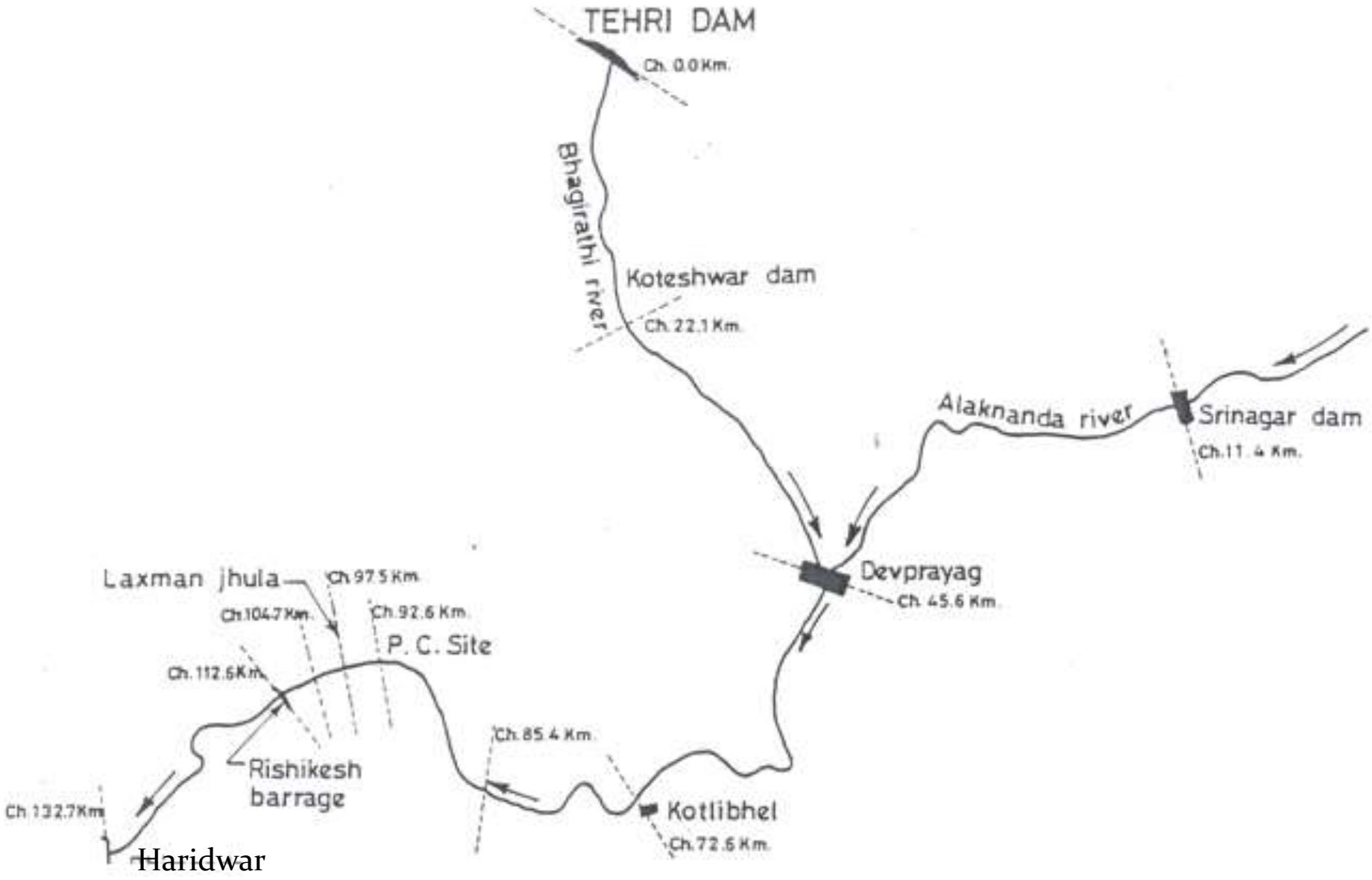
Tehri Dam Project

About the Project

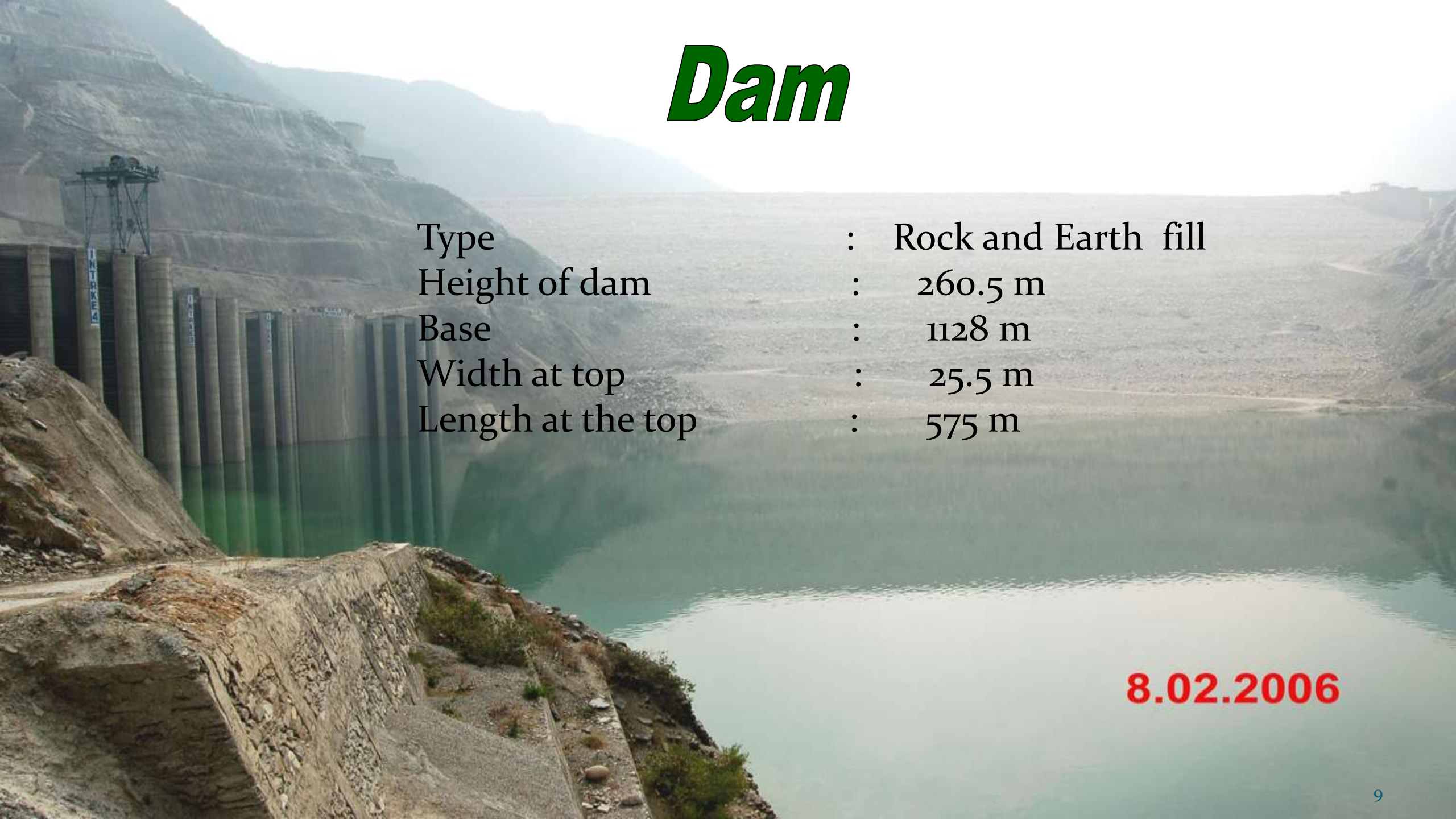
Tehri Dam Project of 1000MW installed capacity is a multipurpose project conceived & designed to store surplus water of the river Bhagirathi, a tributary of river Ganga, during monsoon and releasing stored water after monsoon according to irrigation requirement of State of Uttar Pradesh and drinking water requirement of Delhi and Uttar Pradesh States besides giving peaking support to Northern grid. The Project is operational since the year 2007.

