

Crisis, criticism, change: Regulatory reform in the wake of nuclear accidents

*by Kimberly A. Sexton**

Accidents are a forcing function for change in the nuclear industry. While these events can shed light on needed technical safety reforms, they can also shine a light on needed regulatory system reforms. The TEPCO Fukushima Daiichi nuclear power plant (NPP) accident in Japan is the most recent example of this phenomenon, but it is not the only one.

In the wake of the three major accidents that have occurred in the nuclear power industry – Three Mile Island (TMI) in the United States; Chernobyl in Ukraine, in the former Soviet Union; and the Fukushima Daiichi NPP accident in Japan – a commission or committee of experts issued a report (or reports) with harsh criticism of the countries' regulatory system. And each of these accidents prompted changes in the respective regulatory systems. In looking at these responses, however, one must ask if this crisis, criticism, change approach is working and whether regulatory bodies around the world should instead undertake their own systematic reviews, unprompted by crisis, to better ensure safety.

This article will attempt to analyse the issue of regulatory reform in the wake of nuclear accidents by first providing a background in nuclear regulatory systems, looking to international and national legal frameworks. Next, the article will detail a cross-section of current regulatory systems around the world. Following that, the article will analyse the before and after of the regulatory systems in the United States, the Soviet Union and Japan in relation to the TMI, Chernobyl and Fukushima accidents. Finally, taking all this together, the article will address some of the international and national efforts to define exactly what makes a good regulator and provide conclusions on regulatory reform in the wake of nuclear accidents.

I. International conventions

The Convention on Nuclear Safety (CNS)¹ and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint

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1. Convention on Nuclear Safety (1994), IAEA Doc. INFCIRC/449, 1963 UNTS 293.

Convention)² are ingrained in the world of nuclear energy today, but, for the greater part of the history of nuclear power these conventions did not exist. The negotiators and drafters of these conventions therefore had the difficult task of establishing “an instrument that can be implemented by countries with very different industrial, regulatory and legal systems, at different stages of development, and even with widely different approaches to nuclear power.”³ It is a supreme accomplishment that these individuals were able to craft the conventions in a way that countries in such different stages of nuclear development were able to agree on three major points: who is responsible for safety, the functions of the regulator and the characteristics necessary for regulatory bodies.

A. Convention on Nuclear Safety

The CNS specifically addresses legislation and regulation in Articles 7 through 9. Article 7 requires a legislative and regulatory framework for safety and provides a list of basic elements. Article 8 addresses the regulatory body, stating “Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7”.⁴ Further, the regulator “shall [be] provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities”.⁵

The principle of regulatory independence is embedded in Article 8 in the requirement for assurance of “an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.”⁶ This does not mean that the regulator should be “entirely separate from other government bodies”, but rather “that it is able to perform its functions without undue pressure or constraint.”⁷

Article 9 of the CNS establishes the fundamental principle that the licence holder, or operator, of an NPP bears “prime responsibility for the safety of a nuclear installation”. But, the regulatory body is accountable for ensuring that the “license holder meets its responsibility.”⁸

B. Joint Convention

During the drafting of the CNS, consensus could not be reached on the scope of the convention, with some states desiring that it include radioactive waste management;⁹ thus, the issue was left for another day.¹⁰ Soon after the adoption of

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2. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997), IAEA Doc. INFCIRC/546, 2153 UNTS 357.
 3. Jankowitsch-Prevor, O. (1994), “The Convention on Nuclear Safety”, *Nuclear Law Bulletin*, No. 54, NEA, Paris, p. 19. Although this quote relates directly to the CNS, it can be understood in the context of the Joint Convention as well.
 4. CNS, *supra* note 1, Art. 8(1). Article 7 of the CNS enumerates a number of activities for which the legislative and regulatory framework must provide, but does not specify which governmental body is to be responsible for crafting the legislative and regulatory framework.
 5. *Ibid.*, Art. 8(1).
 6. *Ibid.*, Art. 8(2).
 7. IAEA (2010), “General Safety Requirements Part 1: Governmental, Legal and Regulatory Framework for Safety”, IAEA Safety Standards, No. GSR Part 1, Vienna, p. 6.
 8. CNS, *supra* note 1, Art. 9.
 9. Tonhauser, W. and O. Jankowitsch-Prevor (1997), “The Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Sources”, *Nuclear Law Bulletin*, No. 60, NEA, Paris, p. 12.

the CNS, preliminary discussions began on the development of a convention for the safety of radioactive waste management and not long after a Group of Experts was convened.¹¹ Due to the success of the CNS, the Group of Experts determined that this new convention should be modelled on the CNS.¹² Not surprisingly then, the articles dealing with the regulatory body are quite similar. For example, Article 20 is an exact mirror of CNS Article 8. And just like Article 8, the Joint Convention also speaks towards the independence of the regulator, though this time it uses the term expressly, imploring contracting parties to “take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation”.¹³

Again, reflecting the CNS, Article 21 of the Joint Convention also holds that the licence holder bears “prime responsibility for the safety of spent fuel or radioactive waste management” while the contracting party is responsible for ensuring that the licence holder takes appropriate steps to meet that responsibility.¹⁴

II. National level

A. Regulatory responsibility

As enshrined in the CNS and Joint Convention, there is broad agreement among national and international organisations that the fundamental objective of all nuclear safety regulatory bodies – the regulator’s prime purpose – is to ensure that nuclear licensees operate their facilities at all times in a safe manner. This usually forms the basis of a definition of safety, or an overarching mission statement or foundational principle applied by the regulatory body.

Some countries explain their regulatory responsibility in a positive way, detailing what they will *provide for* or *ensure* as a regulatory body. For example, in the United States, the US Atomic Energy Act states that the US Nuclear Regulatory Commission must ensure that licensed uses are “in accord with the common defense and security and will provide adequate protection to the health and safety of the public”.¹⁵ “Adequate protection is the statutory minimum safety standard – the floor below which safety standards may not fall – to be ensured by the NRC before allowing licensed activities to take place.”¹⁶ It is then up to the NRC to determine what is “in accord with the common defense and security” and what provides “adequate protection” of public health and safety. Similarly, Japan’s post-Fukushima Act for Establishment of a Nuclear Regulation Authority also takes a positive approach, stating that “In order to protect the lives, health and property of the population, preserve the environment and contribute to the national security of

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10. See Preamble to the CNS, *supra* note 1, para. IX, “Affirming the need to begin promptly the development of an international convention on the safety of radioactive waste management as soon as the ongoing process to develop waste management safety fundamentals has resulted in broad international agreement.” See also Tonhauser, W. and O. Jankowitsch-Prevor (1997), *supra* note 9, p. 12.
 11. Tonhauser, W. and O. Jankowitsch-Prevor (1997), *supra* note 9, p. 12.
 12. *Ibid.*
 13. Joint Convention, *supra* note 2, Art. 20(2).
 14. *Ibid.*, Art. 21(1).
 15. US Atomic Energy Act of 1954, 42 USC 2232(a), Section 182a.
 16. Ostendorff, W. and K. Sexton (2013), “Adequate protection after the Fukushima Daiichi accident: A constant in a world of change”, *Nuclear Law Bulletin*, No. 92, NEA, Paris, p. 24.

Japan, the task of the Nuclear Regulation Authority is to ensure safety in nuclear power use”.¹⁷

Other countries take a different approach, defining their regulatory responsibility in terms of what they will *prevent*. For example, instead of using a phrase like “provide adequate protection” as in the US, the Nuclear Safety and Control Act of Canada states that the objective of the Canadian Nuclear Safety Commission (CNSC) is to “prevent unreasonable risk”.¹⁸ Similarly, France’s Act on Transparency and Security in the Nuclear Field also speaks to what the regulations will prevent – “preventing accidents or limiting their effects” and “preventing or reducing the harmful effects of ionizing radiations caused to people, directly or indirectly, including by their adverse environmental impact” – rather than what it will ensure.¹⁹

Regardless of which approach is taken, however, the end regulatory goal is the same: safety.

B. Regulatory structures

Because the conventions do not prescribe a specific form or structure for the regulator, each country is free to determine that which works best to meet the attributes and carry out the functions prescribed in the conventions. Although there is no requirement, or even preference, for a certain regulatory structure in the conventions, the structures still generally fall into one of two categories: either a multi-member agency or commission, or a regulatory authority headed by a single director or administrator that is organised within a governmental ministry.

1. Commissions / multi-member agencies

Canada, France, Spain and the United States are headed by multi-member agencies or commissions. The number of commissioners or members varies by country, with France,²⁰ Spain²¹ and the United States²² headed by five commissioners or members and Canada’s regulator headed by no more than seven permanent members, with the ability to have temporary members whenever the Governor in Council deems necessary.²³

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17. Act for Establishment of the Nuclear Regulation Authority, Act No. 47 of June 27, 2012, Extra Official Gazette of June 27, 2012, Art. 3.
 18. Nuclear Safety and Control Act (S.C. 1997, c. 9), Sec. 9(a).
 19. Act No. 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field (TSN Act), Title I, Art. 1(I).
 20. The Nuclear Safety Authority (*Autorité de sûreté nucléaire*, ASN) is made up of five members, three of whom, including the chairman, are appointed by the President of the Republic, while the other two members are appointed respectively by the President of the National Assembly and the President of the Senate. *Ibid.*, Art. 10.
 21. The Nuclear Safety Council (*Consejo de Seguridad Nuclear*, CSN) is made up of a Chairman and four Commissioners who are appointed by the Government, on the proposal of the Minister of Industry, Tourism and Trade. Act 15/1980 of 22 April, Creating the Nuclear Safety Council, amended by Act 33/2007 of 7 November, Arts. 4(1) and 5(2).
 22. The US Nuclear Regulatory Commission has five Commissioners who are nominated by the President of the US and confirmed by the US Senate. Energy Reorganization Act of 1974, as amended (ERA), section 201, 42 USC 5841.
 23. Nuclear Safety and Control Act, *supra* note 18, Sec. 10(1).

Regardless of the number of commissioners or members, the governing legislation of Canada,²⁴ France,²⁵ Spain²⁶ and the United States²⁷ all call for one of the commissioners or members to be appointed to serve as the chairman or president. The chairman or president has similar responsibilities across these countries. For example, it is specified in the US²⁸ and France²⁹ that the chairman has special authorities in an emergency, while in the United States³⁰ and Canada³¹ it is specified that the chairman and president are the principal or chief executive officer of the regulatory body.

