Rotork Nuclear Actuators & Environmental Qualification

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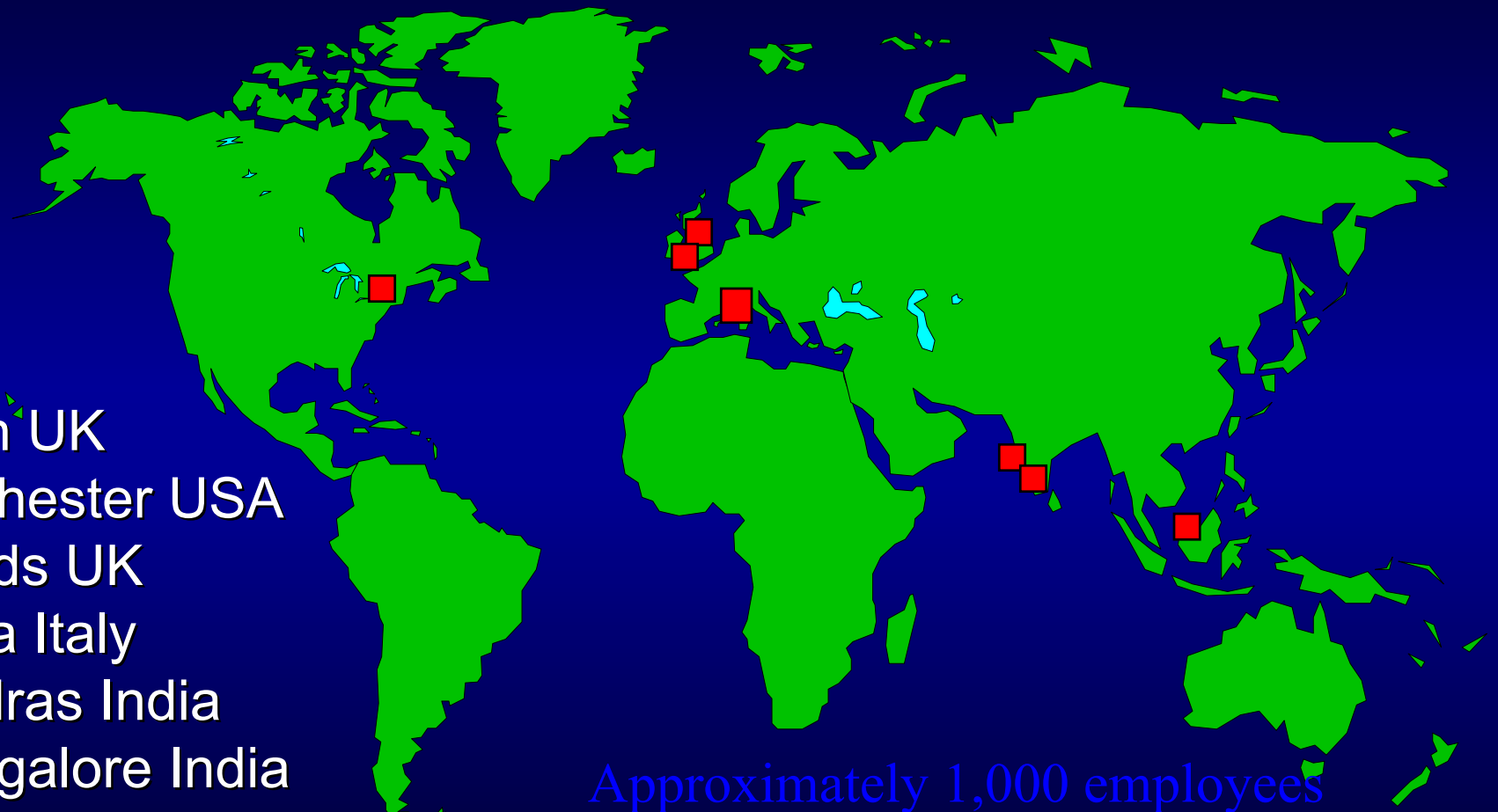
Engineering Manager

