Curtiss-Wright delivered a 15 year life extension for critical computer-based protection systems

Summary

This project extended the operational life of an independent primary protection computer-based system by 15 years. This was achieved through the identification and replacement of life-limited and aging components, removing the need for a wholescale system replacement and saving the operator tens of millions of dollars.

Scope of work

Curtiss-Wright undertook a phased assessment and recovery programme. Initially we reviewed the condition and supportability of custom and commercial equipment. Where items were unavailable, a replacement and justification package of work was completed. Where necessary, we were able to refurbish some units without a requirement for detailed justification.

Systems outline

The high-speed digital trip system monitors reactor core temperature through 816 thermocouples and uses digital data processing, checked by discreet pattern recognition logic, to initiate a reactor trip if excess localised core temperatures are detected.

Each channel contains a selection of custom pattern recognition modules and OEM equipment, including buffer amplifiers, high integrity A to D converters, IBM industrial computers and Compaq desktop PCs.

Initial investigation

The condition and supportability of the equipment was assessed by evaluating operational data, failures, repairs and historic remedies. The design and support data package reviewed ongoing repair and maintenance strategy and already identified life-limited components.

Key findings that enabled us to plan a recovery and refurbishment action plan included:

- Obsolescence within Intel 8080 cards
- Aged electrolytic capacitors
- Opto-coupler performance degradation
- High failure rates in desktop PCs

Recovery action – optical transmitters

The original optical transmitters and receivers were suffering from performance degradation due to age. No direct replacements from the OEM were available. Replacement of the complete optical system, including optical fibre and all the transmitters and receivers was not considered an economic solution. Working with our established supply chain partners, we secured suitable replacement transmitters and receivers.

The new components were extensively evaluated through design analysis, modelling, back-to-back comparison testing, in circuit and system testing. All results were analysed and the conclusions confirmed suitability as a direct replacement. A detailed design change impact analysis was produced to support the safety case change and once approved, new devices were fitted into the system as part of a refurbishment program.

Refurbishment

Refurbishment of the high-speed digital trip system focused on reconditioning the ICS80 PSU, computer chassis and custom modules. 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 electrolytic capacitors, optical couplers, switches, neoprene sleeves and corroded connectors.

Recovery action – card remanufacture

Four different types of obsolete Intel 8080 cards needed to be remanufactured. We used our supply chain to source new equivalent cards that were manufactured to the original specification, using original tooling and with components to the original designs. Firmware was extracted from the programmable devices and the remanufactured cards configured to work as the originals. The cards were subject to a qualification program of environmental and functional test using a bespoke test rig developed and manufactured by Curtiss-Wright. Once approved for use, each card was supplied to the customer as part of a pre-packaged, off the shelf replaceable computer rack.

Recovery action – user interface terminal

The key user interface for the system is a DOS and Pascal based monitoring computer based on an INTEL 386 PC running custom conversion and display software with approximately 16K lines of code. Curtiss-Wright reverse-engineered a new monitoring system program from the original code, installed it on a modern and supportable industrial PC, built a representative plant simulator, then tested and qualified the software on the new hardware.

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About Curtiss-Wright

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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.