

Lloyd's Register services to the energy industry

Independent Nuclear Safety Assurance

Frank Cronin

Nuclear Development Manager , Lloyd's Register

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About Lloyd's Register

- Founded 1760
- Profit-distributing organisation, free from commercial constraints
- Our purpose is to enhance the safety of life, property and the environment at sea, on land and in the air
- Global company: 8,500 employees; offices in 247 cities and towns in ~70 countries worldwide.
- Independent, impartial technical authority in our fields of Energy, Marine, Transportation, and Management Systems
- Funds the LR Educational Trust (LRET)



The Group at a glance: office locations



Lloyd's Register global Offices



Countries where LR has nuclear experience

Our nuclear capabilities

We provide nuclear safety, risk and quality related services to industry, regulators and governments worldwide covering all parts of the fuel cycle and lifecycle:

- technical consultancy
- independent Third Party Inspection and assurance (supply chain assessment)
- accreditation and certification
- risk-based asset Management
- education - skills and training.



Lloyd's Register has assisted in all phases of a NPP's lifecycle

Design stage

- Validation/verification against international and national requirements, incl. IAEA Safety Guides

Regulatory design approval in respective country

- Preparation/Verification/Validation of necessary documentation, analysis, etc.
- Assistance through the entire process of Assessment and Licensing

Building

- Preparation of necessary regulatory documentation
- Evaluation of possible supply chain
- Assistance through the entire process

Regulatory support - Technical support capabilities

The rapid expansion of nuclear and radiation related activities in many States has highlighted the limited number of skilled and experienced persons available. Many regulatory bodies have identified the need for external support. Typical support required by a regulatory body are:

- Development of regulatory technical guidance
- Support in review of safety documents (safety report and risk assessment)
- Support and in audit and assessment of nuclear facilities and suppliers
- Support with regulatory inspection
- Staff education, training and development
- Research and development
- Scientific and engineering analysis



Safety assessment and licensing – Peer review



IAEA standard states that a comprehensive safety assessment and an independent verification of the safety assessment shall be carried out.

The independent verification would be carried out by or on behalf of the operating organization. **This is in addition to the independent review performed by the regulators.**

Independent verification includes review of:

- Deterministic analysis
- Severe accident analysis
- Probabilistic Safety Assessment
- Engineering aspects
- Radiation protection
- Human Factors
- Safety functions
- Emergency preparedness

PLEX - LR can cover all the safety areas as defined in the IAEA standard Integrated Safety Review – NSG 2.10

1. **Plant design**
2. **Actual condition of SSCs**
3. **Equipment qualification**
4. **Ageing**
5. **Deterministic safety analysis**
6. **Probabilistic safety analysis**
7. **Analysis of internal and external impacts**
8. **Operational safety**
9. **Use of experience from other plants and research findings**
10. **Organisation and management**
11. **Operating documentation, procedures**
12. **The human factors**
13. **Emergency planning and preparedness**
14. **Environmental impact**

An Integrated Safety Review is an essential feature in determining the reasonable and practical modifications required to enhance the safety of a facility and allow for long term operation

Technical capability from LR

- **Probabilistic Safety Analysis, PSA Level 1, 2 and 3**
 - Covering all operating states and all Initiating Event Categories
 - Severe Accident Analysis
 - BWR, PWR and RBMK
- Risk-Informed ISI (RI-ISI) program development
- Internal flooding PSA – developer of two EPRI guidelines
- Passive Component Reliability
- Plant Aging Management
- Structural Integrity Management
- Data analysis, e.g.
 - Component Failures, Initiating Events, CCF



Beznau NPP Switzerland

Technical capability from LR cont.

