

OSART Good Practices

CHEMISTRY

Chemistry surveillance and control programme

Almaraz 2, Spain

Mission Date: 5-22 Feb., 2018

Film forming amine (FFA)

The minimization of corrosion product ingress into the steam generators becomes an important goal for ALMARAZ to improve the operation conditions and ensure the life time availability of the major components in the secondary circuit of both units as well as the integrity of the steam generators. In spite of applying high pH All Volatile Treatment (AVT), recent investigations and the results of associated outage works have shown that the iron concentration and transport of corrosion products was higher than expected. With respect to impurity ingress into the steam generators, which cannot be absolutely excluded, this phenomenon increases the risk of corrosion within the steam generators.

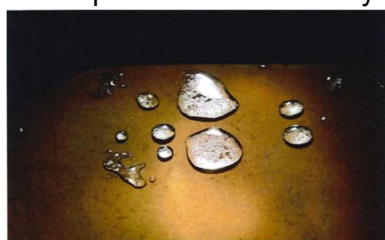
For reducing corrosion products transport for Steam Generators (SGs), the Plant has started as initial strategies:

- Reducing the impurity ingress to SGs, using High pH strategy;
- Decreasing the intake of erosion-corrosion products into SGs by means of AREVA's FFA Injection technology before shutdown, and Ethanolamine (ETA) injection during normal operation;
- Removing the accumulated sludge during outages.

With regarding to FFA injection, the following results were observed:

- Reduction of standstill corrosion during outage periods;
- Minimization of erosion, flow accelerated corrosion (FAC) and general corrosion during operation
- Reduction of the corrosion product transport to the Steam Generators by formation of special conditioned protection layers on the inner surface of the secondary cycle
- Desorption of ionic impurities like chloride from surface deposits (additional cleaning effect for the inner surfaces)
- The adherent and non-wettable film on the metal or oxide surface acts as a shield that limits the access of water and hydrated species to the surface. This barrier lowers the corrosion rate by inhibiting the mass transfer to and from the surface.

Some pictures of the film layer formed after the amine injection:



Condenser Hotwell

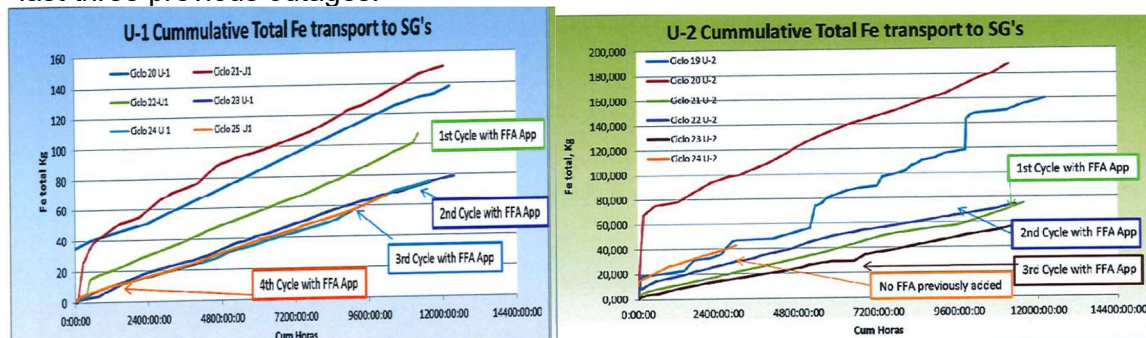


Condenser Hotwell Inspection

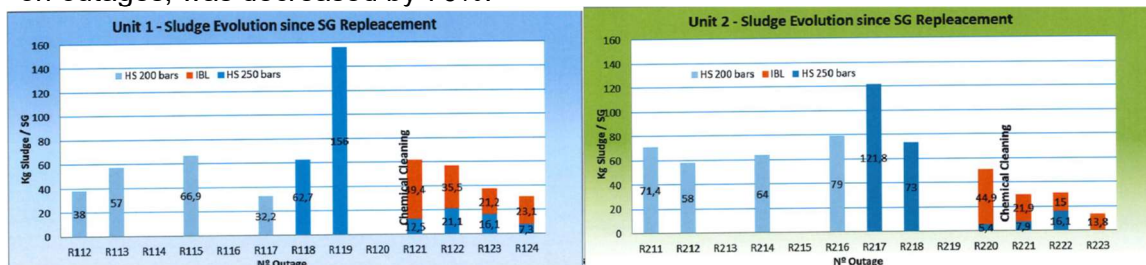


Non-wetted surfaced
on condenser tubes

For both units, after the beginning of injection of FFA injection before outages, the cumulative total Iron transported to SGs has decreased. For Unit#2, in the last outage, there was no injection, and the results show that the iron transport was increased, if compared to last three previous outages.



As a result of reducing corrosion transport to SGs, the amount of sludge removed from SGs on outages, was decreased by 70%.



Temelin, Czech Republic

Mission Date; 2-19 Sep., 2024

The plant has introduced a steam generator (SG) monitoring device to simulate chemistry condition of the SGs and to collect the chemistry data from the crevice area of SGs under the unit operation.

Purpose

The purpose of the SG monitoring device is to enable effective adjustment of the chemical regime in the crevice area of steam generators during full power operation of the unit.

Description

The steam generators are the key components of nuclear power plant since they constitute a major part of primary circuit surface. They should last for a complete power plant lifetime and their replacement is extremely expensive or in some cases, impossible. Knowledge of steam generator crevice chemistry and its proper management are important for the lifetime management of steam generator construction materials. Improperly adjusted chemical environments in the steam generator crevice results in pipe materials coming in contact with high a salt concentration environment and leads to pitting and can cause stress corrosion cracking.

Salts are deposited and concentrated in the steam generator crevice during operation. The release of salts from the crevices occurs during thermal and pressure changes and this phenomenon is called Hide-Out Return. Hide-Out Return cannot assess crevice chemistry directly, but the information is evaluated based on bulk steam generator chemistry during unit power decreases before an outage. This device provides the data during operation and is not limited to during unit outage preparations.

Benefits

- allows sampling of liquids for chemical analyses directly from model crevices inside the device.
- crevices are exposed to the same feed water and heat flux as crevices inside the SG.
- crevices are sampled periodically; samples are analysed in the laboratory and high-temperature pH is calculated.
- the device can also be used for modelling of alternative feed water chemistry without a risk of a negative effect on the unit SGs.

Steam Generator Diagram