Independence is a key component to these regulatory bodies, with this characteristic being established in either law or practice. France's TSN Act states that "The members of the college exercise their duties entirely impartially without receiving any instructions from the Government or from another other person or institution."³² The United States Congress established the NRC as an independent federal agency³³ that does not report to any other agency of the executive branch and which enjoys considerable discretion in regulatory matters but is overseen in certain respects by the president and the congress.³⁴ The Canadian Nuclear Safety and Control Act established the CNSC as a "body corporate",³⁵ which makes reports to the Minister of Natural Resources but is not under the supervision of the Minister of Natural Resources and remains an independent body.³⁶ Finally, the Act Creating

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24. The Governor in Council designates one of the permanent members as President. *Ibid.* at 10(3). The President is a full-time member of the Commission and the other members may be appointed as full-time or part-time members. *Ibid.* at 10(4).
 25. The chairman is appointed by the President of the Republic. TSN Act, *supra* note 19, Art. 10.
 26. The Chairman is appointed in the same manner as the other Commissioners. Act 15/1980, *supra* note 21, Art. 5(1) and (2).
 27. The President of the US designates one member of the Commission as Chairman, who serves as Chairman at the pleasure of the President. ERA, *supra* note 22, section 201(a)(1), 42 USC 5841(a)(1).
 28. See e.g. 45 FR 40561, Reorganization Plan No. 1 of 1980 (16 June 1980), sec. 3(a): "there are hereby transferred to the Chairman all the functions vested in the Commission pertaining to an emergency concerning a particular facility or materials licensed or regulated by the Commission, including the functions of declaring, responding, issuing orders, determining specific policies, advising the civil authorities, and the public, directing, and coordinating actions relative to such emergency incident."
 29. TSN Act, *supra* note 19, Art. 11. "In the event of an emergency, the chairman of the Authority or, in his absence, the member he has appointed, takes the measures required by the situation in the fields within the competence of the college. He convenes the college as swiftly as possible to report to it on the measures thus taken."
 30. Reorganization Plan No. 1 of 1980, *supra* note 28, sec. 2(b). "The Chairman shall also be the principal executive officer of the Commission."
 31. Nuclear Safety and Control Act, *supra* note 18, Sec. 12(1). "The President is the chief executive officer of the Commission and has supervision over and direction of the work of the members and officers and employees of the Commission, including the apportionment of work among the members and, where the Commission sits in a panel, the assignment of a member or members to the panel and of a member to preside over the panel."
 32. TSN Act, *supra* note 19, Article 13.
 33. ERA, *supra* note 22, section 201(a)(1), 42 USC 5841(a)(1). "There is established an independent regulatory commission to be known as the Nuclear Regulatory Commission which shall be composed of five members".
 34. For more information on the creation and governmental structure of the NRC, see Ostendorff, W. and K. Sexton (2013), *supra* note 16, pp. 24-26.
 35. Nuclear Safety and Control Act, *supra* note 18, Sec. 8(1).
 36. See NEA (2009), "Nuclear Legislation in OECD and NEA Member Countries: Canada", available at: www.oecd-nea.org/law/legislation/canada.pdf, p. 21.

the Nuclear Safety Council in Spain specifies that the CSN was created in 1980 to be independent from the central administration of the state and its role has been modified since then only to ensure the preservation of the effective independence of the organisation.³⁷

2. Single director or administrator

The regulatory bodies in Sweden, Finland, Germany and the Russian Federation, on the other hand, are headed by a single director or administrator, sometimes organised within a ministry. For example, the Swedish Radiation Safety Authority reports to the Ministry of the Environment and is led by a Director General appointed by the government.³⁸ The Finnish Radiation and Nuclear Safety Authority (STUK) is also headed by a Director General appointed by the government.³⁹ Although STUK is administratively under the Ministry of Social Affairs and Health, which has overall authority for radiation safety, it is able to function independently of the Ministry in carrying out its regulatory functions.⁴⁰

In Germany, the “regulatory body” is actually composed of two parts: one is the federal government authority – the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) – and the other is the Länder government authorities.⁴¹ The Minister of the BMUB is the head of the regulatory body and it is the BMUB that is responsible for the fulfilment of obligations arising from the CNS. The BMUB also provides federal oversight of the actions of the Länder and is responsible for international co-operation. Supporting the BMUB is the Federal Office for Radiation Protection (BfS), which acts as the technical support organisation for the BMUB and was established in 1989, in part due to the Chernobyl accident. The BfS is also headed by a single-administrator, the President. Although there are five different Länder licensing and supervisory authorities for nuclear installations in Germany, the basic organisational structure is much the same: it is headed by a single minister who is supported by a ministerial directorate (headed by a Director General), which is in turn subdivided into divisions for the execution and the licensing and oversight of nuclear installations.⁴²

The state regulatory authority for safety in the use of nuclear energy in the Russian Federation is the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor). Rostekhnadzor is headed by a single administrator, a Chairman. Within the past five years, there have been some changes to the reporting structure of Rostekhnadzor to ensure true independence. In 2008, Rostekhnadzor was re-subordinated to the Ministry of Natural Resources and Environment of Russia, but over a period of two years it was determined that “for the state safety regulatory authority in the field of the use of atomic energy to exercise its functions efficiently, it must be genuinely independent and must not be

37. Act 15/1980, *supra* note 21, Preamble.

38. Swedish Radiation Safety Authority (2013), “About the Authority”, www.stralsakerhetsmyndigheten.se/In-English/Facts-about-us/.

39. STUK (n.d.), “Organization”, www.stuk.fi/web/en/about-us/organization.

40. IAEA (2012), Integrated Regulatory Review Service (IRRS) Mission to Finland, available at: www.stuk.fi/documents/12547/281526/iaea-irrs-mission-report-to-finland-2012.pdf/52130c5b-acb2-44d3-aa67-4fe9233a7989, pp. 16, 30.

41. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2014), Convention on Nuclear Safety – Report by the Government of the Federal Republic of Germany for the Sixth Review Meeting in March/April 2014, available at: www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/bericht_uebereinkommen_nukl_sicherheit_en_bf.pdf, p. 46.

42. *Ibid.*, p. 53.

part of any ministry [or] other authorities”.⁴³ Thus, it was decided in 2010 to re-subordinate Rostekhnadzor directly to the government of the Russian Federation where it is now independent of the state bodies that control the uses of atomic energy.⁴⁴

C. Regulatory functions

Regardless of whether the regulatory body is headed by a single administrator or a commission, the conventions make clear that the legislative and regulatory framework governing the safety of nuclear installations must provide for certain basic regulatory functions. For example, national safety requirements and regulations or directives must be established.⁴⁵ Within the legal framework of the regulatory system, a licensing system shall be established for nuclear installations, which includes authorisations and prohibitions.⁴⁶ Moreover, the regulator is to be empowered to verify compliance with such standards and regulations through inspections and assessments.⁴⁷ Finally, the regulator must be able to enforce compliance with established standards and regulations using measures that include the suspension, modification or revocation of a licence.⁴⁸

Korea describes its regulatory functions as encompassing, among other activities: the establishment of policies and systems, the issuance of licences and permits and the performance of inspections and issuance of executive actions.⁴⁹ Similarly, Spain’s CSN states that its functions are to: “regulate[] the operation of nuclear and radioactive facilities”, “propose[] rules and regulations”, “issue[] operator’s licenses” and “propose[] coercive measures”, among others.⁵⁰ India’s Atomic Energy Regulatory Board (AERB) also details its functions quite comprehensively, which include the development of safety policies, codes, guides and standards; grant consent; and ensure compliance.⁵¹ The UK Office of Nuclear Regulation explains that it regulates through permission and compliance inspection, enforcement and influence.⁵²

Although countries may use different words to describe their duties, there is a broad consensus regarding the functions of nuclear regulators.

D. Summary

At a high level, it appears that there are more similarities than differences in the current responsibilities, structures and functions of regulatory bodies. But, key

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43. Answers of the Russian Federation to the questions of the Contracting Parties to the 6th National Report of the Russian Federation on implementation of CNS over (the period of) 2011-2013, available at: <http://en.gosnadzor.ru/international/Answers%20Russian%20Federation.pdf>, p. 41
 44. Rosatom (2013), Sixth National Report of the Russian Federation on the Fulfillment of Commitments Resulting from the Convention on Nuclear Safety, Sixth Review Meeting under the Convention on Nuclear Safety, available at: www.rosatom.ru/en/resources/8e6c70804524ef3ba621b77680b11dae/cns_rf_nr_6_eng.pdf, p. 132.
 45. CNS, *supra* note 1, Art. 7(2)(i); Joint Convention, *supra* note 2, Art. 19(2)(i).
 46. CNS, *supra* note 1, Art. 7(2)(ii); Joint Convention, *supra* note 2, Arts. 19(2)(ii) & (iii).
 47. CNS, *supra* note 1, Art. 7(2)(iii); Joint Convention, *supra* note 2, Art. 19(2)(iv).
 48. CNS, *supra* note 1, Art. 7(2)(iv); Joint Convention, *supra* note 2, Art. 19(2)(v).
 49. NSSC (n.d.), “Nuclear regulation that everyone can trust”, available at: www.nssc.go.kr/nssc/en/nci/elif/Qhqd.pdf, p. 7.
 50. CSN (2015), “Functions”, www.csn.es/en/funciones-del-csn.
 51. Government of India, Atomic Energy Regulatory Board (2013), “Functions of AERB”, www.aerb.gov.in/AERBPortal/pages/English/AboutAERB/functions_aboutUs.action.
 52. Office of Nuclear Regulation, Information about ONR, available at: www.onr.org.uk/onr-information-leaflet.pdf.

differences and outliers still remain, with the revelations following the Fukushima accident being a key indicator of this. While there is great support for the safety conventions (78 parties to the CNS and 70 parties to the Joint Convention, as of the date of publication), not every party has fully subscribed to the articles on responsibility, functions and characteristics of regulatory bodies. This speaks to the “incentive” nature of the conventions,⁵³ which was critical to reaching agreement,⁵⁴ but left much up to the will of the contracting parties.⁵⁵ Without any forcing function in the conventions, countries are left with only encouragement to subscribe to the principles of the conventions.

