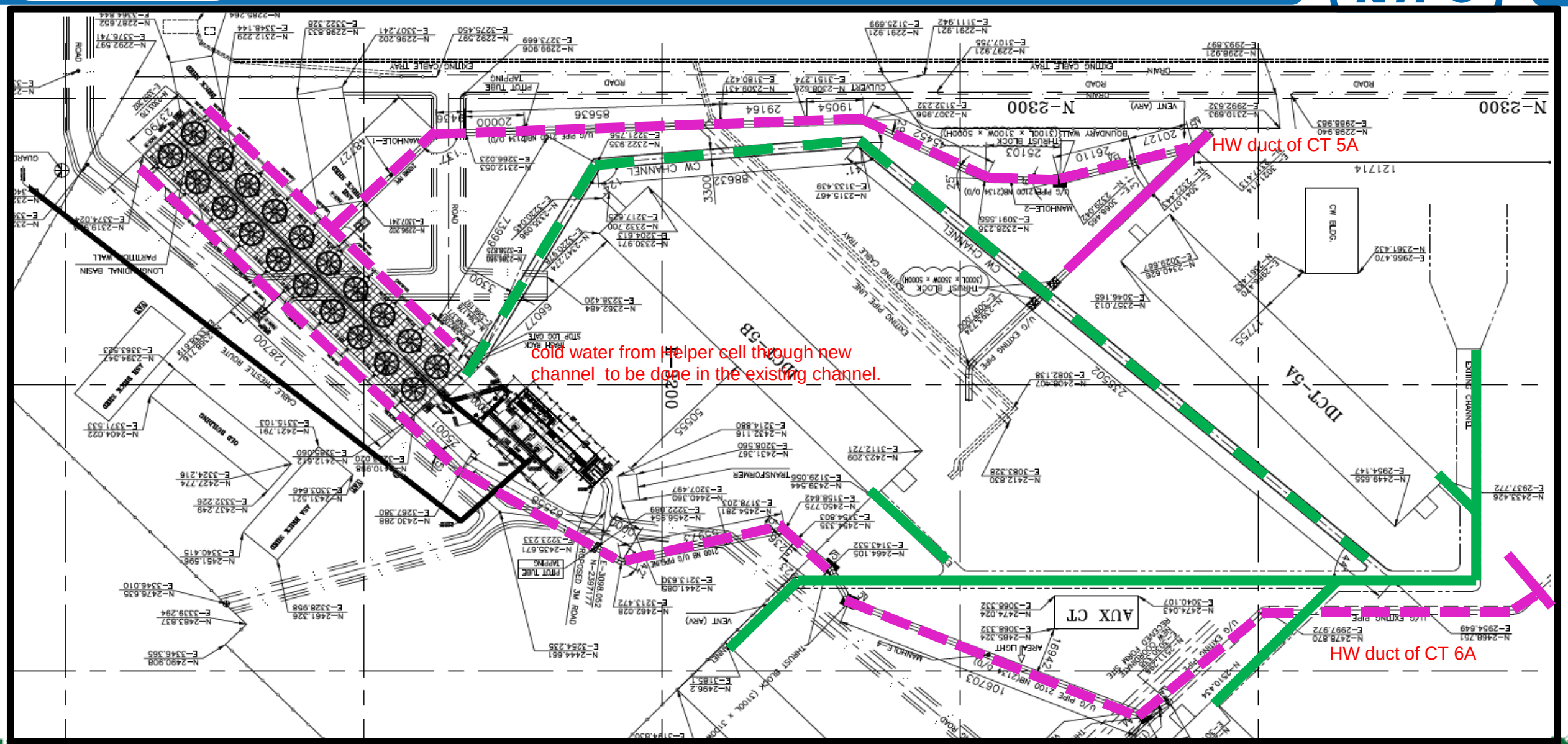
Interconnection of New Cold water channel with Existing Channel of Rihand Stage III

Rihand

SCHEMATIC DIAGRAM OF COOLING TOWER

एनटीपीसी NTPC



Objective

- Interconnection of new CW channel with existing CW channel.
  - By cutting and lifting the RCC wall section of existing channel at interconnection.
  - Work to be carried out with water flow in channel.
  - Work to be carried out with utmost safety and within schedule time.
- Capability building for carrying out similar works in NTPC wherever required.

