UAE's Acceptance of the Nuclear Gold Standard

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by

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Abstract

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Abstract: The Korean Electric Power Company (KEPCO) reactor design is mainly based on the American Combustion Engineering 80+ design. As the design at Barakah comprises Korean APR-1400, which is heavily based on American technology, United Arab Emirates (U.A.E.) was obliged to form a bilateral agreement with the United States (U.S.) in order to use the technology. The agreement is known as the 123-agreement and commonly labelled as the Nuclear Gold Standard (NGS). The basis of the agreement is the Atomic Energy Act of 1954, specifically Section 123 "Nuclear cooperation with other countries." The agreement went beyond norms outlined in the nuclear agreement, as it posed restrictions that could curb any country's plans of pursuing a full nuclear fuel cycle. These restrictions pertaining to the NGS included the fact that UAE will forgo the enrichment of uranium and reprocessing of spent fuel.

The only country that has signed the US–UAE style NGS agreement is Taiwan, which signed the agreement in 2014. No other country has accepted the NGS, as countries have always strategically wanted to keep their enrichment options open for various reasons. The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) states that it is within a country's right to enrich nuclear material for peaceful use. This thesis will investigate the reason behind why UAE accepted this strict agreement, and the reasons that led to their agreement. Moreover, the thesis will look into how UAE adopted the NGS into its legislative system in the form of new norm adoption. Various nuclear energy and policy experts will be interviewed as primary sources of data on this specific topic. The main goal will be to analyze the agreement from an in-depth point of view on how countries can adopt it. The topic comprises the case study of UAE, and this study can be taken further to investigate the reason behind why other countries did not adopt NGS at the global level.

Indexing terms: nuclear energy; international agreements; non-proliferation; nuclear gold standard; international norms

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Declaration and Copyright

Declaration

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List of Abbreviations

Abbreviation	Expanded Form
BNPP	Barakah Nuclear Power Plant
DOE	Department of Energy – U.S.
DV	Dependent Variable
IAEA	International Atomic Energy Agency
IV	Independent Variable
KEPCO	Korean Electric Power Company
NGS	Nuclear Gold Standard
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NRC	Nuclear Regulatory Commission
NSG	Nuclear Supplier Group
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
U.S.	United States of America

1. Introduction

1.1 Context to the Topic

The bombing of the Japanese cities Hiroshima and Nagasaki[1] in World War Two was a major trigger to the immense worry of the superpowers[2] of the horror and devastating kinetic power of nuclear weapon proliferation. As a part of the American media campaign "Operation Candor"[3], Dwight D. Eisenhower, President of the U.S., delivered a moving speech at the United Nations (UN) General Assembly in New York on December 8, 1959, which was aptly titled "Atoms for Peace"[4]. In his speech, Eisenhower urged nations to use nuclear energy for peaceful applications. The Atoms for Peace program became the cornerstone of a subsequent initiative – the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The NPT, which was opened for signature in 1968 by UN member states and went into force in 1970, recognized the existence of five nuclear weapon states [namely U.S., United Kingdom (UK), France, China and the Union of Soviet Socialist Republics]. These states were granted the status of recognized nuclear weapon states because their testing regime took place prior to the cut-off date of January 1, 1967, as set out in the treaty. The NPT does not prevent signatories from enriching uranium and plutonium separation, which may potentially produce weapon-grade nuclear material, provided it is done under the supervision and inspection of the International Atomic Energy Agency (IAEA), an autonomous intergovernmental organization under the auspices of the UN.

Aside from the NPT, the US is also guided by its own nuclear non-proliferation type of agreement, which must be signed by any state that intends to seek US' assistance to develop a peaceful nuclear program. Known as… (Section 123 of the Atomic Energy Act of 1954 on "Cooperation with Other Countries") , it imposes certain requirements and frameworks in the form of a government-to-government agreement aimed at restricting proliferation among non-nuclear weapon states. [5] The agreement is commonly known within policy circles as a "123 Agreement" between the US and other states. Section 123 of the AEA of 1954 does not prevent the enrichment of uranium; however, it requires a separate negotiation. The Gold Standard is

1 During World War II, the U.S. dropped nuclear bombs on the two Japanese cities.
2 Superpower countries in 1959 included the U.S. and the Union of Soviet Socialist Republics.
3 Operation Candor: A public relations campaign run by the administration of Dwight D. Eisenhower. Memorandum regarding "Operation Candor", White House Office, National Security Council Papers, 1953.
4 Atoms for Peace: A program intended to contain nuclear weapon proliferation by assisting non-nuclear weapon states with their peaceful nuclear programs.
5 Non-weapon state: Any country that did not experiment with nuclear weapons prior to January 1, 1967.

the colloquial name given to the particular version of the 123 U.S.-UAE agreement which allows the cooperating country to neither enrich nor reprocess spent fuel and states that as a legal commitment. The administration of US President Barack Obama took great pride in getting the NGS signed and paraded as a model agreement for nuclear newcomers. Pushing states into the NGS without an explicit nuclear weapon campaign was a key reason behind Obama being awarded the 2009 Nobel Peace Prize.[6] The agreement was named as the 'Gold Standard,' as the US hoped it would be the model for future nuclear agreements with nuclear newcomer countries.

1.1.1 What is Nuclear Gold Standard (NGS)?

In 1946, the US Congress passed the Atomic Energy Act, which generally regulated and controlled the nuclear weapon program. Subsequently, Democratic Senator Brien McMahon sponsored the Atomic Energy Act in the 1946 bill; therefore, the act is referred to as the McMahon Act in certain instances. The act had to be refined later to include privatization of nuclear energy under the Eisenhour administration.

The Atoms for Peace program, which was led by the same administration, motivated key stakeholders to have an open stance regarding the nuclear technology transfer. During the time of amendment of this act, the concept of nuclear energy was relatively new and unpredictable results could be derived if the technology was misused or if the NPT was not in place. Therefore, the transfer of nuclear technology was restricted, which created discomfort between the U.S. and their closest ally, the UK, as the UK had an ambition to develop its own nuclear weapons. This eventually led to the revision of the act, thereby allowing the US to share nuclear technology with its allies in 1958.

According to the Atomic Energy Act, if the U.S. wanted to be engaged in developing or being a part of the civilian nuclear program with other countries, then the U.S. needed the appropriate framework and legislative agreement in place, as per Section 123 of the Atomic Energy Act 1954 (as amended). Section 123 "Nuclear cooperation with other countries" outlined a specific guideline on how the US deals with other countries through a full regulatory framework and commitments on both countries. It should be noted here that the agreement itself does not

6 The Nobel Peace Prize was awarded to Barak Obama in 2009 for his contribution to a world without nuclear weapons in addition to other miscellaneous contributions. Some argue that the Gold Standard was a key factor in his nomination for the award.

authorize the transfer of nuclear technology, nuclear material or reactors, it only sets up a framework for the countries to work on.

As of December 30, 2021, the US has concluded 123 agreements with 47 countries (see Table 1)[7].

Table 1

Details regarding Agreements Concluded by the US

Entity	Entered into Force Date	Expiry Date
Argentina	16 October 1997	16 October 2027
Australia	22 December 2010	22 December 2040 with rolling five-year extensions
Brazil	15 September 1999	15 September 2029
Canada	21 July 1955	1 January 2030 with rolling five-year extensions
China	29 October 2015	29 October 2045
European Atomic Energy Community (Euratom)[8]	12 April 1996	12 April 2026 with rolling five-year extensions
India	6 December 2008	6 December 2048 with rolling ten-year extensions
Indonesia	30 December 1981	30 December 2031
Japan	17 July 1988	17 July 2018, but it remains in force until terminated by a party

7 "U.S. Bilateral Agreements For Peaceful Nuclear Cooperation Pursuant to Section 123 of the U.S. Atomic Energy Act of 1954, As Amended", US Department of State, accessed April 4, 2022, https://www.state.gov/remarks-and-releases-bureau-of-international-security-and-nonproliferation/u-s-bilateral-agreements-for-peaceful-nuclear-cooperation/

8 Euratom states: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden

Entity	Entered into Force Date	Expiry Date
Kazakhstan	5 November 1999	5 November 2029
Korea, Republic of	25 November 2015	25 November 2040
Morocco	16 May 1981	16 May 2021 with rolling five-year extensions
Norway	19 January 2017	19 January 2047
Russian Federation	11 January 2011	11 January 2041
South Africa	4 December 1997	4 December 2022
Switzerland	23 June 1998	23 June 2028 with rolling five-year extensions
Turkey	2 June 2008	2 June 2023 with rolling five-year extensions
Ukraine	28 May 1999	28 May 2029
UAE	17 December 2009	17 December 2039
United Kingdom	31 December 2020	31 December 2050
Vietnam	3 October 2014	3 October 2044 with rolling five-year extensions
International Atomic Energy Agency (IAEA)	7 August 1959	7 August 2054
Taiwan	22 June 2014	Indefinite

UAE was the first country in the GCC to sign the 123-agreement, as the country aggressively wanted to kick off its nuclear energy program. Having already been awarded a tender in December 2009 to Korean Electric Power Company (KEPCO) to build four APR-1400 reactors to produce a total of 5600MW of electricity, the UAE had to get the framework in place with the US in order to use the technology. The preliminary signature of the NGS was

recorded in January 2009, and it was reopened for negotiations later in 2009 – the year when it was finalized and signed by all parties in December 2009. The Korean technology is heavily based on the old Combustion Engineering 80+ design, which means there will be a transfer of American technology to the Barakah Nuclear Power Plant (BNPP) project. Moreover, major American subcontractors, who will provide certain technical deliverables of the mega project, will be involved.

The UAE signed the NGS or "the 123-agreement" in December 2009 during the Obama administration. The Obama administration hoped to leverage the US–UAE agreement as a model for any nuclear newcomers in the region, as they were proud it worked seamlessly in UAE's case. The Obama administration aimed to universalize the NGS for nuclear newcomers, especially in unstable regions (that is, the Middle East).

The term 'Gold Standard' was first used by the US State Department spokesperson, P.J. Crowley, in 2010 during a press briefing, when referring to the success of the agreement with the UAE.[9]

The NGS differs from most other previous agreements due to additional conditional articles that pose the restrictions. In addition to the UAE, the only other country who signed a similar UAE-style 123-agreement is Taiwan, which signed a similar agreement in June 2014.

There is no standard 123-agreement, and the US stakeholders consider it as a case-by-case type of agreement. For instance, the US–India 123-agreement permits India to enrich uranium. In addition, the US has managed to secure an exemption from the Nuclear Supplier Group (NSG)[10] to allow India to reprocess the nuclear material exported from the US. Euratom member countries and Japan have similar 123-agreements with 'exceptions' to reprocess US-regulated items that have been imported into their projects. There is another exception, which allows Euratom member countries to enjoy further extensive privileges than UAE, such as the enrichment and reprocessing of nuclear material.

1.2 Research Problem Statement and its Significance

NGS is considered as an unusual 123-agreement, as only two entities in the world have signed it – UAE in 2009 and Taiwan in 2014. It is, therefore, pertinent to understand the primary reasons behind UAE's rationale for signing the NGS, even though it is a very

9 According to a CRS report, then-State Department Spokesperson P.J. Crowley coined the 'Gold Standard' term in August 2010 during a press briefing.

10 Nuclear Supplier Group (NSG): A group of nuclear supplier countries that ultimately have the same goal of preventing nuclear weapons' proliferations by controlling the export of nuclear materials, technology and equipment, which can be used in the design and/or production of nuclear weapons.

restrictive type of agreement. Restrictions are associated with the fact that the signatory can neither enrich uranium nor reprocess nuclear spent fuel with the country's territories, in addition to as per U.S. government request the UAE will need to provide country's nuclear material inventory.

This is a very important topic that helps to investigate the norm adoption in the UAE, specifically in the nuclear industry, and the findings can be generalized for different applications. Moreover, a keen understanding of the reasons behind UAE's agreement will enable researchers to further comprehend the reasons behind why this agreement has not become a new international norm, thereby suggesting that an amendment of the nuclear agreement may resolve such flaws.

This thesis will perform an in-depth investigation on why UAE agreed to and signed the NGS while the majority of newcomer countries did not. In addition, this thesis will also explore the steps that UAE has taken to assimilate the agreement into the current policies and how the agreement was adopted as a norm into the legislative system. The research will highlight the lessons learned by the nuclear newcomer states, which might want to adopt the NGS in order to establish their nuclear power programs.

As the gold standard was not adopted by many countries, it naturally entails that there was some sort of objection to this agreement, which prevented such agreement to be a new international norm of the nuclear agreements in the end. Moreover, the lessons learned can be taken into consideration when countries intend to draft similar large-scale agreements in their nuclear programs in the future.

1.3 Research Objectives

1.3.1. Statement of Research Aims

To enable UAE to build its nuclear energy program, it was important for international cooperation to be in place for exchanging nuclear technology and expertise and ensuring that the BNPP was up and running. The UAE contracted the KEPCO to be the prime contractor in their nuclear energy project, for building four units of 1400 MWe energy producing reactors. The technology chosen is the Advanced Power Reactor (APR1400), which was mainly based on the old American design CE System 80+. As American technology will be exchanged in UAE's project, UAE struck a nuclear agreement with U.S. in order to use the American technology in BNPP. This nuclear cooperation agreement has been named as 'the Nuclear Gold Standard,' with gold symbolizing something rare and precious. The agreement intended to showcase that it was a perfect baseline for all future nuclear agreements with U.S.. However, the NGS was not widely adopted at the international level across diverse nuclear new entities.