Agenda

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

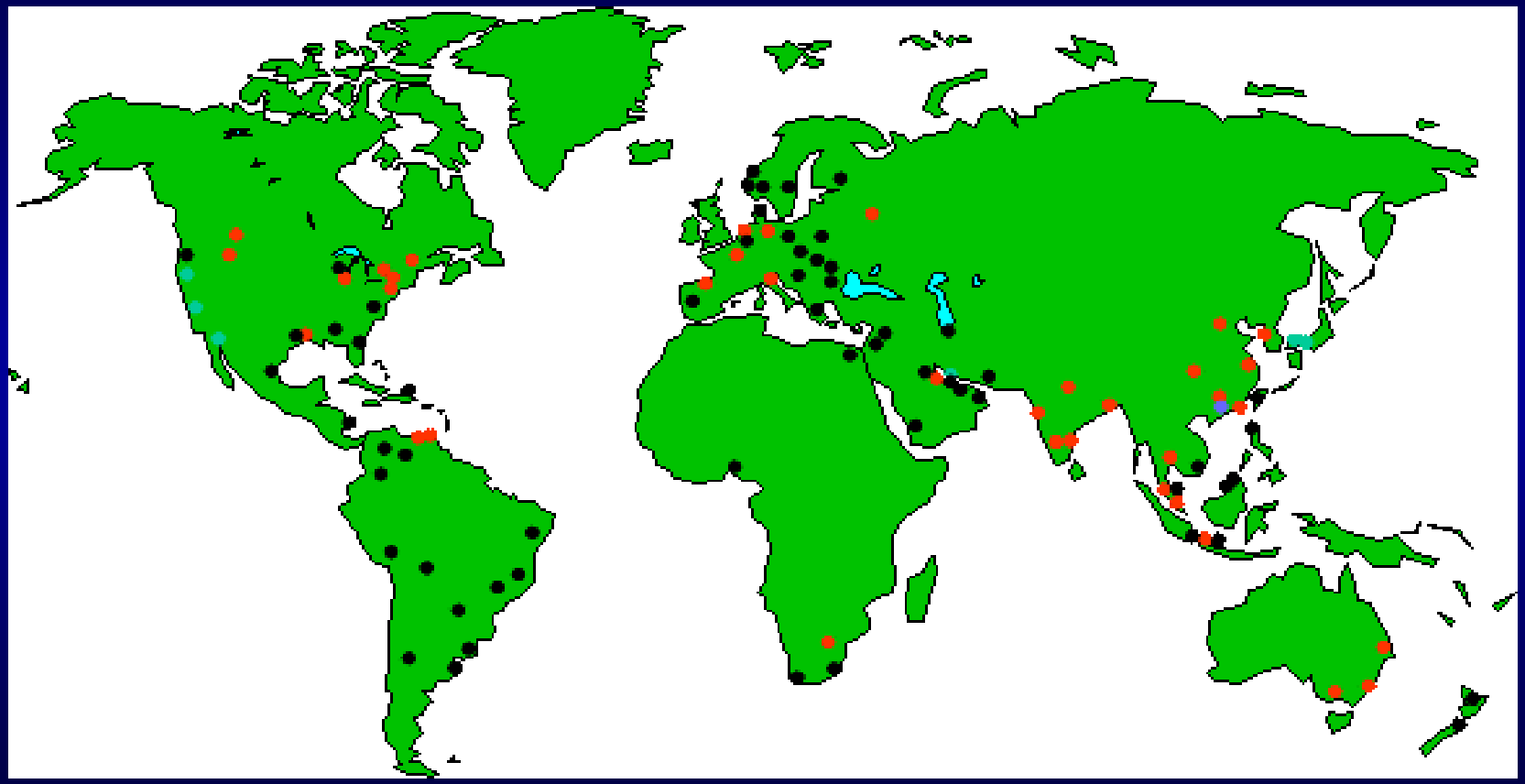
Manufacturing Centers



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

Approximately 1,000 employees worldwide

Principal factories & Offices



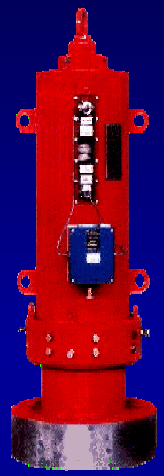
Jordon Controls

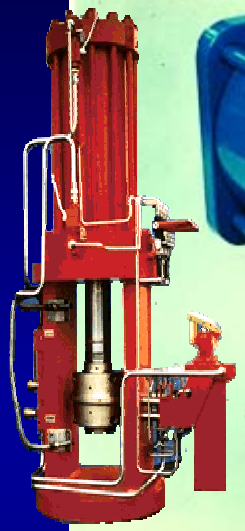
rotork Controls

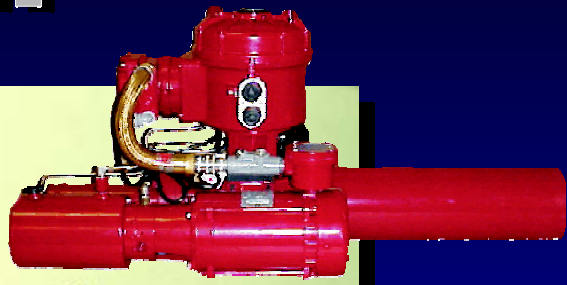
rotork skilmatic

Actuation powered by: 3 phase, 1 phase, DC, Air, or Hydraulic, for on/off, modulating & failsafe valves