III. Three Mile Island

The two-unit Three Mile Island Nuclear Station is located in Middletown, Pennsylvania, about ten miles (16 km) southeast of Harrisburg, Pennsylvania. On 28 March 1979, Unit 1 was shut down for refuelling, while Unit 2 was undergoing some maintenance procedures. Just after 4:00 in the morning, two pumps connected with one of the steam generators shut down, which caused “an almost simultaneous and automatic shutdown of the Unit 2 turbine.”⁵⁶ A subsequent series of equipment malfunctions, design-related problems and operator errors led to the partial meltdown of TMI Unit 2.⁵⁷

Though the accident resulted in only very small off-site releases of radioactivity, and involved no deaths or injuries, it was, at the time, “unquestionably the most serious [accident] in the history of commercial nuclear power.”⁵⁸ Countless reports and investigations were written and conducted following the accident, with the two most important being: the Report of the President’s Commission on the Accident at Three Mile Island⁵⁹ and the NRC’s Special Inquiry Group Report to the

53. See CNS, *supra* note 1, preambular paras. vii, “Affirming the importance of international co-operation for the enhancement of nuclear safety through existing bilateral and multilateral mechanisms and the establishment of this incentive Convention” and viii, “Recognizing that this Convention entails a commitment to the application of fundamental safety principles for nuclear installations rather than detailed safety standards”. See also Joint Convention, *supra* note 2, preambular paras. ix, “Affirming the importance of international co-operation in enhancing the safety of spent fuel and radioactive waste management through bilateral and multilateral mechanisms, and through this incentive Convention” and x, “Mindful of the needs of developing countries, and in particular the least developed countries, and of States with economies in transition and of the need to facilitate existing mechanisms to assist in the fulfillment of their rights and obligations set out in this incentive Convention”.

54. Jankowitsch-Prevor, O. (1994), *supra* note 3, p. 13.

55. For further information on the incentive nature of the CNS and Joint Convention, see Handle, G. (2004), “The IAEA Nuclear Safety Conventions: An Example of Successful ‘Treaty Management’?”, *Nuclear Law Bulletin*, No. 72, NEA, Paris, pp. 7-27; deWright, T. (2007), “The ‘Incentive’ Concept as Developed in the Nuclear Safety Conventions and its Possible Extension to Other Sectors”, *Nuclear Law Bulletin*, No. 80, NEA, Paris, pp. 29-47.

56. NRC (1980), “1979 Annual Report”, NUREG-0690, Washington, DC, p. 12.

57. See e.g. NRC (2013), “Backgrounder on Three Mile Island Accident”, www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.pdf. For a more detailed account of the accident and the events that followed, see Walker, J. S. (2004), *Three Mile Island: A Nuclear Crisis in Historical Perspective*, University of California Press, Berkeley, California.

58. 1979 Annual Report, *supra* note 56, p. 11.

59. President’s Commission on the Accident at Three Mile Island (1979), “Report of the President’s Commission on the Accident at Three Mile Island – The Need for Change: The Legacy of TMI”, GPO Document Number 1979 0-303-300, Washington, DC (hereafter the “Kemeny Commission Report”, so named for John G. Kemeny, the President of Dartmouth College and Chairman of the President’s Commission).

Commissioners and to the Public.⁶⁰ In fact, the proliferation of reports even generated its own report, with the Government Accountability Office (GAO) tasked “to determine whether the various TMI investigations fully and accurately disclosed what happened and why it happened.”⁶¹ What follows is a review of those reports and recommendations, as well as the reforms that were ultimately made.

A. **Kemeny Commission Report**

Within two weeks of the start of the TMI accident, on 11 April 1979, US President Jimmy Carter issued Executive Order 12130 (EO), which called for an independent body (or group or committee) to investigate and explain the accident at TMI.⁶² Specifically, the EO established the President’s Commission on the Accident at Three Mile Island, to be composed of not more than 12 people appointed by the President who are nominally independent of the Executive Branch. In a six month period, EO 12130 required the President’s Commission to study and investigate a number of specific items, though the structure and functioning of the Commission itself was not one of the enumerated items.

In the six months of investigation, the President’s Commission took more than 150 depositions and interviewed many others.⁶³ Public hearings were also held, where individuals provided testimony under oath.⁶⁴ The result of all of this was a document collection that could cover 91 meters (300 feet) worth of self-space,⁶⁵ a final report of 179 pages and 44 recommendations deemed to be of “vital importance”.⁶⁶ The President’s Commission concluded its investigation with this powerful overall assessment:

With its present organization, staff, and attitudes, the NRC is unable to fulfil its responsibility for providing an acceptable level of safety for nuclear power plants.⁶⁷

To the President’s Commission, “fundamental changes [were] necessary in the organization, procedures, and practices – and above all – in the attitudes of the Nuclear Regulatory Commission, and to the extent that the institutions we investigated are typical, of the nuclear industry.”⁶⁸

The recommendations related to the organisation and management of the NRC led off the President’s Commission’s recommendations. Finding that “as presently constituted, the NRC does not possess the organizational and management

60. NRC Special Inquiry Group (1980), “Three Mile Island: A Report to the Commissioners and to the Public”, NUREG/CR-1250, Washington, DC. (hereafter the “Rogovin Report”, so named for Mitchel Rogovin, a noted Washington, DC attorney and director of the NRC group).

61. Government Accountability Office (GAO) (1980), “Three Mile Island: The Most Studied Nuclear Accident in History”, EMD-80-109, Washington, DC, p. 4 (“Most Studied Accident Report”).

62. Carter, J. (1979), Executive Order 12130 – President’s Commission on the Accident at Three Mile Island, Washington, DC.

63. Kemeny Commission Report, *supra* note 59, p. 3.

64. *Ibid.*

65. *Ibid.*

66. “Nevertheless, we feel that our findings and recommendations are of vital importance for the future of nuclear power. We are convinced that, unless portions of the industry and its regulatory agency undergo fundamental changes, they will over time totally destroy public confidence and, hence, they will be responsible for the elimination of nuclear power as a viable source of energy.” *Ibid.*, p. 25 (emphasis in original).

67. *Ibid.*, p. 56.

68. *Ibid.*, p. 7.

capabilities necessary for the effective pursuit of safety goals”, the President’s Commission recommended a complete restructuring of the agency, starting first with abolishing the five-member commission and instituting a single administrator.⁶⁹ Expanding on this point, the report stated:

we recommend a total restructuring of the NRC. We recommend that it be an independent agency within the executive branch, headed by a single administrator, who is in every sense chief executive officer, to be chosen from outside NRC. The new administrator must be provided with the freedom to reorganize and to bring new blood into the restructured NRC’s staff. This new blood could result in the change of attitudes that is vital for the solution of the problems of the nuclear industry.⁷⁰

As Dr Kemeny described it at an October 1979 US Senate Joint Hearing on the President’s Commission on the Accident at Three Mile Island Findings, this change was recommended “not necessarily [because the NRC is] a mismanaged agency, [but because] it is an unmanaged agency.”⁷¹ In fact, Dr Kemeny went so far as to say: “Nobody is running the show down there.”⁷²

His position was not roundly supported. Four of the five sitting Commissioners “felt that the objectives of the President’s Commission could be accomplished by reforms effected within the existing structure.”⁷³ NRC Commissioner Peter Bradford outspokenly stated that the proposal to create a single-administrator agency “does not make good sense” and actually proved a “contradiction in terms”.⁷⁴ At the same October 1979 US Senate Hearing, Senator Gary Hart, Chairman of the Subcommittee on Nuclear Regulation, stated in his opening statement that a single administrator would “eliminate[] the diversity of views provided by a multimember commission.”⁷⁵

B. Rogovin Report

Before President Carter established the President’s Commission, the NRC instituted its own “Special Inquiry” into the accident. The NRC contracted with a private Washington law firm to conduct the inquiry, but the bulk of the inquiry staff was made up of NRC staff members who volunteered for the job.⁷⁶ Although the Special Inquiry consisted of approximately “70 nuclear engineers, scientists, lawyers and investigators” and 21 outside consultants, the conclusions and recommendations were solely the product of two lawyers: Mitchell Rogovin and George T. Frampton, Jr.⁷⁷ In their inquiry, the team deposed approximately 270 individuals – including top management of the NRC, Metropolitan Edison (the utility company) and Babcock & Wilcox (the reactor’s manufacturer) – and conducted hundreds of additional interviews, in addition to the access the Special Inquiry team was given to the transcripts from other post-TMI investigations.⁷⁸

Although “the Special Inquiry was not intended to duplicate the efforts of the President’s Commission”, in the end, the authors of the Rogovin Report strongly

69. *Ibid.*, p. 61.

70. *Ibid.*, p. 22.

71. United States Senate (1979), Joint Hearing on the President’s Commission on the Accident at Three Mile Island Findings, Transcript, p. 78.

72. *Ibid.*

73. 1979 Annual Report, *supra* note 56, p. 43.

74. *Ibid.*, p. 58.

75. Joint Hearing, *supra* note 71, p. 4.

76. Rogovin Report, *supra* note 60, p. ix.

77. *Ibid.*, p. x.

78. *Ibid.*, p. ix.

agreed with much of the Kemeny Commission. Echoing much of the same language as Dr Kemeny in his Senate testimony, the Rogovin Report bluntingly declared:

We have found in the Nuclear Regulatory Commission an organization that is not so much badly managed as it is not managed at all. In our opinion, the Commission is incapable, in its present configuration, of managing a comprehensive national safety program for existing nuclear powerplants adequate to ensure public health and safety. A radical reorganization of the Commission's structure and management is called for, now.⁷⁹

And, in no uncertain terms, the Special Inquiry team stated what it believed the reorganisation should be: "The central and overwhelming need is ... to establish a single chief executive with the clear authority to supervise and direct the entire NRC staff."⁸⁰

In championing the single administrator, the Report firmly took to task the oft-cited rationales for retaining a commission structure at the NRC, that a commission structure: (1) is more transparent, (2) provides for a diversity of views, (3) ensures that a pro-nuclear head does not overlook legitimate safety concerns and (4) provides for more effective congressional oversight.⁸¹ The Report was remarkably frank when it stated that "Mounting an affirmative, comprehensive safety program is not a task that requires a diversity of opinion. It is a task that absolutely requires strong central management controls and unified policymaking."⁸² The Report went on to note that the "NRC is virtually the only agency in the Federal Government charged with protecting public health and safety that is headed by a Commission",⁸³ and that a 1971 report by the President's Council on Executive Organization (the "Ash Report") decried commission structures for their inefficiency, inertia, insularity and inflexibility, among other unfavourable traits.⁸⁴

Not only did the Report call for the abolishment of the Commission, but just like the Kemeny Commission, it also called for the scaling back of the independence of the agency. Instead of being an independent Congressionally-created administrative agency, the Report would restructure the NRC as an executive agency that formulates standards, implementable only after presidential and congressional review and approval.⁸⁵ This recommendation, while only meriting a brief paragraph in the 183 page report, would actually have been the most substantive change to the organisation and functioning of the NRC.