- **Deterministic analyses, e.g.**
 - Thermal hydraulic Analyses, Containment Analyses, LOCA Analyses, Emergency Core Cooling
 - Event Analyses, incl. External Events
 - Radiation and Radiation Protection
 - Nuclear Fuel Analysis
 - Fire and explosion analysis
- **Human Factors/MTO**
 - HRA/MTO
 - Control room design
- **Organizational analyses**
 - Human factors, safety culture
- **Audits**
 - Audits, management systems, safety management
- **Extensive participation in national and international R&D**
- **Training and competence assurance**



Daya Bay NPP

Independent Compliance

Independent Third Party Inspection Agency (ITPIA)

UK requirement to verify that items or services have been designed, constructed and tested in accordance with the technical specification

A component possibly for assurance of PLEX project execution

Conformity assessment

Confirms that assets comply with statutory requirements, regulations or standards. Lloyd's Register has the authorisation to carry out third party inspections including: ASME, PED, RCC-M, KEPIC etc

Project quality management and assurance

Third party audit and assessment of project quality management to recognised national or international standards or client specific requirements

Supply chain assessment

Ensures best practice within the supply chain in terms of safe, competent and contractually compliant delivery of the product or service.



Independent Third Party Inspection Agency (ITPIA)

Typical scope of ITPIA

Includes all major components of the Nuclear Steam Supply System and other safety classified components, including:

- Reactor Pressure Vessel, Pressuriser
- Steam generators, primary piping
- Coolant pump, emergency core cooling systems
- Safety significant civil structures

Typical role of ITPIA

- Design review and verification
- Assess and monitor the QA programme
- Review drawings and process procedures
- Verify material procurement
- Verify fabrication and construction
- Witness final pressure tests
- Verify non-destructive examination
- Review welder qualification and procedures
- Review and endorsement of records



Risk Informed Asset Management

Asset Management System

- Provide advice, assessment, training and certification to recognised asset management system standard, PAS 55

In-Service Inspection

- In-service inspection and testing of nuclear power plant components performed to standards such as ASME Section XI for the periodic inspection and testing of components.
- Risk Informed In-service Inspection programmes enhances safety and economics by focusing inspections on areas with the highest potential for reduction of plant risk and maintenance costs.

Structural Integrity Management

- Load Combination Analysis for Structural Verification
- Plant Aging Management
- Passive Component Reliability



Organisation Capability and Quality Management

Certification of Management System

Demonstrates a robust management system to minimise risk and improve operations. Some relevant standards::

- Quality - ISO 9001
- Asset management - PAS 55
- Nuclear Management system - IAEA GSR- 3 and ASME NQA-1

Human & Organisational Factors

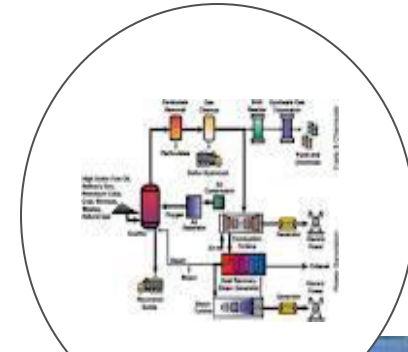
A system comprises of assets, processes and people. The interactions between them are crucial to the successful operation of the asset. Human factors aims to improve operator performance and reduce human errors by assisting with:

- Operational Planning
- Managing Organisational Capability
- Ensuring Usability
- Human Reliability Assurance

Knowledge Management

Knowledge Management supports the development and maintenance of the organisation's capability through improved decision making and corporate learning.

Process



People



Plant

Nuclear Supply Chain Development Experience



- Lloyd's Register is supporting the Nuclear Industries Association in developing the UK's supply chain ready for new build
- This entails preparation of guidance documents such as the one opposite
- Lloyd's Register is also supporting the establishment of the Nuclear Advanced Manufacturing Research Centre
- This is aimed at bringing business benefit to the UK through development of the country's domestic supply chain - HMG

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Independent Verification Service for KHNP



Lloyd's Register has been engaged by Korea Hydro & Nuclear Power Co., Ltd., (KHNP) for independent verification services of nuclear safety related equipment.