Line diagram of Ganga River System from Tehri to Haridwar

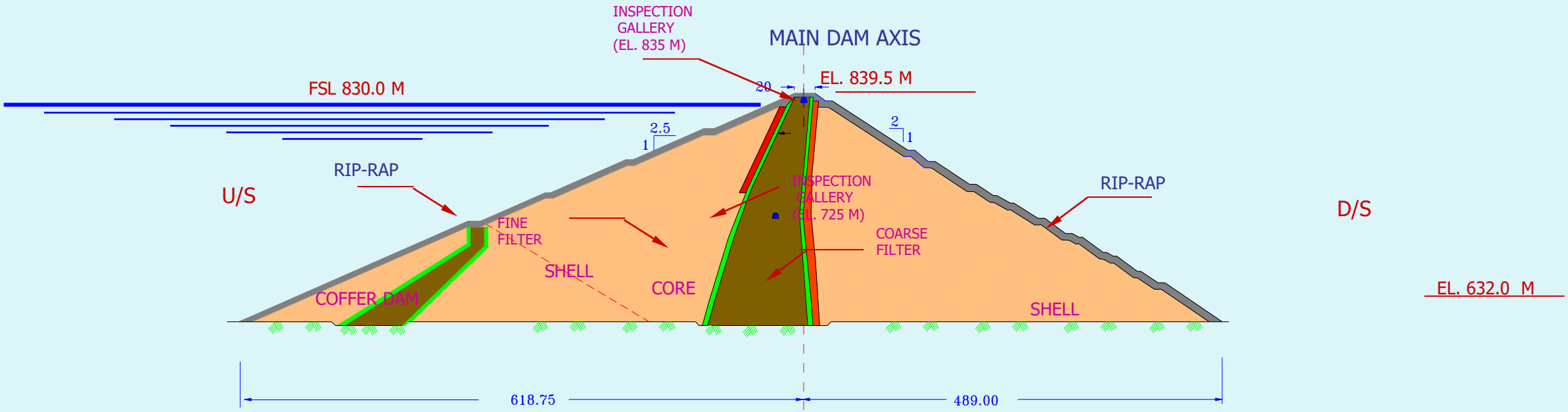


Dam

Type	:	Rock and Earth fill
Height of dam	:	260.5 m
Base	:	1128 m
Width at top	:	25.5 m
Length at the top	:	575 m



TEHRI DAM - CROSS SECTION



SHELL	:	201.6 LAC CUM
CLAY	:	35.3 LAC CUM
FILTERS	:	15.10 LAC CUM
RIP RAP	:	27.8 LAC CUM

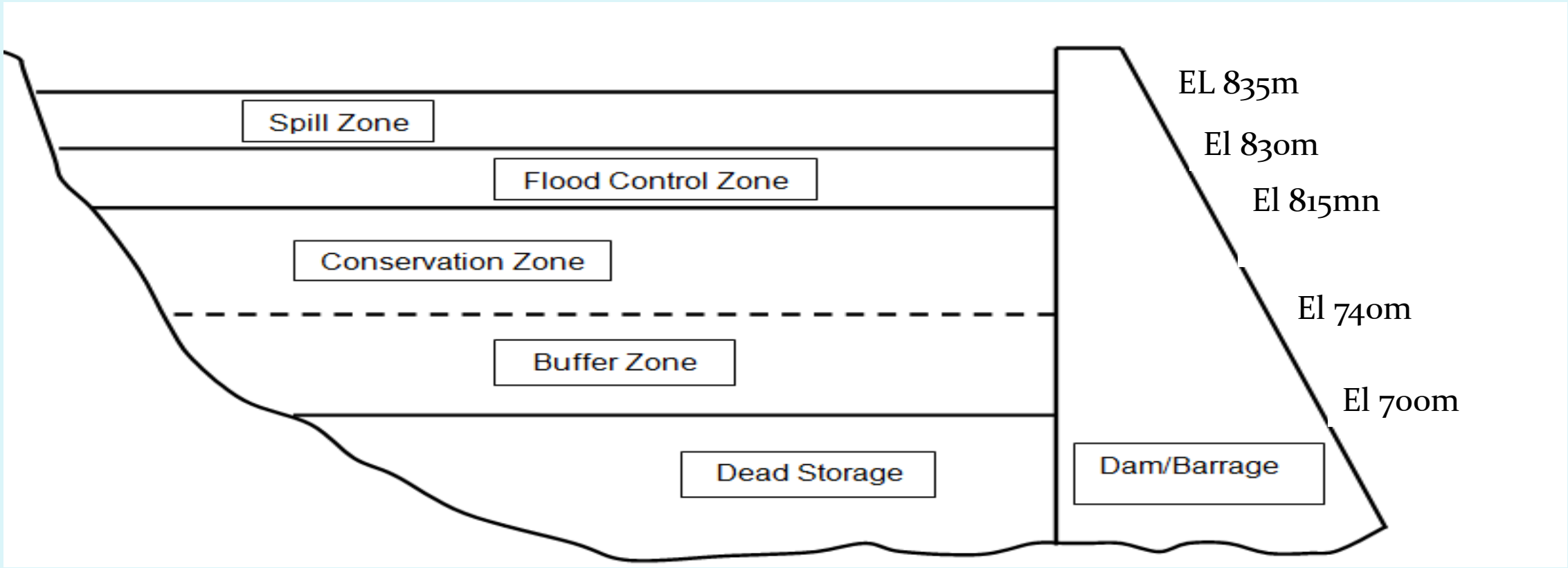
TOTAL QTY OF FILL PLACEMENT: 279.8 LAC CUM

Reservoir

Water Spread	:	42 SQ KM
Gross Storage	:	3540 Million Cum
Live Storage	:	2615 Million Cum
Max. Flood Level	:	EL 835 m
Full Reservoir Level	:	EL 830 m
MDDL	:	EL 740 m