C. Government Accountability Office Leadership Report

In 1980, the GAO released a report that bore directly on the management and structure of the Nuclear Regulatory Commission following TMI.⁸⁶ Not surprisingly, the GAO report also had negative outlooks on the then-current commission. But what is interesting is that the Leadership Report, which was initiated before TMI and

79. *Ibid.*, p. 112.

80. *Ibid.*, p. 115.

81. *Ibid.*

82. *Ibid.*, p. 117 (emphasis in original).

83. *Ibid.*, p. 115.

84. *Ibid.*, p. 116.

85. *Ibid.*

86. GAO (1980), "The Nuclear Regulatory Commission: More Aggressive Leadership Needed", EMD-80-17, Washington, DC ("Leadership Report"). This report was already underway before the accident at TMI as it was required under the Energy Reorganization Act of 1974, ERA, *supra* note 22, sec. 306(b), 42 USC 5876(b), which required an audit and report of the Commission's performance within five years of its establishment. Letter from the Comptroller General of the United States to the President of the Senate and the Speaker of the House of Representatives (1980), introducing the Leadership Report.

ostensibly was not related to the problems associated with the accident, stated that “the Commission’s regulatory performance can be characterized best as slow, indecisive, and cautious – in a word, complacent”; however it did at least note that it was “showing signs of improvement.”⁸⁷

Although the Leadership Report did not specifically address the TMI accident, because of the conclusions in the Kemeny Report, the GAO provided an analysis of which organisational form was best for a nuclear regulator. The Leadership Report took a more contemplative view of the subject matter than either the Kemeny Commission or Rogovin Reports, noting that neither approach is perfect. Acknowledging that there are advantages and disadvantages to both, the GAO made the perceptive comment that “To some extent, NRC’s leadership problem may be a price that must be paid for the benefits of a commission rather than a single-headed agency.”⁸⁸

Interestingly, however, much of the analysis focused on the two chief roles of the Commission and their potential conflict: on the one hand, the Commission is in charge of making policy, which “requires deliberate contemplation of issues that affect both the near- and long-term direction of regulated nuclear activities”, while on the other hand, the Commission has a daily regulatory function, which “requires firm and timely” decision making.⁸⁹ And with each role, one organisational form is better suited than the other. A single administrator is better equipped to “develop goals and objectives, measure performance, and address and resolve regulatory issues in a timely manner”,⁹⁰ while the commission form “offers continuity of regulation and independence from the policies and actions of the executive branch.”⁹¹ Thus, the authors of the report looked into the possibility of separating the NRC into two agencies – one with a commission responsible for nuclear regulatory policy and the other, headed by a single administrator, to handle the day-to-day regulation. Ultimately, however, the Leadership Report recommended to Congress that it retain the current commission organisational form but with a strengthened mandate for the Chairman and the Executive Director for Operations.⁹²

D. Regulatory reform in the United States

In the end, although President Carter “agreed fully with the spirit and intent of the Kemeny Commission’s recommendations”, he did not sign off on its recommended reorganisation of the agency. Instead of abolishing the commission structure, President Carter set out more modest organisational changes.⁹³ In December 1979, President Carter issued a statement that he would send Congress a reorganisation plan that would strengthen the role of the Chairman of the NRC, providing “power to act on a daily basis as the chief executive officer” and would ensure the Chairman could act on behalf of the commission during an emergency.⁹⁴

87. Leadership Report, *supra* note 86, pp. ii, 6.

88. *Ibid.*, p. 26.

89. *Ibid.*, p. 50.

90. *Ibid.*, p. v.

91. *Ibid.*, p. 52.

92. *Ibid.*, pp. iv, 41, 52-54.

93. Carter, J. (1979), “President’s Commission on the Accident at Three Mile Island: Remarks Announcing Actions in Response to the Commission’s Report”, Washington DC.

94. *Ibid.*

President Carter submitted his first proposal, “Reorganization Plan No. 1”, to Congress on 27 March 1980. This first draft generated great controversy for the authority given to the Chairman, despite assurances by Harrison Wellford, the architect of President Carter’s plan, that this was “not a radical shift in the system to regulate nuclear power”.⁹⁵ Questions were raised in a three-day Senate hearing in April 1980 about whether the Chairman was made too strong and whether the Commissioners would still have sufficient access to information.⁹⁶ After this, President Carter made several amendments to the original plan to “underscore that the collegial role of the Commission remains strong notwithstanding the added powers granted to the Chairman”.⁹⁷ These amendments gave the Commissioners a greater role in the selection of key agency officers, ensured the free flow of information to the Commission and vested more direct management responsibility in the Executive Director for Operations (EDO) (rather than the Chairman).

Ultimately, the final version of Reorganization Plan No. 1 of 1980 vested the five-member Commission with authority to formulate policy, issue rules and orders and adjudicate matters.⁹⁸ It then transferred all other functions not specifically outlined in the first section to the Chairman, designating that individual as the “principal executive officer” and spokesman for the Commission.⁹⁹ Most importantly, in response to TMI, it:

transferred to the Chairman all the functions vested in the Commission pursuant to an emergency concerning a particular facility ... including the functions of declaring, responding, issuing orders, determining specific policies, advising the civil authorities and the public, directing, and coordinating actions relative to such emergency incident.¹⁰⁰

But, while the Chairman was imbued with additional authority under the Reorganization Plan, it ensured that the Chairman was still “governed by the general policies of the Commission and by such regulatory decisions, findings, and determinations ... as the Commission may by law ... be authorized to make.”¹⁰¹

A second GAO report from 1980 endorsed the President’s Reorganization Plan.¹⁰² The GAO came out strongly against the recommendations in the Kemeny Commission and Rogovin Reports, stating that a single administrator would not solve the “management ills” of the NRC.¹⁰³ Instead, it is the commission form of the organisation that “is clearly superior”, due to its ensuring “continuity of regulation and independence from the policies and actions of the executive branch.”¹⁰⁴

E. Summary

The post-crisis environment of TMI came close to resulting in major changes to the regulatory system at the NRC, though in the end, moderation prevailed. While the accident made clear that some changes were necessary, there was no need to

95. Hearing Before the Comm. on Governmental Affairs on Reorganization Plan No. 1 of 1980, to Strengthen Management of the Nuclear Regulatory Commission, 96th Cong. 8 (1980).

96. See *ibid.*, p. 22.

97. Statement of Harrison Wellford, Executive Associate Director of the Office of Management and Budget, Before the House Government Operations Committee, 6 May 1980.

98. Reorganization Plan No. 1 of 1980, *supra* note 28, sec. 1(a).

99. *Ibid.*, sec. 2(a).

100. *Ibid.*, sec. 3(a).

101. *Ibid.*, sec. 2(c).

102. Most Studied Accident Report, *supra* note 61, p. v.

103. *Ibid.*, p. 39.

104. *Ibid.*

radically overhaul the system. The success of the final approach can be seen with the passage of time: in the intervening 35 years since Reorganization No. 1 of 1980, there have been no significant changes to the agency's structure.¹⁰⁵ While there have been minor progressive developments to further refine certain elements, the overarching structure of the agency has remained the same.

IV. Chernobyl

In the early morning hours of 26 April 1986, a test was set to be carried out on a reactor system of Unit 4 of the Chernobyl nuclear power station in the former Soviet Union (now the Ukraine). During this test, a sudden surge of power occurred that ultimately led to a steam explosion.¹⁰⁶ As a result of the first explosion, a second explosion occurred, this time ejecting hot pieces of the reactor from the destroyed reactor building.¹⁰⁷ The violent explosions and series of fires that followed led to large releases of radioactive material for more than a week.¹⁰⁸ The whole northern hemisphere was "affected by the radioactive plume and the consequent deposition of radioactive substances on the ground".¹⁰⁹ Clean up of the Chernobyl disaster continues to this day.

According to the IAEA's International Nuclear Safety Advisory Group (INSAG), the factors leading to the accident were threefold: (1) the safety features of the design of the plant, (2) the inadequate actions of the operators and (3) the general safety and regulatory framework in existence at the time.¹¹⁰ This was truly a systemic failure and no part of the nuclear power programme was blameless.

Like in the United States at the time of TMI, at the time of the Chernobyl accident, nuclear power had been deployed in the Soviet Union for a few decades, but the regulatory system was not well developed. The state oversight of NPP safety

105. This is not to say, however, that there have not been questions, or even challenges, raised regarding the Commission's structure in the years following the Reorganization Plan. In fact, the US Senate held a series of 10 hearings over the course of a one-year-period just seven years after the Reorganization Plan was issued. Among a number of proposals related to the Commission's organisation was one to re-structure the NRC into a single-administrator agency. Senate Bill 1770, "To reorganize the functions of the Nuclear Regulatory Commission by abolishing the Commission and, in its place, establishing the Nuclear Regulatory Agency, in order to promote more effective and efficient nuclear licensing and regulation", 100th Congress (1987). Three of the five sitting Commissioners supported the legislation (Chairman Zech, Commissioner Roberts and Commissioner Bernthal), believing it would enhance accountability and responsibility, while those who did not support it (Commissioners Carr and Rogers) believed that such changes would only result in minor enhancements. Proposals to Reorganize the Nuclear Regulatory Commission: Hearing on S. 14, S. 100, S. 908, S. 1769, and S. 1770 Before the Subcomm. on Nuclear Regulation of the S. Committee on Environment and Public Works, 100th Cong. 14-22 (1987). Ultimately, after still more hearings in the House and Senate in 1988 and 1989, no changes were made.

106. IAEA (1986), "INSAG-1 Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident" (hereafter "INSAG-1"), Safety Series No. 75-INSAG-1, IAEA, Vienna, pp. 3-4.

107. *Ibid.*, p. 4

108. NEA (1995), *Chernobyl Ten Years On: Radiological and Health Impact – An Assessment by the NEA Committee on Radiation Protection and Public Health*, NEA, Paris, p. 6

109. NEA (2002), *Chernobyl: Assessment of Radiological and Health Impacts, 2002 Update of Chernobyl: Ten Years On*, NEA, Paris, p. 11.

