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An efficient and effective nuclear security regulator

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Abstract

Global security is a growing political concern. Advances in cyber technology, increasing numbers of reports of violent fanaticism, and a rise in the prominence of non-state actors, have all contributed to an unsettling of the traditional view of security provision. In parallel, governments have been under pressure following the Global Financial Crisis of 2007/08 to reduce the burdens of their regulatory frameworks, both to reduce public spend, and to allow the grass roots of recovery to take hold. Consequentially, the "Better regulation" movement has challenged regulators to become more efficient and effective. The way nuclear security regulators respond to these challenges will be important for present and future global security, as well as the level of trust held by the public in the nuclear industry. This report uses established literature to define what "efficient and effective" means for regulators. It then provides an overview of nuclear security and safeguards, and explores the international guidance on national nuclear security and safeguards laws and regulations. The main section of the report continues by discussing four metrics which strongly influence efficiency and effectiveness, concluding that in order to hold industry to account, regulators must: strike a balance in their approach to internal and external relationships; carry out their regulation on a national assessment of threat; and do both of these through an established, agile, framework of law and regulation.

Chapter 1

Defining "efficiency" and "effectiveness" for regulators

This chapter begins with providing an overview of a regulator's purpose. The expectations of a regulator, their role, and metrics for their efficiency and effectiveness, are also discussed.

1.1 Expectations of modern-day regulators

Regulation is: "Any rule endorsed by government where there is an expectation of compliance" [1, p3], or: "Any government measure or intervention that seeks to change the behaviour of individuals or groups" [2, p1]. A regulator is any government body which devises, prescribes, implements, maintains or removes regulations. The purpose of regulation is to ensure that those entities carrying out activities which attract both benefits and risks, operate to the required level to protect the interests of all affected parties. Regulators are commonly found in high-hazard and complex industries, including the nuclear industry, due to the significant consequences of incidents or accidents affecting large populations.

It is critically important for regulators to represent and act independently of undue influence from industry or other partisans. It is also important that their regulatory framework is understood by all regulated and potentially affected parties. The regulator plays a critical role in enabling regulated companies to achieve institutional trustworthiness, thereby providing them with a public mandate to continue to operate. Trustworthy and stable legal institutions (e.g. trusted regulators) are a pre-requisite for the continuation of high-hazard and complex industries [3, p22], while it could be argued that ineffective regulators may accelerate the cessation of such activities[1].

[1] The German Bundestag's response to the Fukushima accident of March 2011 is an example of how losing the public mandate may impact ongoing operations. By voicing their lack of trust in the global nuclear power industry, the German people expressed their emotions to the German nuclear power industry through a series of anti-nuclear protests, prompting an order from the national government permanently to shut down a number of older nuclear reactors and phase out nuclear power altogether by 2022. The Japanese regulator had assured the safety of the industry against natural events, but (with the benefit of hindsight) to an insufficient

The UK Government's "Better regulation initiative" lists five key principles for regulators for "measuring and improving the quality of regulation and its enforcement" [2, p1], within which the importance of regulatory effectiveness is evident. These principles are presented in Table 1.1 on page 3.

Principle	Explanation
Proportionality	Regulators should only intervene when necessary. Remedies should be appropriate to the risk posed, and costs identified and minimised
Accountability	Regulators must be able to justify decisions, and be subject to public scrutiny
Consistency	Government rules and standards must be joined up and implemented fairly
Transparency	Regulators should be open, and keep regulations simple and user-friendly
Targeting	Regulation should be focused on the problem, and minimise side effects

Table 1.1: The five principles of good regulation [2, pp4-6].

More recently, governments have reduced public spend budgets and acted to remove unnecessary burdens on industry. Regulators are "cutting red tape" to become more "efficient and effective" and this phrase has now been adopted within the contemporary language of regulatory governance. For example, the UK's Office for Nuclear Regulation ("ONR") mission includes "Providing efficient and effective regulation of the nuclear industry" [5, p1][2].

Recent developments in regulatory governance result from a movement in government's assessment of the balance between both public interest in the protection a regulator provides, and perceived restrictions on growth, entrepreneurism, and the associated costs of regulation.

1.2 What does efficient and effective mean?

OECD-NEA define effectiveness in nuclear regulation as "ensuring that nuclear facilities are operated safely," and efficiency as "doing this work right and with good governance" [7, p20]: efficiency therefore presents as a subset of effectiveness[3]. An alternative view is that to be effective one must incur some inefficiency, and vice-versa[4]. Regulatory efficiency has recently risen in importance, but governments must also continue to improve the effectiveness of their regulatory regimes to counter new and growing threats, and demonstrate better

level. Further: post event analysis and investigation has concluded that the approach of the Japanese regulator to regulation directly contributed to the disaster [4, Executive Summary, p9].

[2]More recently the same phrase was used by the Chairman of the US Nuclear Regulatory Commission at their 27th annual Regulatory Information Conference in 2015: "The NRC must reposition itself to function as an even more effective and efficient regulator in this new environment, while retaining the capability to respond in an agile manner to a range of possible futures" [6].

[3]i.e. one cannot be effective without also being efficient.