DIFFERENT OPERATIN ZONES OF TEHRI RESERVOIR

Dead Storage Zone – Below EL 700m i.e. lowest outlet (ILO) level
Buffer Zone – From EL 700m up to 740m (MDDL)
Conservation Zone – From EL 740m (MDDL) up to 815m (Spillway Crest Level)
Flood Control Zone – From EL 815m (Spillway Crest Level) up to 830m (FRL)
Spillage Zone – From EL 830m (FRL) up to 835m (MWL)



Spillway System

Spillway system of Tehri is designed to cater 1 in 10000 years return period flood having peak discharge of 15540 cumecs and consists of –

- Gated Chute Spillway with crest at EL 815m
- Gated Left Bank Shaft Spillway (LBSS) with crest at EL 815m
- Un-gated Right Bank Shaft Spillway (RBSS) with crest at EL 830.20m

Chute spillway and LBSS are regular spillways whereas RBSS is emergency spillway which comes into operation automatically when water level crosses WL 830.2m

CHUTE SPILLWAY

Head
: 220 M
Type
: Conventional Stilling Basin type
Max Discharge
: 5500 cumecs
Width
: 39.5m at top and 50m at toe
Regulating Gates
: Radial 15.5m high/10.5m wide
Aerators
: 3 nos on Glacis
Stilling Basin
: 140 x 50 m, 22m deep pool
55 m high walls
D/s River Bed
: Protection by Concrete Blocks

LEFT BANK SHAFT SPILLWAYS

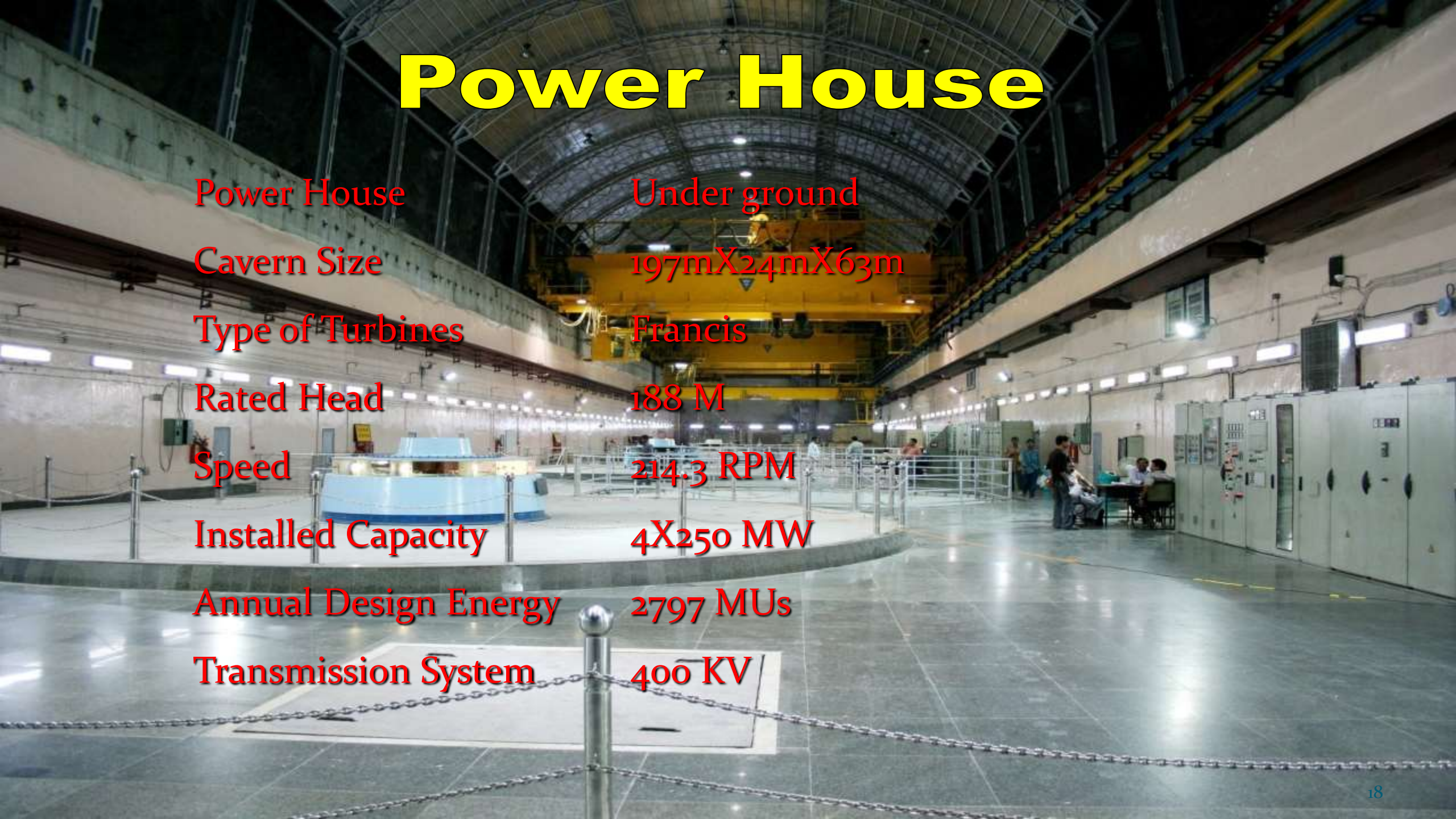
Head
: 220 M
Type
: Vertical Shafts
Nos
: 2 (Gated)
Intakes
: Tunnel type (80m long)
Total Discharge
: 3800 cumecs
Vertical Shaft
: 12m dia
Junction with
: Tangential with 5.5m tunnel opening
De-aeration
: Through a Separation Chamber and System de-aeration shaft opening in a De-aeration tunnel
Velocity at toe
: 45 m/s

