

A large, white, hemispherical dome of a nuclear power plant, constructed from a grid of metal panels. It is set against a clear blue sky with some light clouds. The dome is partially obscured by a dark blue horizontal band, likely a walkway or structural element. The foreground features a wavy, abstract graphic composed of many thin, parallel lines in shades of yellow and orange, creating a sense of motion and depth.

Nuclear Power Inspection Systems

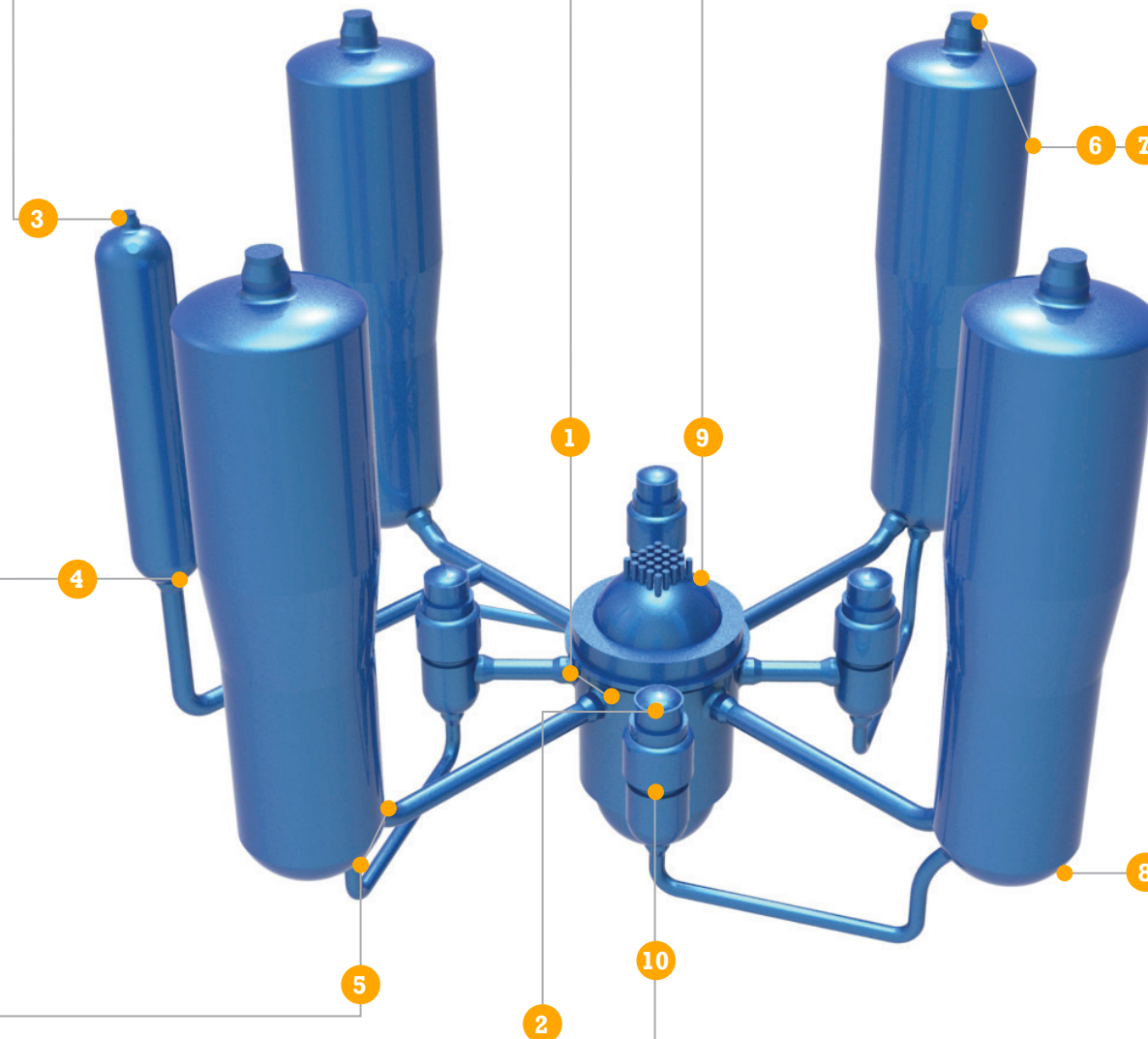
Phoenix Inspection Systems Limited is a leading supplier of non-destructive testing solutions for the inspection of Nuclear power plant and is frequently the first-choice provider for high-profile, safety-critical interventions. Phoenix ISL delivers, complete, integrated solutions for service providers, encompassing advanced instrumentation, transducers, scanners and manipulator systems.