It was only signed by the only two entities, the UAE and Taiwan. This thesis performs an in-depth investigation into the reason behind why the UAE agreed and signed the NGS while most countries did not, despite the additional onerous restrictions over and beyond a 'typical' 123-agreement. In addition, the steps that the UAE has taken to assimilate the agreement into the current policies and how the agreement was adopted as a norm into the legislative system and nuclear program have also been explored.

In order for new countries to adopt the NGS agreement, the countries will need to go through policies and process changes to accommodate the conditions of the Gold Standard. These research questions are descriptive and explanatory, as they will investigate the reason behind why the UAE accepted the NGS and the attributes that the UAE needed to change in order to adopt the NGS. A qualitative research method (case study) will be used in order to understand how the UAE has adopted the agreement and what lessons can be translated for use in the context of other countries.

1.3.2. Research questions

The research design consists of two parts that are explanatory and descriptive in nature. Empirical questions are investigative questions that look into how things work and why things appear to be the way they are.[11]According to Halperin and Heath, "explanatory questions need a design that enables the researcher to determine where one or more variables causes or affects one or more outcome variables, and to rule out other feasible explanations."[12] As for descriptive questions, they may involve the description of characteristics of a component or entity or illustrate how things work and/or behave.[13]

It will examine why UAE signed NGS, even though the agreement is restrictive and may require countries to go out of their way to adopt the agreement into their policies and UAE's nuclear program. The first research question is explanatory in nature and was inspired by the low overall acceptance of this agreement amongst nuclear newcomer entities. The second research question is descriptive and a follow up to the first question on how UAE adopted a new norm in its policies and its nuclear program.

The research questions are as follows:

- Why did the UAE sign the restrictive NGS?

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[11] Halperin, Sandra, and Oliver Heath, *Political Research: methods and practical skills* (Oxford: Oxford University Press, 2017), 156.
[12] op. cit., 156.
[13] op. cit., 156.

- How did the UAE adopt the agreement into its policies?

The research questions are exclusive to the UAE, which, in turn, forms a case study.

1.3.3. Research Hypothesis

The hypothesis has been generalized so that it can be applicable to different international agreements. The NGS is an international agreement and can, therefore, serve as a case study to prove or disprove the hypothesis and test it.

The research hypothesis as follows: The more challenging the international agreements, the less likely and willing are countries to sign them.

The hypothesis will specifically question why such agreements are not easy for countries to implement or accept, due to various challenges and restrictions. The research will test the hypothesis against UAE's case. The same hypothesis will dig deeper into whether countries accept restrictive agreements and the manner in which they adopt the norms in their policies.

1.3.4. Variables, concepts, and indicators

Given the hypothesis stated above, the dependent and independent variables can be summarized as follows:

- Independent variables (IV): Challenging international agreements
- Dependent variables (DV): Fewer states sign the agreement

The indicators for IV and DV are as follows:

- For IV indicators: Technical restriction, financial restriction, political restriction, human resource shortage due to hiring restrictions, sovereignty of countries, existing country policies and laws
- For DV indicators: Number of countries who did not sign the NGS and number of countries who signed the NGS

The independent variable indicators have been outlined, as stated above. Restrictions can be associated with countries' wishes to not sign an international agreement (DV). The indicators show that the wide realm of different challenges may be attributed to technical, financial or even political aspects, and they can sometimes get in the way of the newcomer state. The indicators for dependent variables will comprise the number of countries that signed and the number of countries that did not sign the nuclear 123-agreement.

The primary independent variable is general, stated as "*Challenging International agreements*," when a restriction can act as a proxy of challenge. The thesis will define 'challenging' as the difficulty associated with the implementation due to various constraints. The indicators will dig deeper into the restrictions (challenges) and look into how these restrictions may have dissuaded states from signing the NGS. Moreover, the indicators will measure the independent and dependent variables, as outlined in Table 2.

Table 2

Independent Variable Indicators and How They are Measured

Independent Variable Indicator	**How the Independent Variable will be Measured**
Technical restrictions	Will investigate the technical challenges that NGS poses in its articles
Financial restrictions	Due to the limitation pertaining to the supplier that the agreement poses, it will limit countries from using cheaper technologies from countries that are not in good terms with U.S.
Political restrictions	NSG may limit the country from dealing with certain countries, which does not help the overall political and strategic ties of a neutral country
Human resources shortage	This pertains to limitations of export control in the NSG, as it limits the nationalities that can work on American technologies. This may result in a shortage in human resources of the signee state
Sovereignty of countries	The agreement may have leverage over the civilian nuclear program, which, in some cases, is associated with the national pride and sovereignty of countries
Country policies and laws	Existing laws and policies of the country do not support the additional articles in the

Independent Variable Indicator	How the Independent Variable will be Measured
	NGS, as they may be associated with out of regular conditions.

Table 3

Dependable Variable Indicators and How They are Measured

Dependable Variable Indicator	How the Dependable Variable will be Measured
Number of countries did not sign the NGS	The number of countries that did not sign the NGS will support the main dependent variable of countries who showcase reluctance to sign
Number of countries signed the 123-Agreement	This indicator will help to measure the acceptability of countries to the NGS. Subsequently, it will be compared to the above indicator to perceive the ratio of sign/no sign number of countries

Data will be collected from various sources, and the technical restrictions can be collected from NGS itself. For example, only US technology has to be used, and countries cannot reprocess spent nuclear fuel with the exception of countries such as UK, France or other specific countries. Another key data source will include interviews with nuclear policymakers and experts in the nuclear newcomer countries. In addition to international nuclear experts, such as IAEA inspectors and policy experts, secondary data sources will include international policies, financial obligations and laws. Furthermore, the IAEA reports of country readiness and current technical capabilities will also be taken to consideration.

1.4 Thesis Structure

The thesis comprises six chapters. Chapter one will cover the main introduction, the significance of the issue and the research questions. Chapter two will review the literature on creation of NGS, Proliferation concerns as precursor to the NGS, economical and legal loopholes and proactiveness of the UAE prior to singing the NGS. Chapter three will discuss the methodology used and the manner in which data will be collected and analyzed. Chapter

four will examine the results obtained from the research data collection. Chapter five will discuss the results and what do the findings entail for this research. Finally, Chapter six will conclude and summarize the research.

2. Academic Literature Review

The primary objective of the literature review section is to examine previous findings of researchers and scholars on UAE's nuclear international agreements, specifically, the NGS. In addition, it will take an in-depth look at how the UAE policy evolved around the NGS. The literature review will investigate the range of theories related to the main topic of this thesis, how the topic is connected to a larger issue or how it can be used for different applications in the form of generalization. Another aspect will be to understand the adoption of international norms by entities and investigate the similarities between the adoption of norms by these entities and the adoption of NGS in UAE's policies. The norm adoption comprises non-nuclear cases; however, the cases will investigate the process of norm adoption and then compare the same to UAE's adoption of NGS. In literature, UAE's nuclear program lacks attention, as the impact of the 123-agreement on UAE's nuclear policy and how UAE dealt with the restrictions of the agreement were not researched in depth. Moreover, this research will investigate how the literature covered the NGS, to what extent it has affected countries that signed it and what do academic scholars think of the agreement.

To this date, only a few studies have been conducted on the US–UAE nuclear agreement, its impact and the justification of why UAE agreed on the gold standard while other surrounding countries did not. The recommendations in this thesis can be carried forward to cover this gap in literature. This section will also briefly look into why these countries agreed or disagreed with the current NGS.

Another concept to be looked at in the literature pertains to UAE's pursuance of the "soft power" by having the first nuclear power program up and ready in the Arab world. Moreover, the act of abiding to such restrictive agreements is a clear demonstration of good will.

2.1 Role of the US in Creating a New Norm – The NGS

Scholars have engaged in debates regarding the effectiveness of the NPT and how there are additional country-to-country agreements that can fill in the loopholes of the NPT.[14] Lavoy explained that nations could either exploit or have different interpretations of NPT.[15] Furthermore, he highlighted how Iran viewed the treaty, indicating the truth that it did not prevent them from enriching uranium; however, Iran looked at it as a sovereign right and

[14] Peter. R. Lavoy, "Nuclear proliferation over the next decade," *The Nonproliferation Review*, 13, no. 3 (November 2006):433-454, https://doi.org/10.1080/10736700601071363.
[15] op cit., 435.

demanded respect for Islam from the international and regional audience by becoming a nuclear weapon state. Lavoy described that, as NPT looks at enriching uranium as the right of the country, countries that have exploited the fact that they are in the international scene can be backed up legally by an agreement that they have signed.[16] An example of how he discusses the flaws of the NPT is the case of Iraq and how it went undercover with its own nuclear program completely unnoticed, thereby indicating one of the weaknesses of the NPT. IAEA inspectors rarely go beyond their designated parameters – this is a huge loophole for which the US has been compensating with their own 123-agreements through the Department of Energy (DOE) and Nuclear Regulatory Commission (NRC) Export Control laws and regulations.[17] Lavoy's discussion indirectly explores the effectiveness of the NPT against non-proliferation, which clearly forms the basis for modifying the original 123-agreement into the restrictive NGS in the UAE–US style.[18]

Other scholars have different points of view that support Lavoy in his hypothesis of the weakness of the NPT, which needs to be compensated by additional agreements. This supports the idea that a stricter agreement may complement the NPT and translate it into a complete proliferation-proof agreement.[19] It is one of the hypotheses that the scholars argued forms the origin of the NGS – from the American perspective, the NPT was not enough, and it is believed that the NGS will complement the agreement.

Another study reinforces the hypothesis of the origin of the NGS. McGoldrick explains the logic behind U.S. going beyond the NPT through their Gold Standard.[20] during the George W. Bush administration in 2004[21], the first initiative to go beyond the agreed in international agreements was launched. The Bush administration wanted to impose new guidelines on the Nuclear Gold Standard (NSG)[22], such as the guidelines that forbid countries from selling

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[16] op cit., 442.
[17] op cit., 450.
[18] op cit., 451.
[19] Valerie J. Pelton, "Achieving the gold standard in the UAE: commercial and economic considerations in the pursuit of peaceful nuclear power." *The Journal of World Energy Law & Business 10*, no. 6 (2017): 550–565. doi:10.1093/jwelb/jwx030
[20] Fred McGoldrick, "The US-UAE Peaceful Nuclear Cooperation Agreement: A Gold Standard or Fool's Gold?" *CSIS Policy Perspectives, Center for Strategic and International Studies* (2010): 2. Nuclear Cooperation Agreement
[21] op cit.,2.
[22] Nuclear Supplier Group (NSG): A regime consisted of countries that supply nuclear materials, regulated items and dual-use items that may be used in the creation of nuclear weapons. The group controls the trade of those items through strict Export Control laws and

enrichment technology to any state, which does not possess a full-scale nuclear infrastructure. The NSG have vetoed and refused the proposal, as half of NPT signees will not be able to get the technologies, and it defeats the purpose of the NPT's Article IV "Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty".[23] He added that the U.S. gave up the original proposal and loosened up their requirement by 2008 but did not achieve what the Americans really wanted. The Obama administration carried on the same vision but interpreted that into a bilateral agreement "the Gold Standard – 123-Agreement." It was a win–win situation for both the Emiratis and Americans, as later in this article we will discuss how the U.S. wanted to impose the same agreement on other newcomer entities. The UAE stated in the nuclear policy[24] of 2008 that they will forego enrichment, and this agreement was reinforced in the Gold Standard agreement Article 7, which explicitly states that the UAE shall neither enrich nor reprocess nuclear material.

To conclude, scholars have argued through a few key points that the current NPT is not really a proliferation-proof type of agreement and the Americans had to come up with a restrictive agreement to cover the loopholes that exist in the current NPT.

2.2 Proliferation Concerns as Precursor to the NGS, Economical Challenges and legal loopholes

Abdul Qadeer Khan, also known as A.Q. Khan, was the mastermind behind the Pakistani nuclear weapon program.[25] A.Q. Khan worked in the Netherland's Physical Dynamic Research Laboratory (FDO), which allowed him to gain access to Ultra Centrifuge Nederland (UCN), which in turn got him access to blueprints of the URENCO design centrifuges. A.Q.

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regulations circulated through the International Atomic Energy Agency (IAEA) through the Information Circular INFCIRC254/Part 1 and Part 2

23" NPT Treaty Article IV", United Nations, accessed April 2, 2022, https://www.un.org/en/conf/npt/2005/npttreaty.html

24 United Arab Emirates Government. "Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy, 2008" Accessed February 10, 2022, https://www.enec.gov.ae/doc/uae-peaceful-nuclear-energy-policy-5722278a2952f.pdf

25 David Albright, Paul Brannan, and Andrea Scheel Stricker, "Detecting and disrupting illicit nuclear trade after A.Q. Khan," *Washington Quarterly* 33, no. 2 (2010): 85–106.

Khan built the Pakistani Nuclear Enrichment program using the blueprints that he illegally obtained through his work in the Netherlands.[26]

The literature has discussed the logistics of how he masked the transporting network through the world into getting Pakistan the needed equipment and material to enrich Uranium. Not only Pakistan but to other states that tried to obtain enrichment technologies to UAE have always been mentioned as main hub in his proliferation network.