[4]i.e. that absolute efficiency and total effectiveness are mutually exclusive.

protection for affected parties. Both efficiency and effectiveness are therefore expected by society, this is especially relevant in the field of nuclear regulation.

Characteristics	Explanation
Clear and consistent regulation	Regulatory requirements and guides should have a clear legal basis and status; be readily understood, coherent and logical; connect clearly with the regulator's goals and objectives; and be benchmarked against established international expectations
Consistent and balanced decision making	Regulator's decisions should have a clear legal / regulatory basis; be fact-based and justifiable; be consistent across similar scenarios or circumstances; and be seen by impartial observers as being fair to all parties
Accountability	Regulators should be able to explain their decisions and actions, and withstand challenges if they arise
Strong organisational capability	Regulators should possess sufficient financial resources; be competent in all important areas including leadership; and have an effective management system
Continuous improvement, peer review and international involvement	Regulators should monitor the performance and effectiveness of their strategies and embrace a culture of continuous improvement through both internal assessment and external involvement
Efficiency	Regulators should make sound use of their resources to act without unnecessary delays without harming the effectiveness of their activities
Credibility, trust and respect	Regulators should strive for credibility, trust and respect by exhibiting the attributes described above

Table 1.2: Characteristics of an effective nuclear regulator [7, pp17-20]

Continuous improvement is an important addition to the essential attributes of an efficient and effective regulator. OECD-NEA offer their view of essential characteristics (see Table 1.2 on page 4) in their publication on effective nuclear regulation[5]. Separate contributions from the UK and Australian governments [8, 9] (see Section 4)[6] draw very similar conclusions to OECD-NEA on the characteristics considered to be most important.

[5]OECD-NEA focus strongly on the regulation of nuclear safety; nuclear security is mentioned just once in this publication. However the contemporary nuclear viewpoint is valuable to this report.

[6]Both of these guides are non-specific to the nuclear industry but their common themes should be recognised, along with the observation that in the UK, the ONR (which holds responsibility for the regulation of nuclear safety, nuclear security and nuclear safeguards) is bound by the content of the Regulatory Code [9, and supporting documents].

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1.3 Metrics for efficient and effective regulators

Regulator performance expectations are progressively evolving rather than undergoing revolutionary change. This gradual, rather than paradigm, shift implies that metrics for efficient and effective regulators are reachable through a rebalancing of existing essential characteristics, rather than a wholesale change to established thinking. Therefore, noting that the "hygiene factors" of regulatory enablement are not described further within this report[7], "efficient and effective" may be expressed as a recombination of existing characteristics, most importantly those detailed in Table 1.3 on page 5. It is proposed that by establishing a world-class rule book (i.e. being "Structured"), working with all relevant parties to implement those rules in as clear a way as possible (i.e. being "Co-ordinated"), taking into account emerging trends (i.e. being "Agile") and focussing on those with higher risk (i.e. being "Proportionate"), regulators are fully able to establish, monitor and enforce clear compliance standards for the regulated, thus holding them firmly to account.

Metric	Explanation
Structured	Regulators establishing accessible and logical regulatory hierarchies, linking implementing / technical guides and standards, through regulations and law, to the fundamental objectives which need to be addressed
Co-ordinated	Regulators working with external parties to reduce the burden on the regulated, by finding better and simpler ways of regulating while creating strength from critical "strategic alliances"
Agile	Regulators acting in an appropriate and timely manner, either to improve practices for regulators or the regulated, or in reaction to increasing external threats, all within a consistent framework of law and regulation
Proportionate	Regulators assessing risks across a wide spectrum and addressing all those that are most critical

Table 1.3: Important metrics for efficient and effective regulators

[7]The IAEA lists the important aspects of the organisation of the (safety) regulator as including: "structure, allocation of resources, co-ordination with other authorities, management system, staffing, and relationship with advisory bodies and support organizations." [10, pp16-17]. Only two of these aspects, being co-ordination with other authorities and relationship with advisory bodies and support organizations, are considered herein as of critical interest in the differentiation of nuclear security regulation from other regulatory disciplines

Chapter 2

Nuclear security and safeguards regulation

This chapter overviews the need for, and the objective of, nuclear security regulation. The tools instruments and requirements of the international framework of nuclear security regulation are explained at a high level. In recognition of their close link with nuclear security, a brief overview of international safeguards requirements is also included. Finally, an example of the implementation of international guidance within a state system will be provided.

2.1 The need for nuclear security regulation

Nuclear security is defined as: "the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities" [11, p1]. Principally evolving from the need to protect international transport of nuclear material, nuclear security has since developed due to: growth in peaceful uses of radioactive material[1]; changing threat characteristics to nuclear material and facilities; and therefore the growing expectation of a future requirement to prevent or respond to a nuclear security event.

The nature of threats to global peace continually evolve, currently due to the increasing geographical reach of malicious people unconcerned about causing harm to civilians and their property. Threats have grown with both technological advance[2] and the willingness of those branded as "radicals" to act in violent and potentially irrational ways for their causes[3]. Further, since the Chernobyl

[1]Including use in industrial, medical and scientific research fields.