110. IAEA (1992), "INSAG-7 The Chernobyl Accident: Updating of INSAG-1, A Report by the International Nuclear Safety Advisory Group" (hereafter "INSAG-7"), Safety Series No. 75-INSAG-7, IAEA, Vienna, p. 22.

was carried out by three different organisations, which were responsible for: (1) engineering safety, (2) nuclear safety (Gosatomenergonadzor) and (3) radiation safety (State Sanitary Inspection).¹¹¹ Just like in the United States, these organisations were still in their infancy at the time of the accident (four years for the NRC and TMI¹¹² versus three years for Gosatomenergonadzor and Chernobyl). The requirements, however, had been in existence for longer. The regulatory requirements for NPP safety were adopted in 1973, but presented only general requirements without concrete detail.¹¹³ Further detail and specificity for the design and operation of NPPs were provided in codes, guides, rules and procedures, the most important of which were developed in 1975.¹¹⁴ There was not, however, any overarching law governing the use of nuclear power.¹¹⁵

The vast analysis and debate around nuclear safety and regulatory reform that occurred following TMI did not have an apparent impact in the Soviet Union prior to the accident at Chernobyl.¹¹⁶ One could even go so far as to say that the accident at Chernobyl can be partly attributed to this lack of reflection.¹¹⁷ But, up to this point, the Soviet nuclear establishment had shown no ability to learn from the accidents that occurred within its own territory either (three accidents in the Kyshtym/Chelyabinsk region of the Urals between 1949 and 1967¹¹⁸). And it took an extraordinarily long time for the Soviet Union to make the necessary reforms post-Chernobyl.

A. IAEA Reports: INSAG-1 and INSAG-7

Within four months of the accident, the IAEA and the Soviet Union held a Post-Accident Review Meeting, which was summarised in a report by INSAG, referred to as INSAG-1. In this first report, it was declared that “[t]he root cause of the Chernobyl accident ... is to be found in the so-called human element.”¹¹⁹ To correct this, the INSAG-1 report listed three necessary action items: training, auditing and “[a] permanent awareness by all personnel of the potential safety implications of any deviation from the procedures.”¹²⁰ Importantly, this is the first mention of the concept of “nuclear safety culture”.¹²¹

A follow-up INSAG report, INSAG-7, released six years later in 1992, de-emphasised the human factor and instead emphasised plant design and regulatory regime deficiencies. Although one can point to deficiencies in plant

111. Semenov, B.A. (1986), “Nuclear power in the Soviet Union”, *IAEA Bulletin*, Vol. 25, No. 2, pp. 53-54.

112. The NRC was formed on 19 January 1975. Ford, G. (1975), Executive Order 11834 – Activation of the Energy Research and Development Administration and the Nuclear Regulatory Commission, sec. 1. Prior to this, the NRC was the Atomic Energy Commission, which was assigned the functions of both promoting nuclear power as well as regulating its safety. US Atomic Energy Act, *supra* note 15, 42 USC 2011 et seq.

113. *Ibid.*, p. 54.

114. *Ibid.*

115. INSAG-7, *supra* note 110, p. 87 (Annex 1).

116. Vishnevsky, Y. (1996), “Radiation Safety Following the Chernobyl Accident”, paper submitted to the international forum One Decade after Chernobyl: Nuclear Safety Aspects, IAEA and UNDHA, Vienna, 1 to 3 April, p. 448.

117. See e.g. INSAG-7, *supra* note 110, Foreword.

118. See e.g. Collins, D. (1992), “Nuclear Accident in the Former Soviet Union: Kyshtym, Chelyabinsk and Chernobyl”, Defense Nuclear Agency, Armed Forces Radiobiology Research Institute, Bethesda, MD.

119. INSAG-1, *supra* note 106, p. 76.

120. *Ibid.*

121. *Ibid.*, pp. 77, 83.

design to potentially absolve the regulator of responsibility, the design issues were not an unknown element. Standards existed, but the “design fell well short” of those standards and “even incorporated unsafe features”.¹²² While there was an approval process for the design of the Chernobyl reactors, it “was approved despite the lack of conformity to many of the USSR’s design requirements for nuclear power plants.”¹²³ More serious was the fact there were three potential precursor events, one in 1975 (Leningrad, Unit 1), another in 1983 (Ignalina plant) and even one at Chernobyl (Unit 1) in 1982, that indicated important design problems with the Chernobyl plant design but this information was either not adequately reviewed or “not fully understood and ... essentially ignored.”¹²⁴

Serious issues like this arose because there was no such thing as “a strong and independent regulatory regime, properly resourced, backed at Government level and with all necessary enforcement powers” in existence in the Soviet Union prior to or at the time of the Chernobyl accident.¹²⁵ The regulatory regime in the Soviet Union was “insufficiently effective” and “unable to counter pressures for production”.¹²⁶ Part of this lack of effectiveness was due to “[i]nsufficient attention [being paid] to independent safety review”,¹²⁷ a fundamental component of any regulatory regime.

Although the INSAG-7 report minimised the significance of the lack of safety culture, it was still noted as an important contributing factor to the accident. Part of this was the fault of the regulator (or lack thereof). While there were apparently requirements for certain elements of safety culture in the regulations, there were no enforcement mechanisms in place.¹²⁸ “Many other necessary features did not exist at all.”¹²⁹ This lack of safety culture was not a flaw of simply one organisation in the nuclear structure of the Soviet Union; instead, these deficiencies existed at every level: from the Chernobyl plant to the “operating and regulatory organizations for nuclear power that existed at the time”, and from the national level to the local level.¹³⁰

B. Chernobyl Commission Report

On 27 February 1990, almost four years after the accident, the USSR State Committee for the Supervision of Safety in Industry and Nuclear Power (SCSSINP) set up a six-member Commission. Over the course of approximately a year, the Chernobyl Commission looked into the causes and circumstances of the accident by analysing and making “generalizations” from previously-available documents and reports.¹³¹ Even though a Governmental Commission to Investigate the Causes of the Accident at the Chernobyl NPP had been formed the same day as the accident,¹³² at the time the Chernobyl Commission report came out in 1991, “no scientific organization in

122. INSAG-7, *supra* note 110, pp. 20, 24.

123. *Ibid.*, p. 21.

124. *Ibid.*, p. 20.

125. *Ibid.*, p. 21.

126. *Ibid.*, p. 25.

127. *Ibid.*, p. 23.

128. *Ibid.*, p. 22.

129. *Ibid.*

130. *Ibid.*, pp. 23-25. See also *ibid.*, pp. 84-85 (Annex 1).

131. *Ibid.*, pp. 29-30 (Annex 1).

132. Voznyak, V. Y. (1996), “Social, Economic, Institutional and Political Impacts: Report for the Soviet Period”, paper submitted to the international forum One Decade After Chernobyl: Summing up the Consequences of the Accident, IAEA, Vienna, 8 to 12 April, p. 370.

the USSR [had] published a thoroughly substantiated comprehensive account explaining how the accident originated and developed.”¹³³

As explained succinctly by the Chernobyl Commission, Chernobyl Unit 4’s design deficiencies “predetermined the severe consequences of the accident”; however, that is not the end of the story.¹³⁴ The Commission determined that the design of the plant “violated the safety standards and regulations so seriously that it could only be operated in a country where there was an inadequate safety culture.”¹³⁵ And it was this deficiency of the regulatory regime that allowed this situation to arise that was the true cause of the Chernobyl accident.

To put it mildly, Soviet regulatory authorities were “lax in bringing plants with the [Chernobyl reactor design] into line with the safety standards and regulations.”¹³⁶ There were “many violations in the design of Chernobyl Unit 4 of the safety standards and regulation in force at the time of the design, construction and operation of the plant. Nevertheless, the design was approved and authorization given for construction by all the relevant authorities and regulatory bodies.”¹³⁷ Such careless oversight was bound to occur when at the time of the Chernobyl accident there was no atomic energy law in the Soviet Union; “when there is no law governing the utilization of nuclear power, no one bears the full responsibility for the safety of the operating nuclear power plants.”¹³⁸ There was no operating organisation in existence and plant management decisions were carried out by governmental ministries.¹³⁹ In fact, the concept of an “operating organization/utility” did not exist in the USSR until 1988.¹⁴⁰ Thus, the same bodies that were building nuclear power plants and supplying the nation’s electricity were also the same bodies responsible for developing safety standards. As explained by the Chernobyl Commission:

The USSR State Committee for the Supervision of Nuclear Power Safety [Gosatomenergondzor] was established only three years before the Chernobyl accident and, notwithstanding the safety culture concept, it could not be regarded as an independent body, since it was part of the same state authorities responsible for the construction of nuclear power plants and electricity generation.¹⁴¹

Ultimately, when these governmental processes were viewed as a whole, one could but determine that the nuclear power plants in the Soviet Union “are dangerous facilities for which no one is responsible.”¹⁴²

When the Chernobyl Commission report came out in 1991, five years after the accident, although many reforms had been taken, the most important were still in the waiting. There was still no law on the use of atomic energy, thus continuing a situation wherein the regulatory bodies had “no legal basis, no economic methods of control”.¹⁴³ A challenging nuclear economy decreased financial resources making it

133. INSAG-7, *supra* note 110, p. 30 (Annex 1).

134. *Ibid.*, p. 85 (Annex 1).

135. *Ibid.*

136. *Ibid.*, p. 50 (Annex 1).

137. *Ibid.*, p. 87 (Annex 1).

138. *Ibid.*

139. *Ibid.*

140. Vishnevsky, Y. (1996), *supra* note 116, p. 449.

141. INSAG-7, *supra* note 110, p. 88 (Annex 1).

142. *Ibid.*, p. 87 (Annex 1).

