

INTRODUCTION

The Nuclear Generating Station included in this case study uses 90 MGD of treated municipal wastewater to cool its nuclear reactor. The wastewater travels through 36.4 miles of underground pre-stressed concrete cylinder pipe (PCCP), called the Water Reclamation Supply System Pipeline (WRSSP), with pipe diameters ranging from 96" diameter pipe to 114" diameter pipe. The PCCP segments are constructed of a 16 gauge steel shell protected by 0.162" diameter pre-stressing wire wrapped around the exterior concrete core and protected with a cement mortar coating.



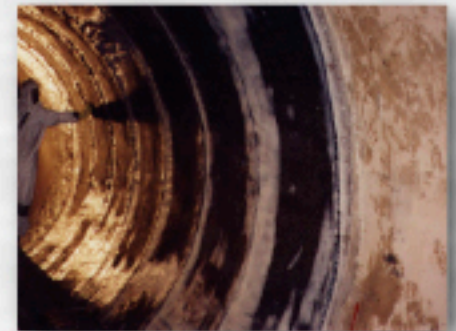
PROBLEM

Active Corrosion of the existing steel reinforcement was detected throughout the WRSSP. Analysis of corroded areas showed that significant degradation had occurred and continued corrosion could result in loss of capacity and failure. Both carbon fiber and steel were initially considered to repair the WRSSP.



TESTING

The owners created a test chamber to house and pressurize a 10-foot long by 96 inch PCCP pipe segment wrapped either internally or externally with carbon fiber. The pipe segment was capped with 1 inch steel bulkheads secured with thirteen 2-inch diameter steel rods through the pipe. The tested pipes were intentionally damaged allowing pressure to be fully carried by the carbon fiber-epoxy composite. The result of these tests showed that no leakage or structural distress was observed in the composite, which was subject to test pressures of up to 150 psi (equivalent of over one million pounds of force on the steel bulkheads), well in excess of system operating pressures.



INSTALLATION

The pressure tests demonstrated that the Carbon Fiber – Epoxy Composite incorporates the required strengths to resist the pressure loads expected to occur in typical PCCP pipelines at this Nuclear Generating Station. The successful testing of the system lead to the installation of several layers of carbon composite over 1,000 linear feet of pipe - ranging from 96" diameter to 114" diameter. Additionally, the system was installed on the internal area of the pipe and access was obtained through a 2-foot manhole.

CONCLUSION

The results of the case study demonstrates that carbon fiber is a high strength, corrosion resistant material capable of withstanding tremendous surge pressures when installed to either the internal or external area of the pipe. The system provides for a long-term repair solution. In fact, the carbon system has been in place since 1998 and the owner recently verified that it is performing "as good as new". Finally, the cost savings for this system installed were 20% of the costs to excavate and repair with steel – amounting to over \$20 Million in savings when downtime costs were considered.