The UAE is known to be the largest transshipping hub in the Middle East to be one of the largest port transfers[27] in the world. Lack of export control regulations in the beginning of the twenty first century have helped the network to grow its network and bypass any regulations in place.[28] In the article *Detecting and Disrupting Illicit Nuclear Trade after A.Q. Khan,* the authors illustrated that export control regulations in the UAE were characterized by weaknesses, which indicated that the country was pressured by the U.S. to implement export control.[29] The UAE then issued the Export Control law in 2007. The form of pressure that applied by the US on the UAE was in excessive licensing process for countries that do not implement their export control obligations from being transshipped to unauthorized countries. Although scholars did not link the A.Q. Khan logistics and his major transport theatre Dubai to the NGS restrictions, but it can be understood that as the UAE implanted the Export Control law in 2007 and published its nuclear policy in 2008, the U.S. have look for extra assurances from a country that played logistical role in rouge countries obtaining nuclear enrichment technologies.[30] Another scholar have touched on the network of A.Q. Khan in the article *AQ Khan nuclear smuggling network,* including the UAE and how these countries have failed from Export Control point of view in preventing such nuclear proliferation.[31] MacCalman reiterated Albright's point these smuggling states have a weak export control laws and regulations in place which led A.Q. Khan and his regulated materials to roam freely through these states, including the UAE.[32] Although scholars have not mentioned specifically the relation of the NGS with A.Q. Khan but Indirectly the A.Q. Khan affairs in the region have had its influence in having extra assurances that these countries can demonstrate the right measures when it

26 op. cit., 88.
27 Port transfers meaning: Exporting, importing and transshipping of goods.
28 Albright, Brannan, and Stricker, "Detecting and disrupting," 92.
29 op. cit., 97.
30 op. cit.,100.
31 Molly MacCalman, "AQ Khan nuclear smuggling network," *Journal of Strategic Security,* 9, no. 1 (2016): 104–118.
32 op. cit., 115.

comes to nuclear non-proliferation. The U.S. have put it all in legal binding document such as the NGS.

It is understandable why the U.S. would want to impose restrictions beyond the NPT's scope. Ian Jackson discusses the unthinkable and highlights the instability of some parts of the world as possible reasons for the US pushing further restrictions on proliferations.[33] Jackson mentioned a perfect example of unexpected scenarios in unstable regions.[34] As part of *Atoms for Peace*, the U.S. went ahead and built a five-megawatt (MW) research reactor in Tehran University using fuel created by 93 per cent enriched uranium-235[35]; this project went into operation in 1968. Just eleven years later, the unthinkable happened. The Mullahs overthrew the Shah and *Death to America*[36] chanters roamed the streets of Tehran. This has raised the bar for the U.S. on sharing nuclear technology in developing countries. Jackson used Tehran's Mullahs and Cuba's communists as two lessons learned for the Americans on sharing nuclear technology. He also discussed the UAE's nuclear policy, which outlines that spent fuel will not be reprocessed, and if so, it will be sent to the West under a take-back agreement. This reassured the international community and especially the US about the transparency of UAE's Nuclear Program. The US used this fact to reap benefits, by scripting the 'model' agreement known as the NGS. He also discusses how proliferation is not possible with the Pressurized Water Reactor-type[37] Reactor, which was deployed in the Gulf. Similarly, he discussed the Plutonium Route[38] and how countries such as India and Israel were in pursuit of that road. This literature may have looked at both possibilities, the good intention and transparent approach of the UAE's nuclear program and also looked at the slim possibility of the Nuclear Weapon proliferation out of a Civil Energy Reactor. This shows the flaw in the American 123 "Gold Standard" agreement – there is no proliferation-proof nuclear program, at least there is this loophole in this specific agreement.

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33 Ian Jackson, "Nuclear Energy and Proliferation Risks: Myths and Realities in the Persian Gulf*," International Affairs (Royal Institute of International Affairs 1944)* 85, no. 6 (2009): 1157.

34 op. cit., 1157.

35 For weapon grade, Natural Uranium that is enriched to reach 93 per cent and above of U-235 is known as Highly Enriched Uranium (HEU).

36 A political slogan in a movement anti-American movement in Iran that was popularized by Ayatollah Khomeini during the 1979 Iranian revolution

37 Barakah have adopted the design of Advanced Pressurized Water Reactor (APR1400)

38 Producing "dirty Plutonium" produced bomb out of Nuclear Power Reactor spent fuel.

Evan Tyler Beese in his article *Nonproliferation: Rapid Retreat from the Gold Standard Negatively Impacts Future Nuclear Negotiations Impacts Future Nuclear Negotiations* (compared the US–UAE and US–Vietnam agreements.[39] Beese argued that the US–UAE Nuclear agreement "123-Agreement" is the strictest nuclear agreement that the US has ever negotiated.[40] The US tried to use the UAE agreement as a model to the Vietnamese agreement. The Obama administration agreed to tone down the agreement into a non-legally binding softer commitment so that Vietnam does not use the American Technology in Enrichment and Reprocessing. Beese described that as a retreat from the 'Gold Standard,' as the agreement legally allows Vietnam to enrich uranium if they obtained their technology from different countries. While in the UAE the agreement was set to forbid the country from enriching within its border. That being said, he did not necessarily question the effectiveness of the Gold Standard but rather how the U.S. loosened the terms in the agreement in order to get back into the nuclear business.

A similar argument was posed by Henry Sokolski in his article *Obama's Nuclear Mistake*. He discusses Vietnam's case from a different angle.[41] Sokolski described how there are other key nuclear moguls in the world that may cease the chance of restricted agreements that the U.S. enforces on its potential customers.[42] France and Russia have been aggressively pushing their nuclear projects around the world, which are worth billions of dollars. He did not question the effectiveness of the Gold Standard but rather its business implications. In this research, we will look at how the UAE-style Gold Standard agreement may push the Americans away from the nuclear business (transcribed as financial challenges) unless they restructure the model agreement as they did with Vietnam.[43] Also, it explores how indirectly the American technology was bought from the US through a prime contractor in South Korea, yet the UAE has been cornered into a strict agreement.

Literature has looked into how these loopholes can be backed up with real-life historical events. In certain events that went undetected, such the development of the Iraq and Iran

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39 Evan Tyler Beese, "Nonproliferation: Rapid Retreat from the Gold Standard Negatively Impacts Future Nuclear Negotiations" (2015). *MSU Graduate Theses*. 1504. https://bearworks.missouristate.edu/theses/1504

40 op. cit. 1504.

41 Henry Sokolski, "Obama's Nuclear Mistake," The National Review, accessed March 4, 2022, https://www.nationalreview.com/2012/02/obamas-nuclear-mistake-henry-sokolski/.

42 op. cit.

43 op. cit.

nuclear programs, the world led the U.S. to compensate for the weakness in NPT in their international nuclear cooperation agreement.[44]

The literature has discussed how the U.S. would want to impose the model agreement on other states.[45] Other scholars support the argument why the U.S. would want to impose such restrictive agreement is politically instable parts of the world, the author used Iran and Cuba as perfect examples. [46]As strict as the NGS may look, some literature argued that the rules may get bind in order to sustain business in the world.[47] Different point of view discusses that how this agreement may hurt the nuclear business.[48] This research will look deeply into the countries that rejected the model agreement and how would that impact the American Nuclear business. Moreover, through this thesis, we will look into the effectiveness of the agreement from a financial point of view (financial challenges) and attempt to uncover its consequences.

2.3 Proactiveness of the UAE in relation to the NGS

Pelton[49] discussed how the UAE has had the legal fundamental ready and how it has made it easy on the US to have the agreement in place, as UAE committed in their 2008 *Policy of the UAE on the Evaluation and Potential Development of Peaceful Nuclear Energy* that "renouncing any intention to develop a domestic enrichment and reprocessing capability, developing a comprehensive waste management system, and possibly participating in the IAEA-initiated multilateral fuel-assurance network.[50] He lays down the facts that even though the UAE as an NPT member has the right to enrich nuclear material, but they decided to forego the uranium enrichment and spent fuel reprocessing aspect in their nuclear policy. He discusses how this "good will act" got the UAE ahead and ensured less resistance with their nuclear power program within the international community, specifically making it easier to finalize the NGS agreement with the US. [51]The good will act came in after the Dubai Ports issues were observed with transshipping and A.Q. Khan and how UAE did not have proper export control laws. Khan's proliferation network used Dubai as the transportation ground. His argument results in a perfect reality check when compared with other neighboring countries' nuclear power projects. For example, Saudi Arabia, a neighboring country, neither came to terms with

44 Lavoy, "Nuclear", 450.
45 McGoldrick," US-UAE", 2.
46 Jackson, Nuclear Energy," 1150.
47 Beese, "Nonproliferation," 1504.
48 Sokolski, "Nuclear Mistake."
49 Pelton, "Gold Standard," 560.
50 op. cit., 564.
51 op. cit., 565.

the U.S. when forming their 123-agreements or agreed nor agreed to a similar style NGS. The Saudis have had the ambition to enrich their high deposit of natural uranium, as the Saudis have recently announced their discovery that it possesses about 1.4 per cent of the current world reserve. [52]Additionally, the Saudis have been seeking to penetrate the nuclear fuel supply world and claim their stake in the global market of nuclear fuel. [53]

2.4 New Norm Adoption by States into their Policies

Although the research topic that is specific to the UAE, there is a wider literature that studies how global norms proliferate and are adopted by specific countries. The term norm has been defined as "*By 'norms' we mean ideas and beliefs about what behaviour is appropriate*.[54] In addition, the other terms that have been defined were the Norm entrepreneurs: "*This case is also different in that the worldwide emergence of the norm did not involve conventional 'norm entrepreneurs' at the international level, nor were the actors involved networked in its early stages*".[55] A person that well known in the UAE's nuclear industry since its inception is Hamad Alkaabi, the current Emirati Ambassador in Vienna and the permanent representative of the UAE in the IAEA. Alkaabi has always been in the scene when UAE negotiated the NGS and other bilateral agreements, in addition he is the Vice Chairman of FANR the term norm entrepreneur can well describe him. He played a big role in embedding international commitments understanding into FANR regulations and through getting the right regulatory together to form common understanding. Clapp and Swanston discussed the case of norm adoption by states and used the anti-plastic policies as a test case on why it differed from a country to another.[56] The article identified the literature gap as that the way in which the norm emerged around the world has been counter to broad assumptions in the literature, and that's why she looks deeper into the question via her research question. In addition, the international

52 Jennifer Gnana, "Saudi Arabia to develop 'huge' uranium resources in energy diversity push: minister," S&P Global Platts, accessed January 12, 2022, https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/011222-saudi-arabia-to-develop-huge-uranium-resources-in-energy-diversity-push-minister

53 Justin Dargin, "Saudi Arabia to tap nuclear energy market, "The Belfer Center for Science and International Affairs, accessed April 5, 2022, https://www.belfercenter.org/publication/saudi-arabia-tap-nuclear-energy-market

54 Bernstein, Steven. "The compromise of liberal environmentalism." *Columbia University Press*, 2001.

55 Op. Cit.

56 Jennifer Clapp, and Linda Swanston, "Doing away with plastic shopping bags: international patterns of norm emergence and policy implementation," *Environmental Politics* 18, no. 3 (2009).

norm dynamics literature assumes that an international norm has been adopted when it is codified by states in international agreements (both hard and soft), practices, and institutions.[57] In the case of plastic bags, however, there is no international level treaty or institution to govern the adoption of the norm. In UAE's case the norm adoption was driven by key personnel/organizations such as Alkaabi and FANR by pushing all stakeholders and licensees to adopt the norms that was already embedded into FANR regulations. In conclusion, the researcher has reached to conclusion that the issue can be looked from different point of view especially on the broader view of norm than case specific. Although the research in this thesis is specific to the NGS agreement, it is a case a comparison can be drawn with how the UAE adopted the agreement into its legislative system.

Other studies imply that the Gold Standard was orchestrated by the two states, by having the 2008 UAE Nuclear Policy in place prior signing the agreement, which just confirms what in the country's policy.[58] The UAE Agreement was used a model agreement (Gold Standard) to be used in future nuclear cooperating agreements. Another argument that is Egypt-US 123-agreement which expired in December 2021 and may resist not to have a similar UAE-style agreements. Egyptians do not seem to want to restrict themselves as the UAE on tight measures in term of enrichment and reprocessing as Egypt had legacy ambitions on enriching since Nasser's era.[59]

Another article digs deeper into the main problem, and it is too specific to the UAE case on how it will achieve the gold standard via honoring its own international commitments and stand to its reputation. [60] That's how the literature has investigated the UAE's adopting a new norm into its legislative system, FANR was used as an example. It was explained how FANR and has raised the bar in term of norm adoption and benchmarked its regulations against world's best practices to meet and even exceed UAE's international commitments.

2.5 Literature Review Summary

As literature has argued and mostly agreed on the basis of the NGS, mostly on how the US looked at the NPT as an ineffective treaty. Historically, events have supported the American argument (Iran, Iraq, Libya and others). Other scholars dig deeper into the agreement in its

57 op. cit.

58 Pelton, "Gold Standard,"585.

59 Gawdat Bahgat, "Nuclear Proliferation: Egypt," *Middle Eastern Studies* 43, no. 3 (2007): 409–421.

60 Pelton, "Gold Standard,"580.

financial challenges, moreover loopholes that may exist in the current NGS. Discussion the financial challenges researchers have used Vietnam as a great example where they can go to the nuclear open market and pick other vendors other than American suppliers (for example, French, Japanese, Russian, Chinese and so on). The financial challenges here are different that the financial challenges that the researcher of thesis going to discuss. As the Vietnam example, meant that there will financial implications on the U.S., however in this thesis will investigate the financial challenges of the UAE as consequence of agreeing on this restrictive agreement. Another major aspect that the researcher think of the U.S. came up with a stricter nuclear agreement than the usual (India, EU, and so on). That the A.Q. Khan proliferation network activities in the region which have demonstrated a worrying weakness in UAE's export control laws. That led to the UAE to adopt new norms that came out of the NGS into its legislative system. The research will investigate further on how UAE adopted a new nuclear norm despite the fact that this norm has not widely accepted among the nuclear newcomers.