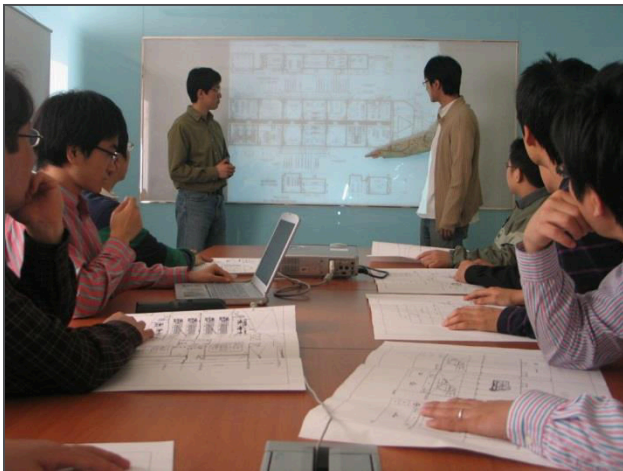
The project is to strengthen KHNP's Quality Assurance performance for the prevention of counterfeit and fraudulent documents and substandard equipment. This project is of critical importance to further strengthen the safety performance of the Korean nuclear industry.

The Scope of work include verification of:

- Equipment Qualification (Environmental and Seismic Qualification)
- Commercial-Grade Item Dedication (CGID)
- Quality Verification Document

Lloyd's Register Educational Trust (LRET)

The LRET, wholly funded by the Lloyd's Register Group, works to achieve advances in transportation, science, engineering and technology education, training and research, worldwide, for the benefit of all.



LRET - Distribution of University and Research

LRET are engaged with 17 major research programmes involving 26 institutions, including;

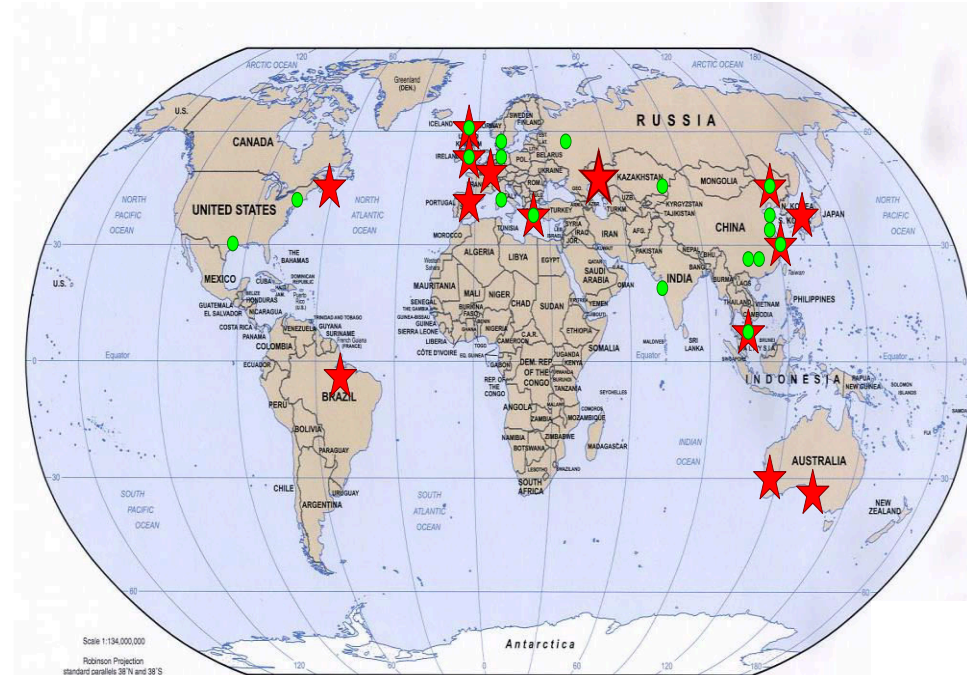
Imperial College London,
LRET Transport Risk Management Centre

Lancaster University,
The LRET Chair in Nuclear Engineering and Decommissioning

Open University with The Welding Institute,
LRET Chair in Materials Fabrication and Engineering

