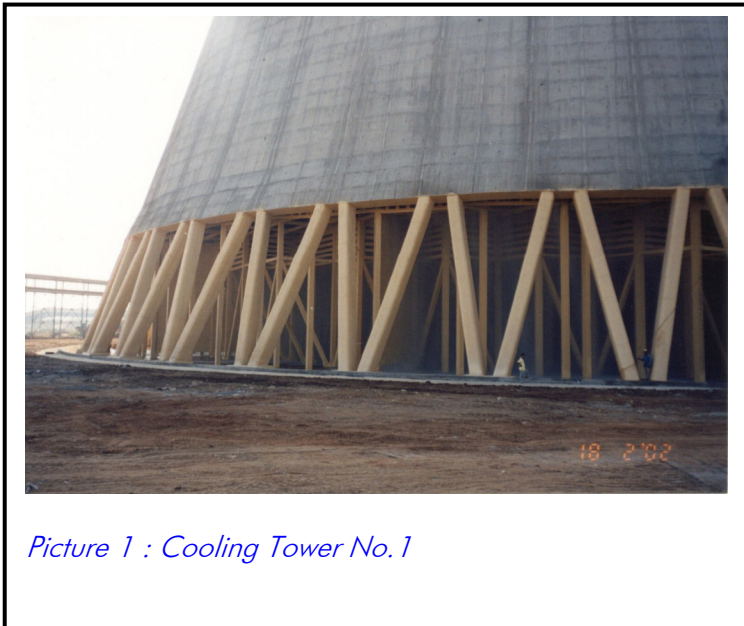


Seawater Cooling Tower

Amchem completed, during January 2002, a landmark project for NTPC / NBCC at NTPC's 2 X 500 MW Simadhri Thermal Power Project near Visakhapatnam. We finished coating approx. 61,000 sq metres of Concrete and Steel Substrates with 2,000 Microns Purethane® 386/9000 in the Cooling Tower No.1.



Picture 1 : Cooling Tower No.1

The Natural Draught Cooling Towers are one of the largest in the world with following dimensions :

Height	:	165.45 m
Dia At Bottom:		111.73 m
Dia At Top	:	74.13 m

Each tower has 32,000 CuM of Concrete and 4,700 MT of reinforcing steel.

Approx. 60,000 M³ / Hour (60 Million Litres / Hour) of Seawater at 1.5 cycles of concentration will flow through the towers.

To prevent concrete degradation and re-bar corrosion in the highly corrosive sea water immersion / splash environment, a number of measures were taken in the design. Principally, all concrete and steel surfaces in contact with sea water / sea water spray i.e up to drift eliminator level (15 m) are coated with 2.00 mm of Purethane® , 100% Solids High Build Polyurethane Coating. The polyurethane coating provides a strongly bonded, tough, impermeable membrane, which prevents transmission of Chlorides, Sulphates and greatly retards transmission of Oxygen and Water Vapour into the concrete and underlying reinforcing steel. Additional corrosion protection measures include use of Sulphate Resistant Cement with 5-8% C₃A content & Marine Grade CRS. Above the drift eliminator (coating line), the shell structure uses an organic migratory corrosion inhibitor.

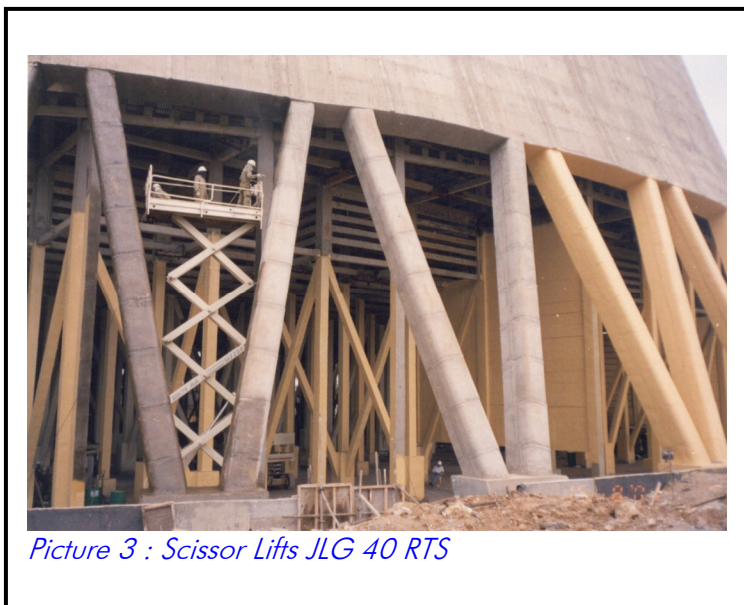


Picture 2 : Racker Columns being Primed and coated .