3. Research Approach and Methodology

3.1 Research Approach

The research approach will be as follows:

Case study: Exclusive to the UAE as the main subject in this study.

Case studies can be advantageous among the comparative type of research methodologies when trying to dig deeper into issues in specific countries.[61] Depending on the aim of the research, case studies are focused on a specific subject and, in this case, a country. As this research only extended to the UAE, and this research can be taken further to be compared in the future with other states that have the same nuclear ambition, the case study methodology was selected. In addition, a case study tends to investigate the specific subject country in depth. A case study is considered to be useful for comparative purposes with other subject countries.[62]

The use of this specific approach will help the researcher to:

- Understand the rationale behind UAE's agreement on the NGS.
- Content analysis of international nuclear policies and UAE's nuclear laws and regulations.
- Look in depth into how the UAE coped with the restrictions into the policies and nuclear program.

3.2 Methods

The primary methodology for data collection will be interviews with experts from the nuclear industry. The pool of interviewees has been selected from amongst international and national experts, including former IAEA international inspectors. The researcher has opted for a semi-structured type of interview to allow the interviewees to dig deeper into the NGS topic. The interview guideline not only specifies the primary questions to the interviewees but also recommends the use of open-ended questions, which gives one the freedom to explore the topic in further detail.

Secondary data was derived through the content analysis of policies and other media releases. The researcher will look at some international policies and local nuclear law

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[61] Halperin and Health, *Political Research*, 214.
[62] op. cit., 156.

regulations to examine how NGS may contradict with legislative system. A thematic analysis will be used for the interviews to analyze the total data collected from interviews. In thematic analysis, the researcher will investigate the data to identify common themes, topics, opinions and patterns of meaning that come up repeatedly.[63]

3.3 Limitations of Findings (Validity, Reliability, and Generalizability)

The limitations of this research findings can be explored through the following categories: Validity, Reliability and Generalizability.

3.3.1. Validity

Validity refers to the extent to which the data collected can measure an issue that the researcher claims it measures.[64] In most cases, researchers will have to confront validity when collecting the data (regardless of the collection method). However, there are diverse ways to assess the validity – face validity, content validity and construct validity.[65] In this research, the limitation may be the validity of data collected through interviews, as some information can be politically sensitive. Therefore, interviewees may try to not be very straightforward when answering interview questions. This may produce results that may not be as credible, defensible and warranted in some cases. To overcome these limitations, the researcher should assure that names can be anonymous in case interviewees are worried about that aspect. Another way to limit the validity issue is to retain the interview in a semi-structured form so that interviewees can explore the area of question themselves through the guidance of the researcher.

3.3.2. Reliability

Reliability usually refers to how accurately researchers have measured their indicators. In some cases, the indicators can be valid but they might not have been measured accurately, which can result in inaccurate data. In short, data can be valid but not reliable and vice versa. Ideally, data must be valid and reliable. In order to address this limitation, the interviewees will be asked generally about every indicator and their inputs to ensure effective comparison. Also, in order to have more diverse data, the pool of interviewees could be bigger than the case selection, with diverse backgrounds and unbiased opinions to ensure the reliability of data when being measured. In addition, anonymity can play a critical role in ensuring that participants share their insights in the topic.

63 op. cit., 156.
64 op. cit., 156.
65 op. cit., 156.

3.3.3. Generalizability

The hypothesis of this research is generalized and applicable to other international agreements. The Gold Standard agreement is a ‘case’ of the international agreements that prove or disprove the hypothesis. The ability of generalizing the finding on various other topics related to the main research can be stressed.[66] In our case, as the hypothesis is generalized, NGS is an agreement will test the hypothesis. The findings could be generalized and compared to the same international agreement domain.

3.4 Ethical Issues

I have completed my final application on Human Subject Research, which I have submitted to the Research Ethical Committee of Khaliah University on 24 February 2022. I have received the Research Ethical approval for my study on 07 April 2022.

66 op. cit., 156.

4. Results

4.1 Interviews details

This chapter will present, examine and analyze the data gathered for this research. The data was collected via interviews with international and national experts. The total number of interviews was eight. Interviews were conducted in the period of 13 March 2022 to 14 April 2022. Table 4 below details the interviews conducted:

Table 4

Interviewees' Details

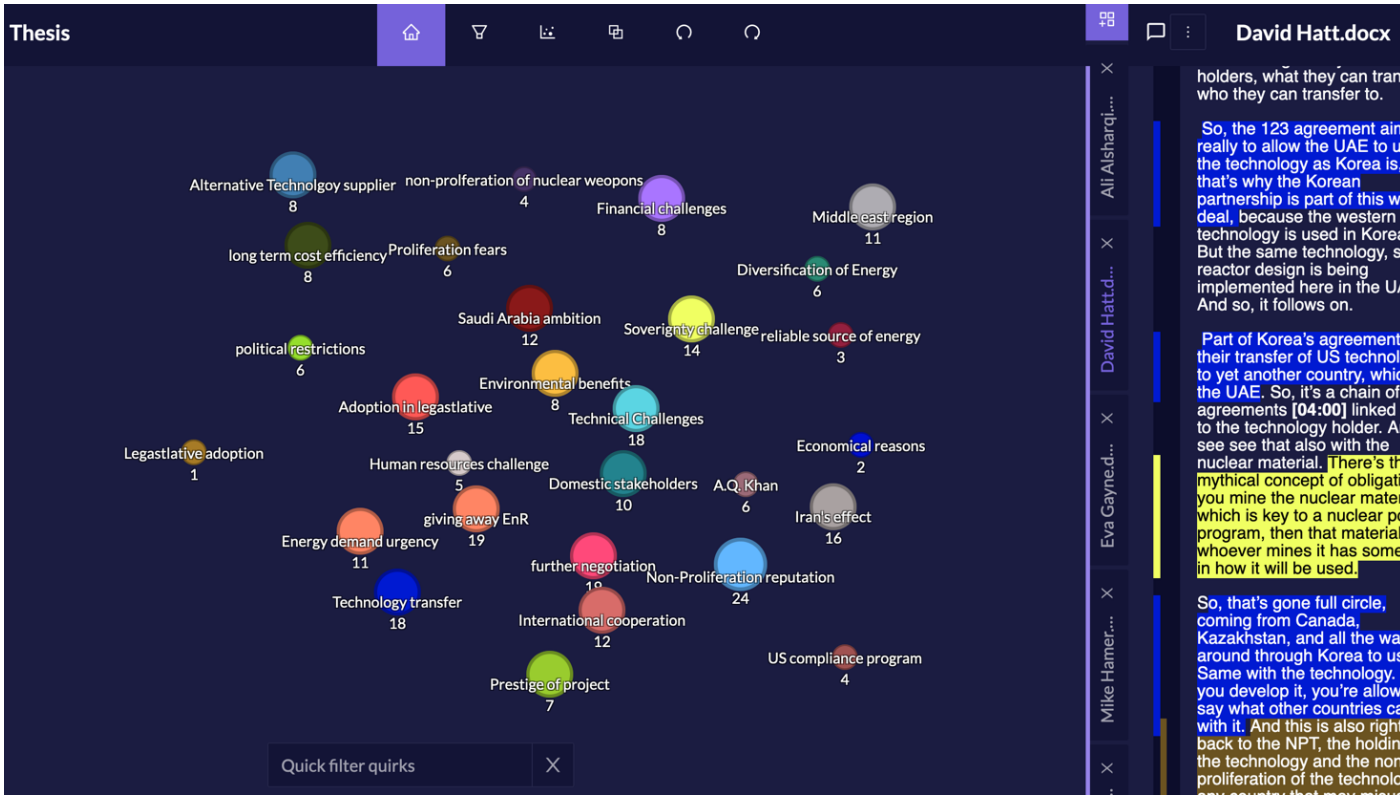
Interviewee's name	Affiliation
Shaikh Ali Alsharqi	Nawah Energy Company
Eva Gayne	Former IAEA Inspector / Designated to Iran
Christopher David Hatt	Former IAEA Safeguards Inspector
Michael Hamer	Nawah Energy Company
Nasir AlKetbi	Nawah Energy Company
Steven Brion	Former UK Regulator. Currently FANR Safeguards Manager
Ian Blanch	Former Licensing specialist in Jordan/KSA/Egypt. Currently Nawah Energy Company.
Current Executive Person (anonymous)	NA

4.2 Codes and Themes Identifications

To analyze the data a mixture of pre-defined themes and newly discovered themes through the interviews were identified as per a sample shown in Figure 1, the interviews were then coded using the cloud software Quirkos® for qualitative research analysis.

Figure 1

Quirkos Qualitative Analysis Software



4.3 Themes and Codes Frequency

Table 5

Themes and Codes Frequency

Code/themes	Frequency	Code/themes	Frequency	Code/themes	Frequency
Non-Proliferation reputation	24	Adoption in legislative	15	Domestic stakeholders	10
giving away EnR	19	Sovereignty challenge	14	Environmental benefits	8
further negotiation	19	International cooperation	12	Financial challenges	8
Technical Challenges	18	Saudi Arabia ambition	12	Alternative Technology supplier	8
Technology transfer	18	Energy demand urgency	11	long term cost-efficiency	8
Iran's effect	16	Middle East region	11	Prestige of project	7
political restrictions	6	US compliance program	4	Human resources challenge	5
Proliferation fears	6	reliable source of energy	3	non-proliferation of nuclear weapons	4
Diversification of Energy	6	Economic reasons	2	Legislative adoption	1
A.Q. Khan	6				

The highlighted boxes in Table 5 showed the themes identified at the outset of the research, whereas the rest of the themes were identified during the interviews through the coding process. The pre-identified themes were captured earlier through the concepts, hypothesis, and independent/dependent variable process in this thesis structure. The most common theme mentioned was the “Non-Proliferation reputation”. Two other notable themes were regional powers such as “Iran’s effect” and “Saudi Arabia's ambition” since they had and will continue to exert great influence on decisions about nuclear energy in the region.

4.4 Interview Results

The interviews were conducted in a semi-structured style [see Appendix 8.1 for a list of interview questions], which gave the interviewees the freedom of expression beyond the pre-defined questions. This format helped the researcher to capture additional valuable information pertinent to the analysis. The questions started from a broader point of view up to the specifics of the NGS agreement.

Question 1: Why was the UAE so intent on acquiring nuclear energy while alternative fossil fuel is available?

Through coding, energy demand urgency got 11 mentions while analyzing the answers for the first question. The majority of the participants agreed that one key driver behind nuclear energy in the UAE is to align the energy output of the country with the UAE's vision to reduce carbon emissions by 2030. The carbon footprint reduction "coded as environmental benefits" was not the only major that drove UAE to pursue nuclear energy. In addition, diversification of energy is one of the main pillars of the convexity's vision of phasing out fossils in the next fifty years. Nasir AlKetbi confirmed the argument of energy demand "*based on the studies that the UAE has done in early 2000, there is a high growing demand for electricity and power supply required, and relying on fossil fuels, considering the cost of gas and oil, and relying on other alternatives, solar and wind, is not cost-efficient".* Similarly, Michael Hamer stated that "*five or eight years ago, there was a study done that showed that the power demand following the growth of the UAE has doubled within 20 years. 50% of the power used for desalination of seawater."*

Other points were also mentioned, such as that energy is a power status and can drive economies into a new dimension. Additionally, nuclear energy will provide the UAE with a stable baseload for the whole operation life of the plant, unlike renewable where energy baseload can fluctuate depending on natural causes (lack of winds, clouds, etc.).

Another supporting argument on that how nuclear may help the country in putting the unused fossil in the international market can be comparable to Saudi Arabia. Ian Blanch stated that "*So I worked in Saudi Arabia for a year, between 2012 and 2013, and they currently burn somewhere around 50% to 55% of their entire production for internal use. Well, if you could divert that onto the open market, you've got money."* Although Ian's statement about Saudi Arabia applies to the UAE as the country has similar production and U.S.ge style. Noting that the nuclear energy will provide 25% of the country's energy, meaning the amount of fossil will be freed up and the total reduction of carbon emission. The interviewees also mentioned that

there was another major factor for the UAE to establish its nuclear energy, the national prestige, as stated by Steven Brion: "*I think it offers prestige for the country to be involved in such a high-profile scientific project."*, in addition to the prestige, such project brings that level of technology into the country which eventually elevated the country's technical and scientific level.

Themes identified: *Energy demand urgency, Environmental benefits, Economical reasons, reliable source of energy, Middle East region, long-term cost efficiency, Diversification of Energy, Technology transfer, Prestige of project, international cooperation.*

Question 2: What (in your opinion) were the main reasons to have the 123 nuclear agreement deal (as known as the NGS) with the U.S.?

