Analogue instrumentation recovery program for six reactors

Summary

Analogue instrumentation is a key component in the safety and protection system of many nuclear power plants. This programme of work gave a further 10 years of operational life to over 350 individual instruments of 15 types that make up the Diverse Guard Line (DGL) safety systems fitted to six reactors.

Scope of work

Curtiss-Wright undertook a multiphase programme of work that provided investigative engineering, change justification and refurbishment services for our own and third-party equipment. We designed and supplied hot spares for Pulse Coded Voting Logic (PCVL) units. This meant that spare instruments and voting logic units could be stored and boxed for years until required. A custom hot spares facility was developed to allow the PCVL units to be held in a powered and working state so that working spare equipment was available for use when required.

Systems outline

The DGL provides temperature monitoring in the primary cooling system and the circulating pump performance outputs to PCVL units and relays drivers. Failsafe operation is provided by analogue and discreet digital circuity.

Initial investigations

We assessed the condition and supportability of the equipment by evaluating failed units, OPEX (operational historic data), repairs reports and previous analysis, which all helped in identifying the specific causes of failure and signs of aging. The assessments also include a design assessment to identify life-limited components.

Single findings and recommendation reports were produced for each of the 15 types, with key findings:

- Neoprene sleeves breaking down
- Tin whiskers and silver dendrites growing
- Aged electrolytic capacitors
- Opto-coupler performance degradation
- Meter display failing
- Relay contact corrosion
- Gaps in baseline design and test data
- Significant obsolescence in key components such as transistors, diodes, capacitors, switches and connectors

Refurbishment

Over 200 DGL units were refurbished. The full scope of service included point-to-point shipping on dedicated transport, inspection and documentation of condition, diagnostic testing, repair and refurbishment, test, soak test and history file completion.

The works included replacement of meter displays, relays, capacitors, opto-couplers. The testing and replacement of degrading neoprene sleeves and general improvements related to tin whisker remediation, cleaning and replacement of missing or broken fasteners.

Recovery

The recovery actions implemented to achieve the 10-year life extension of the instrumentation focused on identifying and justifying alternative components, developing refurbishment procedures and refurbishing the equipment.

Identification and justification of alternative components required for refurbishment and the station safety case considered:

- Operating environment
- In-circuit performance
- Suitability of fit, materials and finishes
- Reliability and failure mode impacts
- Testing of changes for proof of performance

Production of refurbishments and control procedures for each unit type covered:

Shipping, receipt and storage
Inspection and strip down
Component change, inspection and test
Records, reporting and change control

Procurement of components for refurbishment and as spares holding was managed under our long-term support agreement.

United States of America

707 Jeffrey Way
Round Rock
Texas 78665-2408
USA

Tel: +1 512-434-2800

United Kingdom

Innovation House
Lancaster Road
Ferndown Industrial Estate
Wimborne
Dorset BH21 7SQ
UK

Tel: +44 (0) 1202 850 450

For more information

Web: cwic.curtisswright.com
Email: sales@nspi.curtisswright.com

About Curtiss-Wright

Curtiss-Wright Round Rock and Wimborne have worked with nuclear and industrial customers for over 60 years. We support customers across the world from facilities located in the US and UK. Our solutions are embedded in strategic national infrastructure and our people are active partners in customer programs that are focused on delivering advanced future nuclear and industrial capabilities.

Curtiss-Wright Corporation (NYSE: CW) is a global integrated business that provides highly engineered products, solutions and services mainly to Aerospace & Defense markets, as well as critical technologies in demanding commercial power, process and industrial markets. We leverage a workforce of approximately 8,600 highly skilled employees who develop, design and build what we believe are the best engineered solutions to the markets we serve. Building on the heritage of Glenn Curtiss and the Wright brothers, Curtiss-Wright has a long tradition of providing innovative solutions through trusted customer relationships.