rotork fluidsystem





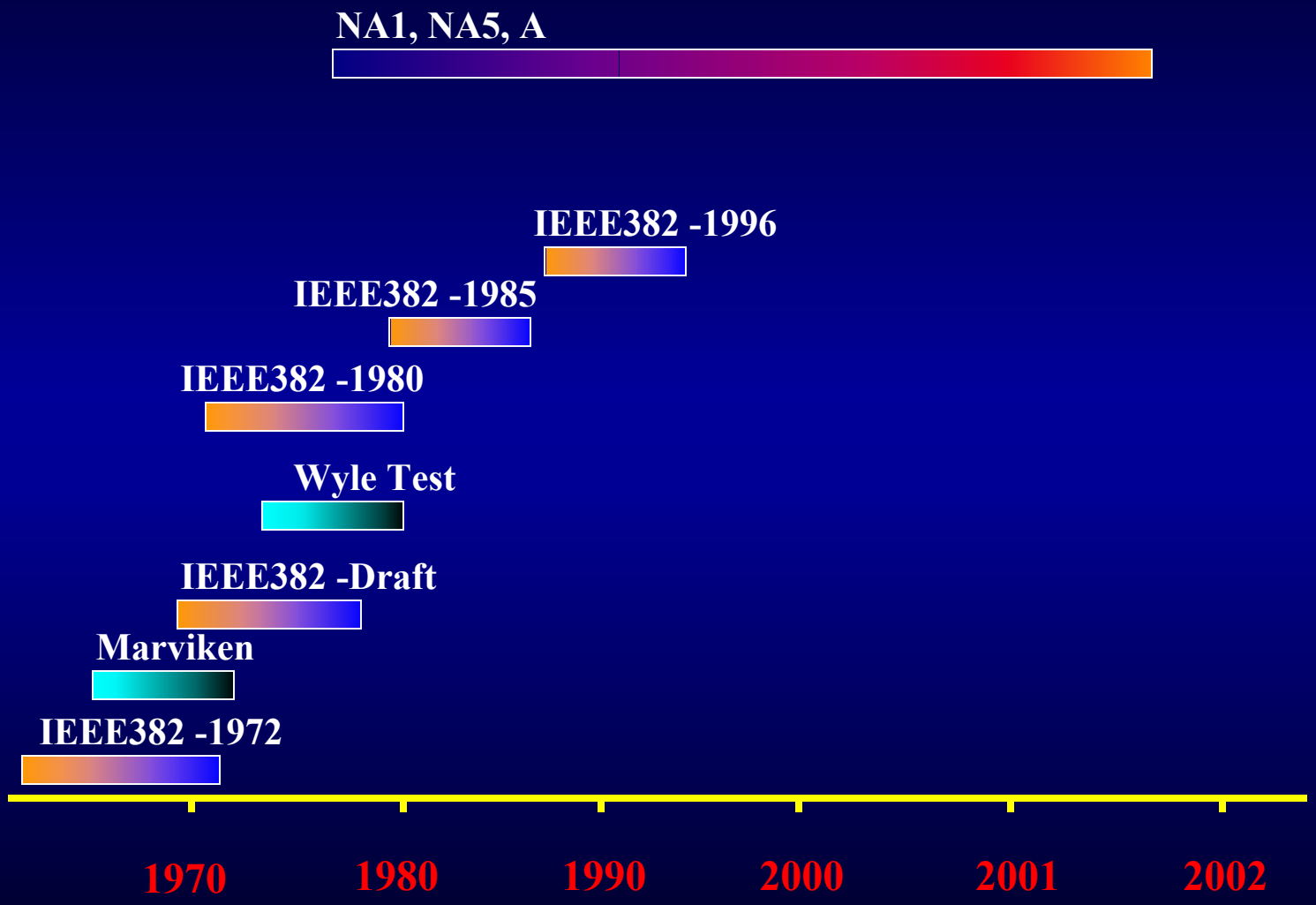


rotork

Rotork Nuclear Actuators

Sept 2005

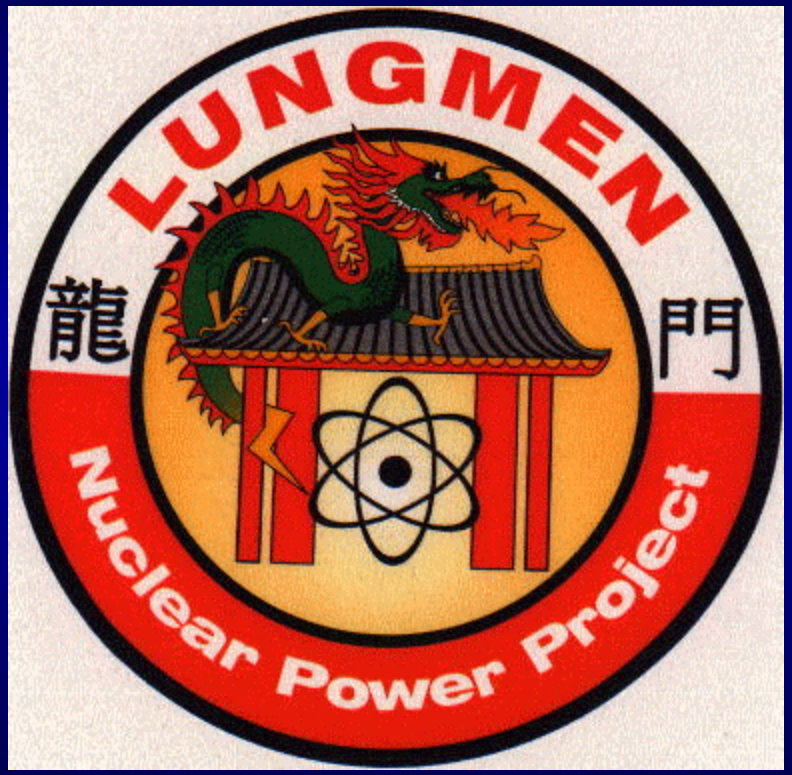
Product Qualification History



RE-QUALIFICATION

WHY??

Project Driver



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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

Environmental Qualification

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 @ 125ºC
- Activation Energy 1.0eV
- Qualified Life
  - 41.6 years @ 54ºC
  - 203.2 years @ 40ºC

