



# OVERVIEW OF CONTROL AND INSTRUMENTATION (C&I) NUCLEAR SAFETY RESEARCH

By

R L Yates

HM Nuclear Installations Inspectorate



# Introduction

## Structure of presentations

- NII
  - Overview of C&I Nuclear Research (this presentation)
- British Energy
  - EU FP5 CEMSIS Project
- British Nuclear Group – Management Services, Sellafield
  - Dissemination of Research
- British Nuclear Group – Management Services, Reactor Sites
  - Essential Capability
- NII
  - Key Messages



# Introduction



# TOPICS

- C&I Systems Important to Safety (SIS)
- Key Safety and Technical Issues
- Current Nuclear Research Index (NRI) Issues
- Programme Management
- Historical Spend Profile



# C&I SYSTEMS IMPORTANT TO SAFETY (SIS)

- PROTECTION
  - Defence against failures in other plant systems e.g. reactor shutdown.
- CONTROL
  - Maintenance of plant within operating envelope
  - Minimise demand on protection functions
- MONITORING AND DISPLAY
  - Allow operators to maintain plant within safe operating envelope
- TESTING
  - Confirm availability and effectiveness of other functions



# Key Safety and Technical Issues

## Scene setting/challenges:-

- Ageing plant and equipment (some first generation)
- Mature workforce (key contractors and industry)
- New and Developing Standards
- Need for new and replacement systems
- Development of safety cases for new technology
- New systems are becoming obsolete sooner



# Key Safety and Technical Issues

This area addresses safety issues associated with

- production, installation, modification or replacement of **computer-based** systems important to safety (SIS)
- maintenance of legacy and ageing C&I SIS (e.g. nucleonics instrumentation and unique “Laddic” based reactor protection systems)
- technological development in the area of C&I SIS such as SMART (computer based) sensors and use of Commercial Off The Shelf (COTS) based systems
- development of hardware based C&I SIS
- maintenance of key competence



# Key Safety and Technical Issues

## Key Technical Goals

- develop and improve theories and practical methods for enhancing the process of justifying the safety of C&I SIS (the main goal)
- solve practical problems associated with the safe operation of C&I SIS (e.g. hardware based SIS development options).

## Key Management Goals

- maintain capability for unique nuclear based control and instrumentation skills associated with specific technologies (e.g. nucleonic instrumentation, Criticality Incident Detection and Laddic protection equipment)
- facilitate co-operation with relevant national (e.g. MoD) and international agencies and programs (e.g. EU research programmes).



# CURRENT NRI ISSUES

## Computer Based SIS

Containing elements of longer term fundamental research

- Software diversity (City and Bristol)
- Statistical software/systems testing and reliability estimation
- Goal based assessment of COTS for safety related systems - NEW

Application within the near term (2/3 years)

- Formal analysis of software techniques (phased functional assessment based on mathematical techniques)
- Software test coverage and formal proof (NuSAC Study Group on the safety of operational computer systems recommendation)
- Development of an Approach to the Assurance of SMART Sensor Software



# CURRENT NRI ISSUES

## Computer based SIS

Application within the near term (2/3 years) - continued

- Complex safety-related measurement and data processing system
  - Study into new source/code comparison methods
  - Guidelines for assessment of SMART Instrument Suppliers - NEW
- Immediate Application/Results under review
- Safe use of open system technology in data processing and control systems
  - Application of COTS to low safety integrity level systems
  - **Cost Effective Modernisation of Systems Important to Safety (CEMSIS)**
  - Safety implications from use of Personal Computers in low safety integrity level systems



# CURRENT ISSUES



# PROGRAMME MANAGEMENT

- Control & Instrumentation Nuclear Industry Forum – CINIF
- Arrangements similar to previous TWG
- CINIF Members
  - British Energy (BEG L and BEG(UK)L)
  - British Nuclear Group Management Services, Reactor Sites
  - British Nuclear Group Management Services, Sellafield
  - HSE NII
- Chair/Secretary provided by British Energy
- Minuted meetings held quarterly (covering progress reports, technical issues, priorities, finance etc)
- Projects addressing Issues have nominated technical monitors (licensee/regulator) and project controllers (licensee).



# PROGRAMME MANAGEMENT

- Project Priorities determined by Licensee/NII Review
- Contribution to Projects determined by relevance to Licensee (e.g. Historically BE/Magnox allocation typically 60/40)
- British Nuclear Group Management Services Sellafield Funding to be added in future
- Other Licensees invited to join (UKAEA/AWE)
- Potential for further collaboration (EU FP6) and information exchanges (e.g. EDF, EPRI, Halden IRSN & MoD etc. ) kept under review.



# PROGRAMME MANAGEMENT

## Pedigree of Researchers

- Mix of commercial and academic organisations
- Use of experts in field – feature of programme
- Researchers have wide experience of other industrial sectors
- Many have long history of undertaking work for Nuclear sector



# HISTORICAL SPEND PROFILE

