Rotork Nuclear Actuators &
Environmental Qualification

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Agenda

- Rotork?
- Qualification
- Re-Qualification
- Why?
- Resources
- What did we learn?
- Maintaining Qualification
Manufacturing Centers

Bath UK
Rochester USA
Leeds UK
Luca Italy
Madras India
Bangalore India
Kuala Lumpur, Malaysia

Approximately 1,000 employees worldwide
Principal factories & Offices
Actuation powered by: 3 phase, 1 phase, DC, Air, or Hydraulic, for on/off, modulating & failsafe valves
RE-QUALIFICATION

WHY??
Project Driver

Nuclear Power Project
Project Overview

• Re-qualification of the NA1, NA5 and AB variants to severe project requirements
• Design and qualification of pneumatic actuators
• Design and qualification of 2ndary gears
• Re-qualification of the NA1, NA5 and AB variants to the latest industry standards
Scope of Work

• Full Environmental Qualification
• Full Seismic Qualification
References

- IEEE382 - 1996 Actuator Qualification
- IEEE323 - 1983 Environmental Qualification
- IEEE344 - 1987 Seismic Qualification
- IEEE112 - 1991 Motor Tests
- NEMA MG-1 Motor Design
References

- 10CFR50 Appendix B - Quality Standards
- 10CFR21 Non-Compliance Reporting
- EPRI NP-5652 – Dedication of Commercial Grade Components
- NRC Generic Letters
- Customer Specification
Mechanical Aging

• 2000 cycles
• Future life extension for 4000 cycles
• 33% rated torque during travel
• Rated torque at the close position
Environmental Qualification

Thermal Aging
- 648 hours @ 125°C
- Activation Energy 1.0 eV
- Qualified Life
  - 41.6 years @ 54°C
  - 203.2 years @ 40°C
Pressurisation Aging

- 15 cycles 0-65psig
Radiation

- $2.3 \times 10^8$ Rads/$2.3 \times 10^6$ Gy
  - Gamma radiation
Environmental Qualification

Seismic Qualification

Rotork Nuclear Actuators

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Vibration Aging

- Level 0.75g
- Frequency Range 5-100-5Hz
- Duration 90 mins in each orthogonal axes
- SRV simulation > 8400 stress cycles (Lungmen)
- Chugging > 9000 stress cycles (Lungmen)
Seismic Simulation

• RMF
  – ZPA = 8g (Lungmen) 1- SSE, 5 - OBE
  – ZPA = 6g (IEEE382-1996 fig 7) 1- SSE, 5 - OBE

• RIM
  – Input = 5g (Ulchin)
  – Input = 4.5g (IEEE382-1996 fig 6)
• IEEE382-1985/1996 Case IV – MSLB inside containment
• Lungmen 100day LOCA
Resources/Requirements

- Nuclear Logistics & Kinectrics
- Trentec, & Thermodyne
- for
- Ulchin 5 & 6
- Lungmen NPS – Taiwan
• What did we learn?
• Beware the Nuclear EXPERT.
• No body knows your product like you - they just think they do!
• The IEEE standards do not cover all issues.
• Everyone has a different opinion!!
• Do Not consider starting testing until final requirements are agreed.
• Do NOT under estimate the power of Steam.
- Don’t let it in.
‘Unique Double Sealing’

during construction, cabling or commissioning

during operation

cable

a loose gland would permit moisture ingress to terminal area only

cable

electrical failure

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Maintaining Qualification

- ISO9000 Accredited
- Dedication program to EPRI NP-5652
- 10CFR50 Appendix B Suppliers for safety related components
- Lot control and material traceability system for safety related components
- Engineering Change Procedures
- Rotork Controls Inc – NUPIC Audited
Quality assurance

- Bath, Leeds, Rochester and Madras manufacturing plants all have independently approved quality systems complying with ISO 9001 for all products
Maintaining Qualification

- 10CFR21 Reporting
- Supplier development
Questions?