Environmental Qualification

Pressurisation Aging

- 15 cycles 0-65psig

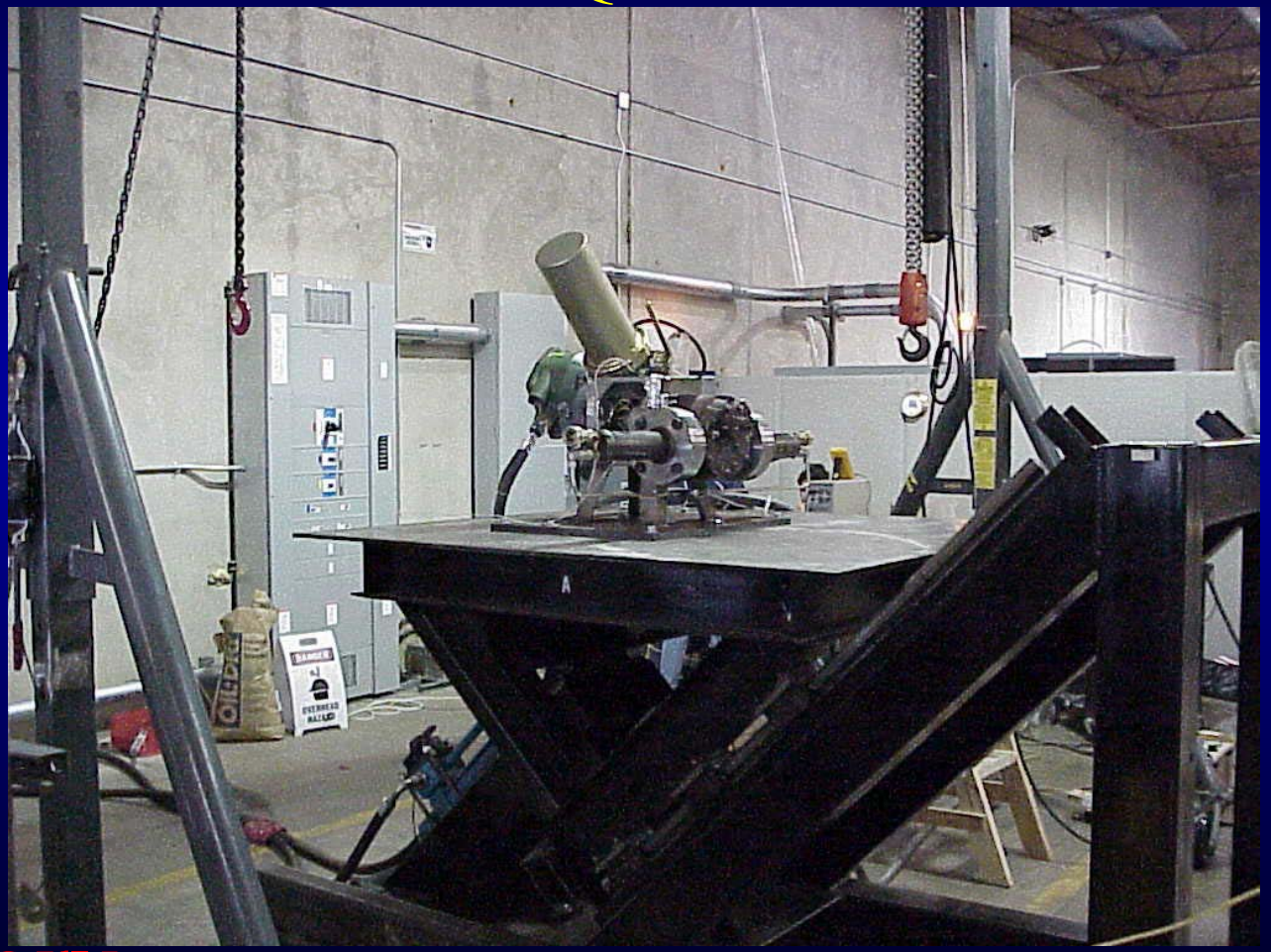
Environmental Qualification

Radiation

- 2.3E+08 Rads/2.3E+06Gy
  - Gamma radiation

Environmental Qualification

Seismic Qualification



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

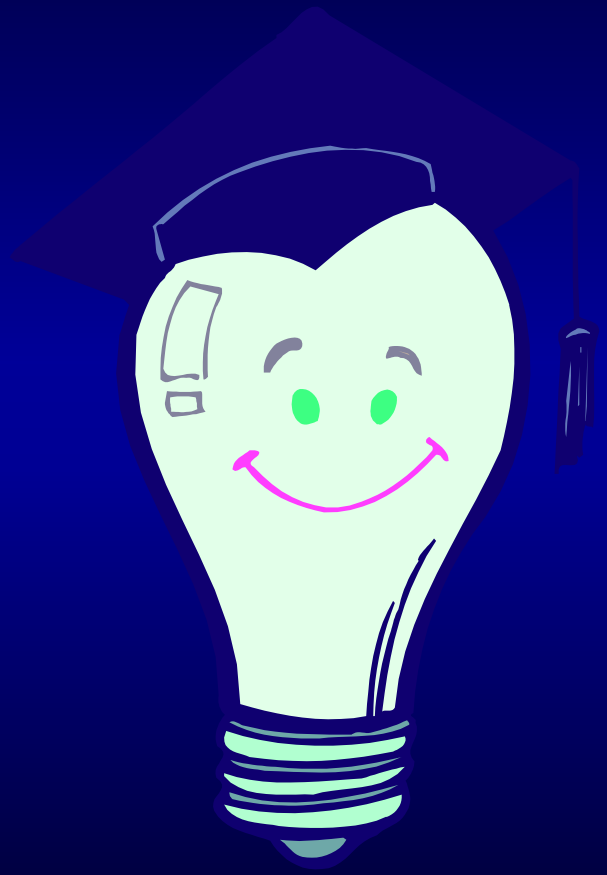
- RMF
  - ZPA = 8g (Lungmen) 1- SSE, 5 - OBE