[2]For example the increasing range and accuracy of ballistics (e.g. Iraqi WMD), the increasing mobility of pseudo-weapons (most vividly illustrated by the events of 11 September 2001) and the spread of technology with all of its benefits and vulnerabilities (e.g. access to information, increasing prevalence of untrustworthy e-contacts and the interconnectedness of essential infrastructure control systems) into everyday life.

[3]Minimising risk from inside actions (where legitimate knowledge and access is put to malicious use) is also increasingly important to counter both independent and (active or passive) collaborative actions by persons occupying positions of trust. The recent Malaysia Airlines MH370 and Germanwings Flight 9525 tragedies are most poignant reminders of this

disaster in 1986, the international nature of threats and the consequences of a nuclear security event have driven the IAEA and others to action, encouraging a global effort to increase nuclear security performance[4].

Nuclear security is the discipline of protecting against malicious threats. Nuclear security regulation is the established means of ensuring that appropriate protective measures are implemented throughout the international community. A nuclear security regulator is a government-backed organisation which sets out those regulations at the state level. So long as bad people exist, nuclear security regulators will be required to perform their role in ensuring adequate protection exists to defeat attacks, however they may manifest.

2.2 The objectives of nuclear security regulation

The IAEA have defined the objective of a nuclear security regime[5]: "to protect persons, property, society, and the environment from [the] harmful consequences of a nuclear security event" [12, p3]. Nuclear security possesses synergies with both nuclear safety (through its shared objective of protection[6]) and international security organisations[7]. Therefore, although nuclear security attracts internationally agreed definitions, principles and best practice recommendations, it must be established, implemented and maintained at the state level, in order to be consistent, or compatible, with a state's wider assessments of security threats.

The criminal sanctions required to deter and punish those who perpetrate or attempt to perpetrate nuclear security events necessarily also lie within a state's laws. Therefore it is appropriate that the legislative and regulatory framework for nuclear security at the state level, utilises principles and philosophies which are consistent with its own wider system of law, so allowing nuclear security to use existing national legislation and criminal sanctions.

In order to provide a seamless global blanket of security, a largely non-binding international framework of nuclear security guidance[8] has been authored. These documents address the protection of nuclear and other radioactive material in international transport against theft or sabotage; as well as the protection of nuclear and associated facilities from unauthorised access and sabotage, thereby reducing the risk of a nuclear security event being successful. The framework permits states to implement nuclear security regimes in accordance with their own domestic legislative requirements, while drawing from a set of established

requirement.

[4]The main motivation for this effort is the realisation that, as geographical reach of malicious people has increased, the least protected asset is also the most vulnerable asset. Irrespective of where the breached asset may be located, the potential consequences of any successful major security breach are likely to be global.

[5]This term is defined to encompass the legislative and regulatory framework, the regulator, and systems and measures for the prevention of, detection of and response to, nuclear security events [12, p13]

[6]c.f. the fundamental objective of nuclear safety, being: "to protect people and the environment from harmful effects of ionizing radiation" [13, p4].

[7]i.e. those providing protection against similar threats on non-nuclear facilities and materials, including intelligence communities and law enforcers.

[8]Including the IAEA Nuclear Security Series and World Institute of Nuclear Security Best Practice Guides.

best practices. They therefore contribute to providing countries with confidence in the nuclear security regimes established not only for their own undertakings, but also those of their neighbours.

2.3 International instruments of nuclear security regulation

National nuclear security regimes are heavily influenced by conventions, resolutions and treaties which are binding (under international law) on signature states. The critical convention in direct respect of the regulation of security of nuclear facilities and nuclear material is the Convention on Physical Protection of Nuclear Material (1980) ("CPPNM"). Other important conventions and treaties are listed in Table 2.1 on page 8

Term	Title
CPPNM	The Convention on Physical Protection of Nuclear Material (1980)
SUA	The Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (1988)[9]
Nuclear Terrorism	The International Convention on the Suppression of Acts of Nuclear Terrorism (2005)
NPT	Treaty on the Non-Proliferation of Nuclear Weapons (1970)
Early Notification	The Convention on the Early Notification of a Nuclear Accident (1988)
Assistance	The Convention on Assistance in the Event of a Nuclear Accident or Radiological Emergency (1988)

Table 2.1: Important binding international conventions relating to nuclear security [11, pp3-8]

Other international tools - including resolutions and non-binding arrangements - seek to promote national adoption and implementation of multi-lateral treaties aimed at non-proliferation and counter-terrorism[10]. CPPNM and subordinate documents however remain critically important in shaping national regulatory approaches to nuclear security. The structure of this document hierarchy is illustrated in Figure 2.1 on page 9.

CPPNM came into force in 1980. It was amended in 2005, although this amendment is not yet in force[11]. CPPNM sets out to protect civil nuclear material during international transport by requiring signature states to commit to a standard of physical protection of any relevant material crossing any international

[10]Most notably these include UNSC Resolutions 1373 and 1540; the US National Nuclear Security Administration ("NNSA") Global Threat Reduction Initiative; and US President Obama's Nuclear Security Summits.

