Chapter 3. Leadership and Management

Leadership	Governance	Assurance	Improvement
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3.1 Introduction

Quality in the nuclear industry has developed into what is now referred to as Leadership and Management for Safety, with the prime objective being Safety. To achieve that objective the following key principles, must be achieved:

1. Leadership for Safety and a strong safety culture must be established and sustained in organisations that govern nuclear facilities and activities.
2. Management for Safety must be achieved by
    a. a strong safety culture; and
    b. an effective integrated management system.

This thinking recognises that all activities undertaken by nuclear organisations have the potential to impact on nuclear safety, be it engineering, operations, finance, security, health, environmental or stakeholder relations. Strong leadership will establish clear objectives, whilst the integrated management system will define all the actions needed to achieve the required outcomes. A strong safety culture will then effectively implement the requirements.

Nuclear quality professionals can be expected to be involved in establishing and maintaining leadership, the management system and the culture. It is important to recognise that their roles are generally supporting rather than directing, otherwise the Leadership and Culture elements will be flawed. Potential areas of involvement could be:

1. Assisting the directors and senior management in establishing the policies of the organisation, and the goals, strategies, plans and objectives.
2. Assisting the directors and senior management in establishing the organisational structure.
3. Developing with responsible management the integrated management system needed to deliver all the policies, goals, strategies, plans and objectives. That can apply internally within the organisation or externally through the supply chain.
4. Assessing the effectiveness of the management system, identifying issues and seeking improvements to enhance customer satisfaction. This can relate to a range of activities from supplier capability and product quality at component through to system level, process control, document systems and cultural / compliance aspects.

3.2 Leadership and Culture

Understanding

The topics of Leadership and Culture are closely integrated and need to be understood. In considering Leadership and Culture, it is also important to differentiate between Management and Leadership. Management ensures that work is completed in accordance with requirements, plans and resources. It is through Leadership that individuals may be influenced, motivated, and organizations changed. Managers may also act as leaders. A study published by NEA in 2012 [1], based on an international workshop held in 2007, identified the key issues in the headings below in relation to leadership for safety and safety culture:

Leadership

Senior managers should be the leading advocates of safety and should demonstrate in both words and actions their commitment to safety. The 'message' on safety should be communicated frequently and consistently. Leaders develop and influence cultures by their actions (and inactions) and by the values and assumptions that they communicate. A leader is a person who has an influence on the thoughts, attitudes and behaviour of others. Leaders cannot completely control safety culture, but they may influence it. Being "role models" and "actions matching words" are necessary traits in leaders.

Managers and leaders throughout an organization should set an example for safety, for example through their direct involvement in training and in oversight in the field of important activities. Individuals in an organization generally seem to emulate the behaviours and values that their leaders personally demonstrate. Strong involvement in the following sends the right messages:

- Organisational reviews and **involvement in establishing/maintaining the integrated management system** needed to deliver all the policies, goals, strategies, plans and objectives. That can include review and authorisation of sub-tier publications. One of the issues that should fall out of this is a culture of **conservative decision making**.
- **Clear communications** regarding underpinning issues, setting **clear priorities** and **definition of responsibilities**.
- Participation in Training and Development to set appropriate levels of qualification and experience (i.e. **ensure the organisation has current nuclear experience** and that there is a **common understanding of what is important to ensure safety**.)
- Utilising Staff feedback, reporting and comment systems to ensure that there is **open reporting,** the system makes it easy to **do the right things right**, and **encourage a questioning and learning attitude**. Leaders need to strongly **encourage open and honest, prompt reporting of issues** – a good-news culture must be strongly avoided.
- **Active participation** in safety walk downs (including security and environmental aspects) and in safety committees. These should foster a no-blame culture whilst **discouraging complacency with regards to safety.**
- Working with Quality and Technical professionals to ensure the implementation of a **strong programme of management system assessment and effective management review.**

Operational attitudes and behaviours

In setting guidance for nuclear management systems, IAEA GS-G-3.5 Appendix 1 [2] 'Achieving the attributes of a strong safety culture' identifies that there are five attributes that contribute to the desired characteristics:

- Accountability for safety is clear
- Leadership for safety is clear
- Safety is integrated into all activities
- Safety is a clearly recognized value
- Safety is learning driven

A statement by the Honourable Gregory B. Jaczko [3], a former US NRC Chairman, is worth noting: "If we want to continue to improve on safety, we must look beyond just engineered controls. It is possible that bad decisions or a lack of a sufficient focus on safety, not technological failures, will ultimately cause problems in the future. Perhaps the greatest additional safety benefits are to be found in a renewed and deeper focus on the safety culture of licensees."

Nearly all the following aspects that can affect operational attitudes and behaviours have been identified in discussing Leadership, but the difference is that, whilst leaders set the directions, it is the organisations that actually have to be engaged to ensure the outcomes.

- Procedures that work, are used, respected, and fit-for-purpose – with associated risks understood.
- Questioning attitude/constructive challenge – risks not "normalised" and unsafe acts
- Conservative decision making clearly and visibly supported by management.
- Recognition of danger of "organisational drift"/complacency.
- Empowerment in reporting of human, technical and organisational issues
- Transparency in communication between teams (e.g. shifts, technical/operators).
- Involvement in sharing the Lessons Learned, challenges and improvements – leading to "trust" and a feeling that things get done and people listen.

Business environment

Attention needs to be paid to manage, and preferably avoid, pressures that lead the business to lose the safety/production "balance".

History has shown that the following factors are associated with catastrophic failures:

- Poorly considered change.

- Too many concurrent initiatives.
- Continuous resource reduction.
- Outsourcing or use of contractors with poor control.
- Use of inappropriate incentives.

These factors can be avoided by careful review of policy and business decisions in terms of their potential impact on safety.

Competence

Nuclear organisations need to address a multitude of disciplines and often have limited directly employed resources, requiring them to procure services and products. As such, they have to be aware of lack of or loss of capability – often without realising it! The terms "Intelligent Customer" along with "Baseline" and "Organisational Capability" have been introduced in considering this aspect.

Issues have included:

- Gradual erosion/loss of key skills and knowledge (and corporate memory).
- Leaders not always understanding risks – they need to be Suitably Qualified and Experienced Persons (SQEPs) and need to be involved in Risk Informed Decision-Making programmes.
- Competence in dealing with abnormal conditions. Training needs to actively prepare for the beyond-design/accidental scenarios.
- Avoidance of inadequate training and qualification methods. Competence is a combination of knowledge and experience. There needs to be a systemic approach to ensuring competence with standards and appraisal.
- The need for development of non-technical skills (e.g. team working).

Risk assessment and management

Discussions have already identified "conservative decision making", "doing things the right way", "understanding of what is important to ensure safety" and "Risk Informed Decision Making". All of these invoke consideration of risk and managing optimal ways to control it.

Issues have included:

- Failure to "stand back" and assess the emerging risks, rather focussing on" normal" states. Managers/leaders need to comprehend the big picture – understanding/awareness of the real risks (clear view of the radar screen and systems thinking).

- Complacency/overconfidence – "the gambler's dilemma". This can be offset by rigour in addressing safety cases, inspection findings, etc, prioritising and checking the actions and seeing these as "symptoms" of wider issues. Addressing alarms/data trends and "unclear" findings (being alert to weak indicators) is also needed.
- There is always a need for enhancement plans that set clear priorities and secure "buy-in" to make improvement work.
- Need to recognise the dangers of "orphan plant or processes". Because something is not showing problems or is not actually being used does not mean that it is working safely or that it is available when needed.

Oversight and scrutiny (equates to assessment)

Experience has shown that the opportunity to use a "third eye", i.e. an independent assessment, is highly beneficial. Such efforts have identified issues such as:

- Safety Departments have authority and "teeth".
- The need for a hierarchical layered system – seek to look at "reality", not just paper trail – plant and people provide safety, not paperwork.
- Avoiding the "good news culture" – it is important that leaders get true pictures and have sufficient knowledge and understanding to make judgements.
    - "Integration" of sources of information to give big picture (e.g. events reports, KPIs, independent reviews etc.).
    - Hierarchical safety metrics – proactive and reactive with effective monitoring.
- Remedial actions must be prioritised and seen to be timely completed.