143. *Ibid.*, p. 88 (Annex 1).

very difficult to ensure well-staffed and well-trained organisations.¹⁴⁴ Therefore, five years after the accident, there was still “finicky supervision of nuclear power plants, rather than a full blooded regulatory system”.¹⁴⁵ And “[t]he system of legal, economic and sociopolitical correlations that existed prior to the accident” continued to exist in the Soviet Union and still did not meet the standards to ensure the safe use of nuclear power.¹⁴⁶

C. Regulatory reform in the Soviet Union

Regulatory reforms came slowly to the Soviet Union. Two years after the accident, in 1988, the Soviet Union finalised a new regulatory document, “Generic provisions on NPP safety”, modelled on INSAG-3’s “Basic principles of NPP safety”.¹⁴⁷ In addition to including needed concepts like defence in depth and beyond design basis accidents, “safety culture” was introduced as “the readiness of personnel, having an adequate professional and psychological background, to realize that safety ensuring is a priority aim and inherent need which results in understanding by personnel of its responsibility and need for self-control in safety-related actions.”¹⁴⁸

One document, however, is not enough as evidenced by the harsh language used by the Chernobyl Commission in 1991. The same year that the Chernobyl Commission report was issued, the State Committee on Supervision of Nuclear and Radiation Safety (Gosatomnadzor) was formed and designated as the state regulatory body for nuclear and radiation safety.¹⁴⁹ Although it had many of same responsibilities as its predecessor (Gosatomenergondzor), one organisation for the first time had “the responsibility to regulate and supervise safety not only at [NPPs], but also in the whole nuclear industry, including nuclear materials and fuel cycle facilities.”¹⁵⁰

Seven years after the accident, in 1993, the first application was submitted to Gosatomnadzor for an operating permit.¹⁵¹ The application was reviewed against the just passed “provisions on issuing provisional permits for NPP operation” and it took less than a year and a half for this permit to be reviewed and issued.¹⁵² Four years after the first license was submitted, in 1997, the final provisions on licensing in the field of nuclear energy, which established the licensing procedures and conditions, were approved.¹⁵³ By this time, at least three temporary operating permits were already issued.

144. *Ibid.* See also Aleksashin, P. P., A. M. Bukrinskii and B. G. Gordon (2006), “Safety Regulation – 20 Years After the Chernobyl Accident”, *Atomic Energy*, Vol. 100, No. 4, p. 274; Mikhailov, M. V. and S. A. Sitnikov (1999), “The Role of the Gosatomnadzor of Russia in National Regulating of Safety of Radiation Sources and Security of Radioactive Materials”, IAEA-CN-84/55, p. 349.

145. INSAG-7, *supra* note 110, p. 88 (Annex 1).

146. *Ibid.*, p. 87 (Annex 1).

147. Vishnevsky, Y. (1996), *supra* note 116, p. 448.

148. *Ibid.*, p. 449.

149. This was not the end of the reforms, however, of the Russian regulatory body. In March 2004, by the Decree of the President of the Russian Federation, Gosatomnadzor was renamed the Federal Nuclear Supervision Service and then two months later it was combined with the Federal Industrial Supervision Service and transformed into the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor).

150. Vishnevsky, Y. (1996), *supra* note 116, p. 448.

151. *Ibid.*, p. 450.

152. *Ibid.*, pp. 449-450.

153. Resolution of the Government of the Russian Federation No 865 of 14 July 1997 “On Approval of the Regulation on Licensing of Activities in the Field of Nuclear Energy Use”.

The most important reform, however, came in the form of a federal law – “On the Use of Atomic Energy” – which was adopted on 21 November 1995. It took over nine years for the Russian Federation to draft and pass its first law on the use of nuclear energy, but it finally did put a proper system into place. For the first time, there was to be a legal relationship between the people and the organisations involved in the different stages of nuclear energy usage. For the first time, it was specified, in law, that the operator “should be solely responsible for the safety of the nuclear facility, radiation source or storage facility, and also for the proper handling of nuclear materials and radioactive substances.”¹⁵⁴ The requirement for state regulatory bodies was also finally put into law and their powers were enumerated.¹⁵⁵ Even the need for independence was explicitly addressed.¹⁵⁶ But, further provisions were needed to effectuate parts of the new federal law. Another two and four years were needed for these to be approved by the government.¹⁵⁷

D. Summary

Unlike in the United States where more modest changes were needed, dramatic changes were needed in the Soviet Union following Chernobyl. But, these changes took entirely too long to institute. Although delays were understandable given the untold challenges it faced in the wake of Chernobyl (including the dissolution of the Soviet Union), had the Soviet Union progressively assessed its system, and learned lessons from the more minor incidents prior to Chernobyl, it may not have taken a decade to implement change.

V. Fukushima

Unlike at TMI and Chernobyl, the 11 March 2011 TEPCO Fukushima Daiichi NPP accident was precipitated by natural disasters: a 9.0 magnitude earthquake followed by a 14-15 metre tsunami. The earthquake, which was centred 150 kilometres northeast of Fukushima Daiichi, resulted in the loss of all off-site power to the Fukushima Daiichi NPP, triggering the supply of backup power from the emergency diesel generators (EDGs). The EDGs provided power to the plant for approximately 40 minutes, until the tsunami struck. The tsunami, which was approximately ten metres higher than what the plant was designed for, caused wide-scale flooding and knocked out four of the six EDGs,¹⁵⁸ as well as other essential plant safety systems.

154. Federal Law No 170 of 21 November 1995 “On the Use of Atomic Energy”, Article 35.

155. *Ibid.*, Arts. 23-25.

156. *Ibid.*, Art. 24, “The abovementioned authorities are independent from other state bodies and organisations whose activities are related to the use of atomic energy.”

157. Decree of the President of the Russian Federation of 21.01.1997 No 26 “On Federal Executive Bodies, Authorized to Execute State Nuclear Safety Regulation” and Government Decree of 1 December 1999 No 1511, “Provisions on Development and Approval of Federal Norms and Rules in the Field of Nuclear Energy”. See also Vishnevsky, Y. G., A. T. Gutsalov, S. M. Bukrinsky and B. G. Gordon (1999), “Development of NPP State Regulation in Russia”, Report presented to the International Conference on the Strengthening of Nuclear Safety in Eastern Europe, Vienna, 14 to 18 June, p. 446.

158. At the time, Units 1, 2 and 3 were operating, but Units 4, 5 and 6 were shut down for refuelling. One of Unit 6’s EDGs continued to operate, which enabled it to keep power to both Units 5 and 6. NRC (2015), “Backgrounder on NRC Response to Lessons Learned from Fukushima”, available at: www.nrc.gov/reading-rm/doc-collections/fact-sheets/japan-events.html. For a more detailed description of the Fukushima Daiichi accident progression, see IAEA (2015), “The Fukushima Daiichi Accident: Report by the Director General”, IAEA Document GC(59)/14, IAEA, Vienna.

Eventually, Fukushima Daiichi units 1, 2 and 3 experienced core melting, while built-up hydrogen in the reactor buildings of units 1, 3 and 4 caused explosions in the upper portions of these units exposing the spent fuel pools to the outside environment and releasing radioactive materials. Like Chernobyl, the Fukushima Daiichi NPP accident was rated a 7, “Major Accident”, on the International Nuclear Events Scale (INES) because of the major release of radioactive material with widespread environmental effects.¹⁵⁹ The difference from Chernobyl, however, is that there were no widespread health effects. In the end, approximately 150 000 people were evacuated.¹⁶⁰

Following the accident, nuclear power plant countries around the world immediately began looking at the safety of their facilities in light of what occurred in Japan. For example, 12 days after the accident, the (now former) Chairman of the NRC directed the staff “to conduct a methodical and systematic review of [the agency’s] processes and regulations to determine whether the agency should make additional improvements to [its] regulatory system”.¹⁶¹ One day later, the European Council determined that all European Union nuclear power plants should undertake “comprehensive and transparent risk and safety assessment[s]” (so-called “stress tests”), which would reassess the safety margins of nuclear power plants.¹⁶²

International organisations got involved as well, with the NEA establishing a Senior-level Task Group on Impacts of the Fukushima Daiichi NPP Accident on 30 March 2011. Two months later, on 7 and 8 June 2011, the NEA co-organised a Ministerial Meeting on Nuclear Safety with the French government, in their role as G8-G20 Chair for 2011, and sponsored a forum on Fukushima, which was “the first international regulatory meeting with industry that focused exclusively on the Fukushima accident and the path forward”.¹⁶³ Later that same month, the IAEA convened a Ministerial Conference on Nuclear Safety.¹⁶⁴ Everyone, however, was waiting for a report from Japan.

A. **Kurokawa Report**

On 30 October 2011, approximately seven months following the accident, the Act regarding Fukushima Nuclear Accident Independent Investigation Commission (the NAIIC Act) was enacted. One of the mandates charged to the NAIIC by the Speaker and the President of the National Diet was “To recommend measures to prevent nuclear accidents and any consequential damages based on the findings of the above investigations. The recommendations shall include assessments of essential nuclear policies and the structure of related administrative organisations.”¹⁶⁵ Additional direction was given by the Joint Council of the Committee on Rules and Administration of Both Houses on the Accident at the Fukushima Nuclear Power Plants of the Tokyo Electric Power Company that, among other actions, “The

159. IAEA (2011), “Fukushima Nuclear Accident Update Log – Updates of 12 April 2011”, www.iaea.org/newscenter/news/fukushima-nuclear-accident-update-log-15.

160. The National Diet of Japan (2012), “The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission”, Executive Summary (hereafter “NAIIC Report”), p. 19.

161. COMGBJ-11-0002, “NRC Actions Following the Events in Japan” (11 March 2011).

162. ENSREG (n.d.), “EU Stress Tests and Follow-up”, www.ensreg.eu/EU-Stress-Tests.

163. NEA (2011), “Proceedings of the Forum on the Fukushima Accident: Insights and Approaches”, NEA Document NEA/CNRA/R(2011)12, NEA, Paris.

164. More information on the Ministerial Conference is available on the IAEA’s website at: www-pub.iaea.org/iaea meetings/42466/IAEA-Ministerial-Conference-on-Nuclear-Safety.