A.1 COOLING TOWER THERMAL PERFORMANCE TEST

Sl. No.	DESCRIPTION	UNIT	Parameter
1	Guaranteed cold water temperature for the design conditions of the flow, range and ambient WBT and relative humidity	Deg C	32.5
2	Predicted cold water temperature at test condition (including 0.3 deg C tolerance)	Deg C	33.15
3	Test cold water temperature	Deg C	38.44
4	Shortfall in test cold water temperature	Deg C	5.29
5	Remarks	-	Doesn't meet the Guarantee

Tower Performance Report

CT 5B Test Performance Report 16.08.2023

Owner: NTPC Rihand
Project: Rihand
Location: Bijpur,sonebhadra
Manufacturer: NBCC
Tower Type: Induced Draft

Cooling Tower Design and Test Data

Parameters	Design	Test
Water Flow Rate	8333.3 l/s	8002.8 l/s
Hot Water Temp.	42.50 °C	48.30 °C
Cold Water Temp.	32.50 °C	37.40 °C
Wet Bulb Temp.	27.40 °C	27.50 °C
Dry Bulb Temp.	36.00 °C	33.50 °C
Fan Driver Power	70.50 kW	66.60 kW
Barometric Pressure	101.325 kPa	101.325 kPa
Liquid to Gas Ratio	1.833	1.802

Cold Water Temperatures vs. Range

At 27.50 °C Test Wet Bulb

Range	7500.0 l/s	8333.3 l/s	9166.7 l/s
8.00 °C	31.19 °C	31.89 °C	32.21 °C
10.00 °C	31.90 °C	32.51 °C	33.12 °C
12.00 °C	32.23 °C	32.93 °C	33.75 °C

Cold Water Temperature vs. Water Flow

At 27.50 °C Test Wet Bulb and 10.90 °C Test Range

7500.0 l/s	8333.3 l/s	9166.7 l/s
32.09 °C	32.72 °C	33.43 °C

Exit Air Properties

	Wet Bulb Temp	Density	Sp. Vol.	Enthalpy
Design	39.62	1.09797	0.9545	163.5000
Test	40.34	1.09424	0.9597	169.5500

Test Results * *Indicates predicted flow is extrapolated.*

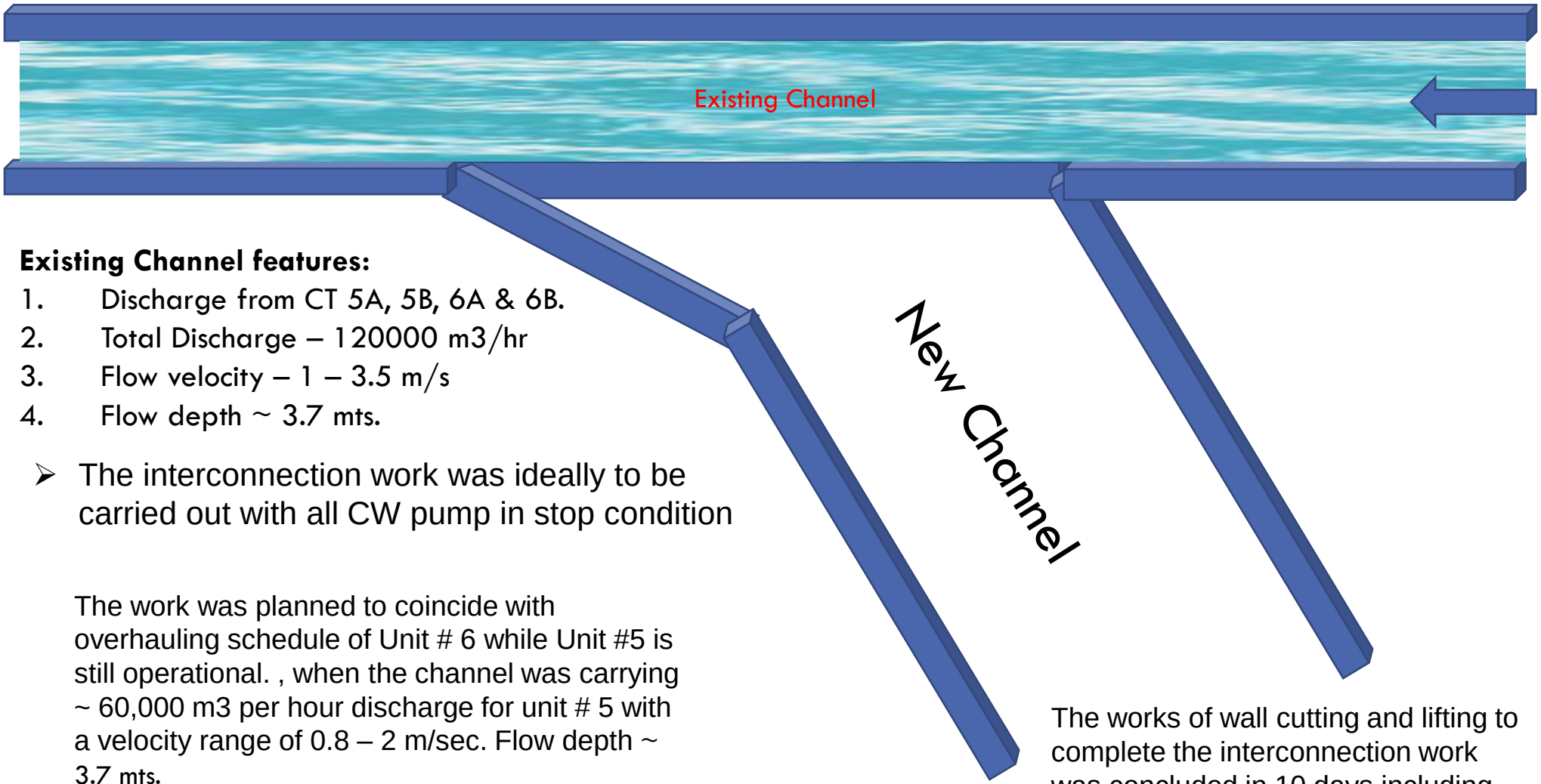
Adjusted Flow	Predicted Flow	CWT Deviation	Tower Capability
8146.8 l/s	13848.6 l/s *	4.21 °C	58.8%