Innovators in NDT Technology

Plant Specific Applications

PWR / EPR

Phoenix ISL delivers advanced ultrasonic inspection systems and transducers for the inspection of nozzles, pipework and critical components within Pressurised Water Reactors (PWR) and Evolutionary Pressurised Reactors (EPR). In particular, Phoenix has supplied inspection manipulators for many of the safety-critical welds on the PWR plants:



1 Reactor pressure vessel - Inlet and outlet nozzles



AquaNox-7

For in-service inspections within the reactor pool of a Boiling Water Reactor (BWR), simultaneously alongside other RPV activities. AquaNox-7 has interchangeable modular heads to perform multiple automated inspections. The scanner is driven into place using Remotely Operated Underwater Vehicles (ROUV's), where it adheres to the inner wall of the vessel with vacuum feet and fine tunes its position with 7 axes of motion, before deploying the telescopic inspection head into a nozzle bore; assisted by built-in radiation proof cameras.



Maxi SAGE

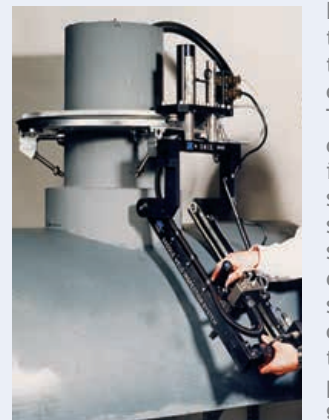
Originally designed for the inspection of PWR primary circuit pipework and RPV nozzle safe end welds, Maxi SAGE can deliver eddy current or conventional ultrasonic probes or array based systems. The modular design allows for rapid setup and interchange of inspection configurations. With light weight components and tool free assembly Maxi SAGE can typically be set up in less than ten minutes.



2 Primary circuit - Branch nozzles and Nozzle to shell welds

SWIS

Branch nozzles on the primary circuit include those for the pressuriser and emergency coolant systems. These geometrically complex components require rigorous inspections. The Phoenix SWIS scanner provides accurate scanning of set-in nozzle saddle geometries with three driven axes, including probe skew. The same manipulator can also be applied to nozzle to shell welds for the reactor pressure vessel and steam generators.



3 Pressuriser – Spray nozzle



SIRUS

SIRUS is our latest scanner for the PWR fleet and is used to inspect the pressuriser spray nozzle inner radius weld. Working with Comex Nucleaire of France, Phoenix developed this two-axis manipulator to scan different configurations of ultrasonic probes on the surface of the pressuriser dome, to inspect the inner radius of the nozzle.

4 Pressuriser - Surge line nozzle



APSYS

The Phoenix surge line inspection manipulator, APSIS, was originally commissioned for Intercontrole (Areva) and Babcocks (Doosan) in 1995 to inspect the safe end and surge line to primary circuit welds for the EDF fleet in France. The system has been in operation ever since and has been continuously refined.