Organisational Learning

Nearly all events have antecedents – "free lessons". Issues include:

- Avoiding denial – "it can't happen to us" – maintaining a sense of vulnerability – keep the boat rocking enough!
- Reporting encouraged within a just culture.
- Investigations addressing real root causes and findings shared.
- Minimising loss of corporate memory – keeping learning alive.
- Avoiding "organisational silos" – blocks to the transfer of learning.
- Learning from outside (with an open mind and not just "lip service").

External regulation

Regulators have often been seen as a necessary evil, who only step in relating to significant breaches, i.e. after everything had gone wrong. However, they often are in a position to stand back and in doing so identify precursor signs. If there is open assessment by regulators with full communication between regulator and licensee, then that information can be a significant opportunity for improvement. In the Ministry of Defence Nimrod Report, Ian Whewell (HSE) [4] is quoted saying that "an organisation with a compliance culture does not have a safe culture".

Safety Culture History

The term 'Safety Culture' was first commonly used in relation to the Bhopal chemical accident. It was used by the International Nuclear Safety Advisory Group (INSAG) [5] in 1986 in the Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident [6] and further expanded in 1988 in the Basic Safety Principles for Nuclear Power Plants [7].

Since then, the term Safety Culture has been used increasingly in connection with nuclear plant safety; however, the meaning of the term was left open to interpretation, and guidance was lacking on how Safety Culture could be assessed. INSAG-4 [8] therefore established the following definition: *"Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance"*
(Source - INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP, Safety Culture, INSAG Series No. 4, © IAEA, Vienna (1991) Page 1.)

The principal publication on strengthening safety culture is INSAG-15 [9] which identifies the Key Issues as:

- Commitment;
- Use of procedures;
- Conservative decision making;
- A reporting culture;
- Challenging unsafe acts and conditions;
- The learning organisation;
- Underpinning issues: communication, clear priorities and organization.

Link to Management System

The topic of safety culture is addressed in the following IAEA documents:

- IAEA GSR part 2 Leadership and Management for Safety [10];
- IAEA GS-G-3.1 Application of the Management System for Facilities and Activities [11]; and
- IAEA GS-G-3.5 – The Management System for Nuclear Installations [2].

GSR part 2 requires the management system to be used to achieve goals safely and to promote a strong safety culture. It also requires regular self-assessment and independent assessment of leadership for safety and safety culture. GS-G3.5 Appendix 1 provides guidance on achieving the attributes of a strong safety culture.

Assessment of Safety Culture

Safety Culture, because it has been recognised as such a significant element in establishing and maintaining nuclear safety has been the subject of many publications. Many experts have set out their thinking and tried to provide guidance on the attributes of a strong culture. A number of assessment tools have been produced. Key points to consider when carrying out assessments are:

1. Periodic survey against set questions is useful in two ways:
   - It identifies progress; and
   - It identifies areas of focus.
2. A survey is not always a predictive tool [12].
3. Using the same (limited number of questions) every year or so can indicate direction but too frequent surveys with perceived inaction can lead to misinformation [13].

International Atomic Energy Agency (IAEA)

The lead IAEA document on safety culture is INSAG–15 Key Practical Issues in Strengthening Safety Culture [9]. The Appendix contains question sets aimed at the following organisational levels:

- Board of Directors;
- Chief Nuclear Officers and Executive Officers;
- Station Director and Senior Managers;
- Middle Managers;
- First Line Supervisors;
- Shop Floor.

A more recent IAEA publication, safety report series no. 83 Performing safety culture self-assessments [14] provides practical guidance on how to conduct safety culture self-assessments. Guidelines on independent safety culture assessments are provided in IAEA Services Series 32 OSART Independent Safety Culture Assessment (ISCA) Guidelines [15].

World Institute for Nuclear Security (WINS)

WINS's Best Practice Guide on Nuclear Security Culture [16] identifies the factors that encourage a strong nuclear security culture and provides guidance on carrying out an Employee Attitude Survey on Nuclear Security Culture.

Institute of Nuclear Power Operators (INPO)

INPO's Principles for a Strong Nuclear Safety Culture 2004 [17] are based on 8 headings:

1. Everyone is personally responsible for nuclear safety.
2. Leaders demonstrate commitment to safety.
3. Trust permeates the organization.
4. Decision-making reflects safety first.
5. Nuclear technology is recognized as special and unique.
6. A questioning attitude is cultivated.
7. Organizational learning is embraced.
8. Nuclear safety undergoes constant examination.

UK

Relevant Office for Nuclear Regulation (ONR) publications are:

- Safety Assessment Principles 2014 section on Leadership and Management [18].
- ONR Nuclear Safety Technical Inspection Guide NS-INSP-GD-017 LC 17 Management systems [19].
- ONR Technical assessment guide - NS-TAST-GD-072 Function and content of a safety management prospectus [20]
- ONR Technical assessment guide - NS-TAST-GD-080 Challenge Culture, Independent Challenge Capability (including an Internal Regulation function), and the provision of Nuclear Safety Advice [21].
- ONR Technical assessment guide - NS-TAST-GD-093 Guidance for undertaking Leadership and Management for Safety Reviews [22].

In relation to reactor New Build, the Royal Academy of Engineering (RAEng) led in the production of several documents entitled "Nuclear Construction Lessons Learned – Guidance on best practice". The lead publication was on safety culture [23]. It recognised that "successfully translating the development of a nuclear safety culture into the construction of a new nuclear power station will be a key challenge". Building on the INPO report "Principles for Excellence in Nuclear Project Construction" [24], the document considers how the following nine INPO key principles can be applied;

1. Demonstration by leaders of alignment on a commitment to excellence.
2. Focused front-line supervision is key to success.
3. People are competent to carry out their jobs.
4. Schedules are realistic and understood.
5. Construction of a nuclear plant has special requirements.
6. Personnel safety is highly valued.
7. The plant is built as designed.
8. Deviations and concerns are identified and communicated.
9. The transition to plant operation is started early.

In the book Safety Culture Assessing and Changing the Behaviour of Organisations [25], John Taylor provides a UK perspective and a general review of lessons from history. Examples in the book include the loss of the Titanic, Bhopal and the Tokaimura criticality event.

US

The U.S. Nuclear Regulatory Commission (NRC) website [26] covers safety culture policy, regulatory oversight and other information on safety culture.

Fukushima Daiichi 2011

The Independent Investigation Commission report [27] following the Fukushima Daiichi accident in 2011 identified major deficiencies in safety standards and emergency procedures. The chairman said “For all the extensive detail it provides, what this report cannot fully convey - especially to a global audience - is the mindset that supported the negligence behind this disaster. What must be admitted - very painfully - is that this was a disaster "Made in Japan."

The Chief Inspector of Nuclear Installations produced a report [28] in September 2011 identifying implications of the for the UK. Stress Tests [29] for both UK reactor and non-reactor sites were subsequently carried out and reported.

3.3 Management systems

Overview

The most commonly used management system standards by the nuclear industry are:

- GSR part 2 Leadership and Management for Safety [10]
- ISO 9001:2015, Quality Management Systems – Requirements.
  - ISO 9000:2015 Quality management systems. Fundamentals and vocabulary
  - ISO 9004:2018 Quality management. Quality of an organization. Guidance to achieve sustained success
- ISO 19443:2018 Quality management systems – Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector supplying products and services important to nuclear safety (ITNS)
- ISO 14001:2015 Environmental Management Systems – Requirements with Guidance for Use
- ISO 45001:2018 Occupational health and safety management systems. Requirements with guidance for use
- ISO 55001:2014 Asset management. Management systems. Requirements
  - ISO 55000:2014 Asset management. Overview, principles and terminology
  - ISO 55002:2014 Asset management. Management systems. Guidelines for the application of ISO 55001

- ISO 22301:2019 Security and resilience — Business continuity management systems — Requirements
- ISO/IEC 27001:2022 Information security, cybersecurity and privacy protection — Information security management systems — Requirements.

