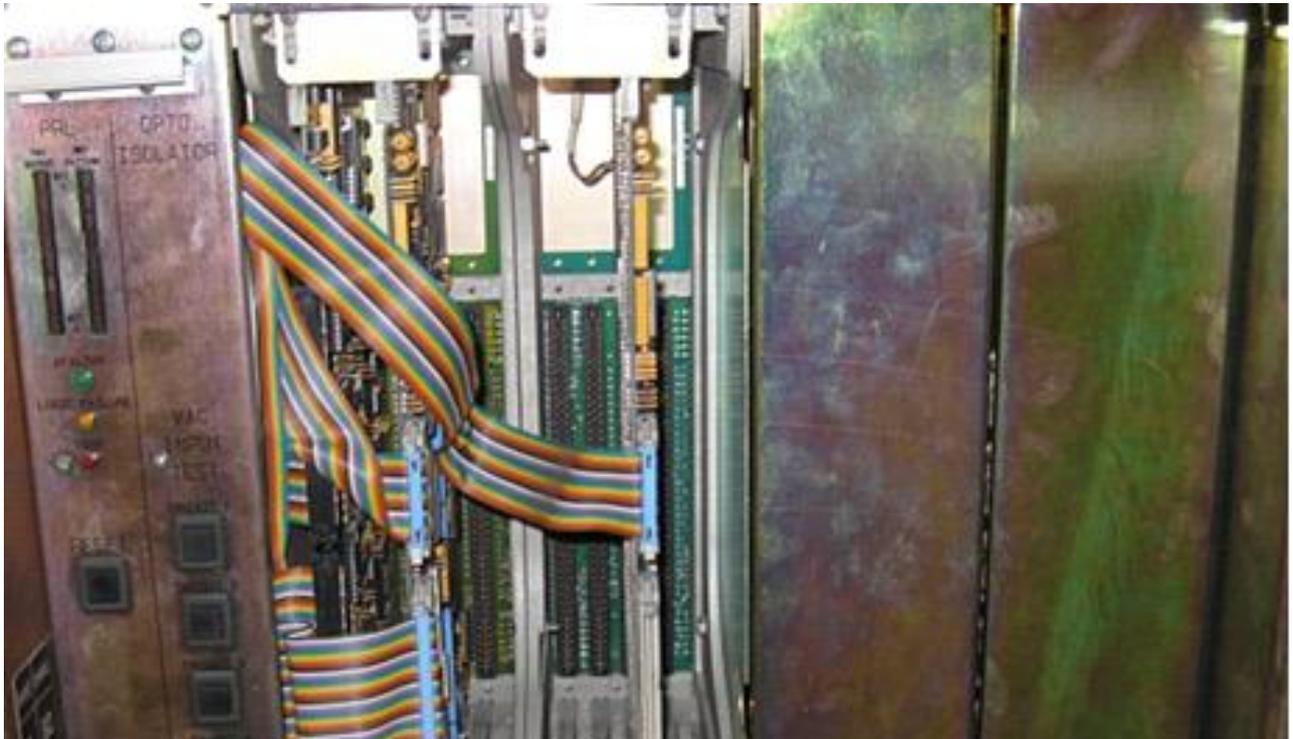# ULTRA.+

Aging and Obsolescence

Computer Based Systems Life Extension

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.

Buffer Amplifiers

System Outline

The high-speed digital trip system monitors reactor core temperature through 816 thermocouples and uses digital data processing, check 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 PC's.

Scope of Work

Ultra undertook a phased assessment and recovery programme. Initially we reviewed the condition and supportability of custom and commercial equipment. Where items where 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.

Initial investigations

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 review 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 PC's

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 that included optical fibre and all the transmitters and receivers was not considered an economic solution. Working with our established supply chain partners over a number of months, we managed to secure 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 of the 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 where fitted in to 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

4 different types of obsolete Intel 8080 cards needed to be remanufactured. We used our extensive 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 Ultra.

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.

Ultra 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, tested and qualified the software on the new hardware.

High Speed Trip Unit – Sub System