RIGHT BANK SHAFT SPILLWAYS

Head
: 220 M
Type
: Vertical Shafts
Nos.
: 2 (Un-gated)
Intakes
: Funnel type (34m dia)
Total Discharge
: 3900 cumecs
Vertical Shaft
: 12m dia.
Junction with
: Tangential with 6.0m tunnel opening
De-aeration
: Through a Separation System Chamber and de-aeration shaft opening above MWL
Velocity at toe
: 45 m/s

Right Bank Shaft Spillways

Power House



Power House	Under ground
Cavern Size	197mX24mX63m
Type of Turbines	Francis
Rated Head	188 M
Speed	214.3 RPM
Installed Capacity	4X250 MW
Annual Design Energy	2797 MUs
Transmission System	400 KV

Role Of Tehri Dam In Flood Mitigation & Control

Tehri Reservoir Operation Cycle

- Start of monsoon season is considered as 21st June and reservoir is depleted to its MDDL EL 740m by this time every year, making a cushion 2600 MCM to absorb flood water of river Bhagirathi.

- Starting from 21st June up to 31st Oct., excess water is stored in the reservoir to achieve FRL .

- From 1st Nov. till 20th June stored water is released as per irrigation and drinking water requirement.

Benefits of Stored Water

- Stored water is released considering the d/s requirements for Irrigation, drinking water and other purposes like Religious Gatherings along the bank of Ganga from Devprayag in Uttarakhand to Allahabad in UP.

- 300 Cusecs Drinking Water is released for Delhi for about 40 lacs population

- 200 Cusecs Drinking Water is released for the State of Uttar Pradesh for about 30 lacs population

- Provide irrigating support to about 8.74 Lac. Hectare land of UP and Uttarakhand states.

Prevention of flood

- Tehri dam, even in the worst scenario can regulate a peak flood discharge approximately twice that of the actual observed till date.

- Tehri dam, during the floods of 2010, 2011 and 2013, played a crucial role in averting the floods of higher order in the river Ganga by storing the high flood inflows of Bhagirathi.

Uttarakhand Flood Disaster - 2013

Uttarakhand Flood Disaster - 2013

- Disaster 2013 can be attributed to widespread exceptionally heavy rainfall across the state from 14-18 June.
- The entire state hit by heavy (64.5 to 124.4mm) to very heavy (124.5 to 244.5mm)rains resulting into flash floods and landslides in many areas.
- The districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were the most affected.
- The worst impact on human settlements was in Kedarnath Shrine Area, the Mandakini valley, the Alaknanda valley (at Govindghat and upstream), the Pinder valley and along the banks of river Kali in Dharchula area.


BEFORE


AFTER

Uttarakhand Flood Disaster - 2013

- All the rivers are in spate and carrying almost highest recorded discharge.
- Out of the two major tributaries of river Ganga, Alaknanda flood was uncontrolled whereas most of the flood water of Bhagirathi was absorbed in Tehri dam reservoir.
- Even then, Devprayag (the confluence town of Alaknanda and Bhagirathi from where Ganga begins), Rishikesh and Haridwar witnessed a historical flood event on 17-June.
- The role Tehri dam played is explained in coming slides.