5 Steam generator - Hot and cold leg nozzles



Maxi SAGE

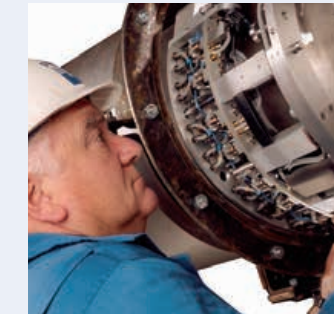
The latest Maxi-SAGE manipulator incorporates a number of design improvements including smaller and lighter modules, for ease of handling on the plant and improved quick release systems for each module, to speed up assembly and satisfy the ALARA radiation exposure requirements. The modular design also results in minimal changes to the system to adapt it for the inspection of other components.

6 Secondary circuit - Feedwater and main steam line welds



SAGE and EPSOM

SAGE has been successfully applied to the inspection of the secondary circuit pipe welds, including the reactor containment penetration welds for the feedwater and main steam line on the EPR. Additional features to SAGE include inspection heads, surface preparation tooling and remote deployment for the inspection of the reactor containment penetration welds. These variants of SAGE are based on the principles of the EPSOM scanner developed for the inspection of similar penetrations on the Advanced Gas cooled Reactor (AGR) design used in the U.K.



8 Steam generator - Channel head to tube sheet weld



CHIM

Inspection of the steam generator channel head to tube sheet weld is particularly difficult behind each of the vessel's support legs. The CHIM scanner allows scanning of this section of the weld using a low profile modular scanner which is supported off the vessel leg. Holding a single probe the scanner is designed to allow probe changes without complete removal of the scanner and therefore loss of the scanning datum.

9 Reactor head - Control rod drive mechanism (CRDM) housing



CISU

The control rod drive mechanism housing forms part of the reactor pressure vessel containment, therefore all welds on the housing need to be treated as class one components and are subject to stringent inspection regimes. Developed in conjunction with China Guangdong Nuclear Power Corporation (CGNPC), the Phoenix CISU scanner inspects the CRDM housing welds on the EPR reactor. The scanner holds six conventional ultrasonic probes and can be configured to carry phased array probes if required.

10 Reactor coolant pump - Flange bolt threads and Flywheel keyway



SIM

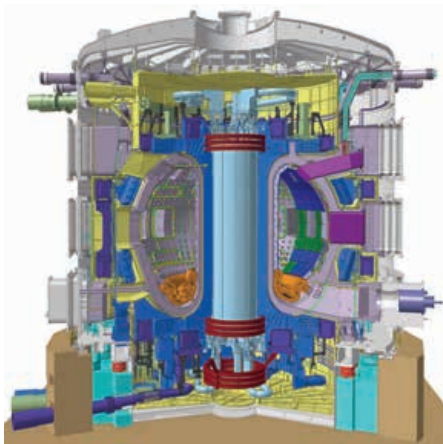
The Phoenix Stud Manipulator, SIM, was designed for the inspection of the Reactor Coolant Pump (RCP) flange bolt threads from within the pump motor stand/coupling housing. The manipulator is easy to set up and move from one stud to another and the probe lance can be swapped to allow scanning with ultrasonics or eddy currents.

SIM has also been applied to the inspection of the RCP flywheel keyway. In this case the SIM is attached to the flywheel and the inspection lance is passed down the bore holes in the flywheel positioned to allow the ultrasonic beam to cover the inspection area.

ITER

Phoenix ISL were involved in the early stages of the International Thermonuclear Experimental Reactor development programme, working with Fusion for Energy (F4E), Iberdrola and AMEC. Projects for the programme have been on the development of:

- Techniques for the inspection during manufacture of the First Wall Panel, the inner wall of the pressure vessel, which uses Hot Isostatic Pressed (HIP) joining of beryllium, copper alloys and stainless steel flat and tubular interfaces.
- Inspection techniques for the pressure vessel segment welds, in particular the splice joint site welds, where scanning access is restricted, and the proposed use of austenitic stainless steel narrow gap welds makes the inspection techniques more challenging.



