

Bluewrist Case Study

Nuclear Safety Component Inspection

Background

To meet rising electricity demands of growing cities, existing nuclear power plants must undergo refurbishments to increase the power generation output safely and to cope with the growing power consumptions in the next half-century. Existing nuclear power plants in North America have been in continuous operations for more than two decades and will require extensive upgrades to their reactor cores as



part of the refurbishment process. Bluewrist Inc.'s vision inspection software is used to verify the quality of the components used in this project.

At the heart of the refurbishment process is the re-tubing of the reactor core, which consists of 380–480 fuel channels housed in individual pressure tubes. The pressure tube resides within another cylindrical housing made of zirconium alloy that acts as the secondary pressure containment safety device in the event of a main pressure tube rupture or failure. This housing is thermally separated from the pressure tube by garter springs and an annulus gas system using carbon dioxide. All of these components must be replaced as part of the re-tubing and refurbishment process. To reliably provide power generation for the next half-century, the pressure tube housing must be manufactured under the highest quality tolerance to ensure the reactor's safety and operational longevity. Bluewrist's software expertise in monitoring and analyzing manufacturing dimensional data played a key role in the inspection process to help aid in the quality control of this pressure housing.

Customer Needs and Technical Challenges

The company awarded the refurbishment contract must manufacture several hundred of this highly specialized cylindrical housing. Each housing is six meters in length with an outside diameter of 132 mm and weighs about 25 kg. They must be designed to withstand a pressure of 25 MPa and a water temperature of up to 208 degrees Celsius. The housing is exposed to such conditions throughout the operational life of the nuclear reactor and must remain structurally intact for the next three decades. To verify the manufacturing process capability and to guarantee the product quality, more than 800 inspection points need to be performed on each cylindrical housing unit to detect microscopic flaws or deviations from tolerance.

Some of the critical features inspected include the following:

- Inner and outer diameter
- Housing wall thickness at various sections
- Concentricity
- Ovality
- Parallelism

This inspection process generates a large amount of dimensional data that must be correlated with CMM measurements and stored for traceability and quality reporting purposes.

Bluewrist Solution

Due to the size and the unique structure of the cylindrical housing, Bluewrist leveraged its in-house SPCWorks software for statistical process control and made several customizations to fit the unique needs of this customer.

This customization allows for the consistent and repeatable measurement and data capture of all the key inspection points for each of the cylindrical housing units manufactured.

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The custom designed Bluewrist system enabled this manufacturer to perform all the required inspections, which greatly sped up the product delivery schedule.

Key Components of the Inspection System:

- Keyence CCD laser displacement sensor LK-G Series (0.02 μ m repeatability)
- Keyence optical micrometer LS-9000 Series ($\pm 0.5 \mu$ m accuracy)
- Bluewrist comXtream software for data communication between the sensors and PLC
- Bluewrist comXtream industrial communications software controls the PLC that rotates the cylindrical housing unit, ensuring that the 3D laser scanners capture all the required features in a repeatable manner
- Bluewrist SPCWorks software monitors and analyzes the trends in the production process by statistically analyzing the dimensional data and automatically generating quality reports such as X-Bar, R Charts and individual control charts for the operator
- All inspection results and dimensional data are stored in SQL database for traceability and future quality reporting and auditing.

The Results

After the deployment of the Bluewrist inspection solution, the manufacturer used the dimensional data captured by the 3D laser cameras and reports generated by SPCWorks to verify the process capability and stability of the production process. As a result, the manufacturer is able to deliver the first shipment of the cylindrical housing units to the customer ahead of schedule while meeting and exceeding all the stringent quality control criteria.

Contact Bluewrist Today!

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