This test result is only certified by CTI if the test data was collected by a CTI Licensed Testing Agency. See www.cti.org for an agency list.

Cooling Towers	M/S NBCC	M/s Paharpur	
Designed (m3/hr)	120000	40000	
Dimensions	3.885 M X 6.750 M	4.035 M X 3.300 M	
Thickness	0.200 M at the top to 0.500 M. at the bottom		
water level	was ~ 3.7 Mts.		
velocity of water	1 m/s to 3.5 m/s from upstream of interconnection point to its downstream.		
CT Capability 5A/5B/6A/6B	61%, 58%, 63%, 64%		
Shortfall in Cold water Temp	5.29 Deg C		
Loss in HR (Kcal/KWh)	27.508		
Loss due to poor CT Performace in unit 5 & 6 (Rs/Year)	**11.22 Cr/Year**		
Helper cell cost (Rs)	**66.29 Cr.**		
Pay back period (Year)	**5.91**		

Rihand

The interconnection between new and existing CW channel , By cutting and eliminating the RCC wall section 6.5 mts X 4 mts of existing channel at interconnection.



The existing channel carries discharge from CT Unit # 5A & 5B along with CT Unit 6A & 6B and auxiliary CT.

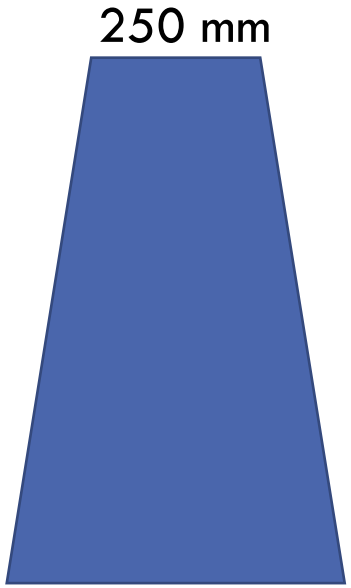
Existing Channel features:

1. Discharge from CT 5A, 5B, 6A & 6B.
2. Total Discharge – 120000 m3/hr
3. Flow velocity – 1 – 3.5 m/s
4. Flow depth ~ 3.7 mts.

- The interconnection work was ideally to be carried out with all CW pump in stop condition

The work was planned to coincide with overhauling schedule of Unit # 6 while Unit #5 is still operational. , when the channel was carrying ~ 60,000 m3 per hour discharge for unit # 5 with a velocity range of 0.8 – 2 m/sec. Flow depth ~ 3.7 mts.

The works of wall cutting and lifting to complete the interconnection work was concluded in 10 days including the preparatory works.