165. NAIIC Report, *supra* note 160, p. 10.

investigation should result in recommendations to benefit the nation's future, and provide an opportunity for strengthening the legislative body of the nation."¹⁶⁶

In December 2011, the National Diet appointed a chairman of the NAIIC, Kiyoshi Kurokawa (a medical doctor and former President of the Science Council of Japan), and nine other members, among whom were two lawyers, a seismologist, another medical doctor and a former United Nations ambassador. After approximately six months of investigation, the report was released on 5 July 2012. In its investigation, the NAIIC:

- conducted more than 900 hours of meetings;
- interviewed 1 167 people;
- held 19 public commission meetings and broadcast 18 simultaneously in Japanese and English, with over 800 000 viewers total;
- utilised various social media outlets to communicate with the public, receiving over 170 000 comments;
- held 3 town hall meetings for evacuees with over 400 attendees; and
- surveyed residents of the designated evacuation area as well as on-site workers, receiving 10 633 and about 500 responses respectively.¹⁶⁷

In an exceedingly frank and candid Message from Chairman Kurokawa introducing the report, he stated that the “disaster was ‘Made in Japan’” and that it “could and should have been foreseen and prevented.”¹⁶⁸ The lessons learned from TMI and Chernobyl were not absorbed in Japan and long after many governments had reformed their regulatory structure, Japan still entrusted the regulation of nuclear power “to the same government bureaucracy responsible for its promotion.”¹⁶⁹ The “regulatory capture” described in the NAIIC report went well beyond what one might imagine at the advanced stage of Japan’s nuclear programme: “Their independence from the political arena, the ministries promoting nuclear energy, and the operators was a mockery. They were incapable, and lacked the expertise and the commitment to assure the safety of nuclear power. Moreover, the organization lacked transparency.”¹⁷⁰ In the end, the Commission’s overall conclusion was that:

In order to prevent future disasters, fundamental reforms must take place. These reforms must cover both the structure of the electric power industry and the structure of the related government and regulatory agencies as well as the operation processes. They must cover both normal and emergency situations.¹⁷¹

A number of findings were made to support this, including the three most relevant here:

- “A ‘manmade’ disaster: The TEPCO Fukushima Nuclear Power Plant accident was the result of collusion between the government, the regulators and TEPCO, and the lack of governance by said parties ... We

166. *Ibid.*, p. 11.

167. *Ibid.*, p. 11.

168. *Ibid.*, p. 9.

169. *Ibid.* At the time of the Fukushima Daiichi accident, the Nuclear and Industrial Safety Agency (NISA) was “a part of the Ministry of Economy, Trade & Industry (METI), an organization that ha[d] been actively promoting nuclear power.” *Ibid.*, p. 17.

170. *Ibid.*, pp. 20-21.

171. *Ibid.*, p. 16.

believe that the root causes were the organizational and regulatory systems that supported faulty rationales for decisions and actions, rather than issues relating to the competency of any specific individual.”¹⁷²

- “Reforming the regulators: The Commission has concluded that the safety of nuclear energy in Japan and the public cannot be assured unless the regulators go through an essential transformation process. The entire organization needs to be transformed, not as a formality but in a substantial way. Japan’s regulators need to shed the insular attitude of ignoring international safety standards and transform themselves into a globally trusted entity.”¹⁷³
- “Cosmetic solutions: Replacing people or changing the names of institutions will not solve the problems. Unless these root causes are resolved, preventive measures against future similar accidents will never be complete.”¹⁷⁴

Out of these findings, seven recommendations were made. While many contained aspects related to regulatory and legal reform, the most direct was Recommendation 5, “Criteria for the new regulatory body”. The NAIIC determined that the new regulatory body must adhere to five “conditions”: independence, transparency, professionalism, consolidation and proactivity.¹⁷⁵

B. Regulatory reform in Japan

Ultimately, the Japanese regulatory body underwent a dramatic reform. In August 2011, just five months after the accident but almost a full year before the NAIIC Report, a Cabinet decision was made to restructure the bodies responsible for nuclear regulation.¹⁷⁶ Under this decision, a new organisation was to be created, tentatively called the “Nuclear Safety and Security Agency”, which would be an “Affiliated Organization” of the Ministry of the Environment (thus outside of METI) and integrating the function of the Nuclear Safety Commission. The goal was to complete this reorganisation by April 2012. The government submitted a bill to the Diet on 31 January 2012 to establish the Nuclear Safety and Security Agency, which was to be headed by a single Commissioner.¹⁷⁷ The opposition parties, however, submitted a counterproposal to the Diet on 20 April 2012 that proposed a multimember commission.¹⁷⁸

Discussions then took place between the government and the opposition parties, resulting in a collaborative submission of a reformed bill to the Diet – Act for

172. *Ibid.*

173. *Ibid.*, p. 20.

174. *Ibid.*, p. 21.

175. *Ibid.*, p. 23.

176. Cabinet Decision (2011), “Basic Policy on the Reform of an Organization in charge of Nuclear Safety Regulation”, available at: www.meti.go.jp/english/earthquake/nuclear/iaea/pdf/20110911/annex4.pdf.

177. Reform of Japan’s Nuclear Safety Regulation (2012), available at: www.nsr.go.jp/data/000099642.pdf.

178. NEA (2012), “National Legislative and Regulatory Activities: Japan – Nuclear Regulation Authority Act”, *Nuclear Law Bulletin*, No. 90, NEA, Paris, p. 122; Burns, S. (2012), “The Fukushima Daiichi Accident: The International Community Responds”, *Washington University Global Studies Law Review*, Vol. 11, No. 4, p. 759.

Establishment of the Nuclear Regulation Authority – on 15 June 2012.¹⁷⁹ This bill was adopted on 27 June 2012.¹⁸⁰

The new bill created the Nuclear Regulation Authority (NRA), which was established under the Ministry of the Environment on 19 September 2012. Under the Act, the NRA's mission is “to ensure safety in the use of nuclear energy ... for the purpose of contributing to the protection of the life, health, and property of the citizens, preservation of the environment, and national security of Japan.”¹⁸¹

The new organisation is quite similar to the US NRC with four commissioners and one chairman (Article 6) who are appointed by the Prime Minister with the consent of both Houses of the Diet (Article 7) and serve five year terms (Article 8). Unlike the US NRC, however, the NRA commissioners have “role-over terms”, where they will continue to serve as commissioner until their successor is appointed (Article 8(3)), thus preserving a full commission.¹⁸²

The independence and technical competence of the commissioners and NRA as an organisation was a prominent component of the Act. Going beyond structural independence, the Act ensured greater protections by classifying the NRA as an “article 3 Authority”, which is a way of “ensuring its independence without any control or supervision by other organizations (i.e., Ministers of other Governmental organizations).”¹⁸³ Further, Article 5 specifically states that “The Chairman and the Commissioners of the Nuclear Regulation Authority shall exercise their authority independently.” They are to have “noble character and have excellent knowledge and experience concerning the ensuring of safety in the use of nuclear energy” (Article 7(1)) and must “exercise their authority independently, based on their own expertise, from a neutral and fair standpoint, thereby contributing to the protection of the lives, health, and property of the citizens, preservation of the environment, and national security of Japan” (Article 1). Thus, organisational and personal independence became legislatively mandated as well.

C. Regulatory reform around the world

The regulatory lessons from Fukushima did not begin and end in Japan. Many other nations, as well as international and regional organisations took note. For example, although the National Assembly of the Republic of Korea had already initiated the regulatory reform process prior to the Fukushima accident, the events in Japan

179. Task Force for the Reform of Nuclear Safety Regulations and Organisations, Cabinet Secretariat, Government of Japan, “Reform of Nuclear Regulation Organisation and System in Japan”, slide 5. See also Fukasawa, J. and M. Okusaki (2012), “Reform of the Nuclear Safety Regulatory Bodies in Japan”, presented at the International Nuclear Law Association 2012 Congress, Manchester, England, 8 to 11 October.

180. Act No. 47, *supra* note 17.

181. *Ibid.*, Art. 3.

182. The NRC is actually an outlier in this regard, as most US regulatory agencies have role-over terms. Breger, M. J. and G. J. Edles (2015), *Independent Agencies in the United States: Law, Structure, and Politics*, Oxford University Press, New York, p. 157. See also 42 USC 7171(b)(1), “Appointment and administration” (“A Commissioner [of the Federal Energy Regulatory Commission] may continue to serve after the expiration of his term until his successor is appointed and has been confirmed and taken the oath of Office, except that such Commissioner shall not serve beyond the end of the session of the Congress in which such term expires.”).

183. Act No. 47, *supra* note 17, Art. 2; NRA, “Nuclear Regulation for the People and the Environment”, available at: www.nsr.go.jp/english/e_nra/nsr_leaflet_English.pdf, p. 3.

“expedited [the] review process.”¹⁸⁴ On 29 June 2011, the National Assembly adopted reform legislation and on 26 October 2011 the Nuclear Safety and Security Commission (NSSC) was established.¹⁸⁵ Previously, Korea’s regulator, the Korean Institute of Nuclear Safety (KINS), had been organised under the Ministry of Education, Science & Technology (MEST), which had the responsibility for the promotion of nuclear energy.¹⁸⁶ But, the new NSSC was organised directly under the President (now the Prime Minister) rather than within in a specific ministry.¹⁸⁷ Under the new organisation, KINS and the Korea Institute of Nuclear Non-proliferation and Control (KINAC) have become technical support organisations. The NSSC is headed by one chairperson, one standing commissioner and seven non-standing commissioners, each appointed for three-year terms with only one possibility of reappointment.¹⁸⁸

The need for independence is specified in Article 2 of the Act, which requires the NSSC to “maintain fairness and independence” in its activities and it is assured that commissioners will not “be compelled to do unjust work or [be] interfered [with] in the performance of their duties”.¹⁸⁹ Ethical restrictions are outlined in Articles 10 and 18, providing that no one may serve on the Commission if they have either “worked as head or employee of nuclear energy users’ groups” or were “involved in research projects or business of nuclear energy users’ groups”.¹⁹⁰ Article 18, “Duty to Maintain Integrity”, goes further providing that “Any commissioners of a special committee of NSSC referred as in Article 15 shall not acquire bribes, favors or other unjust benefits from people involved in any nuclear business, which is subject to deliberation or regulated by this Act”¹⁹¹ with harsh penalties contained in Article 19: violation can result in “imprisonment with/without labor for a limited period of not less than 10 years.”¹⁹²

At the regional level, the European Commission (EC) took significant action to reinforce an earlier commitment to safety when it amended the 2009 Safety Directive.¹⁹³ The 2014 amendment strengthens the power, independence and resources of national regulatory authorities; increases transparency on nuclear safety matters; and promotes an effective nuclear safety culture.¹⁹⁴ And, while the 2009 Safety Directive “reflects the provisions of the main international instruments in the field of nuclear safety, namely the Convention on Nuclear Safety”,¹⁹⁵ the 2014 amendment goes further, incorporating more expressly aspects of the CNS related to

184. Ryu, Y. H. (2012), “Nuclear Regulatory Organization Changes in Korea”, presentation given at the International Workshop on Nuclear Safety Regulation, NEA, Tokyo (18 January 2012), Slide 2.

