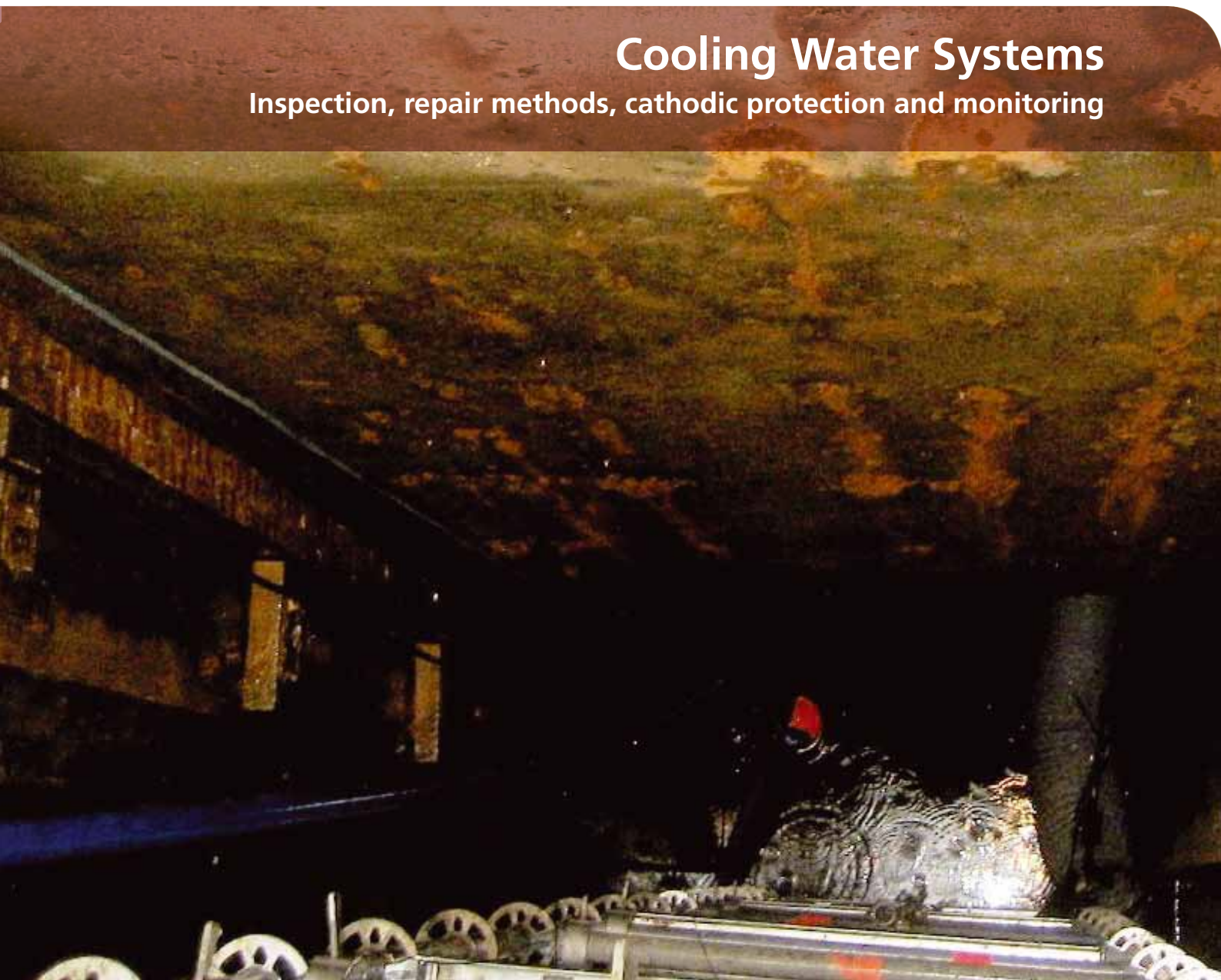


# Cooling Water Systems

Inspection, repair methods, cathodic protection and monitoring



# Cooling Water Systems

General · Inspection · Cathodic protection · Monitoring

## General

The cooling water system is one of the most vital concrete structures at an NPP and the one that is affected the most by the environment. There are a number of ageing mechanisms and damage types that will affect the concrete throughout the service life of the structure. Hence, it is important to inspect, protect and maintain the structure to ensure that the condition and functioning of the system is not impaired throughout the design lifetime.