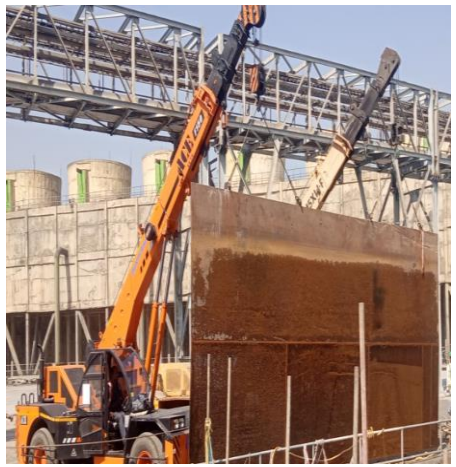
Existing channel wall X Section

The methodology of interconnection works

Expert Divers.

Diamond wire rope cutting machine.

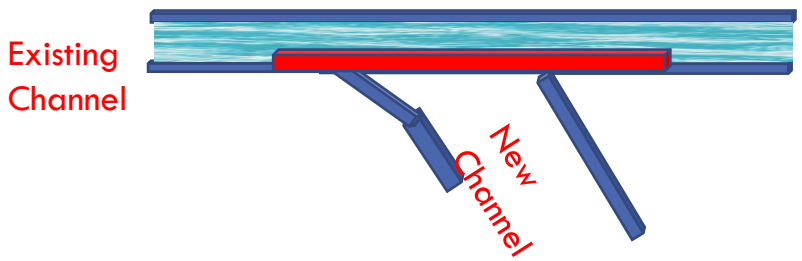
More than 70mts of diamond wire rope.

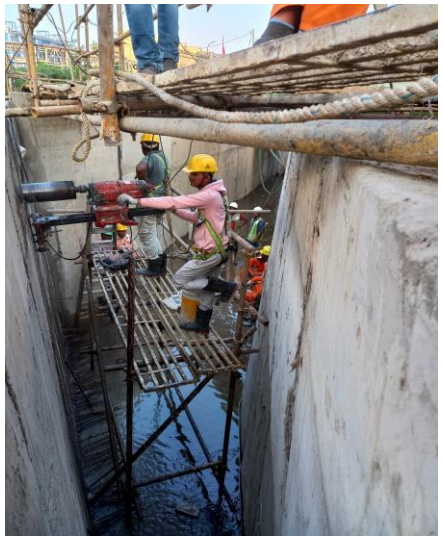


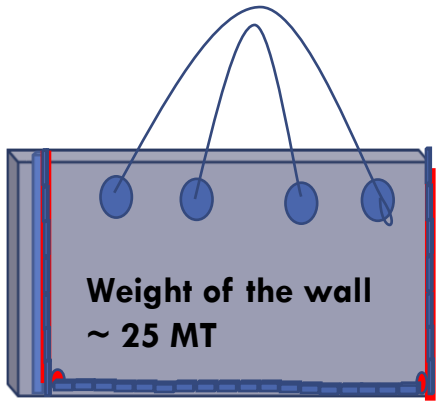
80 MT crane was deployed to lower the C section into the channel.

C Section

Methodology submitted by M/s PCTL and approved by Engineering
Approved by Engineering.
20 mm MS plate 9 mts length to be placed.
Plate to be sealed with wall.
Drilling of holes at the base of wall (at 2 corners) from new channel side.
Drilling of holes at the top of wall (for lifting of the wall).
RCC wall cutting by diamond wire rope operated on machine.
Water filling in the new channel.
Lifting of the wall.
Lifting of the plate.