The internal structure to be coated was very complex. It included the Fill Support Structure, Racker Columns, Baffle Walls, Duct, Walkways, Pond Floor, Pond Wall etc. At heights up to 15 metres (50 feet) .

The fill support structure is a maze of vertical lower columns (> 400 No's), upper columns (> 800 No's), diagonal columns and beams (> 3,000 No's).

The entire structure was blast cleaned, primed using Purethane® PIV, 100% Solids Damp Tolerant Polyurethane Primer and coated in situ.



Picture 3 : Scissor Lifts JLG 40 RTS



Picture 4 : Articulating Boom JLG 60 HA (Left) and Scissor JLG 40 RTS (Right).

In order to access the various parts of the structure Amchem deployed specialised high reach equipment such as articulating booms, scissor lifts, manlift etc. The constrained spaces made access to the surface difficult and the high reach equipment served the purpose admirably.

Three plural component airless spray equipment from Graco Inc., USA were used for the coating. In addition several blast pots and air compressors were deployed for surface preparation. The Graco equipment performed reliably as always with minimal repairs and downtime. Highly skilled crew of around 45 people conducted the surface preparation and coating application.

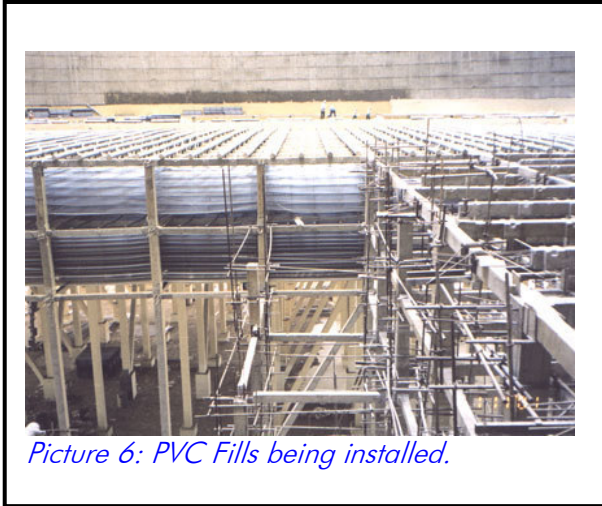
More than 8,000 litres of Purethane® PIV, 100% Solids Damp Tolerant Polyurethane Primer and more than 135,000 Litres of Purethane® 386/9000, 100% Solids Polyurethane Coating were used for the coating operations. Purethane® PIV is a specialized primer which penetrates into the concrete, sealing and consolidating the surface for improved adhesion. Water tolerance allows it to be sprayed onto damp concrete with excellent bond between the primer and concrete as well as primer and coating.

Field tests (over 600) were conducted regularly for Hardness, Film Thickness, Coating Adhesion with 100% of tests meeting specified requirements.

Samples were also drawn and sent to the Indian Institute of Chemical Technology (CSIR), Hyderabad for testing coating parameters like Tensile Strength, Recoverable Elongation, Water Vapour Transmission, Flexibility, Impact and Abrasion Resistance. 100% of tests far exceeded the specified parameters.



Picture 5: Complex internal structure coated with Purethane® 386/9000.



Picture 6: PVC Fills being installed.

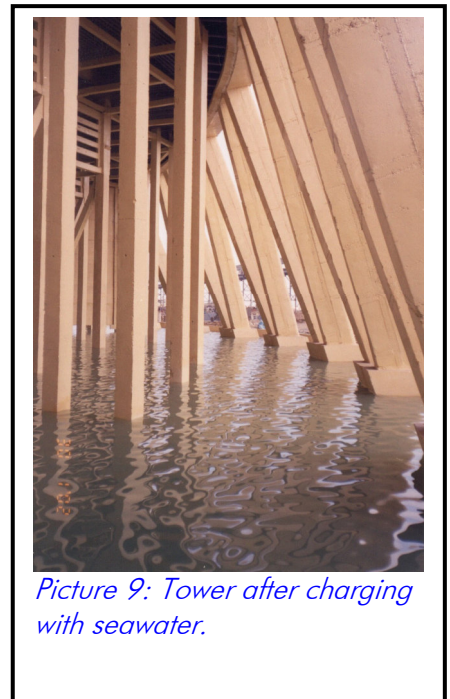


Picture 7: Drift eliminators at the AC Pipe level.