Participants' answers revolved around the idea that to obtain and use American-based technology, a bilateral agreement must be set in place first. These agreements govern the transfer of such technology. The NGS comes as one of the agreements that have been signed to obtain and use nuclear technologies. As the coding quantifies, technology transfer and international cooperation were key reasons for the conclusion of the 123-agreement. The South Korean reactor APR-1400 used in the Barakah nuclear plant is heavily based on an old American light water reactor design, and in order for Koreans to export American technology to the UAE, it was necessary to have a bilateral framework in place. As Christopher Hatta reiterated, "*the 123 agreement aimed really to allow the UAE to use the technology as Korea is, and that's why the Korean partnership is part of this whole deal because the western technology is used in Korea. But the same technology and same reactor design are being implemented here in the UAE. And so, it follows on*."

Another key reason pointed out by Shaikh Ali Asharqi was that "the *UAE is still considering the U.S. as a vital ally, and also one of the leading states in the nuclear industry."* This shows that the UAE required certain technical expertise from the U.S. and according to the Atomic Energy Act. In 1954, a 123-agreement was put in place for the U.S. to cooperate with other countries. Eva Gayne reconfirmed the same point on the relationship of the UAE-US in general and in specifically in nuclear energy to the extent that for UAE to have nuclear energy program going and running the country needed to sign the 123-agreement "*as you know, the US has been a strategic partner of the UAE for quite a while. So, I think if the UAE wanted to obtain, it makes sense to have a 123 agreement for the UAE if it wants to embark on a nuclear program."* Moreover, Gayne has stated that having such an agreement elevates the non-proliferation credential of the UAE worldwide and will encourage the international

community to have the confidence to cooperate with the UAE. Ian Blanch has confirmed the same point by stating that "*I think it gave access to a wider variety of supply chain. Without a 123 agreement, you would not have been able to have American nuclear technology or personnel. So from that perspective, just the signing of that agreement enabled you to be able to employ Americans."*

The UAE could have escaped with minimal damage by building its nuclear energy by having to select an independent supplier that is not bound by American technology such as Russian, Chinese or Indian reactors. However, Steven Brion mentioned that it could have led to a political dispute with the US.

Themes identified: *International cooperation, Technology transfer, Alternative Technology supplier, Middle East region, political restrictions, Non-Proliferation reputation, Energy demand urgency, non-proliferation of nuclear weapons, Adoption in legislative, Sovereignty challenge, Proliferation fears.*

Question 3: Do you believe further negotiations pre-2009 would have allowed the UAE to secure a less restrictive nuclear agreement?

This question elicited two points of view. Three interviewees felt that if the country had further negotiations on the agreement, the outcome would have resulted in less restrictive terms. The majority of interviewees opined that the UAE was not in the right circumstances to negotiate the agreement further to reduce the restrictions that have been imposed by the NGS. The answers were grouped into two categories (With and against the idea of further negotiation).

4.4.1 Views for Pre-2009 Negotiations

Shaikh Ali Alsharqi believes that further negotiations back in 2009 could have landed the UAE a less restrictive deal. He stated the main issue back then, which could have curbed the negotiations was that country was in need to start its nuclear energy program. In addition, the Middle East was and still is a hotspot, and would have taken time for the UAE to get an agreement in time while there was a spike in energy demand in the country. Brion agreed with Ali's argument that the UAE could have secured a better deal. He mentioned that even the US has realized if the UAE did not agree on the NGS and they may go somewhere else to conduct business. The pressure tool would have been back then that UAE could threaten to go to different nuclear suppliers that would not have a strict binding agreement such as the Russians VVER-1200, Chinese CAP-14000, and/or the Indian PHWR-700. That would have been the pressuring point to put things back on the table and could have resulted in getting a less

restrictive agreement. Steve cited the Philippines as an example of how they are situated between the American influence and the Chinese to secure better deals that can be relatable to the UAE when negotiating agreements "*It's kind of like the Philippines. They sit between the US and China, and they swing back and forth, and they play the US and China off each other. I think the UAE probably could have done the same thing, threatened to go and align more closely with other countries, or other spheres of influence."*

4.4.2 Views against Pre-2009 Negotiations

Other interviewees looked at the agreement from different perspectives. Most of them have thought the UAE did not need to argue further in 2009 to get a better deal. The agreement was sufficient enough for the UAE's requirements at the time. The fuel supply was not seen as an issue, as the UAE had the financial and political resources and was able to secure the nuclear fuel agreements with several vendors. Hatt has stated that "*It buys uranium on the open market, and has it enriched in Europe or in Russia, and so it has access to reprocessing and enrichment, but not in the UAE. So, I don't… it may become some sort of negotiable inconvenience in 10-20 years, but at the moment I don't see it as a major obstacle."*

Although that enrichment is not needed at present time, it may be needed in the future to enter the nuclear fuel supply market. Additionally, reprocessing is considered a struggle even for nuclear weapon states as it is costly and can be a lengthy process, taking Japan as an example stated by Gayne "*In terms of reprocessing, there are just the nuclear-weapon states and Japan who are reprocessing. Japan has been struggling with their Rokkasho plant for many decades."* Based on the complexity of the process, it was highly unlikely that the UAE would have pushed further to remove such restrictions on the NGS. Other interviewees have pointed out that due to the lack of nuclear experience back in 2009, the UAE did not have the right guidance on how to negotiate or what to expect if being committed to the gold standard if 2009 was all over again with the similar current nuclear expertise, and probably further negotiations would have been in place. Al Ketb pointed out that "*The UAE at that time wasn't in a position to discuss with the same expertise that we have now. I think the main intention was to get this agreement, and that we are fully transparent to build this nuclear program."* Region instability has also played a major role in forming the agreement, the Middle East is a "hot region" and further negotiation would not have been an option for UAE as it was the newest newcomer and happen to be in this region. Blanch expanded on this point, "*If you look at pre-2009, there was an incredible amount of instability in this region. So it would be pre the Arab spring.*

So Syria hadn't engaged in its civil war, but you'd already had the invasion of Iraq, the resurgence of quite a few terrorist groups, who'd had the suspicion that Iran was engaging in some form of weapons program under the auspices of a civil nuclear program." Some have looked at the agreement as in line with the UAE's nuclear policy so there was no need for further negotiation and since the nuclear law number 6 of 2009 has imposed the same restrictions of not enriching nuclear mater or reprocessing spent fuel. An Executive stated that "*the program is in alignment with UAE law and meets the highest standard. Bilateral agreements came after the establishment of the nuclear policy and nuclear law, so there was no need to revisit the agreement further in 2009".*

Themes identified: *Further negotiation, Technical Challenges, Financial challenges, political restrictions, Sovereignty challenges, giving away EnR, Iran's effect, Middle East region, Technology transfer, long term cost efficiency, non-proliferation of nuclear weapons, Proliferation fears, further negotiation, Non-Proliferation reputation, Alternative Technology supplier, political restrictions, Energy demand urgency.*

Question 4: What are the main challenges that the NGS *poses for the UAE?*

Similar to question three, interviewees had different perspectives of the NGS and its conditions as challenging and some were not believing that there were challenges. The split of opinions was as follows:

4.4.3 Challenges of the nuclear gold standard for the UAE

A few interviewees recognized that the NGS can pose some challenges to the UAE. Shaikh Ali Asharqi stated this specific agreement limited the nuclear trade for the UAE as the technology transfer is limited to certain countries "*That is agreed upon and written in the golden standard. So, it will reduce the number of countries and the number of opportunities to trade such technologies with other states."* That potentially has limited the cooperation with cheaper vendors worldwide. Christopher Hatt mentioned that the UAE was obliged to rescind the small quantity protocol agreement which meant that the UAE will need to go on the comprehensive safeguards plan, which in turn meant that full access will be provided for IAEA inspectors "*one of the conditions of allowing the UAE to use the technology is for it to rescind the small quantities protocol. UAE didn't, it was only rescinded in 2021 when there were already hundreds of tons of uranium in the country, two operating power reactors and two under construction and commissioning.".* Mr. Hatt stated that the US has shown a pattern of not complying with its agreements. In addition to the challenges abovementioned, the agreement also pushed a requirement that did not exist in the nuclear policy which is "reporting

nuclear material inventory" based on request. However, Mr. Hatt confirmed these requests were not implemented by the US, as the country has not requested the UAE to provide nuclear material inventory yet. Another point of view is that the agreement binds you to dependency on other countries if you want to enrich and pursue a full nuclear fuel cycle. Michael Hamer stated that "*the main challenge is, we will have to always buy our fuel from a vendor, and currently, we're also looking at building a fuel fabrication facility, but we'll still have to purchase enriched uranium from another country that has the ability, has the laws allowing them to enrich uranium. So, we're held to that, where we can't enrich it ourselves."* Similarly, Steven Brion reconfirmed the same point on reliance on other countries in reaching the full potential of the nuclear fuel cycle *"So, in general, it limits… it creates a sort of reliance on other states, and it essentially requires us to maintain relationships with certain types of countries, let's say western countries, to maintain a nuclear fuel cycle.".* The NGS may have limited any future ambition of having a regional enrichment center that can cater to the rest of the nuclear newcomer countries. Ian Blanch confirmed this point when he stated that "*it takes away the choice of front and rear end fuel, that's the biggest thing. If you wanted to set up a regional enrichment plant or a regional reprocessing plant, you could quite easily see that as a long-term aspiration for any nuclear program."*

4.4.4 Nuclear gold standard not posing any challenges to the UAE

Not all interviewees felt that restrictions from the NGS significantly impacted the UAE. According to Eva Gayne, the gold standard showcased the UAE on the international nuclear non-proliferation scene by boosting its image which had been put into doubt by the UAE's weak control regime as exemplified by the A.Q. Khan Network, DP World, and transshipping issues. It also showed the high level of transparency in the Emirati nuclear program. Another participant, Nasir Al Ketbi, reiterated the same point, as follows "*I see the gold standard has brought opportunities more than challenges to the UAE. This is how I feel. The UAE didn't have any program in the past, but by having this agreement in place, I think it opened a lot of opportunities for the UAE to explore and bring the technology here for peaceful use."* A comparable example is Iran, where its nuclear program has lacked transparency and full accessibility by the IAEA inspectors.

Themes identified: *Sovereignty challenge, Middle East region, Technical Challenges, political restrictions, International cooperation, Technology transfer, Financial challenges, Non-Proliferation reputation, US compliance program.*

Question 5: Can you give a specific example of how the UAE cooperated with the financial, technical, and other challenges imposed by the NGS*?*

Shaikh Ali Aslharqi recognized that the UAE overcame the human resources challenges posed by the USNRC 10CFR810 by hiring employees that will work with technology from a non-restricted country's list. Alsharqi said "*we have shown a great example of cooperating and also being very transparent when it came to the nuclear project we're working on. So, UAE has abided by the nationalities that they have to hire, for example, on the nuclear project."* Christopher Hatt added that the UAE overcame this restriction by investing *"significantly in its own UAE nationals, in terms of education, training, experience. UAE nationals have this incredible opportunity to study and work around the world, in the industry, in technical, high-quality universities. And so, it's building the knowledge base of its own population, its own Emirati population."* The UAE has worked closely with local institutes (i.e. Khalifa University) and international partners such as KEPCO in training its cadet of young Emiratis that are working and will work in BNPP. Another measure that the UAE has taken was by further digging deeper into the applicability of the certain nationalities that are on the restricted US list by examining it further and pushing it diplomatically through the ambassador Hamad Alkaabi – UAE's permanent mission ambassador at the IAEA. Mr. Blanch detailed his experience in the project *"how can a U.S law be imposed on the UAE, when it's got nothing to do with that? And the fact that also, through contractual conditions and security conditions, we could in effect deliberately exclude certain nationalities from seeing certain, "sensitive American technology" if needed to." Then the team has worked closely to analyze the legitimacy of the condition "We prepared a detailed brief of Muhammad and somebody else whose name escapes me, possibly Ambassador Alkaabi as well went to talk to the U.S government and came back with yes, you can do this because it is your program."* Meaning that the UAE was trusted with their judgment in hiring certain nationalities for their nuclear program.

From a financial point of view, the UAE as confirmed by Christopher Hatt could have easily financed the nuclear project; however, the UAE has looked into the international banking market to finance the project. Mr. Hatt also said "*I do understand is that the whole project could have been financed internally by the UAE, through their sovereign wealth fund, second-biggest one in the world, behind Norway. And that's just the Abu Dhabi fund. The UAE combined is significantly more than that. But, if that were the case, then an internally financed project has no international control."* He also mentioned that when such a project is financed internationally, it added a layer of transparency as the books will be open for audits and other

verification methodologies. The more domestically the project is financed, the more it will be closed circle and less financially transparent.

From a technical standpoint, Mr. Hatt brought an example of how the UAE coped with the challenges "*it employed a prime contractor who would come and build that plant - that's Korea - who have the experience, who have the technical know-how to do this. It's employed many international experts, expat works for other technical aspects to this, and they've drawn those people from the nuclear industry around the world."* The UAE played a big part in setting up an international fuel by financially supporting and promoting the project in Kazakhstan[67]. Steven Brion stated that to overcome the technical challenge that UAE cannot enrich nor reprocess it has instead supported this international initiative. Mr. Brion put it as "the *UAE tried to support this whole regime of the gold standard and not enriching. Partly, one measure was to support this nuclear fuel bank in Kazakhstan. And we supported that financially."*

Some other participants have seen these restrictions as something "normal" to have in a nuclear agreement. Ms. Gayne stated that *"Russia would have done the same*" in terms of sharing technology with competing states. In reality, the Russians were more lenient with their counterpart (Turkey, Egypt) nuclear agreements as the agreement did not pose the same restrictions as the NGS.