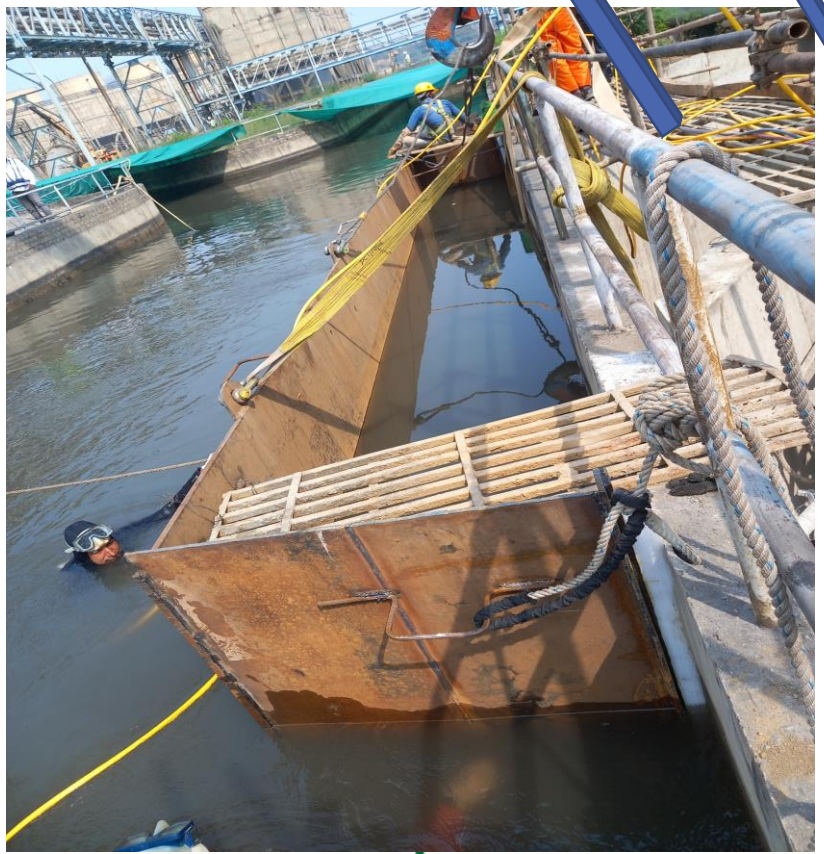




Cutting & Lifting model

Fixing of 20 mm plate on the interconnection wall section.

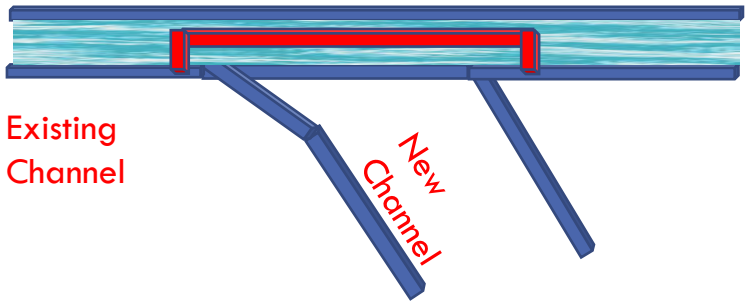
Methodology	Challenges faced
➢ **Approved by Engineering.** ➢ **20 mm MS plate 9 mts length to be placed.** ➢ **Sealing of the plate with wall surface by rubber gasket material to avoid any water leakages** ➢ **Fixing prop supported from opposite wall of the existing channel to keep the 200 mm plate in position.** ➢ **Drilling of holes at the base of wall (at 2 corners) from new channel side.** ➢ **Drilling of holes at the top of wall (for lifting of the wall section).** ➢ RCC wall cutting by diamond rope. ➢ Water filling in the new channel. ➢ Lifting of the wall. ➢ Lifting of the plate..	➢ Plate could not be packed with existing vertical wall due to water flow. ➢ Sealing with wall couldn't be possible. ➢ Diamond cutting wire was frequently broke down due to high water pressure and 20 mm MS plate plate with existing wall. ➢ Plate was close to wall, hence there was no way to loosen the rope from the water side. ➢ Resulted in no work progress on Day -1 – 15.02.23.