[11]It should be noted however that the work plan published as a part of the Washington Communiqué of the 2010 Nuclear Security Summit [14] affirms the intent of parties there present, to work towards adopting the provisions of those conventions to which they have not yet acceded, critically including the 2005 amendment of CPPNM.

borders, and by setting standards for physical protection within national boundaries for nuclear material in domestic use, storage or transport. These physical protection standards must also be met by signatory states intending to transfer such material to or from non-signatory states. International co-operation is required to criminalise specific malicious acts, and to design and enhance physical protection measures. Importantly, although CPPNM is clear in defining a categorisation for nuclear material[12], the standards for its physical protection are not prescriptively described. The sovereign rights of signatory states are therefore respected in terms of determining the "how" of physical protection: national regulators must determine how best to ensure operators meet those standards to which their governments have committed.

CPPNM (amended) extends the requirements on signatory states to the physical protection of civil nuclear facilities[13], and further commits states to the implementation of, as far as is practical, twelve fundamental principles of physical protection. Although the amendments do not commit states to any physical protection methods, by bringing fundamental principles into CPPNM, a clear line of sight is drawn between this binding Convention, and the supporting (and, critically: non-binding) "Nuclear security recommendations on physical protection of nuclear material and nuclear facilities" (INFCIRC/225/Revision 5) [15] and related recommendations and guides (see Figure 2.1 on page 9). The fundamental principles encourage an increase in protection standards around the world, still without encroaching on sovereign rights to define national security. The fundamental principles are listed in Table 2.2 on page 10, followed by a brief explanation of their relevance to national regulation and regulators.

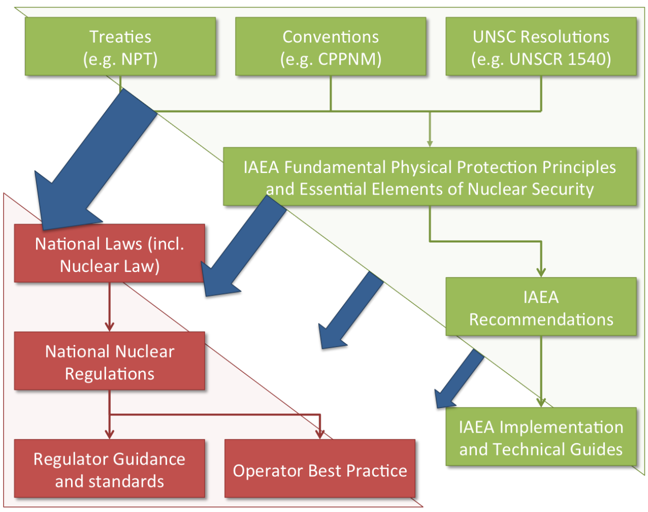

Figure 2.1: The hierarchy of international tools (Green) of nuclear security and their relative influence (sized Blue arrows) on national laws and regulations (Red)

[12]based on the quantity and attractiveness of the material for malicious purposes; including Uncategorised, Category III, Category II and Category I material, where Category I material is the most attractive.

[13]The amended convention is thus renamed the "Convention on the physical protection of nuclear material and nuclear facilities".

Principle	Responsibility of each state under the fundamental principle
A - State responsibility (*)	The establishment, implementation and maintenance of a physical protection regime for its own material and facilities
B - International transport responsibilities (*)	The adequate physical protection of any nuclear materials transported across national borders until that responsibility has been fully accepted by another state
C - Legal & regulatory framework (*)	The establishment and maintenance of a legislative and regulatory framework to govern physical protection, including: the setting of requirements; systems of evaluation, licensing, inspection and verification and a system of authorisation and enforcement, including sentencing
D - Competent authority (*)	The establishment or designation of a competent authority responsible for Principle C, provided with the appropriate authority, independence, resources and competence to perform its duties
E - Licence holder responsibility (*)	Responsibilities for implementing the essential elements of a physical protection regime should be identified, with prime responsibility for implementation resting with licence holders
F - Security culture	The due priority for development, maintenance and implementation of a nuclear security culture throughout organisations involved in implementing physical protection
G - Threat assessment (*)	The requirement to base the design of a physical protection system on its own evaluation of threat
H - Graded approach	The use of a graded approach to physical protection requirements, considering: the threat (Principle G); the attractiveness and nature of nuclear material and the potential consequences if it is removed without authorisation; and the potential consequences of sabotage against it or a facility in which it resides
I - Defence-in-depth	The requirement to design and implement physical protection systems consisting of a number of independent but complementary protective layers which when combined must all be defeated or circumvented by an adversary in order for him to achieve his objectives
J - Quality assurance	The requirement on licence holders to provide oversight on an ongoing basis to ensure the physical protection systems are capable of responding to the threat assessment
K - Contingency plans	The preparation and regular exercise of emergency plans for responding to a nuclear security event
L - Confidentiality (*)	The establishment of requirements to protect information which could cause compromise to the physical protection system if disclosed without authorisation

Table 2.2: Fundamental principles of physical protection of nuclear material and nuclear facilities.[11, pp9-14] and [15, pp5-17]

Asterisked principles set out the responsibilities of the state to: establish a framework for and authority over physical protection systems; define the responsibilities of the licence holder in relation to security; and establish a system for threat assessment and information protection. The remaining principles guide the regulator[14] on the essential elements of regulation of nuclear security. Further discussion on these principles follows in Chapter 3.