Flood Control by Tehri Dam at Rishikesh and Haridwar on 16-17 June' 2013

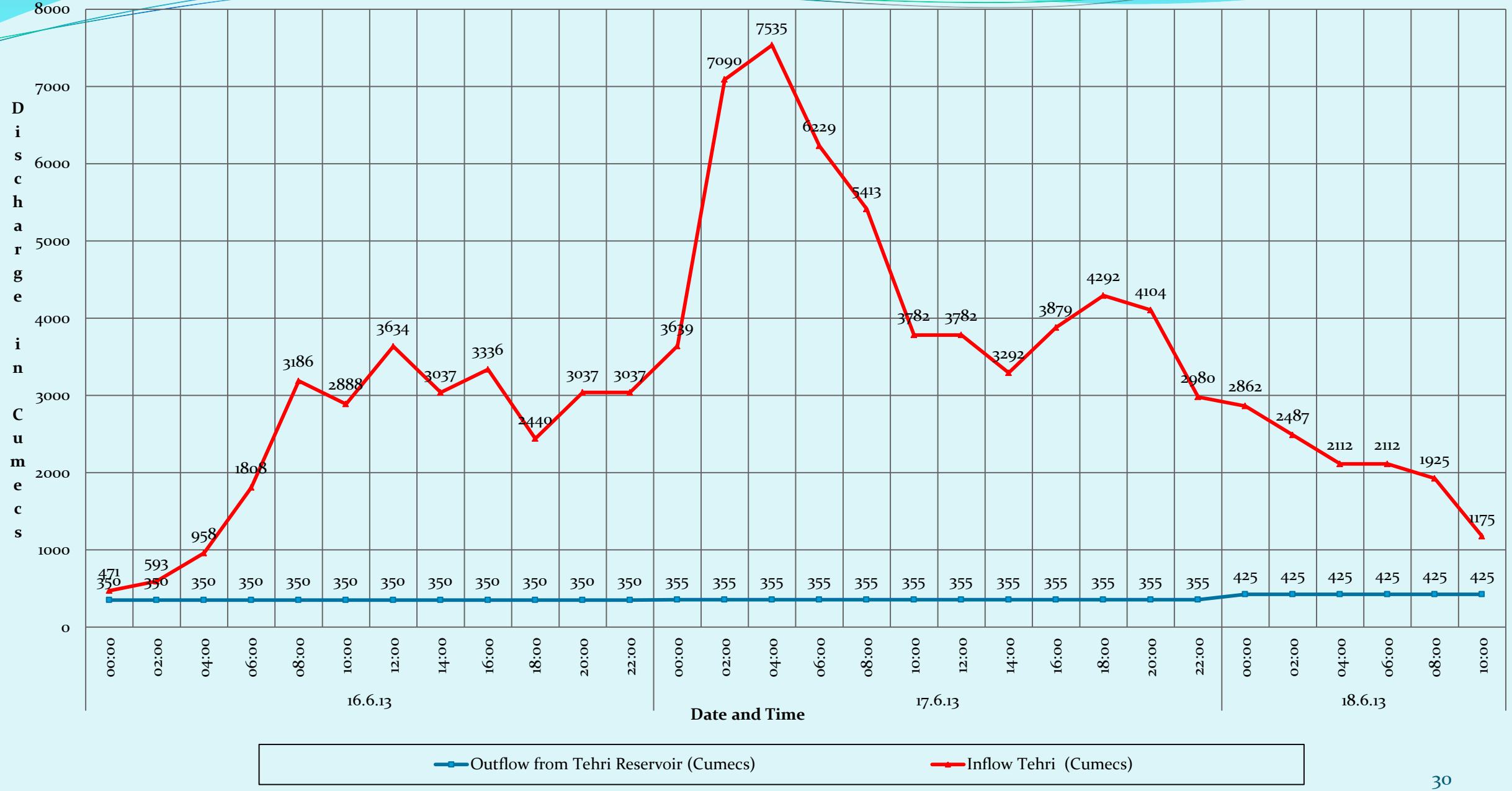
Actual Observations at Tehri Dam

- Actual Peak Discharge of River Bhagirathi on 17-June at Tehri (at 6am) was - 7500 Cumecs (262500 Cusecs)

- Max. release from Tehri Dam from 16-18 June - 500 Cumecs (17500 Cusecs)

- Rise in Tehri reservoir level was 25m in 2 days (16-17 June).
  - At 8 AM on 16-June – 750.00m
  - At 8 AM on 17-June – 764.40m
  - At 8 Am on 18-June – 775.05m