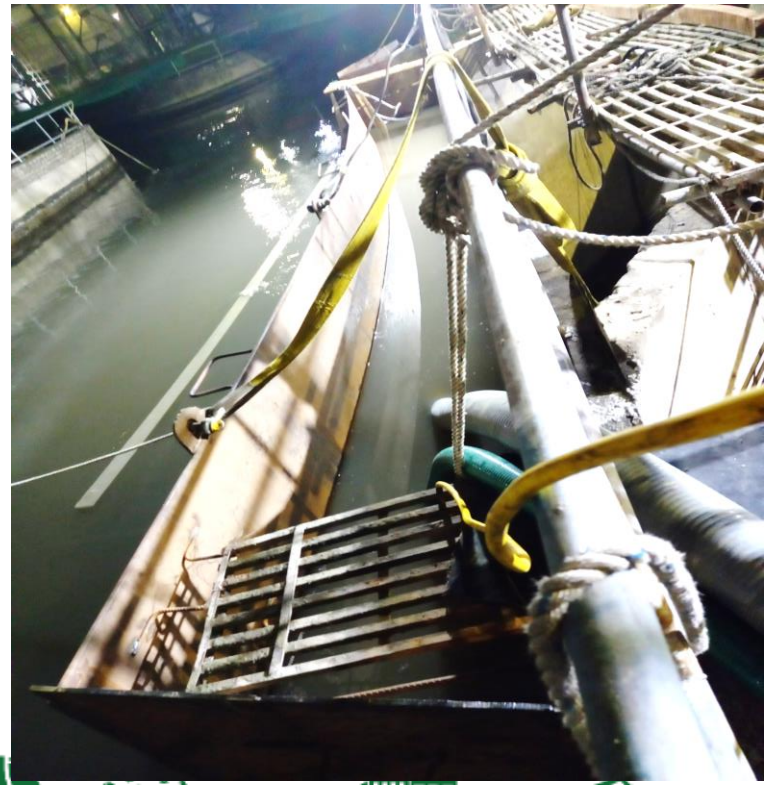


Setting up C Section

Methodology	Challenges faced
➢ Mythology was modified at Site which mainly consist of C section of 20 mm MS plate instead of plate. ➢ Sealing of c section edges by rubber gasket and foam. ➢ Core cutting for lifting to facilitate sling operation. ➢ Dewatering of enclosed area by pump. ➢ Net barricading in D/S for safety. ➢ Dewatering between c section and existing wall	➢ Availability of glue for pasting rubber gasket on edges of C-section. (conveyer pasting glue was used for fixing rubber gasket) ➢ Availability of foam that could withstand in water pressure. (high density foam used)

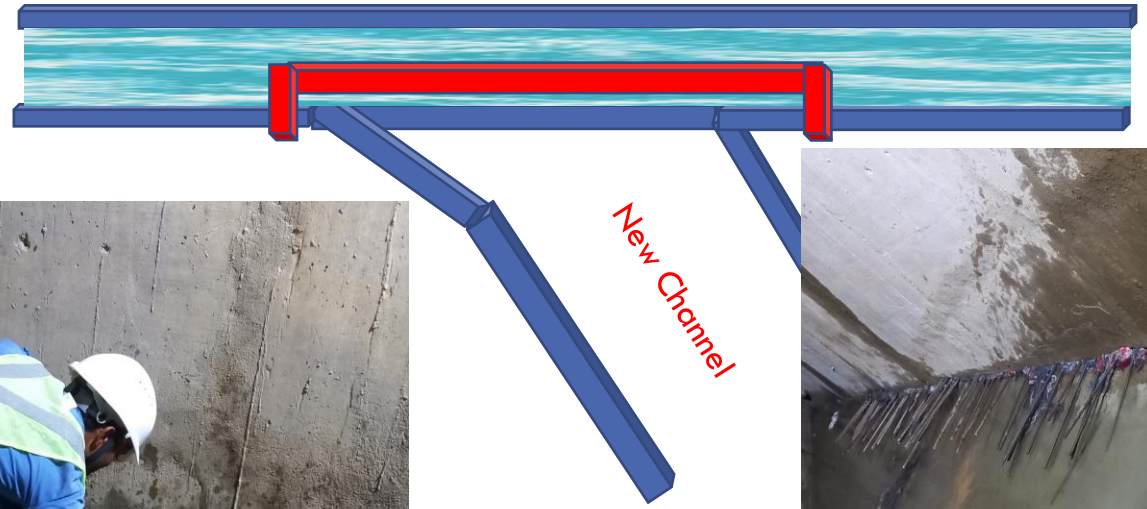
Day -3 Setting up C Section





Methodology	Challenges faced
	➢ During the dewatering operation plate started bending due to high water pressure. ➢ Dewatering stopped