2.4 International instruments of nuclear safeguards regulation

Security and safeguards are closely linked. Safeguards provide an inter-governmental assurance on the non-diversion of nuclear materials from peaceful purposes, thereby limiting the possibility for states to use nuclear material as a weapon. Security supports the same aim, but must also protect against individual, or non-state parties. An effective security regime will prevent the unauthorised removal of nuclear material, complementing safeguards, and an effective safeguards regime will use detailed material accounting processes[15] which by virtue of their existence, improve security.

The primary international safeguards instrument is the Nuclear Non-Proliferation Treaty (1970). Party states are defined as Nuclear Weapons States ("NWS") or non-Nuclear Weapons States ("NNWS"). The treaty sets out obligations on both groups to prevent any further proliferation of nuclear weapons capability and knowledge. A mandatory system of safeguards is also established: the IAEA inspect and monitor NNWS to assure that no nuclear materials are diverted from peaceful uses. NWS are not subject to mandatory safeguards[16].

Under an EEC multilateral safeguards agreement (EURATOM) the task of verifying non-diversion of nuclear materials transferred from individual signatory states to the European Community[17]. EURATOM is therefore responsible under NPT for safeguards within Europe, and IAEA inspects to ensure compliance. The NWS status of both France and UK add complexity to this arrangement as illustrated in Figure 2.2 on page 12. The dual responsibilities for inspection of these state programmes must be fully understood in order for the regulator to remain efficient and effective in its role.

[14] The IAEA refer to the regulator as the Competent Authority.

[15] Collectively known as Nuclear Material Accountancy and Control: "NMAC".

[16] The United Kingdom, Russia, the United States of America, China and France are the NWS due to their having "manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January, 1967" [16, p4]. Importantly, the three nuclear capable states which have not signed the non-proliferation treaty (India, Pakistan and Israel) would, on joining, be classified as NNWS, therefore would therefore be subjected to safeguards inspections and controls.

[17] On its formation in 1957 EURATOM consisted of six member states and safeguards verification for those states moved to the EURATOM Community. Since then EURATOM has grown to cover all members of the European Community. As the EURATOM treaty remains automatically applicable to any new member state, EURATOM is the safeguards agency for Europe.

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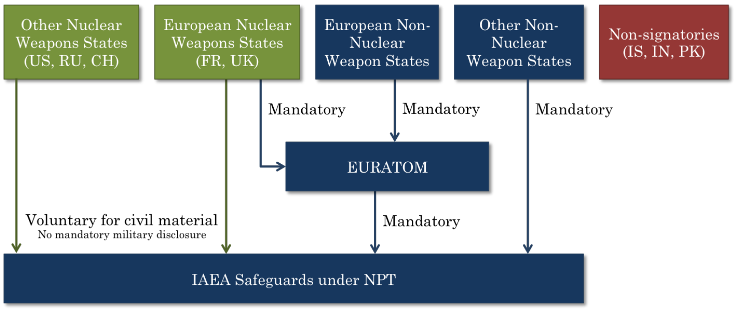

Figure 2.2: Safeguards inspection responsibilities under NPT in Europe through EURATOM and the world for NWS (Green), NNWS (Blue) and non-signatories (Red)

2.5 An example of international guidance shaping state-level regulation: the United Kingdom

The UK provides a useful example of how international security regulations are introduced at a state-level; it is a signatory party to all instruments listed in Table 2.1 on page 8. The UK regulator covers nuclear security, and is responsible for ensuring regulations are consistent with international nuclear-specific requirements and guidance. Until 2014, nuclear regulators were empowered through various Acts[18] permitting the establishment of regulations through which international guidance was incorporated into the UK's legal framework[19]. Table 2.3 on page 14 lists the UK's important legislation for implementing international conventions, treaties, resolutions and guidance for nuclear security and nuclear safeguards at the state level.

Recently, the UK has reduced the number of regulators with of its civil nuclear activities to a single independent statutory body, the ONR, holding responsibility for nuclear safety, nuclear security, nuclear safeguards and the transport of nuclear materials.

In 2007 the UK Safeguards Office ("UKSO") was incorporated into ONR. UKSO, formerly part of the Health and Safety Executive, provided an independent assessment of, and advice and support to the government for, safeguards application and compliance. UKSO also fulfilled the UK's safeguards reporting requirements [17]. In 2011, the Office for Civil Nuclear Security ("OCNS") was also incorporated into ONR. On 1 April 2014, The Energy Act (2013) transferred all relevant national nuclear legislation and regulation[20] to fall subordinate to that Act. Furthermore, the responsible Secretary of State is empowered

[18] Primarily: the Nuclear Installations Act (1965), the Health and Safety at Work, etc Act (1974) and the Nuclear Safeguards and Electricity (Finance) Act 1978 (amended to incorporate the requirements of the 1998 Additional Protocol of the NPT, and renamed the Nuclear Safeguards Act 2000).

[19] Two important regulations for nuclear security in the UK are: Nuclear Industries Security Regulations (NISR 2003) and the Ionising Radiation Regulations (IRR 1999).