## Inspection

In order to observe the condition of the structure, inspections should be made. The inspector should be suitably technically qualified and experienced, know how to detect any damages that might occur. The damages will depend on the inspected area (above water level, above tidal zone and below water level) and will even not always be visible, which could be the case with delamination of the cover above the water level due to relatively dry corrosion. Inspectors at FORCE Technology have long standing experience in the field of inspection of all kinds of concrete structures, and will know what to look for.

## General inspections

General inspections should be made every 4-5 year when the channels are emptied and cleaned. The inspection should include detailed examinations of concrete and reinforcement with respect to the risk of chloride initiated corrosion, inspection of installed protective systems and detection of any damage or deterioration that might lead to increased maintenance or reduce the safety of the system.

## Special inspections

A special inspection is undertaken to make closer studies and tests that might be motivated by defects or deviations found in the course of the general inspection. These inspections would often require specialised equipment and non destructive testing, which could be:

- Half Cell Potential measurements - to estimate the possibility of corrosion.
- Galvanostatic Pulse measurements - to estimate the corrosion rate.
- Covermeter or radar - to control the cover thickness and spacing.
- Seismic and ultrasonic techniques – to control the homogeneity and quality of the concrete as well as ageing and deterioration.

The inspections may also involve sampling by drilling cores for subsequent investigation in laboratory with respect to chloride ingress or concrete quality and deterioration causes. The Concrete department at FORCE Technology has a wide range of advanced NDT equipment and can perform all kinds of concrete and reinforcement tests.

Furthermore, the Concrete department has wide experience in detecting the cause of different kinds of damage types of the knowledge of how to make proper and sustainable repair.

FORCE Technology can also help optimising maintenance programs and routines as this is one of our competences.

## **Cathodic protection**

Many cooling water systems have some kind of cathodic protection installed in order to protect the reinforcement from corroding. No matter if the cathodic protecting is made of for example:

- Tapecrete
- Flame-sprayed Zinc
- Sacrificial anodes
- Impressed current

Will need regular inspection in order to make sure the system is working properly and as intended.

Working with cathodic protection of tunnels, bridges, swimming basins, building blocks and cooling water systems, the Concrete Department has wide experience in designing, inspecting, adjusting and making third party verification of cathodic protection systems.

## **Monitoring**

In areas where inspection is not possible, difficult or not cost-efficient, inspections can be replaced or supported by monitoring by use of mainly corrosion sensors. FORCE Technology produces sensors that can be added in new constructions/repairs or installed in existing constructions. Furthermore we have great experience in designing monitoring systems and evaluating results from the embedded sensors.

## **References**

Over the past ten years FORCE Technology's Concrete department has been involved in general inspections, special inspections, repair strategies, quality control of repair work, design, control and third party review of cathodic protection systems, monitoring by use of corrosion sensors in cooling water systems at:

- Barsebäck, Sweden - B1 & B2
- Oskarshamn, Sweden - O2 & O3
- Olkiluoto, Finland - OL1, OL2, OL3

Besides cooling water channels, the department has been involved in investigations of containment structures, turbine foundations, storage facilities, harbours and chimneys at:

- Barsebäck, Sweden
- Oskarshamn, Sweden
- CLAB, Sweden
- Ringhals, Sweden
- Ignalina, Lithuania
- Olkiluoto, Finland

FORCE Technology is also involved at NPP in the field of steel structures by use of:

- Automated Ultrasonic Testing
- Eddy current testing
- Visual inspection
- Replica testing

For further information please contact  
Allan Lion Kristensen - (+45) 43 26 70 86 or  
akn@force.dk



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FORCE Technology  
Concrete Department  
Park Allé 345  
2605 Brøndby  
Tel. +45 43 26 70 00  
Fax +45 43 26 70 11  
[concrete@forcetechnology.dk](mailto:concrete@forcetechnology.dk)  
[www.forcetechnology.com](http://www.forcetechnology.com)

FORCE Technology  
Headquarters  
Park Allé 345  
2605 Brøndby  
Tel. +45 43 26 70 00  
Fax +45 43 26 70 11  
[info@forcetechnology.dk](mailto:info@forcetechnology.dk)  
[www.forcetechnology.com](http://www.forcetechnology.com)