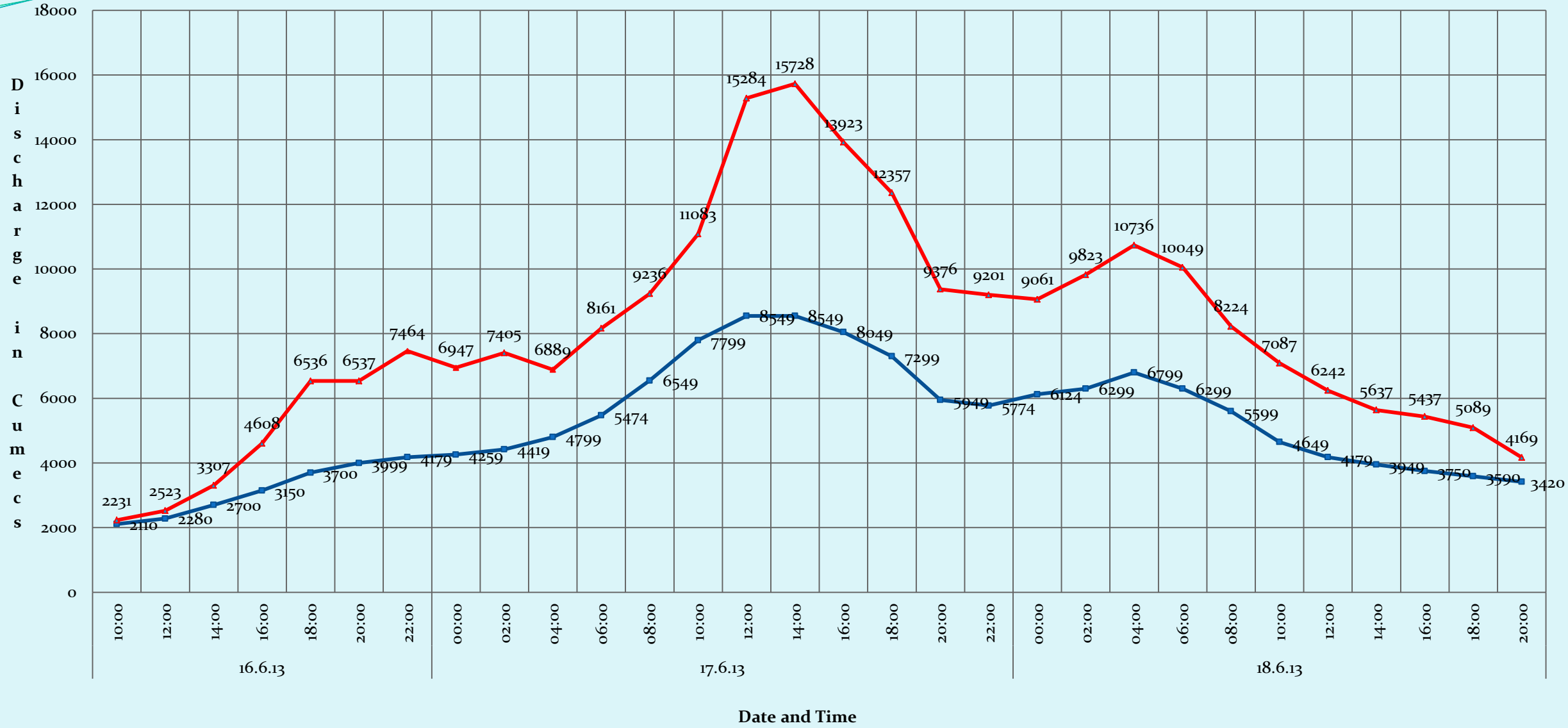
Fig-1: Actual observed inflow and outflow at Tehri



Assessment of Cumulative Flood Impact at Rishikesh

- Peak Discharge on 17-June was recorded around 8500 Cumecs (when water from Bhagirathi was absorbed in Tehri reservoir)
- Bhagirathi flow takes about 10 hrs. in reaching Rishikesh.
- Flood hydrograph of Bhagirathi at Tehri is superimposed after 10 hrs over observed flood hydrograph at Rishikesh to assess the cumulative flood impact.
- Anticipated max. discharge could have increased to around 15700 cumecs.
- Change in max. discharge could have further increase the water level about 2.5 to 3.0m.