[20] Covering all of civil nuclear safety, security and safeguards.

to make or amend regulations for the purposes of civil nuclear safety, security, safeguards and transport. ONR became responsible to Government for regulating civil UK nuclear activities as well as for obligations to Europe under the EURATOM treaty for safeguards. With the UK's nuclear regulation now having a consistent line of sight to primary legislation, importantly through the single regulator, different requirements for safety, security and safeguards regulation must be recognised and brought together in order for ONR to be both an efficient and effective nuclear regulator, as well as an efficient and effective nuclear security regulator.

Legal Instrument	Purpose in relation to international instrument
Energy Act 2013	Primary legislation, incorporating the regulation of safety, security and safeguards through a single independent regulator. Enables the Secretary of State to make regulations for each discipline and transport
Nuclear Installations Act 1965	Enables licensing and attachment of conditions which underpin the operator's responsibility to secure the protection of people and property from hazards arising from nuclear matter or ionising radiation
Safeguards Act 2000	Sets out how the UK government responsibilities under international conventions, treaties and commitments relating to non-proliferation of nuclear material, will be met, including nuclear material accounting
Nuclear Industries Security Regulations 2003	Sets out the requirements for operators of civil facilities to implement security measures, principally relating to physical protection, confidentiality, transport security and trustworthiness of employees
Ionising Radiation Regulations 1999	Establishes the requirement to classify designated areas where radioactive or nuclear material is present; and makes arrangements for the control of radioactive substances which may be susceptible to theft (e.g. sealed sources) including accounting, transport and notification of incidents
Nuclear Industries Malicious Capabilities (Planning) Assumptions (NIMCA)	The UK Government's threat assessment, against which operator security plans and protection measures must be demonstrably robust
National Objectives, Requirements and Model Standards (NORMS)	Guidance for operators on the objectives, requirements and standards in relation to nuclear security performance, against which operator site security plans in the UK should be drawn up
Technical Assessment Guides	Guidance to ONR inspectors on assessing performance against the requirements of regulations and other conditions across the three disciplines of security, safety and safeguards. Where available, these provide information to operators on how to assess the required standards of protection
Operator Site Security Plan	An operator document, required by licence from application, based on NIMCA and approved by ONR, detailing the "design, evaluation, implementation, and maintenance of the physical protection system, and contingency plans" [18, p3]

Table 2.3: The UK Acts Regulations and official guidance relevant for nuclear security and safeguards in relation to international conventions and guidance

Chapter 3

Efficient and effective security regulators

Each of the important metrics listed in Table 1.3 on page 5 are now explored more fully in relation to the efficiency and effectiveness of a nuclear security regulator. This chapter provides background and context to the question sets and levels of organisational success found in the Annex, relating to regulators balancing effectiveness and efficiency, and so holding the nuclear industry to account.

3.1 Structured

Efficiency means: all actions contribute to achieving the common objective; and the framework by which these actions are regulated, is clearly and consistently structured. International consistency at the principle level, and national consistency with law and regulations, are important.

3.1.1 International commitment to recognised standards and Conventions

Table 2.1 on page 8 lists the essential instruments for the international nuclear security community. They encourage best practice sharing and co-operation between states, and encourage the incorporation of standards into national laws. The degree of their incorporation is therefore one indicator for regulatory effectiveness.

Security measures are widely considered to improve through their development and testing with many stakeholders, compared to isolated effort. This is true in both important theatres of nuclear security: physical [19, pp10-11] and cyber [20, p337]. Another indicator of a regulator's effectiveness is therefore its level of participation in international security forums, and contributions to the enhancement of international guides.

A further indicator is the level of interaction with international communities to obtain independent assessments of national systems and practices of regulation.

These three indicators may promote public trust in the national regulatory regime, by validating that the rules by which industry is being held to account are fit for purpose, and properly enforced.

3.1.2 Alignment with national systems of law and regulation

Nuclear security law is a part of national primary law, and nuclear security is one part of national criminal codes. Conventions commit signatory states to the criminalisation of actions against nuclear security; it is therefore critical that the regulator understands and works within existing national legal enforcement and jurisdiction frameworks. This is especially important in defining the rules for nuclear guard force interactions.

The task for industry to understand and comply with regulations becomes complicated when different regulatory philosophies are in play. International guides recommend a goal-setting approach for nuclear security regulation in order to be more effective [19, p12], however many countries apply a prescriptive philosophy of regulation. States enhancing their nuclear security regulations will be required to balance effectiveness as a nuclear security regulator, with efficiency as one of a number of nuclear regulators.

By example, in 2011/2012, recognising that a homogeneous national philosophy on regulation offered benefits at many levels, the UK's OCNS "worked hard to develop a goal setting and performance measurement approach to security regulation" [21, p4] so matching it's safety counterpart in its regulatory approach[1].

3.2 Co-ordinated

Co-ordination is critical between nuclear security regulators, nuclear safety regulators, and other government departments (both domestic and international).

3.2.1 Co-ordination between national nuclear regulators for security and safety

Nuclear security and safety regulators are aligning in pursuit of efficiency and effectiveness goals, due to the many synergies in delivery of each discipline[2]. A joined-up approach is important for both efficiency and effectiveness, yet because of the consequences of a serious breach of either security or safety barriers, it is most important to ensure that effectiveness is never compromised.

[1] It is important to note that on OCNS joining ONR, its well established safety arm (formerly the Nuclear Installations Inspectorate) was already a firm practitioner of goal setting regulation.