Day -4 Horizontal wall portion cut

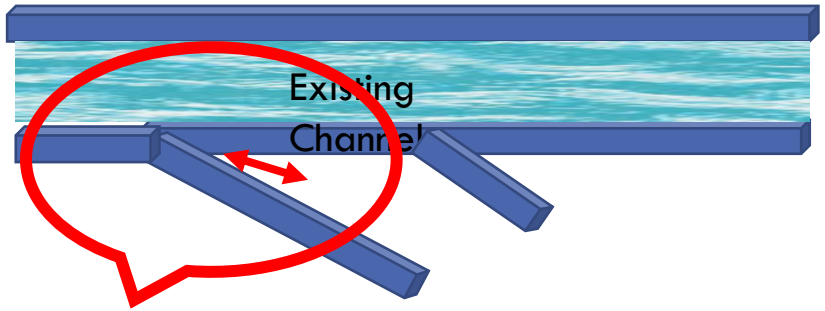


Sealing by foam inside and rugs by outside

Breakthrough Moment

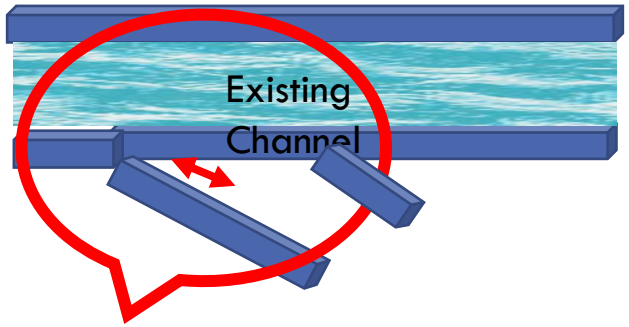
Methodology	Challenges faced
Metholgy was revised & decided to work with water in c section C section benefit was that water inside was still easing the diving operation by divers. Diamond rope cutting machine set-up from new channel. Drilling additional holes at bottom 1.5 mts interval to cult wall in 3 sections	Diamond rope frequently getting stuck to due to longer cutting span of 4.5 mts Due to lower capacity machine, wall thick ness & water pressure cutting rope was breaking – resulting approx. 1-1.5 hrs delay in resuming cutting work (due to underwater wrapping) Resulted in work progress on Day -4 – 18.02.23 Bottom horizontal of the RCC wall was cut.

Day -5 Under water breaking



Methodology	Challenges faced
▪ Under water jack hammer used for ease drilling operation .	➢ Space constraint in the kink portion ➢ No space for a perpendicular drilling from new channel side ➢ Inclined drilling tried but the base of wall exceeded the drawing data. ➢ Result of the day – 5 – no progress.

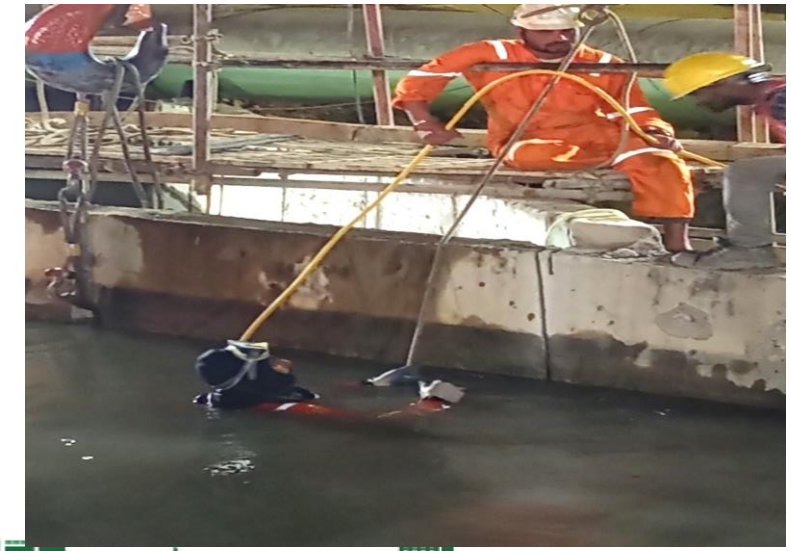
Day -6 water filling in the new channel



Water filled in adjacent segment of channel to avoid risk of brick wall failure.

Eliminating the kink

Methodology	Challenges faced
➢ Water to be filled before cutting of wall vertically ➢ Set up of cutting machine above wall for vertical cut.	➢ No challenges. ➢ Progress : drilling at kink portion successfully done, and water filling in new channel done & holes for lifting RCC Pannel done.



Pulley used to avoid rope wall contact – major reason of rope breakage.

Methodology / working steps	Challenges faced
➢ Set up of cutting machine above wall for vertical cut. ➢ methology revised : set up of machine on the other side of channel ➢ Removal of c section & hand rail was removed	➢ due to space constraint machine could not be placed above wall. ➢ Progress : vertical cutting of wall started.

Day -8 Vertical wall cutting

Methodology/ working steps	Challenges faced
Set up of cutting machine above wall for vertical cut.	➢ Progress : vertical cutting of wall started.