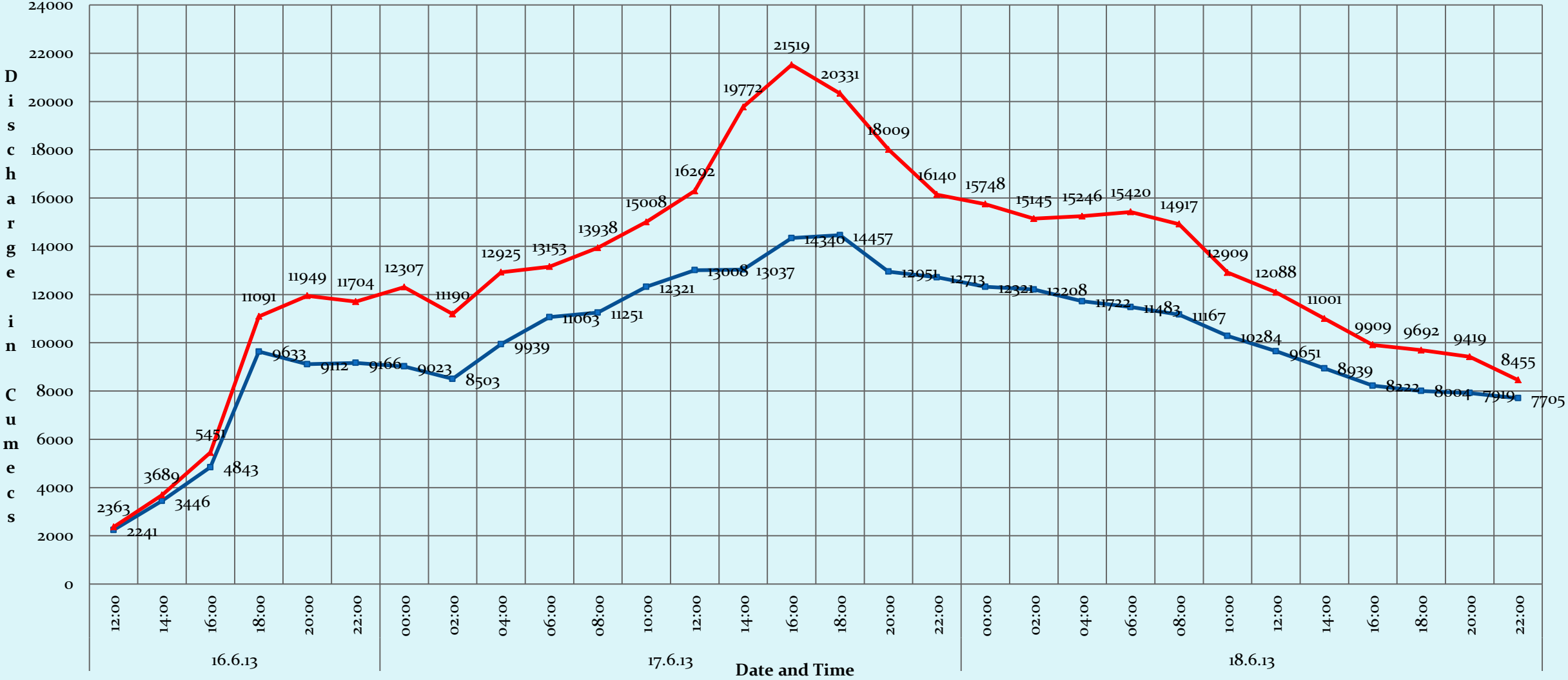
Actual observed discharge of Ganga at Rishikesh and anticipated disch. after superimosing Tehri actual inflows with 10 hrs time lag



Assessment of Cumulative Flood Impact at Haridwar

- Peak Discharge at Haridwar on 17-June was recorded around 14500 Cumecs (when water from Bhagirathi was absorbed in Tehri reservoir)
- Max. water level at Haridwar at 4pm was recorded -295.90 m (1.90 m above danger level)
- Bhagirathi flow takes about 12 hrs. in reaching Haridwar.
- Flood hydrograph of Bhagirathi at Tehri is superimposed after 10 hrs over observed flood hydrograph at Haridwar to assess the cumulative flood impact.
- Anticipated max. discharge could have increased to around 21500 cumecs.
- Change in max. discharge could have further increase the water level about 1.5 to 2.0m.

Actual observed discharge of Ganga at Haridwar and anticipated disch. after superimosing Tehri actual inflows with 12 hrs time lag



Lord Shiva Idol at Parmarth Niketan Rishikesh

River Ganga along Aastha Path in Rishikesh

Flood Situation at Haridwar

Flood Situation at Haridwar

Conclusion

1. Extreme events of cloud bursts are increasing in the Himalayan region drastically. Uttarkhand witnessed 23 such incidents in 2019 against 13 in 2018;
2. Nos. of rain days decreasing and within last decade they come down to 65 from 80;
3. Rainfall distribution is quite uneven over space and time;
4. In the changing scenario of climate change led hydro-meteorological changes we need multipurpose storage dam projects like Tehri dam on each and every major river to -
   - Store surplus water during monsoon to benefit our large population during lean months through irrigation, water supply, hydro power generation etc.
   - Regulate unprecedented floods and saving lives from extreme events like Uttarkahnd disaster of June-2013,
   - Modify unevenly distributed availability of water.
5. Ultimate solution of all these problems is implementation of river linking projects on river systems.


THANK YOU
Safety is Our Concern