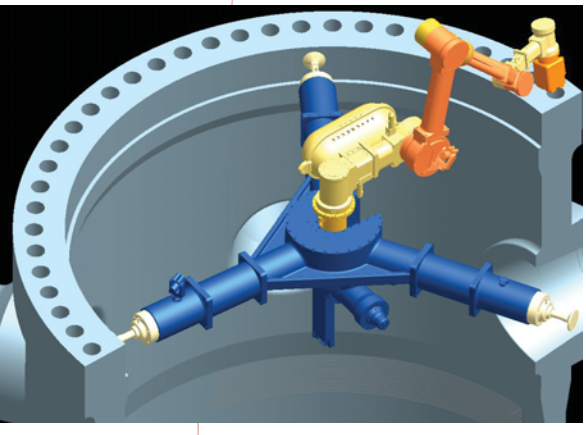
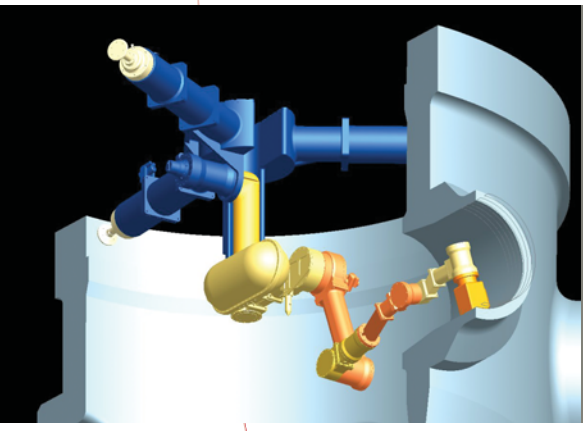
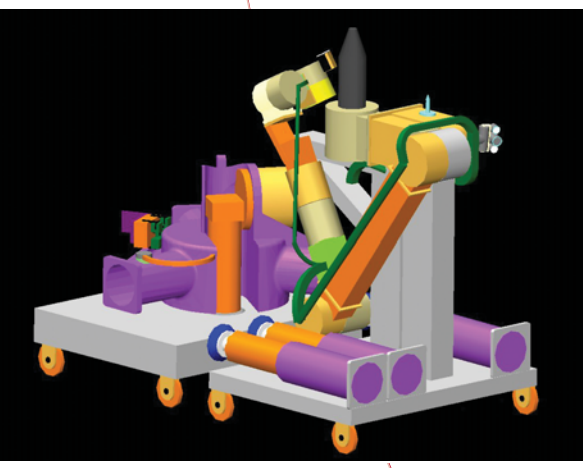
Framatome ANP's Trans-World Reactor Vessel Examination System (TWS)







Efficient Reactor Vessel Inspections Reduce Required Site Support

Framatome ANP developed the new TWS remotely operated manipulator system to reduce vessel occupation time (VOT) and minimize site resource requirements for ultrasonic examinations of reactor vessels. The manipulator can support full 10-year, intermediate, and follow-up surveillance inspections with minimal disruption of outage activity. Transporting the manipulator to the canal floor can be accomplished either through the equipment hatch, or through the personnel hatch. Once on the canal floor, the system requires little or no polar crane time and can be set up quickly in a limited lay-down area. After assembly and dry system checkout, the manipulator is lowered into the vessel — either with an auxiliary crane or with the building polar crane. The UT system calibration is verified with the on-board calibration confirmation block, then the scanning is started.

High-speed precision robot performance coupled with the advanced phased-array Saphir *plus* UT acquisition system allows the examination to be completed in approximately two days. The innovative manipulator arrangement supports maximum weld coverage including remote examinations of the flange surface.

Personnel are not required inside the building except to supervise installation and removal, and to remotely change transducers for the inner-radius examinations and safety injection or core-flood-nozzle examinations.

Efficient, Reliable Coverage

The three-leg base spans the reactor vessel diameter to provide a solid anchor for the six-degree-of-freedom robotic arm. Motor-driven actuators extend and react against the vessel wall with more than 1000 pounds of thrust to virtually eliminate the possibility of the base slipping. If the actuator motors fail in service, a pole-activated release mechanism allows the system to be quickly removed for repair. The anthropomorphic robotic arm comprises a waist, shoulder, elbow, roll, pitch and yaw precision joints. Shell inspections rely primarily on the waist-joint to sweep the transducers circumferentially around the vessel.

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The full dexterity of the robotic arm is used to deliver transducers to inspect the nozzle inner radius and the nozzle bores including the deeper pipe-to-safe-end and bi-metallic welds. A unique base configuration allows the arm to "flip" either above or below the base to support different examination configurations. The entire weight of the system in water is approximately 100 pounds (50Kg).

Phased-array technology enables one transducer to take the place of multiple single transducers with inspection angles ranging from zero to 70 degrees. Combining multiple angle inspections into one unit also enhances coverage capability. A four-channel inspection head supports four phased-array transducers, each aimed in a different direction, eliminating the need to scan the same region multiple times with different transducer orientations.

Trans-World Experience

Corporate alliances and mergers have placed three of the world's leading reactor vessel inspection groups under the Framatome ANP corporate umbrella. The TWS system is designed to capture the best practices from the extensive French, German and U.S. reactor vessel examination experience to produce a superior worldwide solution. The TWS tool will serve as the basis for examinations in all three regions, thereby increasing resource utilization and enabling Framatome ANP to better serve our clients.

For more information on how you can put this unique reactor vessel examination system to work in your plant, contact your Framatome ANP Regional Manager.

BENEFITS

- **Shorter scan distance:** Phased array technology reduces total scan distance. Shorter scan distance translates to shorter examination schedules.
- **Speed and Accuracy:** Advanced robot design enables rapid and accurate vessel scans. Advances in NDE and robot technology enable the robot to scan more quickly than previous systems thereby shortening examination schedules.
- **Reliability:** The building blocks of the TWS are grounded in field-proven designs that Framatome ANP has used in the U.S. and in Europe.
- **Reduced site support:** The compact configuration for transport through the personnel hatch, the light weight and limited reliance on the polar crane, and the small on-site crew minimizes the TWS burden on plant resources for the reactor vessel examination task.
- **Modular design and configuration flexibility:** The robotic components are modular by design permitting rapid replacement of failed components should a failure occur. The system's compact size also enables one spare robot to completely replace a failed unit, or two robots can be used in parallel to accelerate the examination schedule.

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For more information contact:
NDE Business Manager
155 Mill Ridge Road
Lynchburg, VA 24502-0622
Phone: (434) 832-2571
Fax: (434) 832-3660
tws@framatech.com
www.us.framatome-anp.com

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