The adoption of formal management systems compliant with defined standards has been the norm in the nuclear industry since before the emergence of BS5750 [30] in the 1980s, with early practice closely linked to defence standards. Since the 1980s/90s, in the UK, nuclear site operators have been required through Licence Conditions to comply with management system standards which recognise the paramount importance of nuclear safety. Licensees have, over time, used the following standards; BS 5882 [31], IAEA 50-C/SG-Q [32], IAEA GS-R-3 [33] and now IAEA GSR part 2 [10].

IAEA GSR part 2 [10] has some similarities to ISO 9001 [34] and requires a process approach. IAEA GS-G-3.1 [11] and IAEA GS-G-3.5 [2] provide in-depth guidance on management systems for nuclear facilities but are aligned with GS-R-3 not GSR part 2. Revised guidance is being prepared by IAEA.

Site licence companies adopt a graded approach to procurement including management system requirements. Where items or services are safety related, suppliers are normally expected to be ISO 9001 compliant. Additional requirements may be specified such as special inspection, traceability and other requirements (See Chapter 6 Supply Chain).

For nuclear new build contracts the reactor designers/constructors Westinghouse and EDF/AREVA base their requirements on ASME NQA-1 [35] and RCC [36] respectively. These standards are used in their parent countries (See Chapter 11 International).

There have been a number of initiatives to derive a set of agreed common requirements beyond ISO 9001 for the nuclear industry. ISO 19443:2018 "Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector supplying products and services important to nuclear safety" has now been issued.

Management systems in the nuclear industry

The current situation

Management systems in the nuclear industry are under considerable scrutiny from regulators, customers and internal assurance groups. The maturity of the systems, and familiarity that staff has with the systems, is good but it is often conceived as bureaucratic and hindering the opportunity to adopt more advanced approaches, exploiting the use of process mapping and electronic document approval systems. The other downside is that existing site management systems are sometimes not found easy for newcomers and outsiders to the organisation to use, and each licensee, and sometimes sub-parts, has their own stylised approach.

Licence Condition (LC) 17 leaves the Site Licence Companies (SLCs) with a lot of freedom and they have thus established quite different arrangements tailored to their corporate cultures. There is an opportunity, especially for new SLCs and in major corporate reviews, to develop advanced process-driven management systems that are user-friendly and easier to keep up to date.

IAEA revision thinking

IAEA GS-R-3 [33] was replaced by GSR part 2 Leadership and Management for Safety [10] in 2016. The main drivers for revision were:

- Learning from major accidents and research that indicated a need to place more emphasis on leadership and management for safety;
- IAEA's efforts to bring a more consistent approach to requirements and guidance. This approach limits requirements to high level statement of what must be achieved. Statements of how the requirements are achieved is put into guidance; and
- Problems with the application of GS-R-3, such as legal pressures to address management system issues that had nothing to do with safety.

GSR part 2 retains the main management system requirements of GS-R-3 but there is less detail and some reduced prescription. There is increased emphasis on the delivery of safety with an integrated management system as the means not the end.

The IAEA recognises the need to revise the supporting guidance in IAEA GS-G-3.1 [11] and IAEA GS-G-3.5 [2] to include the requirements that were in GS-R-3 that were not included in GSR part 2. IAEA management system guidance has a "comply or explain" status from a regulatory perspective. It, therefore, needs to be considered very carefully.

Approach to third-party certification and review

Generally, nuclear establishments have third-party certification for their management systems although this is not a requirement. The mostly commonly used standards are ISO 9001, ISO 14001 and ISO 45001. GSR part 2 cannot be used as a certification standard.

Benchmarking between sites and organisations is good practice and is internationally encouraged by WANO, INPO and IAEA OSART missions.

Document control, periodic review and key documents that affect the management system

The nuclear site licence conditions that are placed on UK licensees result in a number of strict controls and review requirements. Important examples are;

- Documents and records management. Generally nuclear operators have good control over documents with dedicated staff who may also manage site records.
- Periodic reviews of safety cases. Review periods vary from typically two to five years.
- Licensee organisational changes. Changes are controlled by a formal process, usually known as ‘management of change’ or MoC, where the nature of the change is reviewed for the effect on nuclear safety.
- Changes to safety cases and associated plant engineering modifications, nuclear security and emergency plans and nuclear transport package approvals.

Management system roles

Quality professionals’ involvement with the management system on a nuclear site or supplier to the nuclear supply chain will typically be a combination of:

- Owner of all or part of the management system responsible for ensuring that the management system is defined, controlled, in a fit state and available to the organisation. This involves liaison with senior and middle management who are the authors and approvers of the content.
- Working to the management system within a function or project on a nuclear site with responsibility for quality and records management, for instance, as a Quality Engineer assigned to a specific engineering project.
- Working to own company management system supplying product or services while interpreting the requirements of the supply contract and associated specifications.
- Overseeing or auditing arrangements and monitoring compliance with the management systems.

Expectation of Safety Case (Safety Analysis Report) content

The management system of a nuclear facility is a significant contributor to the safety justification for its operation. Relevant management system arrangements are, therefore, defined within the facility safety documentation. In UK the main safety document is called a Safety Case. The IAEA uses the terminology Safety Analysis Report [37].

UK Regulatory requirements relating to safety cases are defined in licence conditions [38] particularly LC14 Safety Documentation.

Other sources of information

ONR Nuclear Safety Technical Inspection Guide on LC 17 Management systems [19].

Management Systems have been addressed at various Nuclear Special Interest Group (NucSIG) events. NucSIG webinars are available to IRCA/CQI members through the CQI website. The NucSIG website has some material from past events.

Reports published by HSE/ NII regarding major inspections which include management systems give an insight into what can go wrong (Case studies). Issues identified relate to alignment of licence conditions and management systems, over-reliance on contractors, lack of strategic thinking and poor understanding of risks, failure to understand the effects of down-sizing and effort to manage contractors, shortages in key staff and lack of definitions of responsibilities and overly complex management, insufficient resources and lack of independent assurance system. More detail on specific issues is available in the individual reports and later reports provide information on actions taken and outcomes. See list of reports below:

- AWE [39], 1997: relating to licensing of the Aldermaston and Burghfield sites;
- Dounreay [40], 1998;
- British Energy [41], 2000;
- Sellafield [42], 2000.

3.4 Key Concepts

QA Grading

Overview

To avoid inappropriately applying overly prescriptive controls to non-nuclear safety significant tasks, a grading approach is used. This allows due rigour to be applied to those activities that truly are safety significant and lesser control to those that are less significant. The outcome of such grading is integral to almost everything that occurs related to the plant and operators.

To ensure appropriate grading, there is need first of all to appropriately classify/categorise all aspects of plant structures, systems and components (SSCs) (see IAEA Safety Guide No. SSG-30 Safety Classification of Structures, Systems and Components in Nuclear Power Plants [43] and ONR SAPs [18]).

The following legislation needs to be considered when grading requirements:

- Licence Conditions (LCs);
- RSA 1993 (Scotland);
- Environmental Permitting Regulations 2010 (England and Wales);

- Statutory plant legislation issued under HSWA 1974 such as pressure systems, COMAH, COSHH and CDM. All such legislation is risk-based with action criteria depending on the levels of hazard.

The following documents consider grading:

- IAEA GSR part 2 Leadership and Management for Safety;
- IAEA Safety Guide GS-G-3.1 Application of the Management System for Facilities and Activities, Section 2 Paras 2.37-2.44.

Additionally, there is useful detailed guidance to be found in the now superseded IAEA 50-C/SG-Q [44] and TECDOC-1740 Use of a Graded Approach in the Application of the Management System Requirements for Facilities and Activities [45].