Themes identified*: Non-Proliferation reputation, Adoption in legislative, Technical Challenges, Sovereignty challenge, Financial challenges, Human resources challenge, Non-Proliferation reputation, Adoption in legislative, giving away EnR.*

Question 6: Was there any form of objections among domestic stakeholders in the UAE to the NSG prior to it being adopted? If so, to what extent were these objections?

The majority of the interviewees were not sure if any objections were made at the time of signing the NGS. Most of the interviewees have joined the nuclear project after UAE has already signed the NGS. On the contrary, there were many initiatives by domestic stakeholders to elevate the process of the nuclear energy program. Most notably was the E11 highway that leads to the Barakah Nuclear Power plant. Christopher Hatt mentioned that "*As an example, I was amazed that the motorway from Abu Dhabi or Dubai down to the Saudi border was built very quickly. In Western Europe, because of multiple landowners, because of multiple interests, multiple objections, hearings, court cases, and projects take an incredibly long time. In the*

[67] "United Arab Emirates Overview," The Nuclear Threat Initiative, accessed May 3, 2022, https://www.nti.org/analysis/articles/united-arab-emirates-overview/.

same way, the siting of Barakah was done through a legitimate process, environmental studies, logistical studies, and so on and so on". In a statement that how stakeholders were so cooperative with the project unlike in Europe where it may take way longer time due to the decision process lengthiness. Another point was the availability of the site where some beach houses were relocated and compensated for their summer houses to be removed from that specific location. In 2009, the UAE wanted to start the project and most importantly many things were happening at the same time such as the bilateral agreement, prime contract selection, and initiation of the Federal Authority for Nuclear Regulation. So the priority was focused on getting the program in place. Nasir Alketbi confirmed that by saying "*As I said, at that time it was a new technology, and we didn't have the expertise in place. I think the main intention of the UAE was to set the stage for building this program and having the 123 agreement in place is the first step."* Also, lack of expertise at the time has contributed back then to not having a lot of understanding of the nuclear energy projects, let alone the NGS. That helped the agreement not to have any objections. Ian Blanch confirmed that by stating "*They just want to know is it safe? Is it going to end up with some form of environmental dis-benefit for me? So, they, and I used the term they collectively, as in people and stakeholders, probably didn't understand what it meant,"* Priorities were on mostly on safety rather than any other bilateral-technical means.

Themes identified: *Domestic stakeholders.*

Question 7: Why do you think other nuclear newcomers have not agreed to the nuclear "Gold Standard"?

Every country has its own strategic vision and energy policy. The non-proliferation treaty allows nations to enrich uranium for peaceful uses. In UAE's case, it was clear that it was not needed from a vision and strategic point of view, so it was easier to accept the agreement although there were other restrictions. Michael Hamer stated that countries do not want to be held hostage and become "unambitious" if they want to pursue the fuel cycle or even get bullied by the nuclear-weapon state, and that's how he sees it as one key reason that countries did not sign the NGS. Interviewees have mentioned mainly the Saudi vision and why they did not agree on a similar agreement. Political influence was another reason as stated by Nasir AlKetbi "Another thing is, they are maybe larger countries who have more political influence on the region they're in, or there are threats around those countries which limit them from agreeing to certain conditions. For example, Saudi Arabia has announced that they have resources they can utilize for fuel supply." Regional rivalry between Iran and Saudi Arabia is

a key reason why they did not agree on a similar agreement. The Saudis were vocal about developing its nuclear weapons in case of Iran has obtained any. The NGS goes against their ambition and deterrence plans, which contributed to the reason why they are still negotiating with the Americans to get a better deal that can still meet their vision.

Eva Gayne said "*I know about Saudi Arabia specifically. I know that Saudi Arabia had some concerns in signing this standard. They didn't want to forego enrichment and reprocessing. And we should not forget that they've also made statements that they want to develop nuclear weapons in case Iran develops nuclear weapons."* So in the Saudi case, it is mostly from sovereignty, security, and even economics. Saudi has a massive uranium deposit that was discovered lately. However, Gayne has argued that even though if country has that deposit of uranium does not mean that it needs an enrichment program "*You have Kazakhstan, which has huge uranium reserves. You have Namibia, you have Niger, and you have a lot of countries that have huge uranium reserves and still don't have enrichment. You have South Africa, which is producing uranium as a byproduct of their gold mines. They don't have enrichment. It doesn't mean that because you have uranium you need enrichment. You can outsource it."* Sovereignty challenge is another important challenge that was identified by the interviewees, Ian Blanch clearly said that: *"So you can understand that there's almost a subtle power being applied to sovereign states through these, what, again, in inverted commas, are cooperation agreements. But actually, they come with a huge amount of string attached to that; you can do this, but we're not going to allow you to do that. And that's why a lot of the newcomers see this as both frustrating, and to some extent, interference in their strategic ambitions."* Dictating what countries can do or not with their international right to enrich uranium has played a key role in why newcomer countries were not agreeing on the terms of the NGS.

Themes identified: *Sovereignty challenge, Saudi Arabia's ambition, Middle East region, giving away EnR, Iran's effect, Proliferation fears, International cooperation, Non-Proliferation of Nuclear Weapons, Non-Proliferation reputation, Alternative Technology supplier.*

Question 8: As UAE is a nuclear newcomer, what advantages does the UAE with its NGS have over other countries that only have the "classic" 123 agreement?

The majority of answers have listed the NGS as being advantageous to the UAE. Although almost all answers listed the challenges and showed this agreement is a restrictive agreement that poses many challenges, the answers were varied when looking at the NGS from

an optimistic point of view and what value it has added to the country's program. Shaikh Ali stated that this agreement may kick off the nuclear energy program, but that it was less advantageous than a regular 123 agreement signed by other countries. Other participants expressed that this agreement helped the UAE in elevating its peaceful nuclear program, which opened the door of the international western market to help and assess the program. Eva Gayne cleared that by stating that the UAE is even leading the world by example in coming up with the most important two technologies enrichment and reprocessing. However, there are other innovative ways of establishing nuclear energy programs without stepping into that space. According to Christopher Hatt, this agreement has been a promoter of nuclear peace: "*So, there are issues now with Iran, there was with Iraq. Egypt has been questioned. Libya has been questioned. Jordan. The region has been under the microscope for so long. So, the importance of a peaceful program stated and demonstrated, as we said, through international financing, through accepting gold standard conditions, have led to that success."* Another advantage that the UAE has gained via singing the NGS is the exposure to the international supplier's market. Nasir AlKetbi stated that without this agreement, it would have been to get the same access to the nuclear supplier group market. The agreement just assured the world that the UAE is serious and has no intention other than peaceful use of a nuclear program. Moreover, any additional negotiations at the time of signing the agreement would have delayed the Brakah Nuclear Power Plant project beyond its planned schedule. Steven Brion agreed with Mr. Alketbi's point that the NGS was like a gold trophy in the non-proliferation world, it showed a fine example of how countries can kick off their program with the need for enrichment and reprocessing.

Themes identified: *giving away EnR, Adoption in legislative, Non-Proliferation reputation, International cooperation, Energy Demand urgency, Non-Proliferation of nuclear weapons.*

Question 9: What do you think was the largest sacrifice the UAE made by accepting the NGS*? And was the sacrifice worth it?*

The answers to this question have revolved around the word "sacrifice" and the interviewees' understanding of what they consider a sacrifice. Shaikh Ali Alsharqi considered the missed future opportunity is a sacrifice. By missed opportunity, it is meant that the UAE could have been in the nuclear market and established a regional enrichment center, but these opportunities are futuristic. He also looked at it from a diplomatic point of view to involve more countries in the project and not just stick to the US nuclear allies. Alsharqi stated that for 2009, it was worth signing to get initiate the project. Steven Brion mentioned the sacrifice the

UAE made is giving away to exercise article 4 of the non-proliferation treaty. The article allows countries to enrich and pursue a full nuclear cycle to guarantee their fuel supply. Mr. Brion also stated that jettisoning our right to enrich and reprocess may have a future impact as a threat to the nuclear fuel supply to the country. The remaining participants believed that no sacrifices were made. Interviewees who believed that there were no sacrifices had different interpretations of why UAE did not really sacrifice. For a project similar to Barakah which only comprised four reactors, giving away the enrichment and reprocessing could be even more cost-to-benefit in UAE's favor. Enrichment can be very costly technology as it requires specific expertise in various specific specializations, Ian Blanch validates this by stating: "*I'm not certain that it would have, with only four units, you've not got a massive amount of potential to sell into the marketplace, and as a new nation, who would have been prepared to buy your fuel or send, spent fuel into the region for reprocessing."* However, his statement is only temporary. Notably, the UAE aspires to fuel the region's energy. An Executive stated that "*there were no sacrifices as UAE already had the vision to go ahead without enriching and reprocessing.*" The same point was confirmed by Nasir AlKetbi: "*I don't think at that time the UAE sacrificed to sign this agreement. I think this is a win-win situation for the UAE, and also for the US and the rest of the world to show a good model for peaceful use of nuclear technology."* The openness to the international community was one of the results of the UAE singing the NGS, as stated by Michael Hamer: "*In the end, they ended up getting support from the international community and all the international countries helping them, sharing their experience, sharing all their information on how to make the plants better and safer, being part of the World Association for Nuclear Operators, being a part of INPO, all of these different agencies that they would not have access to, had they not done that.".*

Themes identified: *Political restrictions, Energy demand urgency, Human resources challenge, Non-Proliferation reputation, Technical Challenges, giving away EnR, Technology transfer, long term cost efficiency, International cooperation, further negotiation, Sovereignty challenge.*

Question 10: if Iran did not have an ongoing nuclear program, would the UAE have accepted the NGS?

According to most of the answers to the questions asked, the Iranian nuclear program was deemed irrelevant to the UAE's agreement on the NGS. Opinions varied as it was already known program since 2003 and in reality, it may put pressure on the Iranian to accept a stricter deal. Eva Gayne noted that "*the UAE started its nuclear program with a policy paper of 2008.*

So, at that time it was widely known that Iran had a nuclear enrichment program which was revealed in 2002 and put under safeguards in 2003. So, to my mind, those two things are completely not related." Iran has been challenging the world publicly with its nuclear program and massive proliferation risk. It is not just Iran that was the hotspot in the Middle East; Iraq and Libya also assume significance, as stated by Christopher Hatt: "*Because of the history of the region. Egypt, before the board of governors, plutonium experiments and all that. Iraq, with an enrichment program that we all know about. Libya with the material and ambition for a nuclear program."*

When the UAE signed the agreement, it was not something new, although the UAE's ambassador to US Yousef Al-Otaiba has been vocal about the NGS in terms of unfairness.

Themes identified: *A.Q. Khan, Middle East region, Iran's effect, Non-Proliferation reputation, Adoption in legislation.*

Question 11: In your opinion, if other GCC countries or Jordan develop nuclear energy programs without the NGS, would the UAE seriously consider reviewing its NSG?

The way the NGS was established, if any country in the region gets a more favorable agreement (can enrich and reprocess), the UAE has the right to renegotiate the agreement. Two interviewees opined that the UAE may review the nuclear gold standard if any other countries get a better deal. This is mainly because they will be in the nuclear business, as per Ian Blanch. Being in the nuclear club will be a missed business opportunity for the UAE, as the country may aspire to supply countries with nuclear fuel. If more countries get into the nuclear business, it will be translated into more business opportunities for the UAE. As the country is the most experienced in the region, constructing and operating four reactors will play a big role in penetrating the fuel supply market.

The rest of the interviewees opined that the UAE should not believe that it is missing anything, as the fact that the country wanted to forego enrichment and reprocessing was clear from the beginning. Even if the UAE had the right to enrich and reprocess, it will be very complicated to do so, as the country will be heavily monitored by the international community and the margin of error will be very thin. Additionally, it is expected to have a stringent agreement for any western technology provider. Christopher Hatt stated that "*Europe will probably have a similar type of agreement. They would still want some gold standard-type conditions attached to that. So really, in terms of traditional power generation reactors, they would struggle to get a program which was acceptable as the UAE's program has been."* Even

though other interviewees think the UAE may not revise the agreement, the country is likely to be annoyed by the new agreements. The UAE will make sure that the US should know that.

Themes identified: *Further negotiations, Alternative technology supplier, Non-Proliferation reputation, Proliferation fears, Long-term cost-efficiency.*

Question 12: How important was it for the UAE to include the prohibitions about reprocessing and enrichment in its legislative system? Was it more important for foreign or domestic stakeholders?

All of the interviewees generally agreed that it was important for the UAE to underscore how it abides by its international commitments by embedding them into its legislative system (Nuclear policy, law, regulations, and regulatory guides). Eva Gayne explained the process of embedding the international agreements as a "cascade-down" to citizens and local experts to be able to understand "*This is something between states, or the state and the IAEA, or the UN or whoever. And then once a state makes that agreement, it still needs to incorporate it into the national legal system and its laws and regulations, otherwise, how would I, or you as a UAE citizen know? You wouldn't be reading the international agreements, you would be looking at a UAE law that is relevant for your activities to be guided, what you may and may not do."* In the case of the NGS, it was cascaded down from the nuclear policy, law number 6 of 2009 "nuclear law" up to the implementing regulations such as FANR Regulation 09 and 10. That is equally important for both foreign and domestic stakeholders. For specifically domestic stakeholders, the law of any nuclear facility will be falling under FANR regulations for nuclear facilities, and these regulations have already embedded the international commitments (including the NGS). Ultimately, by complying with the local regulations, the domestic stakeholders are adhering to the UAE's international commitments. Moreover, this shows the world how the UAE takes commitments seriously by cascading down to domestic suppliers through local laws and regulations, and through a firm inspection program, thus assuring that everyone complies.