  - ZPA = 6g (IEEE382-1996 fig 7) 1- SSE, 5 - OBE
- RIM
  - Input = 5g (Ulchin)
  - Input = 4.5g (IEEE382-1996 fig 6)

DBE (LOCA) SIMULATION

- IEEE382-1985/1996 Case IV – MSLB inside containment
- Lungmen 100day LOCA

Resources/Requirements

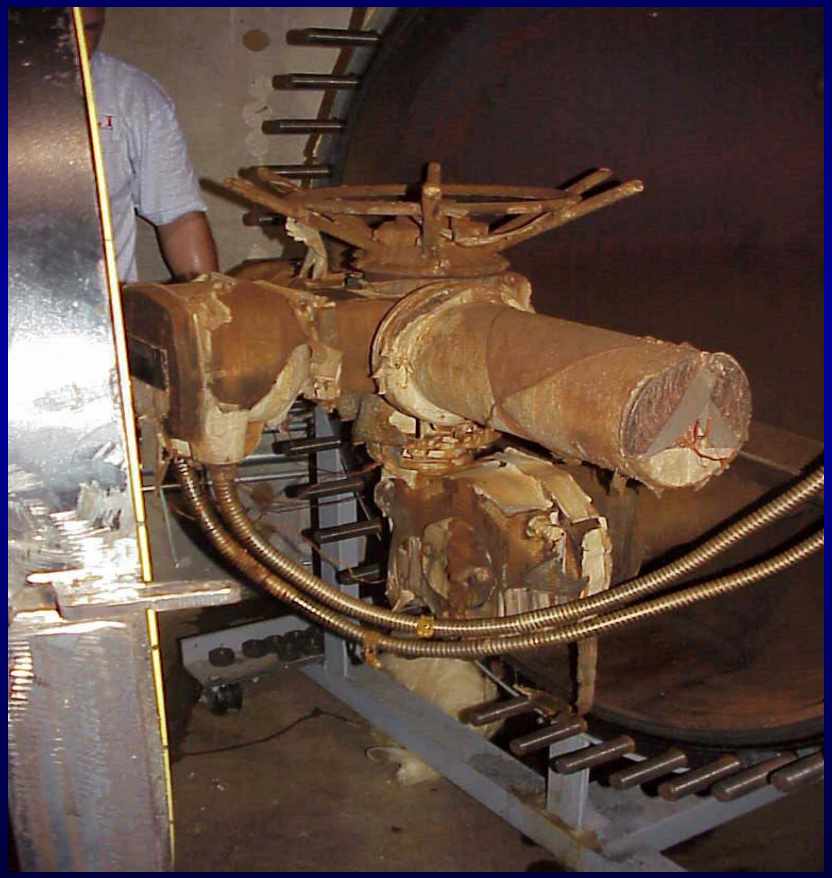
- Nuclear Logistics & Kinectrics
- Trentec, & Thermodyne
- for
- IEEE382-1985/1996
- Ulchin 5 & 6
- Lungmen NPS – Taiwan



- What did we learn?

