

C³ Concept

Customized Chemical Cleaning of Steam Generators and Heat Exchangers

Chemical cleaning is an essential part of asset management. It restores the steam generator's (SG) or heat exchanger's clean conditions which ensure long-term performance and reliable operation.

Challenge

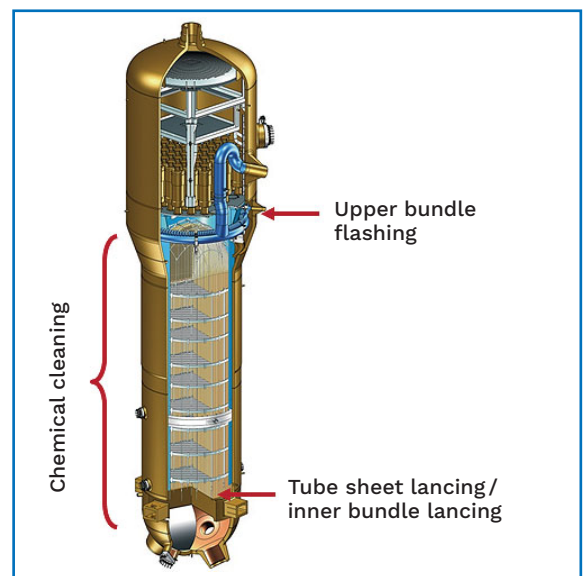
The unsupported spans of heat exchanger and SG tubing are susceptible to fouling which can significantly degrade their thermal performance in the long term. Clogging of SG flow paths causes level fluctuation or even tube vibration that may initiate outer diameter cracking. Formation of hard scale on tube sheet causes denting and/or pitting. Unmitigated fouling or formation of hard scale can make it necessary to exchange the valuable component long before it would normally be necessary and costly unbudgeted repair outages are the consequence.

Solution

For heat exchangers and SGs chemical cleaning is the only way to remove accumulated deposits from tube sheet to top of bundle. Our secondary-side chemical cleaning processes restore heat transfer efficiency and extend operating life of the component by chemical mobilization, minimization and removal of deposits from heat exchangers and SGs. To obtain optimum cleaning results in SGs, the chemical cleaning processes are adapted to the nuclear power plant (NPP) specific history (water chemistry, material concept, blowdown system design) and the resulting individual prevailing conditions (deposit amount and constitution, deposit distribution, existing or expected corrosion problems).

Tailored solutions for each SG or heat exchanger:

- Maintenance and preventative cleaning:
Deposit minimization treatment (DMT)
- Intermediate cleaning:
Deposit accumulation reduction treatment at high temperature (DART HT)
- Full scale and curative cleaning:
High temperature chemical cleaning (HTCC)
- Chemical cleaning method developed by Steam Generator Owner's Group (EPRI SGOG)
- Deposit accumulation reduction treatment at low temperature (DART LT)



SG scheme: chemical cleaning is the only way to access the entire SG surface

Customer benefits

- Restores heat transfer efficiency
- Protects components and extends their operating lifetime
- Ensures high plant availability
- Efficient and proven chemical cleaning technology with low corrosion and associated risks
- No or very low impact on outage duration
- Each chemical cleaning application reconditions the heat exchanger or SG
- The chemical cleaning process is tailored to the individual needs and requirements of each individual plant
- Our international experience and expertise covers hundreds of SGs designed by different original equipment manufacturers

Your performance
is **our** everyday **commitment**

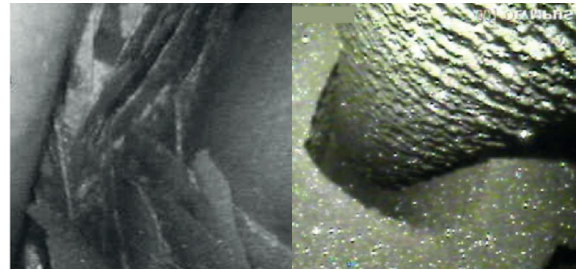
Technical information

Characteristics of DMT process

- Designed for multiple applications
- High magnetite dissolution capacity up to one ton per SG
- Very low corrosion of carbon steel due to self-inhibition effect ($< 30 \mu\text{m}$)
- Innocuous towards stainless steel and nickel base alloys
- No use of hydrazine or other toxic substances
- No release of ammonia to environment
- Easy decomposition of waste
- The complete SG surface from tube sheet to top of bundle is accessible and cleaned

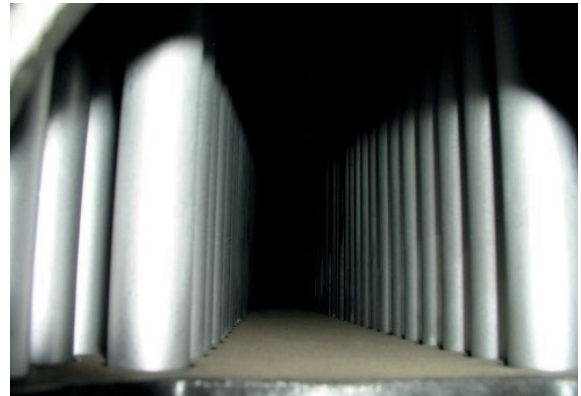
Characteristics of DART / HTCC

- High magnetite dissolution capacity up to 1 ton per SG
- Excellent hard sludge, crevice and broach hole cleaning efficiency
- Low to moderate corrosion of carbon steel (DART LT/HT $< 50 \mu\text{m}$, HTCC $< 250 \mu\text{m}$)
- Innocuous towards stainless steel and nickel base alloys
- Very short duration (DART HT, HTCC $< 12 \text{ h/SG}$)
- Low plant intrusiveness
- The complete SG surface from tube support plate to top of bundle is accessible and cleaned

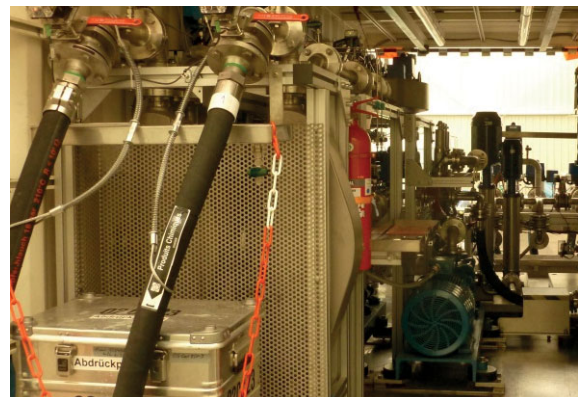


Blocked flow paths in the tube support structure

Tube fouling on free tube span or over complete tube length



After chemical cleaning



Chemical injection system

Key figures

Worldwide **97** secondary-side chemical SG cleanings

595 SGs of many different designs cleaned

11 consecutive applications on one SG

References

• DMT

France (2 NPPs in 2017), France (2016), France (2014), France (2013), France (3 NPPs in 2012), France (2011)

• DART

DART LT: the Netherlands (2017), Rumania (2006)
DART HT: Spain (2010), Spain (2009)

• HTCC

Argentina (2009), France (2 NPPs in 2008), France (4 NPPs in 2007)

Contact: chemistry-services@framatome.com
www.framatome.com

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