Graded application

Requirements

Like any other business, resources on a nuclear facility are limited. They must be deployed in a manner that ensures:

a. Nuclear safety,
b. Conventional safety,
c. Environmental compliance and performance,
d. Security,
e. Programme, Commercial and Financial performance.

The LCs have always required a graded approach based on safety significance, for instance:

- Safety Cases and Modifications (LC 14 and LC 22);
- Control of Organisational Change (LC 36);
- Incidents on Site (LC 7).

These LCs ensure that issues, proposals, activities, items and occurrences that have a potentially greater impact on nuclear safety (safety significance) receive greater management attention and control.

The schedules associated with nuclear waste and discharge authorisations, issued by the EA and SEPA, similarly require a graded approach to be applied to activities required for achieving and demonstrating compliance.

The requirements of plant safety-related legislation issued under HSWA 1994 are all risk-based and set various criteria and levels which prescribe the extent of controls to be applied to mitigate risks, e.g. Pressure Systems Regulations, COMAH, COSHH, Regulatory Reform (Fire Safety) Order and CDM.

The IAEA management system standard GS-R-3, which sites have adopted in compliance with LC 17, explicitly requires that nuclear facility management systems requirements be graded so as to deploy appropriate resources based on:

- Significance and complexity;
- The hazard and the magnitude of the potential risk;
- The likelihood and potential of failure of the item or task.

GSR part 2 that has replaced GS-R-3 contains similar requirements relating to the application of a graded approach. ISO 9001 implicitly requires the application of a graded approach.

Graded application and process design

On nuclear sites, grading requirements are written into the process control arrangements. These arrangements set out the criteria for grading the various issues, proposals, activities, items and occurrences. The grading often considers criteria such as the likely impact on nuclear safety, conventional safety, environment, security, quality and financial and economic impact.

The following topics can significantly impact safety and business outcomes. They are examples of the type of issues to consider when deciding QA grading:

- Design verification: The extent and level of design verification is often graded on the complexity or novelty of the design and on the potential safety and environmental impact implications.
- Safety categorisation and classification: See IAEA SSR-2/1 Safety of Nuclear Power Plants Design [46]. There is a requirement in this document that “All items important to safety shall be identified and shall be classified on the basis of their function and their safety significance”. IAEA guidance on Safety categorisation and classification can be found in SSG-30 [43]. ONR Safety Assessment Principle ECS [18] addresses Safety Classification and Standards.
- Plant modifications and organisational change. The configuration and change control processes require that the proposed changes be categorised in terms of their potential impact on nuclear and general safety, environmental performance, security and business performance. Related review and approval of plant instructions may depend on the nuclear safety classification category of the plant.
- Plant events. Events are graded on the IAEA’s International Nuclear Event Scale [47] and addressed through emergency planning management activities.

- Project financial sanction. On NDA sites, for example, sanction is based on a priority assessment tool matrix to derive a programme risk score. This method includes consideration of safety and environmental impacts.
- Radioactive waste management. Radioactive waste is categorised based on activity and heat production and management activities are related to the category. In the UK, categories are High Level Waste (HLW), Intermediate Level Waste (ILW), Low Level Waste (LLW) and Very Low-Level Waste (VLLW). See the UK regulatory publication Basic principles of radioactive waste management [48].

The level of grading dictates the extent of process controls to be applied to comply with legislation and to reasonably ensure that satisfactory process outcomes are achieved. Process controls may include:

- The level of authority needed to approve process activities and outputs;
- The level of supervision, checking and inspection required;
- The level of competency of workers, e.g. training and competency grades or levels;
- The detail and extent of process control documents. The review and approval of various site management system documents is graded in so far as higher-level documents will usually require higher level review and approval;
- Hazardous material handling and transport arrangements;
- Validation by use of process arrangements/procedures/instructions;
- Validation of special processes, such as welding, heat treatment, cementation and vitrification;
- Instructions carried to the job or available as reference;
- Records requirements, such as their retention time and storage arrangements;
- Use of approved suppliers.

It can be seen from these examples that the grading and the associated controls applied to activities and items are not always common or similar. It is therefore not advisable to try to use a single set of grading criteria, but rather tailor the criteria and grading to the requirements (product) of each process and incorporate these requirements within the process documentation.

Continuous improvement

Background and definitions

The IAEA along with nearly all the world nuclear organisations express the aim of continuous improvement in almost every aspect of nuclear activity. At its highest-level IAEA's INSAG [5] said "The safety management system has two general aims: the first of which is to improve the safety performance of the organization." For this to happen the following are necessary:

- The operating organization needs to demonstrate a commitment to achieving improvements in safety wherever it is reasonably practicable to do so as part of a continuing commitment to the achievement of excellence.
- The safety performance of the organization should be routinely monitored in order to ensure that safety standards are maintained and improved.
- There will be a well-defined process to support a commitment to continuous improvement. Such a commitment is an essential feature of an effective safety management system.
    - It provides a clear demonstration of the organization’s commitment to safety.
    - However, in the drive for improvement, consideration should be given to the cost effectiveness of possible improvement options.
    - The improvement process should make use of the findings from audits and reviews to identify priorities for improvement.
    - To promote ownership of the process throughout the organization, staff should be involved in generating ideas for improvements.
    - An improvement programme should be drawn up to integrate and co-ordinate the various improvement initiatives and to identify the appropriate priorities and resource requirements.
- Improvement programmes need to be routinely monitored against specified objectives and supporting targets.
    - Senior managers should be involved in this process to demonstrate their commitment.
    - As part of the monitoring process, targets and timescales should be reviewed and revised as appropriate.
- Forward looking indicators (sometimes referred to as ‘input’ or ‘proactive’ indicators) which measure positive efforts to improve safety are particularly valuable, although they are recognized as being more difficult to develop and measure objectively.
- Improvement measures usually take a substantial time to be reflected in performance data, particularly when data are analysed on a rolling basis (e.g. monthly data analysed on a 12-month rolling average).

Specific studies and general experience have shown that frequently occurring underlying conditions at those plants which have had significant problems include:

- Acceptance of low standards of plant condition/housekeeping;
- Failure to recognize that performance is declining and to restore higher levels of performance in specific areas at an early enough stage;
- A lack of accountability among line management and workers;
- Ineffective management monitoring and trending of performance

- deficient performance in the control room;
- an increasing human error rate;
- inadequate and/or poorly used procedures;
- insufficient and/or ineffective training;
- insufficient use of operational experience feedback and root cause analysis programmes in the analysis of events and 'near misses';
- an inadequate control of design configuration;
- failure to benchmark against those with better safety performance;
- a lack of awareness among the top managers about the principal deficiencies and associated corrective actions often reinforced by a 'good news' culture;
- inadequate or insufficient self-assessments being carried out on issues relating to safety culture;
- inadequate capability for supervising and monitoring contractors.

While weakness in a few areas can exist at even top performing plants, experience has indicated as a rough 'rule of thumb' that when weaknesses are apparent in more than a few of these conditions, there is a danger that a significant decline in plant performance is occurring.

Guidance

IAEA TECDOC-1491 [49] provides guidance on management of continual improvement. The document advocates the following principles:

- Long term commitment from senior management throughout the entire organization;
- The implementation in the organization of a process management approach such as that advocated by IAEA Safety Standards, ISO 9001, Malcolm Baldridge National Quality Award and European Foundation for Quality Management (EFQM) Business Excellence model;
- The alignment of the processes with the objectives of the organization through the organization's business plan;
- The utilization by Management of the process information as an input to managing the organization;
- The employment of the information derived from the process performance to identify and prioritize the processes that require improvement;
- The active participation of all staff of the organization to using its processes in order to contribute to continual process improvement (CPI)."

IAEA TECDOC 1491 sets out a management driven 7 step cyclic approach is shown in Fig 1 below. (Adapted from INTERNATIONAL ATOMIC ENERGY AGENCY, Management of

Continual Improvement for Facilities and Activities: A Structured Approach, IAEA-TECDOC-1491, © IAEA, Vienna (2006) page 3.)