Themes identified: *Energy demand urgency, giving away EnR, Domestic stakeholders, Adoption in legislation, Non-Proliferation reputation, and Legislative adoption.*

5. Discussion

5.1 Introduction

The UAE has signed a nuclear agreement with the US that has been labelled as the NGS. Except for Taiwan, the NGS has not been endorsed by nuclear newcomer countries due to its excessive restrictions. These restrictions have been studied thoroughly in this research to understand how and why the UAE has acquiesced to this agreement. Moreover, the research has investigated how did the UAE coop and adopted these restrictions into its policies. The data analyzed in chapter four of this thesis have uncovered the primary reasons that the UAE's acceptance of the NGS. Moreover, further reasons have been discovered through the process of thematic coding analysis. Interviews have been conducted with industry and international experts that were the primary source of data in this research. A thorough thematic analysis has been applied to the data gathered, with results to be discussed in this chapter. The thesis has posed two research questions:

1. Why has the UAE signed the restrictive NGS?
2. How did the UAE adopt the agreement into its policies?

The questions are explanatory and explanatory in nature. The first question is to investigate the rationale behind UAE signing such a restrictive agreement. The second question delved deep into the specifics of how the UAE has coped with the NGS restrictions.

The results of this research can be utilized as the lessons learned to the nuclear newcomer states that will want to adopt the NGS to establish their nuclear power programs. This research will also briefly mention the reasons why this agreement has not become an international norm yet accepted and worked for the UAE.

This case study is specific to the UAE, but researchers can take it further to do a wider study to compare UAE to other nations that did not sign the agreement. Understanding the reasons for UAE's agreement will lead the researcher to further know why this agreement has not become a new international norm, which would help the nuclear agreement to be amended to accommodate such flaws. Findings may be generalized and may apply to different industries where strict agreements (Military, dangerous goods, etc.) may potentially require commitment.

5.2 Rationale Behind the UAE's Signing of a Strict Nuclear Agreement (RQ1)

The first research question was inspired by the low general acceptance of this NGS among nuclear newcomer states. In addition, the NGS has not become an international norm.

Only two states in the world have signed the NGS (UAE in 2009 and Taiwan in 2014). The research looked in-depth into why the UAE signed this restrictive agreement.

RQ1: Why did the UAE sign the restrictive Nuclear Gold Standard?

At the outset, the researcher assumed that the NGS was driven by the urgent need to diversify Abu Dhabi's domestic energy mix away from high emissions of natural gas. However, through a thorough analysis of the data, the following themes have scored the most in terms of frequency as surprising findings to the researcher. The results for the research questions were as the following:

5.2.1 World-class proliferation credential

Through the analysis of data collected, the "Non-proliferation reputation" scored the most detected theme out of all answers when answering RQ1. It was a surprise finding from the data analyzed as the expectation of the researcher was headed toward the UAE's urgent need for diversification of energy. Interviewees have stated that by UAE signing the NGS is a strong message to the whole world on how the country is serious from a proliferation point of view given that its reputation had been damaged in the DP World and AQ Khan saga. The agreement was called the NGS a sign that how nuclear newcomers should follow UAE's path. The UAE has always thrived on its reputation and did not compromise on that big aspect which led to the success that the UAE has seen in recent years. Reputation and prestige are key driver of UAE's policies. Taking safety as an example, Abu Dhabi has been selected as one of the safest cities in the world, which in turn built a safe reputation; from a strategic point of view, that will promote investment and tourism in the Emirates. Similarly, the UAE signed a written agreement that prohibits the country from pursuing enrichment and reprocessing of nuclear material gives the UAE a great credential in the nuclear world on how a country can push through the proliferation field from a different angle. Although the nuclear proliferation treaty allows countries to enrich uranium for their peaceful programs, the UAE has shown that it was not needed. Additionally, the UAE has been a great example to the world on nuclear weapon non-proliferation by clearly showing the world that it will forgo the enrichment of uranium and reprocessing of spent fuel.

5.2.2 NGS has helped the UAE to broaden and deepen its international partnership (International cooperation)

Signing the NGS has pushed UAE's nuclear transparency reputation to a new level, which has made it easier for the UAE to have support from the Nuclear Supplier Group. Which in turn has made eventually it easier for the UAE to have international cooperation from the West in building the Barakah Nuclear Power Plant. Examples include services by Bechtel, Pillsbury, Ch2MILL, Doosan, Siemens, and Westinghouse for consultancy, project managers, reactor design, and fabrication. . International cooperation is tied strongly with the first finding of "non-proliferation reputation", the more transparent country's nuclear energy program the more likely countries will collaborate with the project. In addition, signing the agreement has encouraged the U.S. to push its weight into vouching for the UAE's nuclear project. That has helped the UAE to have easiness in obtaining technology from the open market (mostly the west and East Asian allies). International cooperation emerged as one of the common answers from interviewees that why the UAE has signed such a restrictive agreement. This in a way makes sense, assuming the U.S. has given the UAE assurances that in case the UAE agreed to pursue the NGS, it will help the UAE with its power to reach its primary objective of building nuclear power plants promptly If the UAE had not signed the nuclear gold standard with the US, this would have prevented the UAE per the Atomic Energy Act of 1954 from legally obtaining nuclear technology (and services) that originated in the US.

5.2.3 UAE's urgent energy demand

The UAE has been working on its vision for 2024 to have 20% percent of its energy from clean sources and targeted clean energy in 2050 up to 40%[68]. The aggressive ambitions of the UAE to meet its vision have been a key influencer in signing and finalizing nuclear agreements (including the NGS) to start constructing its nuclear power plants. "Energy demand urgency" was repeated as a key theme when the data collected were analyzed.[69] The country's vision was a key vehicle to agreeing on a nuclear agreement that is considered restrictive and goes beyond the regular government-to-government type of agreement. UAE was ready by 2009 to accept the agreement as the UAE nuclear policy of 2008 was already in place which indicated that the country would forgo enrichment and reprocessing. Moreover, to the urgent energy demand, the country has calculated it from a cost basis point of view, and the sooner the country started the earlier it will get its return on investment. The cost has been looked at

[68] "United Arab Emirates Energy Information," Enerdata, accessed May 16, 2022, https://www.enerdata.net/estore/energy-market/united-arab-emirates/
[69] op. cit.

from a point of view that fossils that are saved from being burned will be sold in open markets. Prices of Diesel and Gas in 2009 were at their highest (in a decade) which has encouraged the UAE to go ahead with signing the agreement. These influencing factors such as the energy demand of the country and cost analysis have been one of the major influencers to the policymakers in UAE to take that decision.

5.2.4 Nuclear technology transfer

The Advanced Power Reactor (APR-1400) is a light water reactor type based on an original US technology by Combustion Engineering (System 80+ design). Major systems of the APR-1400 technology are still being designed and procured from American suppliers such as Westinghouse Electric Company, Thermofisher Scientific, and others. Therefore, the NGS has enabled the UAE to acquire without restrictions technology and expertise from the US. Since the Americans were heavily involved in the APR-1400 (although it is considered a Korean design), an agreement must be struck with the US to fully obtain all technologies related to this specific design. Moreover, any new technology based on an American design must be considered delicate technology and be transferred to the end-user that has an already 123-agreement in place. Without the NGS in place, it is expected that the South Koreans would not be able to provide the reactors or to construct the Barakah Nuclear Power Plant. So, indicates that this is one of the major reasons why the UAE has agreed on the NGS and its conditions, and we can relate it to the urgency of kicking off the nuclear power project. It is observed all findings in answering these questions have been interdependent with each other.

5.3 UAE's Adoption of the Nuclear Gold Standard (RQ2)

The UAE was ready to adopt all these restrictions that were posed by the NGS, as the country had already been clear in its nuclear policy of 2008 that the UAE will forgo enrichment of uranium and reprocessing of spent fuel. However, at a later stage, there were additional steps were taken to adopt the restrictions posed by the NGS. The second research question investigated how the UAE was able to adhere to these restrictions.

RQ2: How did the UAE adopt the agreement into its policies?

The following sections highlight how the UAE has adopted the restrictions into its policies from, financial, human resources, FANR regulations, transfer requirements, and others.

5.3.1 Diversity of financial funding of BNPP and joint ownership of the power plant

The UAE has the financial capability to fully fund the nuclear project of USD 24.5 billion (approx.). However, the UAE chose to diversify the funding of the nuclear power project and to go into a joint venture to provide an additional layer of transparency thus contributing to the country's reputation. The funding of the USD 24.5 billion (approx.) includes the construction and commissioning of four reactors (including initial nuclear fuel cost). The funders are as follows[70]:

Table 6

Finances of Barakah Nuclear Power Plant project

Financiers	Amount in USD
Export-Import Bank of Korea "KEXIM"	$2.4 billion
National Bank of Abu Dhabi "NBAD", First Gulf Bank "FGB", Standard Chartered "SC", The Hong Kong and Shanghai Banking Corporation "HSBC".	$250 million
Direct loans from the Government of Abu Dhabi	$19 billion
KEPCO direct equity in a joint venture	$4.7 billion

Notably, Table 6 above showed final financing arrangement for the BNPP project. The original financial plan was as follows: $10bn USD from the Export-Import Bank of Korea, $2bn USD Export-Import Bank of the US, $6bn from UAE's government, and $2bn from various international/commercial banks[71]. The plan has changed due to an increase in interest rate.

Having the South Korean financing part of the BNPP has given them equity of 18 percent of the ownership of the power plant. In turn, this is a strategic move to ensure the constant support from KEPCO and its sub-contractors for the life of the plant. In addition, having a pool of financiers added a layer of transparency, as books will be open for audits

[70] "About Barakh One Company," Emirates Nuclear Energy Corporation, accessed May 15, 2022, https://www.enec.gov.ae/about-us/overview/barakah-one-company/.
[71] Philippa Wilkinson, " Abu Dhabi nuclear project reaches financial close," Middle East Business Intelligence, accessed May 17, 2022, https://www.meed.com/abu-dhabi-nuclear-project-reaches-financial-close/

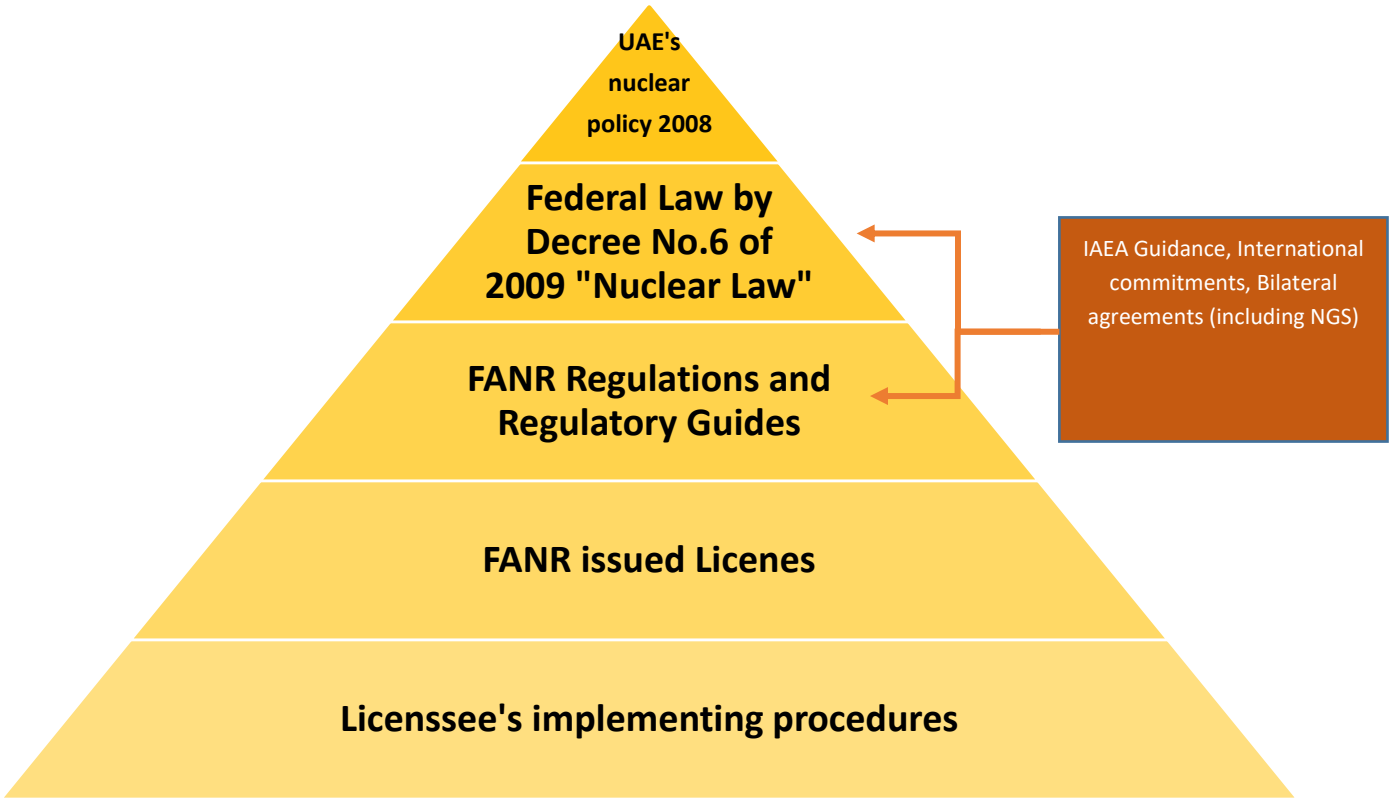
which support the first theme “Non-proliferation reputation” and shows the world that the project is open for technical and/or financial auditing.

