

CHALLENGE

Online **biofilm removal** and heat-transfer recovery in nuclear service water CCW exchangers

A US nuclear plant's Critical Cooling Water (CCW) exchangers were losing heat transfer to biofilm fouling. EHS and Operations restrictions ruled out bleach, hydrogen peroxide and surfactant biocides — leaving the plant facing NRC-directed shutdown unless an online cleanup could be designed inside those constraints.

UNIT SERVED

**Nuclear · Service
Water / CCW**

KEY ISSUE

**Biofilm fouling ·
Heat-transfer loss**

RISK

**NRC-directed
shutdown**

ROI

< 2 days (consulting)

CHALLENGE

What was happening

Two operating cycles of declining heat transfer in the CCW exchangers. Deposit analysis: 50–75% biological forms, including filamentous and exopolymer-encapsulated bacteria, with viable sulfate-reducing bacteria. Bleach, hydrogen peroxide and surfactant biocides were all ruled out by plant constraints. Mechanical cleaning meant shutdown.

INTERVENTION

What we did

Designed a two-phase online cleanup inside the plant's constraints. Stabilized bromine biocide + non-surfactant dendrimer polymer biocides — a novel pairing. Validated on a Bridger Scientific DATS sidestream test rig before full deployment. Startup phase to remove biofilm; steady-state phase to hold performance through the operating cycle.

PROOF · THREE LAYERS

1. **Sidestream trial:** DATS cleanliness improved from 80% to 96% in four days at startup-phase dosing.
2. **Microbiological:** ATP and bacterial activity trended down through application.
3. **Plant data:** CCW-A and CCW-B heat transfer recovered above the admin limit and continued to improve through the 18-month steady-state cycle at much lower application rates.

VALUE DELIVERED

\$27M+ avoided

plus NRC-directed shutdown avoided

Avoided downtime	\$20M in lost revenue
Avoided capex	\$7M engineering + new HX
Service-co. uplift	>\$1M in 3 months
ROI · consulting	< 2 days
ROI · consulting + chem	14 days

The right answer often lives outside the standard playbook. In nuclear, where EHS, regulatory and operating constraints rule out the obvious tools, a first-principles, independent review can build a program that fits the plant — and keeps it running. Your critical system deserves a second look.