185. Act on the Establishment and Management of Nuclear Safety and Security Commission (2011), amended in 2013.

186. Ryu, Y. H. (2012), *supra* note 184.

187. Act on the Establishment and Management of Nuclear Safety and Security Commission (2011), *supra* note 185, Art. 3.

188. *Ibid.*, Arts. 4, 7.

189. *Ibid.*, Arts. 2, 8.

190. *Ibid.*, Art. 10.

191. *Ibid.*, Art. 18.

192. *Ibid.*, Art. 19.

193. Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations, *Official Journal of the European Union (OJ)*, L 172 (2 July 2009) (2009 Safety Directive).

194. Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, *OJ L 219* (25 July 2014).

195. *Ibid.*, preambular paragraph 2.

ensuring that regulatory authorities have the “appropriate means and competencies to properly carry out the responsibilities assigned to them”.¹⁹⁶

At the international level, just a few short months after the Fukushima Daiichi NPP accident, the member states of the IAEA adopted the “IAEA Action Plan on Nuclear Safety”.¹⁹⁷ Under the IAEA Action Plan, among many other actions, member states are encouraged to review their regulatory bodies and assess “their effective independence, adequacy of human and financial resources and the need for appropriate technical and scientific support, to fulfil their responsibilities”.¹⁹⁸

D. Summary

There was no doubt that changes needed to be made to the Japanese regulatory system following the Fukushima Daiichi NPP accident and the Japanese government took immediate action on this. Although it seemed that everyone agreed that something needed to be done, no one could quite agree on the right approach. Fortunately, however, with the benefit of time, a compromise was able to be reached on a bill that reflected the regulatory principles contained in the international nuclear safety treaties and exhibited in international best practices. Time will tell if the implementation of these reforms proves successful.

VI. The ideal regulator

In the almost 65 years since electricity was first generated by nuclear fission, the ideas regarding how to best regulate this source of energy have converged. For the most part, national, regional and international best practices now all but describe the same ideal regulator. Whether this harmonisation developed from the national programmes up or the international efforts down, the roadmap is clear.

A. International and regional perspective

The NEA and the IAEA have contributed much to the international perspective on regulatory reform. From the safety conventions discussed at the outset to the IAEA’s Fundamental Safety Principles and its Safety Standards¹⁹⁹ to the work over the past 15 years by the NEA’s Committee on Nuclear Regulatory Activities (CNRA) in providing regulatory guidance, there is uniformity of opinion on what is needed for an effective regulator.

For example, the CNRA, which is made up of senior representatives from nuclear regulatory authorities around the world, developed a document in 2014 called “The Characteristics of an Effective Nuclear Regulator”.²⁰⁰ The document details the characteristics determined by this leading group of international nuclear regulators to be necessary components of an effective nuclear safety regulator.²⁰¹ To this international body, “an effective nuclear regulator:

- is clear about its regulatory roles and responsibilities, its purpose, mandate and functions;

196. *Ibid.*, preambular paragraph 6.

197. IAEA (2011), “Draft IAEA Action Plan on Nuclear Safety, Report by the Director General”, GOV/2011/59-GC(55)/14.

198. IAEA Action Plan on Nuclear Safety (2011), available at: www.iaea.org/sites/default/files/actionplanns.pdf, p. 3.

199. See e.g. IAEA (2006), “Fundamental Safety Principles”, IAEA Safety Standards Series No. SF-1, Vienna, Principle 2: Role of government; IAEA (2010), *supra* note 7.

200. NEA (2014), *The Characteristics of an Effective Nuclear Regulator*, OECD, Paris.

201. *Ibid.*, p. 7.

- has public safety as its primary focus;
- has independence in regulatory decision making from any undue influence on the part of the nuclear industry and those sectors of government that sponsor this industry;
- has technical competence at its core, with other competencies built upon this fundamental and essential requirement;
- is open and transparent in its regulations and decisions;
- has a regulatory framework and requirements that are clear and easily understood by all stakeholders;
- makes clear, balanced and unbiased decisions, and is accountable for those decisions;
- has a strong organisational capability in terms of adequate resources, strong leadership and robust management systems;
- performs its regulatory functions in a timely and efficient manner;
- has and encourages a continuous self-improvement and learning culture, including the willingness to subject itself to independent peer reviews.”²⁰²

The CNRA has made the determination that “A regulator with [these] characteristics should be effective in ensuring that nuclear facilities are operated at all times in a safe manner, in accordance with international safety principles and with full respect of the environment.”²⁰³

None of these characteristics breaks new ground. In fact, the IAEA’s Integrated Regulatory Review Service (IRRS), an optional peer review service provided to member states, tests some of these very concepts.²⁰⁴ Components like “Independence of the Regulatory Body” and “Prime Responsibility for Safety” trace back to IAEA Safety Standards that have been in existence since 2000.²⁰⁵

Moreover, following the Fukushima Daiichi NPP accident, regional organisations also detailed their ideal regulatory characteristics. As mentioned earlier, in 2014, the EC amended its 2009 Safety Directive to strengthen the powers and independence of national regulatory authorities that supervise the activities of nuclear operators. The EC stated that:

A strong competent regulatory authority with effective independence in regulatory decision-making is a fundamental requirement of the Community nuclear safety regulatory framework. It is of utmost importance that the competent regulatory authority has the ability to exercise its powers impartially, transparently and free from undue influence in its regulatory decision-making to ensure a high level of nuclear safety. Regulatory decisions

202. *Ibid.*, pp. 7-8.

203. *Ibid.*, p. 8.

204. IAEA (2013), “Integrated Regulatory Review Service (IRRS) Guidelines for the Preparation and Conduct of IRRS Missions”, Service Series 23, Vienna, Module 1: Responsibilities and Functions of the Government, p. 36.

205. *Ibid.* Although the IRRS Guidelines specifically reference IAEA (2010), “Governmental, Legal and Regulatory Framework for Safety”, IAEA Safety Standards, General Safety Requirements Part 1, Vienna, this document superseded IAEA (2000), “Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety”, IAEA Safety Standards Series, No. GS-R-1, Vienna.

and enforcement actions in the field of nuclear safety should be based on objective safety-related technical considerations and should be established without any undue external influence that might compromise safety, such as undue influence associated with changing political, economic or societal conditions.²⁰⁶

These high-level principles were then worked into amended Articles 5, 7 and 8 of the Safety Directive. Member states have three years to transpose the new requirements into their national legislations. The requirements in the amended Safety Directive match up with those specified by the IAEA, the NEA and the safety conventions, thus ensuring greater harmonisation across nuclear power generating countries.

B. National perspective

The move towards harmonisation of regulatory principles is evident across a great many national regulatory bodies, as a number of nuclear regulatory organisations make public the doctrines or foundations upon which they operate. For example, the US Nuclear Regulatory Commission adheres to its so-called “Principles of Good Regulation”, which are: independence, openness, efficiency, clarity and reliability.²⁰⁷ With the re-organisation of the Korean regulator, “Core Values” were adopted. Analogous to those of the NRC, the NSSC’s values are:

- technical excellence: accumulate expertise and experiences that the people can build trust on;
- independence: progress vigorously with works only for the nation and people;
- transparency: leave no doubts throughout the safety regulatory process;
- impartiality: stand with impartiality and objectiveness;
- reliability: comply with principles and maintain clarity and consistency.²⁰⁸

The Japanese NRA has similarly established five “Guiding Principles” for its operations, which are: independent decision making, effective actions, open and transparent organisation, improvement and commitment, and emergency response.²⁰⁹ These principles, first published in January 2013, very clearly trace back to criticisms Japan faced (both internally and externally) in their handling of the Fukushima Daiichi NPP accident. For example, under “Independence”, it is explicitly stated that decisions will be made “free from any outside pressure or bias”. In the “Open and Transparent Organization” principle, the NRA states that it “shall be open to all opinions and advice from Japan and the international community and avoid both self-isolation and self-righteousness”. Interestingly, the CNSC has explicitly modelled its ten “Attributes of a World-Class Regulator” off of the NEA’s “Characteristics of an Effective Regulator”.²¹⁰

206. Council Directive 2014/87/Euratom, *supra* note 194, preambular paragraph 6.

207. NRC (2015), “Values”, www.nrc.gov/about-nrc/values.html.

208. NSSC (2012), “Our Mission and Values”, www.nssc.go.kr/nssc/en/c1/sub1.jsp.

209. NRA (n.d.), “NRA’s Core Values and Principles”, www.nsr.go.jp/english/e_nra/idea.html.

210. See e.g., Jamieson, T. (2015), “Insights on the Canadian Nuclear Safety Commission’s Safety Culture Journey”, presentation at the NEA/CNRA/CSNI/CRPPH Joint Workshop on Challenges and Enhancements to Safety Culture of the Regulatory Body, Paris, 3 June, slide 12. The “Attributes” are: (1) clear legislation and regulations; (2) safety focus; (3) independence; (4) open and transparent; (5) technical competence; (6) modern, flexible regulatory framework; (7) science-based decision making; (8) dissemination of

This is not an exhaustive review of all the principles, values or guidelines of national regulatory bodies, but rather a mere sampling. Other national regulators, like the ASN in France²¹¹ and the Federal Authority for Nuclear Regulation in the United Arab Emirates²¹² have similar fundamental concepts guiding their work.

VII. Conclusion

At this stage in the development of nuclear power, the lessons on regulatory effectiveness are known. There is no reason for countries to sit idle only to be forced into action in a worst case scenario. Proactive development of the law, regulations, standards and guidance for the safe and secure use of nuclear energy is essential for a thoughtful, well-considered approach. The same holds true for the improvement of regulatory systems. The time to review, and potentially make changes to, a regulatory system is before the crisis and before the criticism, not after.

information; (9) well-managed and well-resourced organization; and (10) continuous improvement. For an interesting look at the meaning of regulatory independence in Canada, see MacKenzie, B. (2010), "The Independence of the Nuclear Regulator: Notes from the Canadian Experience", *Nuclear Law Bulletin*, No. 85, NEA, Paris, pp. 35-63.

211. ASN (n.d.), "ASN's General Regulatory Policy", www.french-nuclear-safety.fr/Media/Files/General-Regulatory.

212. FANR (2014), "Our Vision, Mission & Core Values", www.fanr.gov.ae/En/AboutFANR/Pages/Our-Vision-Mission-Core-Values.aspx.