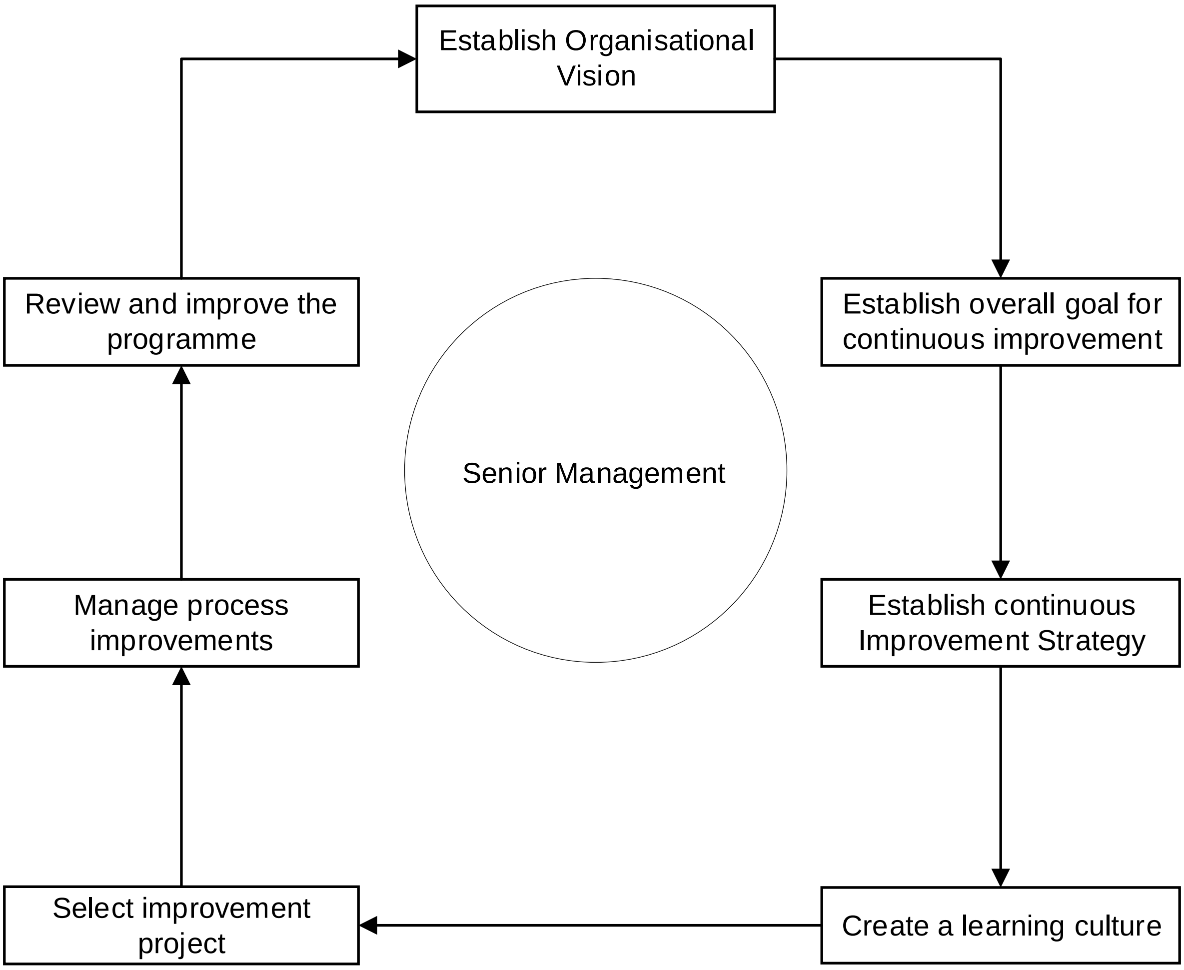

Figure 1 Management driven cyclic approach [Source: IAEA TECDOC 1491]

Organisational Management

Overview

Poor organisational management has been a significant contributory factor in major industrial accidents such as Chernobyl, the Texas City Oil Refinery, Piper Alpha, the Nimrod crash and Deepwater Horizon.

The lifecycle of a nuclear plant, from design, construction and operation through to decommissioning and demolition, stretches into decades and for some facilities even centuries. During this time the configuration of the organisational (sometimes referred to by academics as configuration) and managerial arrangements will change extensively. ONR found this a significant issue in relation to AWE, Dounreay, Sellafield and British Energy in the late 1990s/ 2000 (see summaries in Section 3.2). This led to the introduction of an additional standard Licence Condition (36 - Control of Organisational Change). Before change can be assessed, a "baseline" needs to be established which quantifies all tasks that need to be undertaken. In normal operations this could include fire watch personnel, emergency response teams, security guards, health physics attendants and the management required to oversee them.

Changes must be controlled throughout the lifecycle of the plant to ensure the on-going safety of the public, workers and the environment. This requires effective organisational management. Organisational management requirements and arrangements will vary from one situation to another – but the objective is the same: to enable the maintenance and consistency of systems that ensure performance and operation.

Effective organisational management ensures that:

- The management arrangements required to operate the site safely are adequately defined and understood (the "baseline"), which will inevitably include licensee Headquarters and Supply Chain inputs.
- Organizational changes are controlled (often referred to as Management of Change (MoC) process).

Regulatory requirements

The nuclear site licence and other legislation require that adequate organisational management processes and arrangements be established at each site. It should be noted that the site quality function will be heavily involved with the development, deployment and, in some instances, management of these arrangements.

The following legislation requires organisational management as part of the compliance arrangements:

- Licence Conditions (LC):
  - 17: Management Systems,
  - 36: Organisational Capability;
- RSA 1993 / Environmental Permitting Regulations 2010;
- Environmental protection legislation; and

- Nuclear Industries Security Regulations 2003 and supporting ONR security requirements.

General organisational management arrangements

Organisational management planning is a fundamental aspect of good organisational management for all applications. An organisational management plan should capture responsibilities and authorities and should provide a focus on customer and other stakeholder (regulatory) requirements for plant, project or activity.
The general approach for ensuring effective organisational management would consider the following points:

- A description justification and record of the change;
- A categorisation of the change identifying level of complexity, resources and impact to programmes and scheduling;
- An evaluation of the consequences of the change, this is particularly important in terms of its impact.

General aspects need to be considered such as:

- Documentation of the change itself and resulting procedural changes;
- Human factors aspects of safety assessment – what training needs to be undertaken and capability of individuals / teams to undertake both the change and outcome;
- Authorisation to implement at a point in time;
- Periodic review of the organisation to see that it remains ‘fit for role’.

Other sources of information

There are many publications on the general (non-nuclear) subject of organisational design. A Nuclear Baseline and the Management of Organisational Change Good Practice Guide [50] has been produced on behalf of the Nuclear Industry Safety Directors' Forum.

A useful UK example can be found in NNB GenCo’s application for a nuclear site licence for Hinkley Point C (July 2011), which includes their Management prospectus and Nuclear Baseline documents (Part A and Part B). These should be read with ONR’s Assessment reports which include one on NNB GenCo Organisational Capability Arrangements [51].

Risk informed decision making

Safety Analysis

The topic of risk is fundamental in nuclear safety considerations (see Fundamentals Chapter 2 Section 1) and has been addressed alongside hazards since the outset of the nuclear industry.

Initially the safety cases for nuclear facilities were based on engineering standards and scientific understanding – the deterministic approach, in what became known as Design Basis Analysis (DBA), this was then developed by addition of fault studies. UK terminology and practice was set out in NII (now ONR) Technical Assessment Guide NS-TAST-GD-006 Design Basis Analysis [52] originally based on the 1992 SAPs.

Probabilistic Safety Assessment (PSA) (referred to in US as Probabilistic Risk Assessment (PRA)) was developed through the late 1970s/80s as a means of gaining insights into relative contribution to risk of identifiable initiating faults, generally utilising the high analytical power of computer systems. Reactor PSA studies are typically undertaken at three different levels:

- A Level 1 PSA provides information on reactor core damage frequency;
- A Level 2 PSA provides insights on radioactive releases to the environment; and
- A Level 3 PSA estimates the radiological risks to the public and the environment around the facility.

