



## Review

# A world's dilemma ‘upon which the sun never sets’: The nuclear waste management strategy (part II): Russia, Asia and the Southern Hemisphere

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## ABSTRACT

As world energy consumption continues to grow at an accelerated rate, a number of nation states are expanding or developing nuclear power programs to help meet this rising demand for energy. Part II presents the nuclear waste management programs in Russia, Japan, China, South Korea, India, Argentina, Brazil and South Africa. Additionally, the paper presents a brief dialogue on the topic of corruption in each nation state, and a look at its history of nuclear power and political system. As discussed in Part I, there are currently limited, but successful options, for implementing a nation state's nuclear waste management strategy.

## 1. Introduction

Part I<sup>1</sup> provided the background to this discussion that as world energy consumption continues to grow during the 21st century, nations may look to nuclear power generation to provide a stable, efficient, secure, and low carbon energy supply. Nuclear power generation has the ability to provide constancy in the energy program of a nation state as demand for raw materials, such as oil and natural gas, continue to grow. Therefore, many developing nations have established, or may desire to establish, a nuclear power generating program to alleviate other natural resource restrictions. Additionally discussed, a major dilemma for ‘new-comer’ nuclear nations, and those nations with established nuclear power generating programs, is the closing of the nuclear fuel cycle by successfully managing any created nuclear waste.

Part II builds on the discussion of the nation states in Part I by expanding on this review of the various waste management schemes that are being considered or undertaken to include Russia, Japan, China, South Korea, India, Argentina, Brazil and South Africa. With the exception of Japan, Argentina and South Korea, these nation states are chosen for discussion because these make up a characteristic collection of nation states able to shape world policy and events as middle powers commonly referred as ‘BRIC’ or ‘BRICS’ (Brazil, Russia, India, China plus South Africa). These nation states share certain positive and ne-

gative similarities including: planned and/or expanding nuclear power programs; large or expanding populations with emergent economies; “high GDP but relatively low GDP per capita; large domestic inequalities; and high absolute poverty levels” (Dauvergne & Farias, 2012). Japan and South Korea were chosen for discussion due to their expansive nuclear power programs, and their unique challenges in finalizing a nuclear waste management disposal facility due to internal political struggles. Argentina is unique in that while it developed and maintained a small nuclear power program for years, despite economic and political difficulties, it is now expanding its nuclear power program with the help of Chinese financial support.

## 2. Future energy consumption outlook - BRICS

Certainly, one of the parallel requirements facing developed and newcomer nuclear nation states is the need to gain access to stable, clean, and plentiful sources of power production to drive a burgeoning economy in a cost effective and environmentally friendly manner. Technological advances starting in the mid-2000's have provided an abundance of cheap natural gas through fracking, with an 80% growth in gas demand led by mostly Asian nation states, including China and India, over the next 20 years (World Energy Outlook 2017). Current predictions for China estimate that it will experience power growth at a

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<sup>1</sup> Sanders, M, & Sanders, C 2016, ‘A world's dilemma ‘upon which the sun never sets’ – The nuclear waste management strategy (part I): Western European Nation States and the United States of America’, Progress In Nuclear Energy, 90, pp. 69–97.

rate of 3.8–4.6% per annum through the year 2020, with chronic pollution estimated to cause China an economic loss at almost 6% of Gross Domestic Product<sup>2</sup> (*Nuclear Power in China*). In its fight to tackle pollution, China is seeking to obtain the environmental benefits of clean energy technologies through the use of wind, solar, and nuclear power generation (*China's Engagement in Global Energy Governance*).

Brazil has a small but budding nuclear power program generating about 3% of its electricity, with 84% generated through hydro. Brazil's overreliance on hydro generated power is creating potential challenges due to changing weather patterns and climatic shifts (*Nuclear Power in Brazil*). From the early 1990's, India has experienced rapid growth in energy consumption as its economic output has risen, but is also suffering extreme levels of pollution in its major cities (*Nuclear Power in India*). South Africa currently has two nuclear power plants responsible for generating ~ 5–6% of its electricity and currently plans to add 9.6 GW of nuclear generation capability across the country over the next 10–12 years, with a cost of between 37 and 100 billion USD (*Boosting the Power Sector in Sub-Saharan Africa*).

### 3. Legitimacy through linkage

Part I deliberated a need for stability or 'strength within the law' to provide the legal framework in creating a stable and effective nuclear waste management program. The Joint Convention on the Safety of Spent Nuclear Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) are built upon the concept of adequacy, allowing a nation state that is a party to the convention to use its national sovereignty to develop a nuclear waste management strategy that is "comparable to those of the other nation states, which are [also] party to the convention" (*Sanders M & C, 2016*). As discussed, though the Joint Convention does not provide explicit detail for each intended action in a nuclear waste management strategy, Pronto adds that this type of general working structure is often the intended design of the framers to guide the actions of those parties at the international level through non-formally binding rules of engagement (*Pronto, 2015*).

