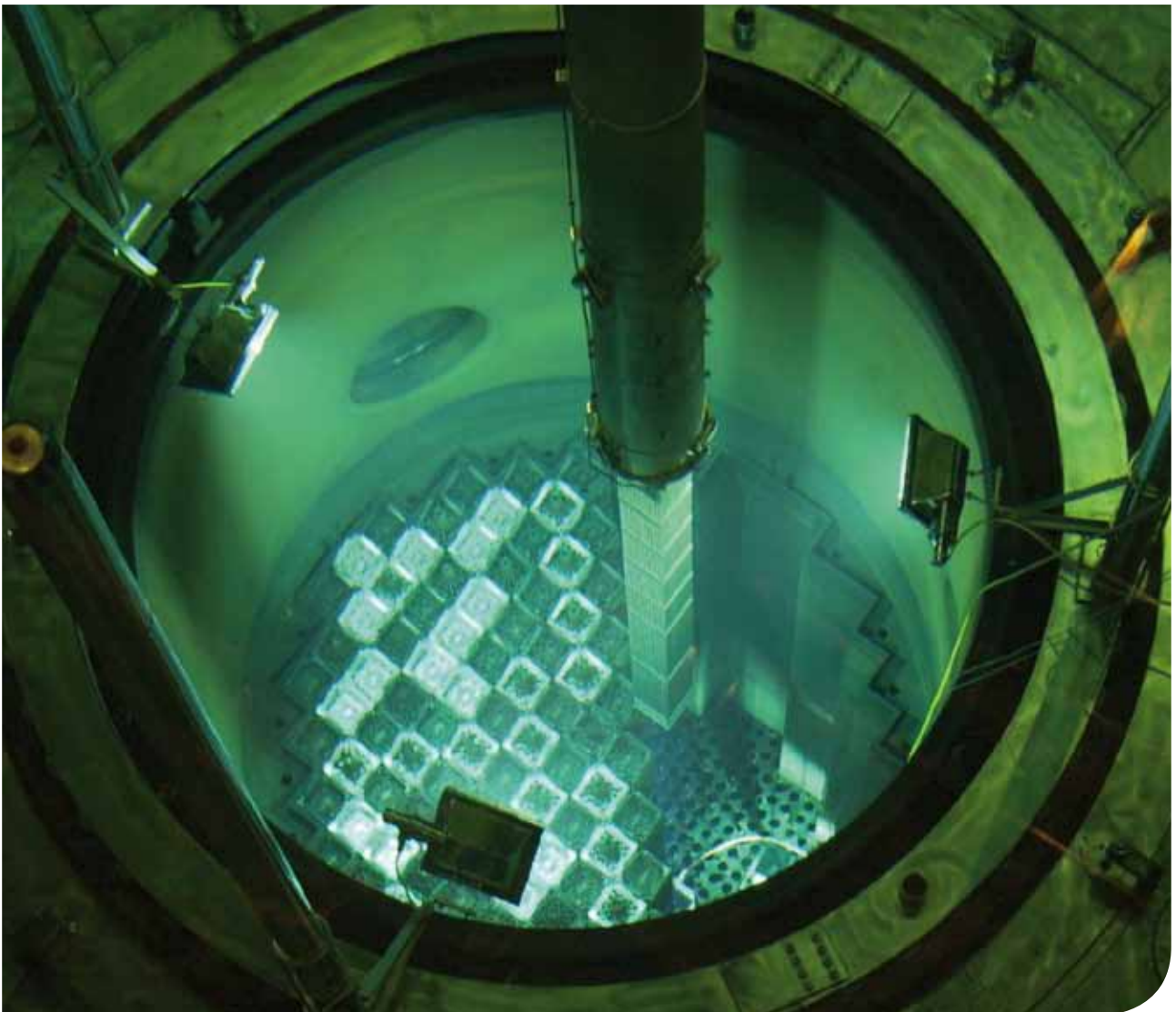


Nuclear Services

– Nuclear engineering, testing and inspection of materials, structures and processes



Nuclear Services

Corrosion • NDE • Monitoring • Consultancy •
Semi-destructive testing • Research

Corrosion

Inspection, condition assessment, preparation of repair and maintenance programmes including cathodic protection and supervision of the same for reinforced concrete structures in marine environments, herewith mainly cooling water systems.

Special investigations relating to corrosion in safety-related structures such as containment buildings, e.g. with respect to embedded steel liner plates.

NDE

Non-destructive examination is used extensively to assist in obtaining information about concrete structures such as pre-stressed containment buildings, where other forms of intrusive examination are not suitable or adequate. This may be as part of a more general investigation of a structure, or in connection with an observed defect or leakage. The objectives can be broadly described according to the following:

Conformity

E.g. reinforcing details or concrete thickness

Condition

E.g. mechanical properties and homogeneity of concrete

Ageing

E.g. effects that drying may have on concrete or corrosion risk to embedded steel

Special incidents

Such as leaks through containment walls or observed cracking

The non-destructive examination methods used include:

High energy computed radiography (HECR) with 7.5 MeV Betatron

Seismic testing of concrete with various techniques:

- Ultrasonic Pulse Echo (UPE)
- Spectral Analysis of Surface Waves (SASW)
- Multi-channel Analysis of Surface Waves (MASW)
- Impact Echo (IE)
- Impulse Response (IR)
- Ultrasonic Pulse velocity (UPV)
- Ultrasonic 3D tomographic testing (MIRA)

Electro-magnetic techniques including radar and covermeter.

Electro-chemical techniques for investigation of the corrosion state of steel embedded in concrete such as the Galvanostatic Pulse method.

Measurement of the electrical resistivity of concrete.

Monitoring

Permanent sensors installed in the concrete to provide information about the corrosion condition of embedded steel (reinforcement), the level of cathodic protection, the ingress of chlorides and the moisture state of the concrete. The sensors and measuring equipment include:

- ERE20 reference electrode
- CorroWatch / CorroRisk Sensors
- Moisture probe
- CAMUR II System data logger

Semi-destructive/intrusive testing

The actual physical and chemical state of the concrete or other material may be investigated with the help of various techniques, that invariably involve drilling into the structure and removal of material. This can be combined with NDE to avoid damage to embedded steel. Typical methods include measurement of moisture (relative humidity) at various depths, removal of cores for mechanical testing and evaluation of damage mechanisms or susceptibility to these. In connection with concrete repair works it is often required that the bond strength between repair and old concrete be measured.

Consultancy

Investigations in connection with specific incidents and observations in terms of cause and consequence, e.g. leakage, corrosion and cracking.

Design and evaluation of cathodic protection systems for reinforced concrete.

Evaluation of design and detailing for new structures and repair of old structures.

Evaluation of structures with respect to condition and ageing including risk assessment.

Research

The increasing awareness of lifetime management issues relating to reinforced concrete containments and other safety-related structures has resulted in research targeting the long-term behaviour of concrete and steel and the dependence on structural quality and detailing.

FORCE Technology is involved in projects dealing specifically with these issues. This is applied research relying on new and traditional investigative techniques, including NDE, FEM and modelling of seismic responses of concrete containment structures. The project is called CONSAFESYS.





Further information

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