CNNP Develops and Deploys Dispersant Technology to Combat Steam Generator Fouling in Nuclear Plants

2025 TECHNOLOGY TRANSFER AWARD

China National Nuclear Power Company Ltd. (CNNP) has taken a major step toward reducing steam generator (SG) fouling with the development and rollout of a polyacrylic acid (PAA) chemical dispersant at its Fuqing Nuclear Power Plant. SG secondary-side fouling—driven largely by transported corrosion products—can negatively impact plant performance over time, affecting heat transfer, SG tube integrity, level stability, and ultimately plant output. Over the past two decades, PAA dispersants have become a proven tool for managing secondary-side corrosion deposit accumulation in SGs by limiting particle buildup and helping loosen and remove material that would otherwise accumulate on SG surfaces.

Benefits

CNNP's introduction of this PAA technology in China's nuclear fleet is already delivering meaningful results. By improving how effectively iron is removed through SG blowdown, the plants experience less fouling which can potentially result in reduced maintenance demands. The dispersant has shown strong performance across different operating conditions. The successful use at Fuqing has enabled further deployment as CNNP is planning development of this technology for more than 50 similar types of PWR nuclear power units.

Application

To develop a product specifically tailored for Chinese PWRs, CNNP drew heavily on EPRI's technical guidance and extensive operating experience with PAA chemistry. EPRI's detailed information on chemical characteristics, impurity limits, expected performance, and application approaches helped CNNP create a lower-impurity dispersant and thoroughly validate its performance through testing. EPRI also facilitated knowledge transfer through technical workshops, supporting the adaptation and qualification of the technology for use in Chinese nuclear units.

Since then, Fuqing units successfully have used the dispersant multiple times to reduce steam generator fouling. Beyond supplying the product itself, CNNP has built a full support model around the technology—including product delivery, performance testing, and on-site application guidance—to help ensure consistent results across current and future deployments.

Key EPRI resources for this project included:

- Dispersants for Tube Fouling Control, Volume 3: Qualification for a Long-Term Trial in a Replacement Steam Generator Tubed with Alloy 690 TT, 1002774
- Dispersants for Tube Fouling Control, Volume 1: Qualification for a Short-Term Trial at ANO-2, 1001422
- Dispersants for Tube Fouling Control, Volume 2: Short-Term Trial at ANO-2, 1003144
- Dispersants for Tube Fouling Control, Volume 4: Long-Term Trial at McGuire Unit 2, 1015021
- Dispersants for Pressurized Water Reactor Secondary Side Fouling Control: Sourcebook for Online and Offline Applications, 1025317
- Dispersants for Pressurized Water Reactor Secondary Side Fouling Control: 2014 Field Evaluations, 3002005416
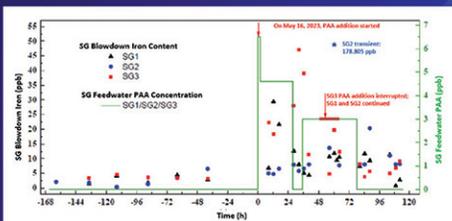

Figure 1
Shows the change in SG blowdown iron content before and after PAA was added 5 days prior to unit shutdown.
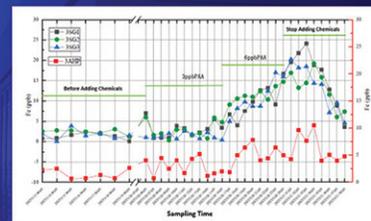

Figure 2
Shows the change in SG blowdown iron content before and after PAA was added 24 hours prior to unit shutdown.
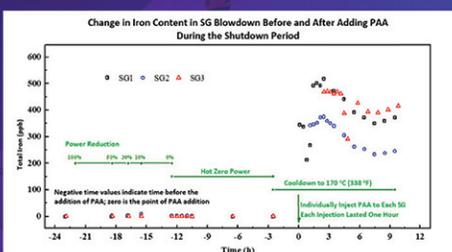

Figure 3
Shows the change in SG blowdown iron content before and after PAA was added during the unit's power-reduction phase.

Table 1
Compares measured impurity values for the developed dispersant versus EPRI recommended indicators.

Impurity Name	Measured Value (ppm)	PAA Specifications (EPRI 102258) (ppm)
Acrylic Acid	31	≤499
Isopropanol	15	≤999
Cl⁻	<0.27	≤10
SO_4^{2-}	<1.59	≤10
F⁻	<0.27	≤10
NO_3^-	<0.27	N/A
$P_2O_5^{3-}$	0.058	N/A
Si	0.25	N/A
Fe	0.014	≤100
Na	0.11	≤10
K	0.028	N/A
Pb	<0.16	≤1
Ca	0.56	N/A
Mg	0.035	N/A
Al	<0.053	N/A
Cu	<0.053	≤10

EPRI