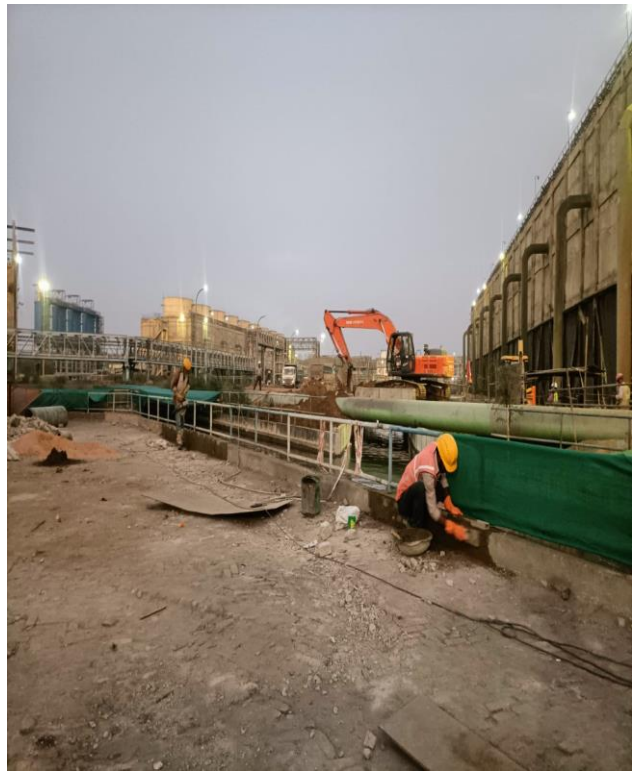
1st panel cut and lifted

Rihand

Day -9 wall panel cut and lifted

एनटीपीसी NTPC

3rd wall panel cut and lifted



railing repairing works

Methodology/ working steps	Challenges faced
▪ Removal of debris (if any) ▪ Restoring of hand rail at existing duct	➢ Progress : ▪ 2nd panel & 3rd panel cuted & removed ▪ Hand rail reparing work done. ▪ Interconnection work completed.

Savings due to interconnection works in unit running condition

- Required conditions for helper cell channel connection
  - Both units in stopped condition (Unit 6 under OH).
  - All CW pumps in stopped condition.

Description	Days
No. of days from Unit S/D to CW p/p stoppage	5
No. of days required for execution of work	5
Total unit outage days	10

Descriptions	Unit	Qty	Loss (Lakh)
DC Loss	MU	112.5	1620
SG incentive Loss	MU	112.5	590.63
Oil consumption during startup	KL	125	100
Marginal contribution loss			22.5
APC loss during Shut down	MU	0.868	13.45
APC loss during Startup	MU	0.1	1.55
RRAS,SCED,AGC revenue loss			20
			2368.13

Methodology

Rihand

Methodology - 1	Methodology - 2	Methodology - 3	Methodology - 4
Approved by Engineering.	Modified at Site.	Modified at Site. Net barricading in D/S for safety.	Walkway after net barricading.
20 mm MS plate 9 mts length to be placed.	C section of 20 mm MS plate.	C section of 20 mm MS plate.	
Plate to be sealed with wall.	Sealing by rubber gasket and foam.	Sealing by rubber gasket and foam.	
Drilling of holes at the base of wall (at 2 corners) from new channel side.	Same	Same	Intermediate holes for contingency.
Drilling of holes at the top of wall (for lifting of the wall).	Core cutting for lifting to facilitate sling operation.	Core cutting for lifting to facilitate sling operation.	Cutting m/c be placed opposite for vertical cutting.
RCC wall cutting by diamond wire rope operated on machine.	Dewatering of enclosed area by pump.	Dewatering stopped and decision made to start cutting with water in the enclosure. C section benefit was that water inside was still easing the diving operation by divers.	Wall cutting in 3 vertical panels. Kink portion hole drilling from outside.
Water filling in the new channel.	Wall cutting.		Cutting progress is slow with 1 m/c. 1 nos. additional m/c to be deployed.
Lifting of the wall.	Water filling.		
Lifting of the plate.	Wall – Plate lifting.		

Se. No.	Risk	Mitigation
1	Tripping on low water level.	Built a brick wall ~40 mts from interconnection area in the new CW channel.
2	High flow of water in the channel.	1. Placing C section along the interconnection. (with proper designe) 2. Placing safety net in the down stream of the interconnection.
3	Completion of work within schedule time	Adequate resources deployed: 1. Two nos. of Concrete cutting machine were deployed. 2. ~100 mts of diamond rope available. 3. Core cutting machine, Drilling machine, Jack hammer. 4. Availability of 80 MT tyre mounted crane. 5. Expert divers and other manpower.
4	Under water fixing of diamond wire rope	5 nos. of expert Divers from M/s IDA were deployed.
5	Space constraint in the Kink portion.	Under water drilling by Jack hammer.
6	Diamond rope frequently getting stuck and breaking.	1. Reducing the span between holes to reduce wire rope length. 2. Increasing the diameter of the hole.

Thank You