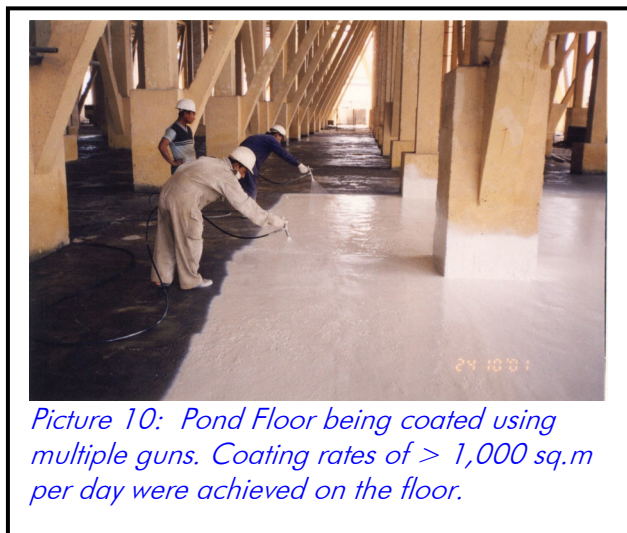


Picture 8: Pond Floor Areas being coated.

Water from the condenser is brought into the Cooling Tower through 3.2 m dia MS Pipe up to Cooling Tower Bottom, which is bifurcated into 2 pipes of 2.4 m rising up to 15 metre level. They enter the cooling tower and discharge hot water into RCC hot water ducts in each half. The hot water is further distributed through secondary ducts from each main duct and AC pipe network. The water is sprayed downwards from the AC pipes through PVC fills. Incoming air from gaps in the racker column cools the water, which collects in the basin.



Picture 9: Tower after charging with seawater.



Picture 10: Pond Floor being coated using multiple guns. Coating rates of > 1,000 sq.m per day were achieved on the floor.

Pond wall and floor were coated after the fill support structure was completed.

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Addendum October 2015

As on 1st October 2015, the following Cooling Tower Projects have been completed by Amchem

Year	User / Location	Customer	No. of Towers	Surface Area
2002	NTPC Simadhri (NDCT #1)	NBCC Ltd	1 No's NDCT	6,50,000 Sq. Ft
2012	NTPC/ APCPL Jhajjar	Gammon India Ltd	3 No's NDCT	21,00,000 Sq. Ft
2014	APGENCO Krishnapatnam	TATA Projects Ltd	1 No's NDCT	8,60,000 Sq. Ft
2015	DVC Raghunathpur	Reliance Infra Ltd	2 No's NDCT	15,60,000 Sq. Ft
		TOTAL	7 No's NDCT	51,70,000 Sq.Ft

15-Year-Old NTPC Simadhri Seawater NDCT Revisited

Amchem coated the world's first seawater cooling tower at 2 X 500 MW NTPC Simadhri Thermal Power Plant in the year 2002. Areas which were coated were the Racker Columns, Basin Floor & Walls, Fill Support Grillage and Internal Shell Till 1.5 m from walkway level.

As part of the long term performance review exercise, Amchem personnel visited the plant in end June 2017, after more than 15 years of operation.



Year 2002



Year 2017

The following was observed:

1. The Purethane coating applied on the concrete was **not deteriorated** in any manner even after **15 years of service**.
2. The coating remains **firm adhered**.
3. There was **no sign of corrosion in the Purethane coated areas**, which were the highest corrosion prone locations in the entire tower with high amounts of available Oxygen, Water and Salts.
4. The areas **not protected by Purethane** (Shell External & Internal) have **badly corroded** despite being in less corrosion prone areas. Severe spalling is observed in the uncoated area and the tower vicinity itself has been earmarked as restricted zone due to risk of falling corroded concrete. The concreting on the lower external part (about 2m) of the uncoated shell has been rehabilitated and replaced.
5. For **future projects**, it is strongly recommended that the **entire shell internal surface** as well as 2m height on external bottom and top should be coated with Purethane.

It can be safely stated, had it not been for the Purethane Coating, the tower today would not have been standing.



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