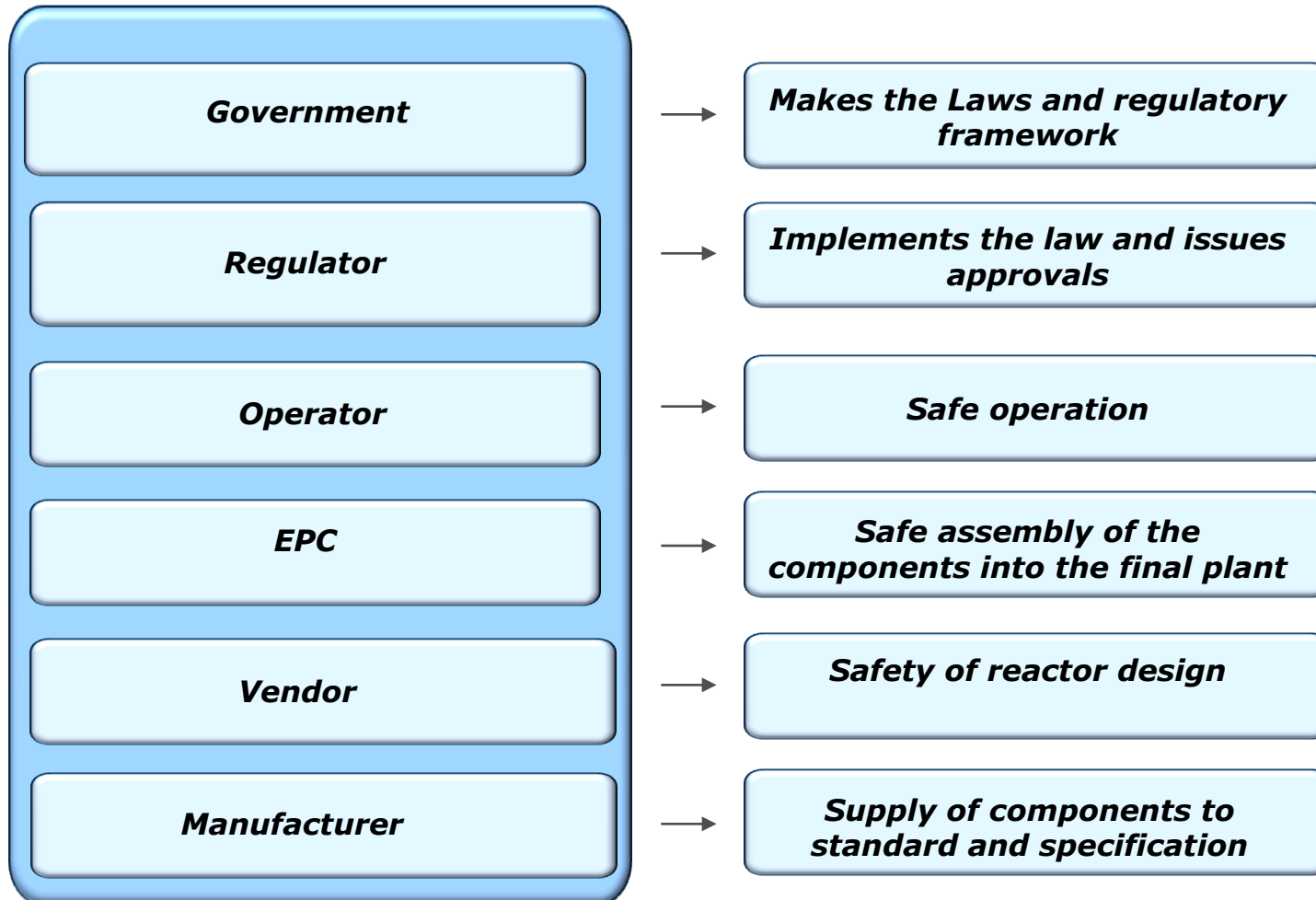
University of Aberdeen,
LRET Centre for Safety and Reliability Engineering

University of Twente
LRET Centre of Excellence in Maintenance Engineering



★ Research Centre ● University Education

Safety Chain – where LR adds value



Summary

- Lloyd's Register is well positioned to support nuclear industry and the regulatory bodies within the UK and internationally.



Lloyd's Register services to the energy industry

For more information, please contact:

Prof Mamdouh El-Shanawany
Nuclear Technical Director, Energy

Lloyd's Register
71 Fenchurch Street
London, EC3M 4BS

T +44 (0)20 7423 1455

M +44 (0)77 94088628

E mamdouh.elshanawany@lr.org

W www.lr.org/energy

Services are provided by members of the Lloyd's Register Group.
For further information visit www.lr.org/entities