[2] For example, relationships between nuclear safety and nuclear security regulation were discussed at length in Cape Town in 2009 at an IAEA conference on effective nuclear regulatory systems, attended by heads of national nuclear regulators [22]. Synergies between safety and security were also an important area of discussion at the 2012 Nuclear Security Summit in Seoul.

Section 2.3 demonstrated how nuclear security regulators are guided by IAEA recommendations; the arrangement for nuclear safety has some significant differences[3]. The fundamental principles of physical protection listed in Table 2.2 on page 10 are similar to those guiding nuclear safety [13] except that it is the state which is ultimately responsible for nuclear security. Therefore, it must set objectives and requirements for nuclear security performance based on it's own assessment of threat[4]. Many security threats lie out-with the control of a nuclear operator[5].

An efficient and effective regulator must manage the implications of this critical difference on the regulation of operator actions. Safety and security requirements must together provide adequate protection, and must not become tools for use against each other.

3.2.2 Co-ordination of national security regulators with Government departments and internationally

Nuclear security regulators must therefore operate within a framework of responsibility shared between both operator and state, with primary interfaces occuring at the threat assessment and communication stage[6] and in the delivery of security through armed guards for facilities or transport. Information from, as well as support and assistance to, international nuclear security regulators is also considered to be critical to the delivery of effective security. An effective nuclear security regulator must therefore master the co-ordination of information flowing between relevant national and international bodies in relation to threat assessment and security provision, wherever they arise[7].

A regulator's relationship with counter-party regulators may impact the effectiveness of the physical protection systems and controls for the international transport of nuclear materials. Efficient and effective regulators will be fully

[3] As a safety regulator, IAEA issues fundamental safety principles, general and specific safety requirements, and safety guides; these documents holding a line of sight to the fundamental safety objective: the protection of people and property from the harmful effects of ionising radiation.

[4] Critically, because security (of which nuclear security is just one part) is a national responsibility, the placing of requirements by the IAEA on states could juxtapose their sovereign rights to define their own security requirements. No IAEA safety requirements challenge such sovereign rights, primarily as a result of the first fundamental safety principle: that the responsibility for nuclear safety lies with the operator (rather than the state).

[5] An example of a threat out-with operator control, is the invasion of one state by an aggressor state, causing the victim's people to rise up in anger to exact their revenge however they assess achievable, within the aggressor state's national borders. Including, possibly, the sabotage of a nuclear facility.

[6] Notably with intelligence agencies, national government and protection forces.

[7] Germanwings Flight 9525 provides an illustration of the importance of a joined-up approach to security between industries. As the motives of the Co-Pilot Andreas Lubitz (who barricaded himself in the cockpit of his airliner before setting its course for destruction on the hills of Southern France) are being unpicked, it has emerged that (a) he was undergoing treatment for mental illness at the time of the crash; (b) his internet history in the days before the included searches for "suicide" and "cockpit doors"; (c) reportedly due to German patient confidentiality regulations, his employer was unaware of his illness and/or mental state, knowing only that he had suffered from a bout of depression some years previously; and consequentially (d) no repeat vetting, surveillance or fitness for duty tests were carried out on the co-pilot running up to the tragedy. At the time of writing, a regulatory response has yet to be made on this matter: was the tragedy preventable by an alternate regulatory approach?

co-ordinated with necessary parties around the world to make accurate current assessments of threat, update physical protection standards, and engage seamlessly with all parties (including industry) to support and regulate industry with planning and completing efficient and secure international shipments of nuclear materials.

3.3 Agile

Agility is important for nuclear security regulator efficiency and effectiveness due to security threat being highly dynamic, as well as the conflicting importance of information confidentiality within threat assessment and protection.

3.3.1 Regulation against a highly dynamic threat landscape

A nuclear security regulator will best hold industry to account to improve the effectiveness of their nuclear material and facilities protection by being responsive and agile to a potentially rapidly changing threat, yet through a consistent regulatory framework[8]. Efficient and effective nuclear security regulators must be capable of accepting that threats will change; and quickly.

"Quality assurance," a specific fundamental security principle[9], recognises the unique human threat against which nuclear security aims to protect. Humans are capable of mischievous innovation and irrational action to attain their desires[10]. Nuclear security regulators must ensure adequate protection exists against a threat which is less foreseeable, faster moving and less predictable than the threats addressed by many other regulators. Continuous quality assurance is therefore essential for maintaining the effectiveness of the physical protection system implemented by industry to meet the fundamental nuclear security objective.

3.3.2 Information confidentiality in threat assessment and protection

Information confidentiality increases the complexity of communication models, restricting disclosure to permitted audiences. Under "need-to-know" arrangements, information and communications are another "asset" requiring protection. Confidentiality restrictions, with their associated burdens, tend to increase over time. While protecting sensitive information, confidentiality requirements may challenge both the efficiency and effectiveness of security measures. Conversely, under "need-to-share" arrangements the provision of more information

[8] Some regulatory approaches may be more capable of an agile approach than others.

[9] Critically, although it could be argued to be implicit within a number of the IAEA fundamental safety principles, quality assurance itself does not appear in that list.

