



Automated RPV-RVH Inspection

SOLUTIONS:
Reactor O-Ring Seal Inspection Robotics

- Precise quantitative and qualitative analysis of reactor vessel and head O-ring grooves
- Greatly reduce dose exposure for personnel and critical path time requirements
- Laser measurements of sealing surface captured every 0.04" along the entire circumference of the RVH and RPV
- High resolution, rad hard camera detects anomalies ≥ 40 microns
- Measurements of sealing grooves and surfaces recorded to a database for comparing groove degradation between outages



Innovative Inspection Technology

Diakont has developed a remote robotic system called the Aurora that conducts remote automated inspections and measurements of the O-ring sealing surfaces between the Reactor Pressure Vessel (RPV) and the Reactor Vessel Head (RVH). By utilizing the Aurora system instead manual inspections, inspection staff reduce their dose exposure by several hundred millirem and gain high accuracy measurements of the sealing surfaces and grooves.

The inspection system is comprised of two robots - one robot inspects the RPV sealing surfaces and the other robot inspects the sealing surfaces beneath the RVH. Diakont's robotic system conducts comprehensive inspections using high accuracy laser profilometry and visual inspection equipment. Checking for deformations, the system measures linear dimensions of O-ring sealing grooves and flange surfaces. The high accuracy readings from the Aurora system eliminate the risk of human error which leads to ineffective seals and pressure boundary leakages. The measurement data is also used for baseline comparisons of vessel and head flange conditions from outage to outage.

Your Solutions Partner

Diakont's expert team of experienced robotics engineers and NDE technicians will partner with your plant's outage management, refueling projects group, and maintenance department to perform comprehensive reactor seal inspections within your outage time frame.

Proven Performance

The dual robotic inspection system was developed in 2011 and has successfully completed inspections on various nuclear power plants throughout Europe. Inspections to date have been performed on VVER-1000 reactors, a design similar to US PWRs, with comparable reactor vessel and head sealing mechanics.

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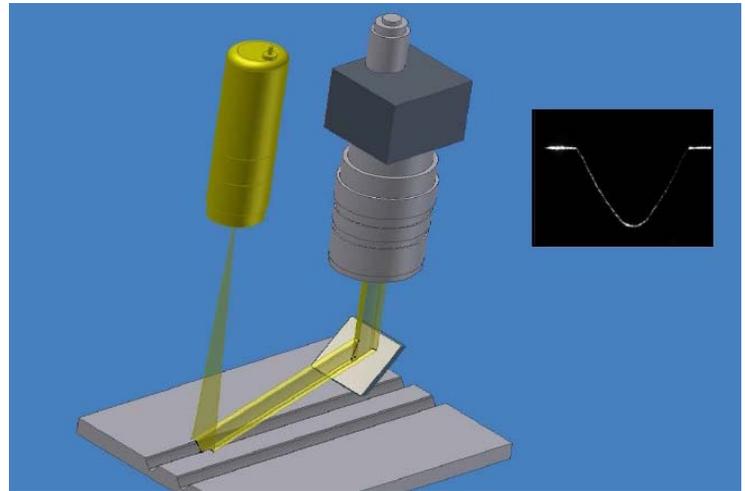
High Accuracy and Reliability

Diakont's laser profilometry system captures a digital image of the sealing surface every 0.04 inches along the entire circumference of the RPV and RVH. The data is then processed using Diakont's patented software to convert the images into digital profilograms. Each digital profilogram is measured at 430 points, with an accuracy of 20 microns, to calculate the required thickness of O-rings. The groove measurements are also analyzed to determine whether repairs or localized honing is required. The position of each profilogram is tracked to within 0.39" on the RPV and RVH so that deformations can be closely monitored over time.

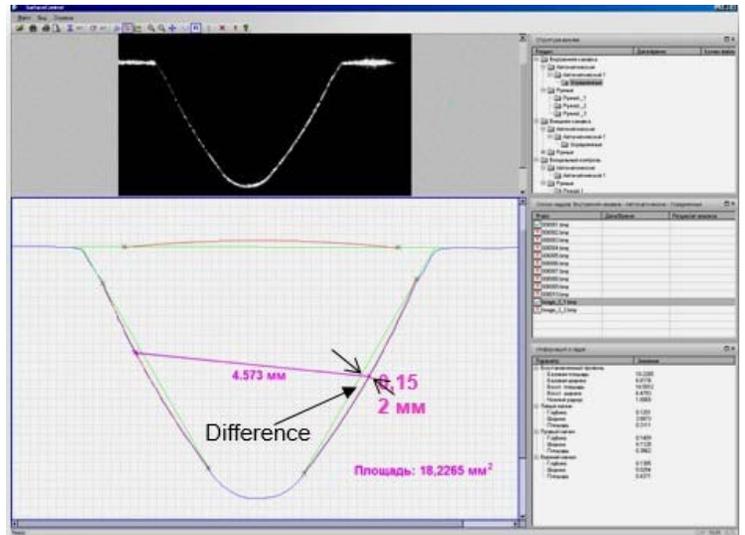
The inspection robots are also equipped with a second camera that examines the sealing surface for foreign material and scratches. This high resolution, rad hardened camera detects any anomalies 40 microns or larger with an accuracy of 20 microns.

Specifications

Inspection accuracy	±20 microns
Reactor flange inspection time	30 min
Travel speed	0.4" - 1.6"/sec
Sample points per circumferential slice	430
Circumferential sampling	Every 0.04"
Detection threshold	40 microns
Absolute circumferential accuracy	±0.04"
Tool envelope	26" x 15" x 4"
Total weight	26 lbs



A precision laser laser-holographic module (yellow) projects onto the O-ring groove, whose shape is reflected towards a special TV camera that receives the contour of the groove in submillimetre detail.



Results of Profile Conversion to Digital Form

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