ITER Reactor



ITER construction, Cadarache

BWR

Primary Pipework Inspection



PET applied to a 4" pipe bend

PET - Pipe Elbow Tracker

Reactor pipework within a BWR is ferritic with a stainless steel internal cladding. The composite structure of the pipework means that the integrity of the cladding needs to be monitored. As the parent pipe is ferritic, magnetic crawlers can be used for scanning. Phoenix ISL were commissioned by BKW of Switzerland to develop a system capable of scanning pipework from 4" up to 20" diameter around the full circumference of the straight sections of the pipework and the extrados on the bends. The design maximises the scanning achievable for minimal access to the reactor containment.

AGR

Advanced Gas Reactor Inspection

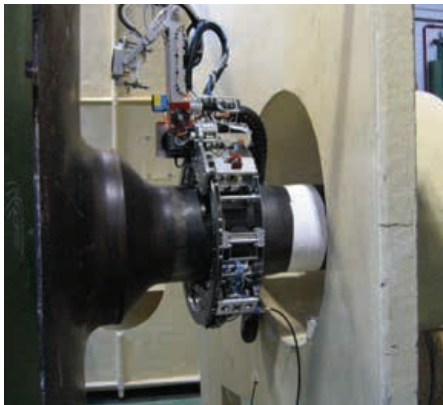


Advanced Gas Reactor - Torness

The gas cooled reactor design is used in the majority of the United Kingdom nuclear fleet. Phoenix have worked closely with the U.K. nuclear industry for many years producing bespoke systems for the inspection of AGR and Magnox stations.

Phoenix ISL have been called upon for mission critical inspections of the UK fleet where our experience and flexible approach, with a problem solving ethos have been recognised as vital to the success of the project.

Robotic Inspection



Nozzle Inspect Robot

Phoenix ISL can develop new methods for the inspection of nuclear power plant and previous work has concentrated on the application of robotics to provide adaptable solutions to the inspection of nuclear components in fabrication, pre-service and in-service inspection.

Programmes include work on NozzleInspect, a €1.4 Million EU funded research project, in conjunction with companies from five other European countries and TWI in the UK. Phoenix ISL have also had an EPSRC Engineering Doctorate programme with the

Research centre for Non Destructive Evaluation (RCNDE), to develop autonomous vehicles and portable robotic arms.

Phoenix ISL have supported a number of clients in the development of portable robotic inspection systems for the inspection of critical nuclear components.

About Us

With over 40 years experience, Phoenix ISL has an extensive range of solutions designed specifically for the nuclear sector which, when combined with our systems for the inspection of steam turbines and generators, means we can offer our customers a single source for equipment to inspect critical power plant components.

Phoenix ISL supplies NDT inspection systems to utilities and inspection providers for the pre and in-service inspection of primary circuit components, from the reactor pressure vessel through to secondary coolant loop piping and has experience in the following nuclear reactor types:

- Pressurised Water Reactors (PWR, EPR)
- Boiling Water Reactors (BWR)
- Advanced Gas Cooled Reactors (AGR)
- Fusion Reactor (ITER)

If our existing solutions do not meet your exact requirements we can modify a current system or design a completely new customised solution to meet your specific inspection needs.

To discuss your particular nuclear power inspection requirements contact one of our experts.

Our Customers

Phoenix ISL has many clients in the field of non destructive testing in the nuclear sector including:



Westinghouse



framatome



NUCLEAR EQUIPMENT & SERVICES



DE L'INGÉNIERIE,
DES SERVICES, DES HOMMES



Taiwan Power
Company



COMEX NUCLEAIRE



the one for the job



Eskom
Enterprises



Contact Us

Phoenix Inspection Systems Limited

Dalton House, 40 Hardwick Grange,
Warrington, WA1 4RF, United Kingdom

t: +44 (0) 1925 826 000

f: +44 (0) 1925 838 788

e: sales@phoenixisl.com

www.phoenixisl.com



Scan

To visit the Phoenix ISL website and
learn more about our NDT solutions.