

Aging and Obsolescence



Analogue Instrumentation Recovery Programme

Summary

Analogue instrumentation is a key component in the safety and protection system of many nuclear power plants. This program of work extended the operational life by 10 years of over 350 individual instruments that included 15 diverse types of equipment which make up the Diverse Guard Line safety systems fitted to 6 reactors

System Outline

The Diverse Guard Line provides temperature monitoring in the primary cooling system and the circulating pump performance with outputs to Pulse Coded Voting Logic unit and relays drivers. Fail safe operation is provided by analogue and discreet digital circuitry.

Scope of Work

Ultra 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 unit for Pulse Coded Voting Logic 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 Pulse Coded Logic units to be held in a powered and working state so that known good working spare equipment was available for use when required.



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 helps in identifying the specific causes of failure, 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 unit types. The key findings were:

- 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, connectors



Pulse Coded Voting Logic

Refurbishment

Over 200 Diverse Guard Line 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 Actions

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 for the stations 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 a spares holding to be managed under our long-term support agreement.



4970 Trip Amplifier