At each level the PSA provides estimates of the probabilities (frequencies) of adverse consequences and information on the dependence of these values on various factors, such as technical design features, potential human errors, or weather conditions.

Expectations

The expectation from SAPs is that a safety case (see ONR Technical Assessment Guide NS-TAST-GD-051 [53]) should provide an analysis of normal operation, potential faults and accidents, and of the engineering design and operations, and demonstrate the risks from all these perspectives have been reduced to ALARP. Guidance on deterministic safety analysis for nuclear power plants is provided in IAEA Safety Standards Series No. SSG-2 [54].

Use of safety analysis

One of the earliest complete studies using PSA on a commercial nuclear plant was the WASH-1400 study prepared for NRC, also known as the Reactor Safety Study or the Rasmussen Report [55].

It has been understood for some time that Level 1 and Level 2 PSAs can provide useful information for decisions influencing the safety of the nuclear power plant, while a Level 3 PSA is particularly useful in decisions relating to the siting of nuclear power plants and to emergency planning. The IAEA's Safety Standards highlight the need for integrated assessment for decision making. IAEA GSR Part 4 "Safety Assessment for Facilities and Activities" [56] requires that the results of the safety assessment be used to make decisions in an integrated, risk informed approach. IAEA INSAG 25 provides an overview of an Integrated Risk Informed Decision-Making Process [57].

Integrated Risk Informed Decision Making (IRIDM)

INSAG argue that "IRIDM is a systematic process aimed at the integration of the major considerations influencing nuclear power plant safety. The main goal of IRIDM is to ensure that any decision affecting nuclear safety is optimized without unduly limiting the conduct of operation of the nuclear power plant." The key elements of the IRIDM process are described in INSAG 25, see Figure 2 below. (Source INTERNATIONAL NUCLEAR SAFETY GROUP, A Framework for an Integrated Risk Informed Decision Making Process, INSAG Series No. 25, © IAEA, Vienna (2011) page 6.)

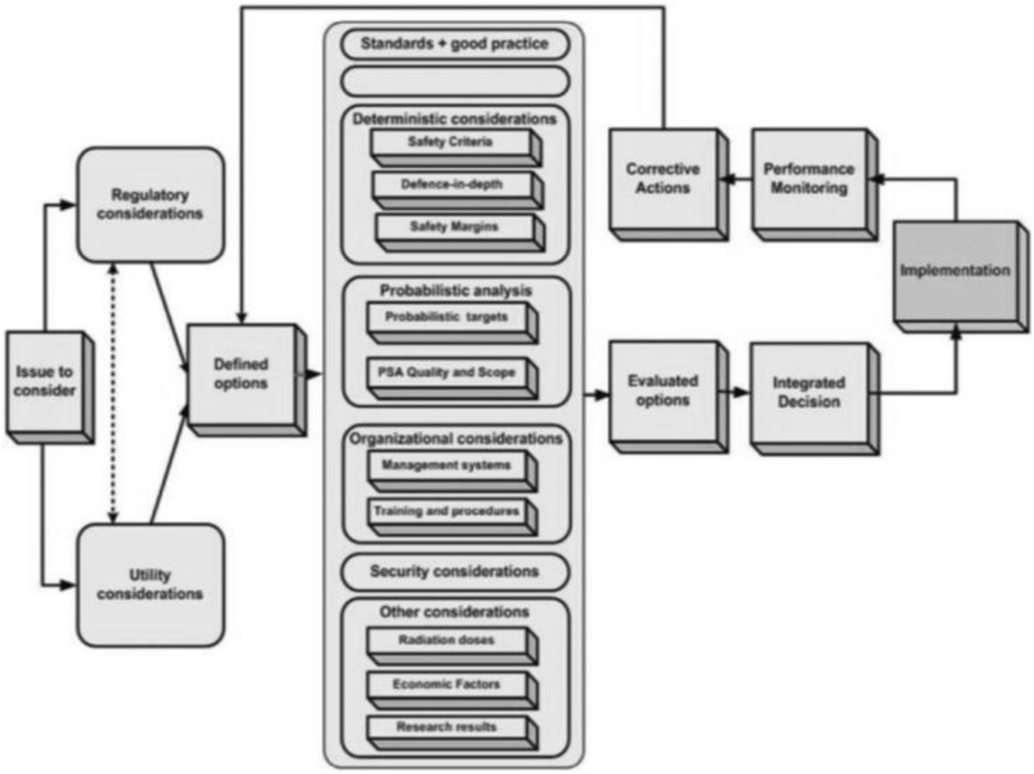

Figure 2 Key elements of the Integrated Risk Informed Decision Making process [Source: INSAG 25]

Other Sources of Information

Paper on IRIDM and IAEA's approach [58]
USNRC's Japan Task Force Report (page 17) [59].
NEA CSNI papers 7 and 8 (2005) addressing Living PSA and Risk Monitors [60]

3.5 Expectations of Supply Chain

Overview

Few if any licensees these days have themselves the capabilities to undertake all the nuclear safety- related work. From concept design through to decommissioning, the use of specialist support can vary from R&D through design and manufacture to activities such as inspection and test, records storage and third-party auditing.

The use of the supply chain is common to most organisations, regardless of activities or sector. Indeed, reports indicate that between 50% and 80% of licensees' annual site budget is with the supply chain. As such Supply Chain Management is addressed specifically in Chapter 7. Differing definitions of Tiering addressing suppliers are set out in Chapter 1.

Before an organisation attempts to become part of the supply chain, it has to understand what is expected of it and what is different from their day-to-day ways of working. Expectations apply both ways and it is important to recognise that Supply Chain companies have expectations of the Operators and Main Contractors.

Operators/Main Contractors

The top tier organisations need to:

- Have a clear understanding of what it is they want from their suppliers (see quote by former CEO EDF Vincent de Rivaz below);
- Ensure their suppliers have the capability to meet their needs (a critical pre-qualification consideration);
- Communicate their needs clearly through explicit contract requirements and detailed specifications/ drawings;
- Confirm that their requirements are well understood;
- Verify that requirements have been delivered including undertaking adequate Quality Assurance and Quality Control activities for items important to nuclear safety and not merely relying on supplier paperwork.

Supply Chain

The supply chain contractors need to:

1. Understand the significance of the role and culture in nuclear work;
2. Ensure that they understand exactly what is wanted of them;
3. Meet the requirements placed upon them;
4. Question any aspects where they have concerns about their understandings;
5. Pass on the appropriate requirements to their own sub-tier suppliers (same criteria as above for top tier organisations now apply to them).

Within larger organisations, procurement systems should also address internal / inter-department / multi-site supply.

The NIA online publication [The Essential Guide to the new build nuclear supply chain] [61] provides a useful overview on expectations.

Evidence by Vincent de Rivaz (CEO EDF) to House of Commons Energy and Climate Change Committee, 23 Oct 2012: Qs195 / 197 / 201

"There are two aspects to the construction risk. The first and most important one is to reduce those risks from the start, and that is the job that we have to do as the leader of the construction of these nuclear power plants. It is a job we do by having put in place a world class team, which is very clear about what it means to reduce the construction risk: to have a stabilised design before starting; to carry out detailed engineering studies before we start construction; and to have robust project management organisation with the role for engineering, the role for construction planning, the role for project managers, the role for commercial directors, the role for quality assurance, and the role for safety control.

We also need to have a one team approach with all the main contractors civil, conventional island, nuclear island-working as one team with the same goal and the same purpose. We need to be clear that we will not start before we are ready, but when we start, we will not stop. That is in a context where, I repeat, the key issue is to have a stabilised design before we start the construction, and it is all that we are doing. So, the first response to the question of construction risks is to reduce them, to mitigate them, to control them as a competent and efficient company.