As also discussed in Part I, there are four compartments to consider when developing a nuclear waste management program and which potentially affects its legitimacy. Shown in *Figure 1*, these compartments comprise (1) concerns surrounding the economic viability towards the funding and building of a nuclear waste disposal facility; (2) that any environmental concerns are duly considered to ensure any negative effects on all stakeholders (e.g., human, vegetable, mineral, animal) have been thoroughly investigated and taken into consideration; (3) the assurance that the science and technology employed are up to date and sound, being free from political influences; (4) that the waste management facility siting, design, construction and operation reflects the desires and will of the society; and, (5) that all actions provide for stability throughout any legal action and/or policy making decisions undertaken by the nation state to guarantee that such actions are performed in accordance with the rule of law found within that society (*Sanders M & C, 2016*).

The values represented within these four compartments are required and important tools in developing a stable and legitimate framework for creating the necessary laws, statutes, regulations, and rules in a nuclear waste management program. As each compartment harmoniously interacts with the other, the process of effectively meeting all the aspects of a nuclear waste management program from inception, to a time point far into the future is achieved. Part I introduced the compartment 'Stability (i.e., The Law),' but did not elaborate on its

characteristics, so therefore consideration is given here to the two main concepts of Stability - 'legal stability' and 'legal legitimacy'.

#### 3.1. The concept of legal stability

The primary objective for designing and operating a nuclear reactor is "the utilization of the energy or radiation released by controlled chain reaction ... [h]owever the achievement of a stable chain of fission reactions is only a part of the responsibility of the nuclear engineer. In addition, he must learn how to extract and use the energy liberated in these fission reactions" (*Duderstadt and Hamilton, 1976*). Equally, only part of the responsibility of the policymaker's primary objective is to provide the written laws, statutes, regulations, and rules, but more so, he must be able to seize the ability to utilize the energy or legal force created toward a series of relevant actions, in a controlled and sustained environment, for achieving the desired end outcome. The "issue of stability and change in constitutional law" (*Williams, 1963*) is continually hotly debated by academics, having fervent partisans on each side of the equation.

'Stability' is a word that is commonly used to present something that is stationary or unchangeable (*Cambridge Dictionary*), or when discussing legal stability we usually refer to the basic building block structuring the personality of the common law - *stare decisis*<sup>3</sup> (*Black's Law Dictionary*). Thus, the judicial or political system has made some determination of a particular path of progression so that those engaged in an activity may know with certainty that the decision/determination is not an arbitrary one, and may therefore be relied upon through a future time period. However, a purpose of government, and a duty of the courts, is to process change as society and technology alters, all while seeking to contain this "constant and restless motion [of government]" (*McKay, 1963*) as it seeks a new stable footing. The force called 'stability' creates an exceptional central challenge for nuclear waste management programs, as laws, statutes, regulations, and rules written today, as promulgated, are for an intended extended outward period, projecting forward today's burden for tomorrow's generations to manage. Such laws, statutes, regulations, and rules are not promulgated in a vacuum of peace and tranquility, but within complex political systems, which at times display outward chaotic change, even though law should portray a sense of stability (*Pound, 1923*). In the 1930's, Goodwin declared:

"We are wont to look upon our government as something permanent, indestructible, and, in its fundamentals, unchangeable. Anyone who accepts this thought unqualifiedly disregards world history. Governments and civilizations arise, prosper, and disintegrate."<sup>4</sup> (*Bar Briefs 8, 1931–1932*).

Human history is fraught with political systems where seemingly stable states become unstable and falter.<sup>5</sup> The concern arises of what happens to a nuclear waste management program in a nation state should that state cease to exist, because that particular political or legal system is unable to process change, in its pursuit of a constant arrangement of 'stability'.<sup>6</sup> It is time consuming and difficult to delve into

<sup>3</sup> to stand by things decided.

<sup>4</sup> From the pen of Clarence N. Goodwin.

<sup>5</sup> Human history provides a number of examples of failed and fallen empires. Certainly, for the western world, the collapse of the Roman Empire is a striking and often discussed example. Other examples might include the Arab Empire, also known as the Caliphate, the Mongol Empire and the British Empire. Common features leading to the decline of these empires include a decline in the values underpinning the empire, political corruption, and military spending. See: *The Decline and Fall of Empires*, <https://www.forbes.com/sites/stratfor/2015/04/20/the-decline-and-fall-of-empires/#1248dd3d383e>, viewed July 11, 2018.

<sup>6</sup> An example could be provided during the breakup of the Union of Soviet Socialist Republic in the early 1990's. The international community rallied to

<sup>2</sup> According to Robert Higgs, "Estimates of gross domestic product (GDP)... Became an essential part of economic analysis ... in the late 1930s and early 1940s". See: HIGGS, R 2015, 'Gross Domestic Product—an Index of Economic Welfare or a Meaningless Metric?', *Independent Review*, 20, 1, pp. 153–157, Academic Search Premier, EBSCOhost, viewed 13 June 2017.

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