[10] In contrast, the role of nuclear safety is to protect against equipment malfunction, human error and environmental events, such events being largely imaginable and quantifiable. An earthquake can be bigger than expected, but it is still an earthquake; the valves on a reactor coolant pump can fail, but they are still valves connected to other plant.

to wider audiences may risk accidental disclosure of legitimately protected information. Ex-US Senator Moynihan [23] advocates the disclosure of all but the most sensitive information, believing this to bring significant efficiency and effectiveness benefits. WINS broadly agrees, noting the importance of communication with many critical stakeholders in support of the effectiveness of security measures [24]; other regulators are following suit[11].

Modern information security is a cyber- rather than a physically-dominated discipline. Recent reports of increases in covert cyber-reconnaissance capability, greater public records disclosure and power plant internet connectivity all imply this dominance will continue. An efficient and effective regulator will therefore frequently consider how to share information as freely as possible, without increasing risk to nuclear facilities or materials by inappropriately disclosing (or failing to protect) important information, or by being inefficient in regulation.

3.4 Proportionate

Regulators may employ proportionate approaches to their duties against the previous three metrics. Proportionality fosters both efficiency and effectiveness because it guides regulators and operators to an appropriate, prioritised remedy for each identified threat. Two important enablers of a proportionate approach to nuclear security regulation, are: the consistent assessment of security threats; and a shared framework for assessing and comparing threats under different regulatory oversight[12] to prioritise their remedies.

The first requires a single Design Basis Threat assessment to be used to identify security measures[13] which cover all important risks, and to inform industry's measured response.

Secondly, to deliver effectively across multiple disciplines, a process to assess all risks and prioritise remedies is required. While there is currently no such integrated security process, further developing IRIDM[14] and similar methods may meet this requirement. Proportionality implies that a single regulator for nuclear security, safety and safeguards may gain an enhanced oversight of all threats and remedies than would multiple regulators with different mandates. As a minimum, co-operation, and a common language of assessment, between multiple regulators may be required in order for them to be efficient and effective.

[11]e.g. ONR have summarised that information which is not disclosable within a UK nuclear context, but recommending "a presumption of openness" unless there are "cogent and defensible reasons against it" [25, pp1-2].

[12]e.g. threats to safety versus threats to security.

[13]Use of a DBT brings an objectivity, independence and consistency to the identification and credibility of emerging security threats.

[14]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." IRIDM works by integrating key elements which reduce risk in a systematic and repeatable fashion. Security requirements are recognised as an input to the process, but their suitability in a shared safety / security sphere is not yet a part of the output [26, pp3, 12-13].

Chapter 4

Conclusion

Efficiency and effectiveness have been described in relation to generic regulator performance areas, listing four performance metrics through which efficient and effective regulator performance may be achieved. Nuclear security has been examined in terms of its fundamental objective, and the international tools and principles designed to ensure the objective is met. Safeguards requirements have also been explored, with an example of how a nation has incorporated all this international guidance into its national laws and regulations.

Finally, a discussion on the four metrics of regulator performance has highlighted many areas where balance is required from regulators in order to be both efficient and effective in holding the nuclear industry to account. This report demonstrates that there is no "magic bullet" to nuclear security regulator efficiency and effectiveness, but that wider considerations must always be taken into account in how local regulation can best be delivered, even against internationally agreed guidance. It does, however, point to some of the important questions to ask when assessing a regulator's methods and practice.

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Characteristics of efficient and effective regulators

Further examples of contemporary views on a definition of efficient and effective regulation and regulators, as mentioned in Section 1.2 are included in the tables following

Indicator	Overarching expectation of regulator performance
Supportive	Regulators do not unnecessarily impede the efficient operation of regulated entities
Clear	Communication with regulated entities is clear, targeted and effective
Risk-based	Actions undertaken by regulators are proportionate to the risk being managed
Joined-up	Compliance and monitoring approaches are streamlined and co-ordinated
Transparent	Regulators are open and transparent in their dealings with regulated entities
Adaptive	Regulators actively contribute to the continuous improvement of regulatory frameworks

Table 4.1: Outcomes-based key performance indicators for fair, effective and efficient regulators [8, pp16-27]

	Principle	Explanation
Supportive	Support the regulated to comply and grow	Avoid imposing unnecessary burden, and consider possible costs and restrictions associated with compliance
Clear	Provide simple and straightforward ways to engage with the regulated and hear their views	Engage with the regulated, the public and others around regulatory developments including decisions and enforcements
Risk-based	Base activities on risk	Allocate resources to address priority risks most effectively, including assessing the appropriate method and scale of intervention
Joined-up	Share information on compliance and risk	Share information with other regulators where permitted about the regulated, to help target resources and activities and minimise duplication
Communicative	Ensure clear information, guidance and advice is available to help the regulated meet their responsibilities to comply	Provide guidance and encourage dialogue to enable the regulated to understand and meet their obligations under the regulation, especially where responsibilities of more than one regulator overlap or guidance is unclear
Transparent	Use a transparent approach to regulatory activities	Publish a set of standards, setting out what the regulated may expect and how it may be received. Performance against these standards should be made available

Table 4.2: UK Government Regulator's Code [9, pp3-6]