It is a matter of great importance for us because we cannot succeed in delivering this project or in operating it for 60 years without a strong, competent, dedicated supply chain. That is why over the last three years we have organised a series of events to inform, to engage and to mobilise the UK supply chain, in the view that they take a significant role in the delivery of our project. I am confident that it will be the case. It is probably not appropriate to give any specific number, but our ambition is clearly that more than half the value of our project will be sourced from the UK. We will create through this project, something that has great importance for UK supply chain. This will be the first English speaking supply chain able not only to deliver in Britain, but to deliver projects of this kind in other parts of the world. That is our ambition.

Part of the supply chain point you are raising is how we are going to engage with the productive workforce during the construction of our project. I am pleased to say, without entering into too many details, that this new covenant we want to have, is now making significant progress. We are involving the unions and we expect to be able, in the next few weeks, to have this framework agreement in place-a tripartite agreement, with us as the client, the main contractors would be the civil works companies, the provider of the equipment for the conventional or the nuclear island, and the unions. That is part of the vision, we cannot engage in such a project without having clear vision of all the key factors to make it a success, and that is what we are doing."

For full transcript see: Evidence [62].

3.6 Stakeholder Engagement

The following generalised diagram (Figure 3) shows typical nuclear stakeholders and their interactions. The actual interactions will vary in practice depending on a number of factors such as licensee organisation, activities and localities.

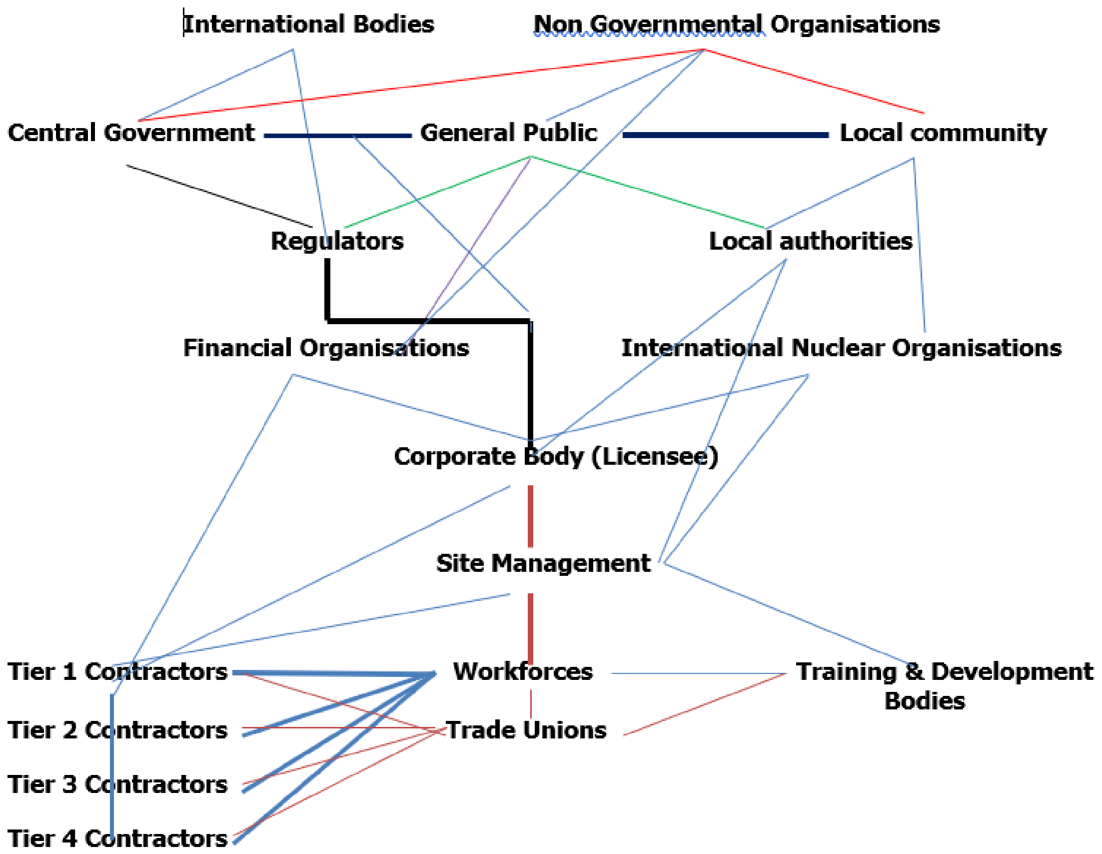

Figure 3 Nuclear related stakeholders and interactions

Annex A below identifies a number of UK Stakeholders and their expectations.

High level interactions (e.g. Government/Regulator/International/Non-Government Organisations) help to formulate the policies that apply to the nuclear industry and the objectives that have to be met by the industry. Outputs from these interactions are most likely to be found in the annals of the various organisations. In the UK, the Government department web sites contain, or direct to, most of the relevant information. Major UK policies are contained in White Papers/Acts of Parliament/Regulations. At international level, such as the IAEA, any interested party can comment on draft documents via their national authorities such as ONR for the UK. UK government departments and regulators have undertaken public consultation on many aspects of UK policy and regulation. Parliamentary Select Committees have heavily scrutinised many of their resultant proposals.

Operators at corporate level interact to diverse organisations in obtaining policies, finance and public acceptance of their business. That is often a long and confused story, but now will nearly always involve “Stakeholder” meetings and presentations, often drawing in NGOs, Regulators and both national and local politicians. Without the right combination of “Stakeholder” support operators will not find the business justifiable.
At site level, the local public will inevitably seek information about the plant(s); many of them or their relatives will be workforce, and some will have high levels of technical understanding whilst others little in-depth knowledge of what is involved. Outwardly looking this will focus through Local Liaison Committees – details of these, including report papers and minutes, can be found via NDA, SLC and ONR web sites. More detailed regulatory reports, such as inspections and technical assessments, can be found on ONR web site; ONR inspectors also regularly meet with site safety representatives who are statutorily established. On site, management interactions with workforce will include staff tool-box briefings, events to champion nuclear safety, newsletters. More recently, in the spirit of openness and no-blame culture, processes for whistleblowing have been developed.

Annex A – Stakeholder Groups’ Expectations (a perspective)

Stakeholder	Expectations	Comment
International bodies	Bodies like IAEA and NEA, which are linked via UK national membership, or ENSREG and WENRA, which interact with ONR. These organisations will expect that activities, be they nuclear power, fuel cycle, defence or medical/ industrial usage, will be conducted safely and securely and without proliferation. As such they will expect “best practices” to be followed with desires for “continuous	The UK actively participates in these organisations. This involves Government, Regulators and Industry. Interests include ensuring that UK approaches organisationally, technically and legally are accommodated.

Stakeholder	Expectations	Comment
	improvement". Additionally, Defence interests will have strong US interfaces.	
Non Governmental Organisations	These will depend very much on the aims of the NGO and can be pro- or anti-nuclear. Pro-nuclear In this group we can include WANO, INPO, WNA, WINS, FORATOM. Anti-nuclear Friends of the Earth (FoE), Greenpeace and CND are probably amongst the best known and worldwide, but there are also more regional / community ones like CORE [63], NFLA [64], PAWB [65] , SCRAM [66] and WISE [67] plus individuals such as John Large and Peter Wilkinson. Some organisations have limited life dependent on individual participants or duration of local activity. The following is an outline of the position expressed by some of the key organisations: FoE work by lobbying internationally, nationally and locally, online and by setting up local groups. A significant activity is centrally producing 'campaign' material, such as 'climate change' and 'clean British energy', amongst which advocating that nuclear power is not a solution. Greenpeace's stated vision and approach to making change happen are: "Our vision is to transform the world by fundamentally changing the way people think about it." "Greenpeace stands for positive change through action. This action takes many forms - from investigating and exposing environmental abuse and lobbying	NGOs are difficult to define and classify, and the term 'NGO' is not used consistently. As a result, there are many different classifications in use. The most common use a framework that includes orientation and level of operation. An NGO's orientation refers to the type of activities it takes on. These activities might include human rights, environmental, or development work. An NGO's level of operation indicates the scale at which an organization works, such as local, international or national. NGOs vary in their methods. Some act primarily as lobbyists, while others primarily conduct programs and activities. Campaigning NGOs seek to "achieve large scale change promoted indirectly through influence of the political system." Campaigning NGOs need an efficient and effective group of professional members who are able to keep supporters informed, and motivated. They must plan and host demonstrations and events

