INDUSTRIAL CATEGORY

# Evaluation and Repair of Natural Draft Cooling Tower

## MID-ATLANTIC REGION OF US

SUBMITTED BY WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Constructed in 1974, a 400 ft (122 m) tall reinforced concrete hyperbolic shell natural draft cooling tower in the Mid-Atlantic region of the United States began exhibiting concrete deterioration after approximately a decade of service. Over time, the deterioration progressed, including large areas of concrete delamination and spalling at the shell exteriors, areas of concrete delamination at the shell interiors, and cracking and corrosion staining in the supporting X-columns.

Beginning in 2006, structural and materials engineers performed multiple condition assessments of the tower to characterize deterioration mechanisms, assess structural integrity, and develop repairs to meet owner-defined repair objectives, including a 25-year service life extension —all while maintaining the tower in an operationally ready state throughout construction. Condition assessment of the cooling tower was challenging due to its size, geometry, and operational constraints, but careful investigation provided critical knowledge to effectively characterize its structural health and plan an aggressive repair strategy.

Evaluation of concrete properties, corrosion rate, and desired repair objectives were considered in the decision to utilize impressed current cathodic protection (ICCP) and galvanic cathodic protection (GCP) as part of the repair program that included an engineered demolition, rebuild of the upper one-third of the tower, and localized concrete repairs of the lower two-thirds. The ICCP system is comprised of 48 individual zones, each with four embedded reference electrodes to monitor the polarization of the steel reinforcement. Three types of ICCP systems were used at different sections of the shell, including over 4,300 discrete titanium suboxide ceramic tube anodes, mixed metal oxide-coated titanium ribbon mesh anodes, and over 6 miles of ribbon mesh anode.

Despite significant technical challenges due to the scale of the structure and deterioration, the design-build project was completed without any lost-time injuries, and the in-place cathodic protection systems remain operational and remotely monitored for performance.

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AWARD OF MERIT