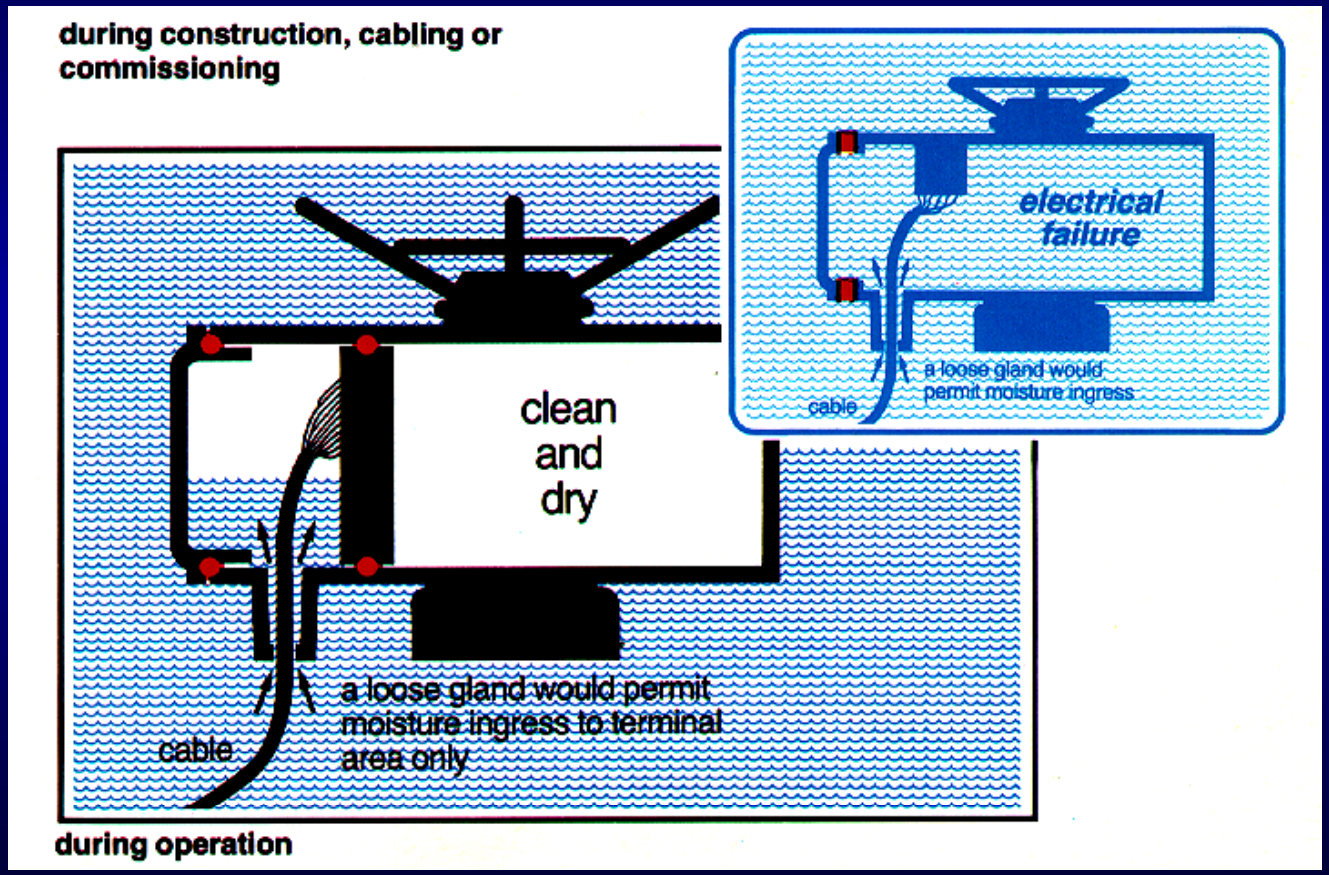
- Beware the Nuclear EXPERT.
- No body knows your product like you - they just think they do!

- 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’



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

BVQI
REGISTRAR ACCREDITATION BOARD
EN 29001/ISO 9001
ANSI/ASQC Q91
APPROVED BY BVQI (NA)
Rotork Controls Inc., Rochester, New York, USA

LLOYD'S REGISTER QUALITY COMPANY
ISO9001
NATIONAL ACCREDITATION OF CERTIFICATION BODIES
ROTORK ACTUATION, BATH, ENGLAND

Maintaining Qualification

- 10CFR21 Reporting
- Supplier development

Questions?