Stakeholder	Expectations	Comment
	governments and decision makers to championing environmentally responsible and socially just solutions and taking nonviolent direct action.” Greenpeace proudly state their first campaign led to The Comprehensive Nuclear Test Ban Treaty. After the Nov 2012 publication of the NAO report on NDA and Sellafield, Greenpeace said “There are several reasons why Greenpeace opposes nuclear power, and the problem of nuclear waste is one of the hardest to resolve.” Greenpeace is known for its direct actions and has been described as the most visible environmental organization in the world. Greenpeace has raised environmental issues to public knowledge, and influenced both the private and the public sector (Wikipedia), Greenpeace has also been a source of controversy; its motives and methods have received criticism and the organization's direct actions have sparked legal actions against Greenpeace activists. CND’s stated objectives are: Elimination of British nuclear weapons and global abolition of nuclear weapons Abolition of other threats of mass destruction or indiscriminate effect Nuclear-free, less militarised and more secure Europe The closure of the nuclear power industry.	that will keep their cause in the media. They must maintain a large, informed network of supporters who can be mobilized for events to garner media attention and influence policy changes. The primary purpose of an Advocacy NGO is to defend or promote a specific cause. As opposed to operational project management, these organizations typically try to raise awareness, acceptance and knowledge by lobbying, press work and activist event (Wikipedia). Details of NGO Forums held by Government [68]and NDA [69] are on the GOV.UK website. Details of ONR interactions with the NGO community can be found via a search on the ONR website.
Central Government	Government departments have defined policies and strategies that can be accessed via the GOV.UK website. Particularly relevant is the British energy security strategy [70].	Parliament, including its bodies such as Select Committees, is discussed under General Public.

Stakeholder	Expectations	Comment
	The NDA [71]and EA [72]sites are also accessed at GOV.UK.	
General Public	The population of England, Wales, Scotland and Northern Ireland. The primary focus of public representation is MPs in parliament.	The level of understanding will be very varied and, in many cases, informed by media or NGOs.
Local community	Each Licensed site has a Local Liaison Committee / Site Stakeholder Group that includes local authorities, trade unions, interested local groups and members of the public. Regulators and operators provide reports to each LLC/SSG meeting (usually quarterly).	ONR publish their reports to the LLC/SSG meetings [73].
Regulators	The regulators prime interest is to undertake activities defined in legislation. Their primary focus is ensuring safety (even security is there to ensure safety) on behalf of the wider public, reporting through government ministers to parliament. ONR's mission is "To provide efficient and effective regulation of the nuclear industry, holding it to account on behalf of the Public."	
Local authorities	Local authorities have their own statutory roles in regulating aspects of sites, such as, local planning issues. They also are required by REPPIR to prepare and exercise Emergency Arrangements. They are members of the various SLCs / SSGs.	
Financial Organisations (incl. Shareholders)	The City / HM Treasury / shareholders are key providers for the nuclear industry; without the provision of funding, it would not operate. As such they need to see 'value for money' and will critically examine management, organisational and programme/ project efficiency.	

Stakeholder	Expectations	Comment
International Nuclear Organisations	The main objectives of each vary. IAEA – Three main areas of work underpin the IAEA's mission; Safety and Security; Science and Technology and Safeguards and Verification [74]. The Nuclear Energy Agency (NEA) [75]. The mission statement is "To assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes. It strives to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD analyses in areas such as energy and the sustainable development of low-carbon economies."	UK government, Regulators and Industry representatives make significant input to many of the activities. A clear aim is to ensure best practices across nations are reflected in conventions, standards and guidance, without imposing anything inappropriate to UK industry or legal practices.
Corporate Body (Licensee)	The corporate body has to meet the requirements of corporate law, regulators and financial markets. In doing so they have to (in EDF Groups 2012 words)" turn in an outstanding industrial, economic and financial performance". To operate efficiently they need to work in partnership with many suppliers and set clear expectations of the whole supply chain.	The average one-day loss of generating on a UK nuclear reactor is in the order of £0.6m.
Site Management	The site management has the prime day to day issues of operating / maintaining the plant. As such it has to operate within the corporate and site procedures / processes yet optimise the work of operators and plant. They need to have significant input into the	

Stakeholder	Expectations	Comment
	supply chain affecting the site. They will be a prime focus for local communities and authorities, as well as regulators.	
Tier 1 Contractors	As Licensee, but may depend on role, have different approaches that need to be reconciled, e.g. New Build reactor designers working to French / US standards and matching into UK approaches / Licensee requirements. For NDA and Defence, they will also need to meet their contract requirements and specifications.	
Tier 2 Contractors	Need to understand the Tier 1 requirements but also meet specific Licensee requirements applied via clear contract requirements and specifications.	
Tier 3 Contractors	Need to meet specific License, Tier 1 and Tier 2 Contractor requirements applied via clear contract requirements and specifications.	
Tier 4 Contractors etc	Need to meet specific License, Tier 1, 2 and 3 Contractor requirements applied via clear contract requirements and specifications.	
Workforces	Anyone working in the nuclear industry, at whatever level in the chain, is already a member of the General Public and in the minority a member of the Local Community. Regardless of their location, they need to be made clearly aware of their role, the nuclear cultural implications, the requirements expected of them in terms of technical skills, and any unusual contractual requirements.	The majority of the workforce is likely to be found in the supply chain, and a significant number may not be in UK based organisations. Probably the majority will work off-site and thus not be employed in radioactive environments.
Trade Unions	TUs have a significant role in looking after the employment conditions including health and safety of their members. They are also likely	

Stakeholder	Expectations	Comment
	to be involved in definition and supply of skills training to give those members employability advantages.	
Training & Development Bodies	The National Skills Academy for Nuclear [76] was set up in January 2008, to work with existing training providers across the UK to develop training and qualifications in the nuclear area. To identify possible future skills gaps and develop mitigating actions, the Nuclear Development Forum and OND requested that Cogent (the Sector Skills Council covering nuclear) look at this issue alongside other reports that they have published on the civil nuclear workforce. In March 2010, they published Next Generation: Skills for New Build Nuclear which identified future possible skills gaps and high-risk skills (if current industry plans are realised), and suggested a series of mitigating actions to minimise the risk of key skill shortages. The Nuclear Energy Skills Alliance [77] is a grouping of the key strategic skills bodies and organisations with an interest in nuclear skills and government. The alliance works to address the current and future skills needs of the UK nuclear programme and all members have agreed to work together in order to ensure an agreed frame of reference regarding nuclear skills and to minimise duplication and overlap of work. The National Nuclear Laboratory (NNL) [78] in Cumbria was established in 2008. NNL's key objective is to help to safeguard and	

Stakeholder	Expectations	Comment
	develop nuclear expertise and laboratories across a number of different sites.	

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RCC-C	Nuclear Fuel
RCC-E	Electrical Equipment
RCC-M	Mechanical components of LWR
RCC-MR	Mechanical components of FBR
ETC-C	Civil Works (Note replaced RCC-G)
RSE-M	In-service surveillance of mechanical components

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Revisions

Revision date	Description	Contributors	Editors
January 2019	Hypertext links checked and updated. Minor textual changes made reflecting formation of ONR in April 2014, formerly NII / HSE. Text updated to reflect GS-R-3 superseded by IAEA GSR Part 2 and updates to ISO and other standards. References to latest IAEA documents on safety culture assessment included.	Richard Hibbert, Mark Lyons, Bob McGeary	Iain McNair
January 2023	Content and format updated by NNG.	NNG Steering Group	NNG Steering Group