5.3.2 Establishment of FANR Regulations, norm adoption into UAE’s legal framework

A major step into adopting all bilateral agreements is to embed them within nuclear law up to implementing regulations. The regulatory framework is as shown in Figure 2:

Figure 2

Nuclear Implementation of Legal Framework in the UAE



The country has already established its nuclear policy before signing the NGS. In UAE’s nuclear policy of 2008, it did specifically indicate that the country will not enrich nor reprocess. At a later stage in 2009, the nuclear law came into force which an article consisted of the establishment of the Federal Authority for Nuclear Regulations (FANR). FANR is the highest nuclear regulatory authority, which in turn has had the duty of cascading down the international agreements and all bilateral agreements into its regulations down to the individual licensees. Regulations have embedded the international commitments/bilateral agreements to assure that there is no misinterpretation of the international commitments and bilateral agreements (including NGS) by the licensees. FANR has issued a few regulations that

specifically address the general commitments from Safeguards and Export Control points of view. Take FANR-REG-09 v01 as an example where there are requirements on technology control that were based on international commitments. As seen in the graph above, international commitments/bilateral agreements are embedded in both Laws and Regulations. In short, the UAE has adopted the NGS via a few means and one of them is by establishing implementing regulations for the licensees to show the world that international commitments are in the legislative system which by law needed to be complied with, by any nuclear operator in the country.

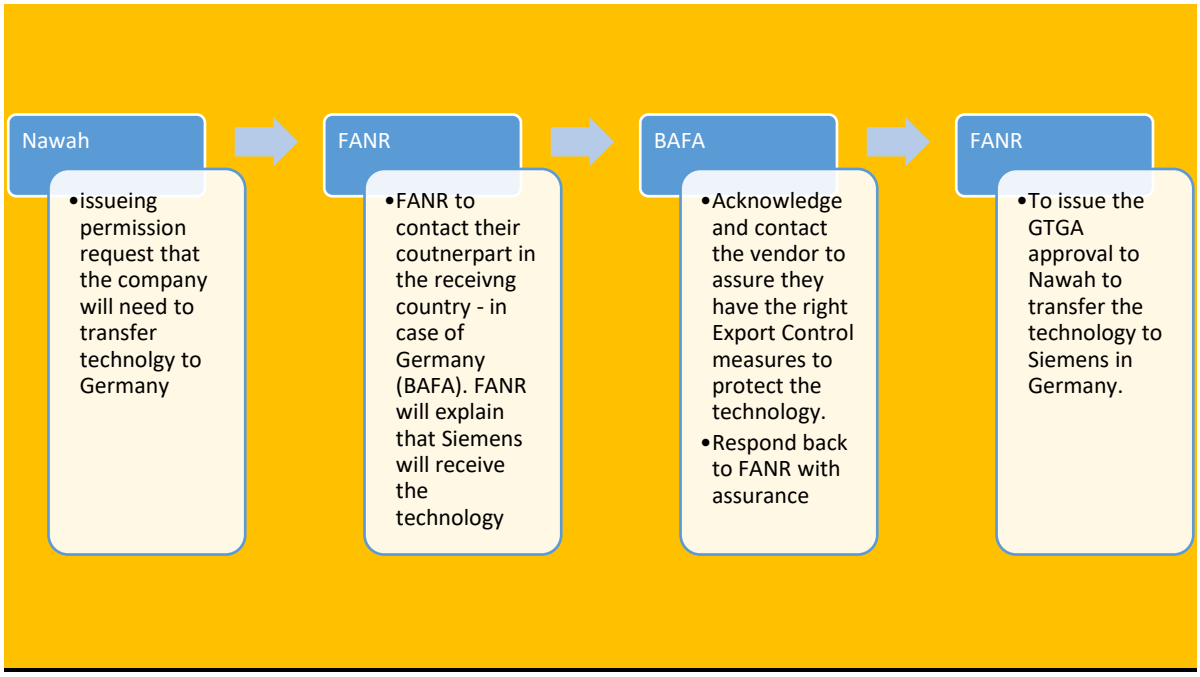
5.3.3 Technology transfer requirement

Technology transfer is highlighted in the NGS that it must be controlled within the country's laws and regulations. To assure compliance with the NGS, in FANR Regulation 09 (FANR-REG-09 v01), article 8 point 1 that any involved licensee that requires to transfer technology, the technology receiver (end-user) must have a valid Government-To-Government Assurance (GTGA) to be able to use and have access to the technology. The GTGA process will be between two government authorities (FANR and The Federal Office for Economic Affairs and Export Control 'BAFA'). Figure 3 shows an example of how the GTGA process works:

Nawah Energy Company to transfer technology to a Siemens Germany:

Figure 3

Transfer Control Process of Technology



In the case above, now all authorities have known of the transfer of technology and assured each other that Nawah and Siemens have the right processes and procedures to protect and maintain technology. The step of GTGA was introduced to control and know in case of misuse of technology as it can be pinpointed. The process in the aforementioned figure how technology can be tracked by states. That adds assurance to the country on how it is doing in protecting the technology it has received. Having these steps into the Regulation shows how the UAE has pushed its legislative system to adopt the NGS and in turn, all licensees in the country must comply with it by law.

5.3.4 UAE voluntarily gave up enrichment and reprocessing

An interesting approach to how the UAE has adopted the NGS is by being a step ahead before signing the agreement. The country issued its nuclear policy in 2008 and declared that it will forgo enrichment and reprocessing. That meant to the international community and especially its American counterpart that the country was ready to adopt the restrictions posed by the NGS. The nuclear policy has retroactively predicted the concerns of the international community in terms of enrichment and reprocessing, stated as follows: “concerns from the international community regarding spent fuel reprocessing and enrichment plants in developing countries, and the dual-use nature of components employed in fuel fabrication and processing.

Considering these factors, the UAE will not seek to develop domestic capabilities in those areas."[72]

That's another major step in how the country was ready and expecting what will come in the NGS and made it easier for the Americans to tailor-made the deal around the UAE's nuclear policy. An extra assurance to the world on how the nuclear business in the UAE is transparent and should serve its intended objective of providing energy to the nation.

5. 4 Evaluating the Research Hypothesis

What intrigued the researcher to primarily pose the main research question of "***Why did the UAE sign the restrictive Nuclear Gold Standard?"*** was the extreme low-level acceptance of the NGS among the countries who have signed the 123-agreement. Currently that there are only 2 countries in the world that have signed NGS out of 49 states and an international organization (the IAEA). The hypothesis was driven by prior knowledge of two major factors. The first factor is how challenging and restrictive is the NGS and the second factor is the low level of signees on this agreement. The hypothesis is as follows:

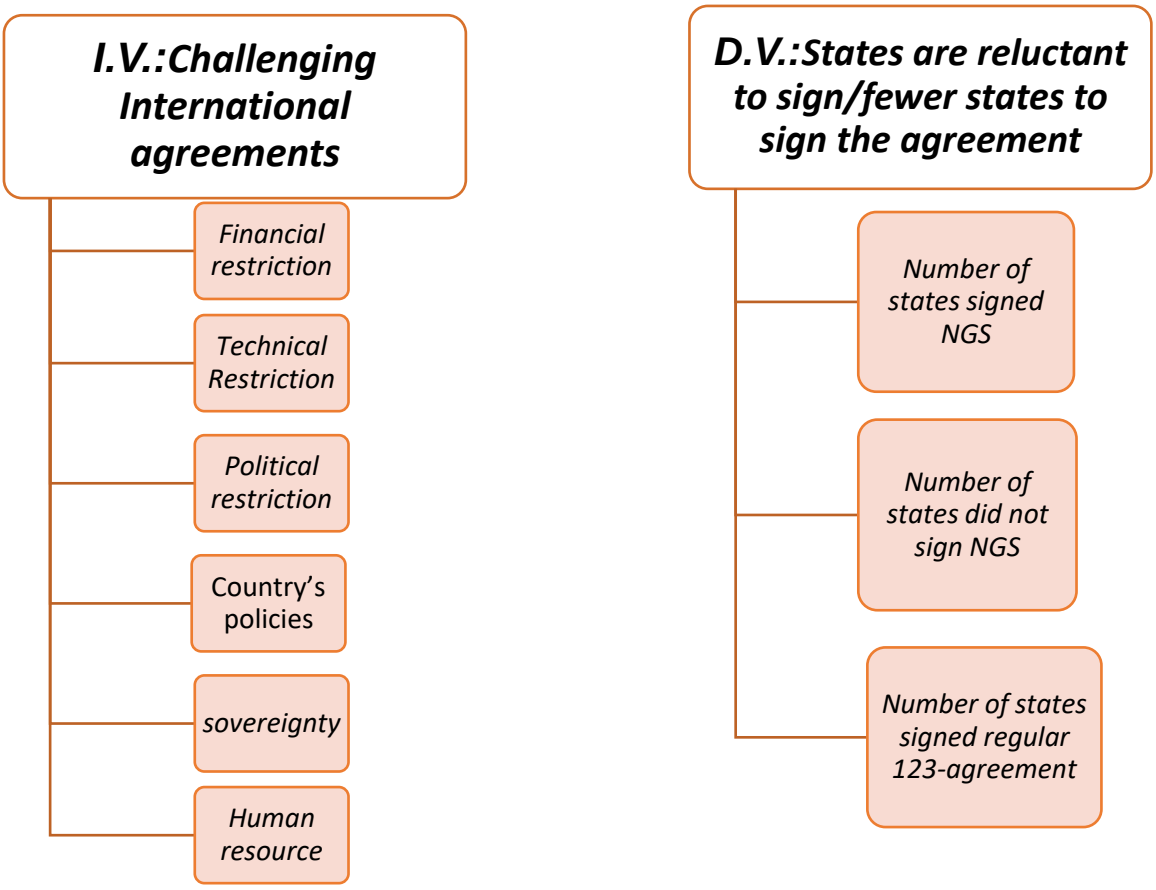
H1: The more challenging the international agreements the less likely countries are willing to sign them.

The independent variables/dependent variables are as shown in Figure 4.

Figure 4

Independent and Dependent Variables and Indicators

[72] United Arab Emirates Government. "Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy, 2008" Accessed February 10, 2022, https://www.enec.gov.ae/doc/uae-peaceful-nuclear-energy-policy-5722278a2952f.pdf



Considering only two countries signed among 49 states that have signed 123-agreement, providing a very slim percentage of **4%** acceptance rate the hypothesis (H1) did not firmly claim that if challenges are presented there will be no countries signing the agreements as the term "likely" used. However, the language used is "Less likely" which means there are countries under certain circumstances will sign the agreements against the expected international norms. The hypothesis is general and the NGS can be used as a testing case of this hypothesis. The hypothesis has proved that it is true in the case of restrictive/challenging agreements such as the NGS country is reluctant to sign such an agreement. The Saudi Arabia case has been discussed in the analysis section (Chapter 4) of this research. Saudi showed up as a great example of how the conditions of forgoing enrichment and reprocessing have prevented the Saudis from signing the NGS. The negotiations are still ongoing on how the Kingdom is still having the ambition of entering the nuclear fuel market by using its large Uranium deposit that was discovered lately.

6. Conclusion

6. 1 Conclusion

The UAE has stepped up to the nuclear weapon non-proliferation scene and signed the NGS with the US. Although the NGS did not become an international norm among nuclear newcomer entities due to its excessive, only two entities have signed the agreement UAE and Taiwan. The NGS posed additional restrictions that were considered abnormal in nuclear agreements such as the entity must forgo enriching uranium and reprocessing spent fuel. This

thesis has investigated the rationale behind UAE's decision to sign such a restrictive agreement. The UAE has always thrived on its reputation in all aspects. The nuclear industry was great to showcase how the UAE can lead the world with its reputation for non-proliferation and transparency in its nuclear power program. Singing the NGS has pushed the UAE to a world-class credential in nuclear weapons non-proliferation, which was well-received among the international community. Signing the NSG has helped the UAE broaden and deepen its international partnership, as UAE was able to bring international companies, primarily Western to help in kicking off the BNPP project from many aspects (consultancy, construction, design, etc.). Notably, the UAE has formed its strategies for 2024 and 2050 in clean energy consumption that have also pushed the country in pursuing nuclear energy, therefore the urge to sign NGS and get the project started. Technology transfer is a major aspect of any nuclear power project, similarly to the UAE's case, to get the American technology for BNPP which the Korean reactors are heavily based on American technology, the NSG had to be signed. When entities sign a restrictive agreement, these new norms must be adopted within the country's policies and its nuclear program. UAE adopted these restrictions via having financial transparency, and the establishment of FANR that is ready to embed the norms in its regulations and regulatory guides. In addition, the country has imposed a technology transfer methodology that can track and control the transfer of nuclear technology, as that is another way how the UAE showed adopted the norms. Technology transfer is bound by a government-to-government assurance that both sender and receiver authorities have so provided each other assurances that the technology has been transferred to the right companies and will not be misused. The UAE demonstrated to the world that even though some agreements may be restrictive, the greater good of a country should always take precedence over everything else.

6.2 Future Research

This case study is specific to the UAE; yet it can be developed into comparative research to either regional or global level. The hypothesis has been generalized to be used from a wider perspective and can be applied to future research. The UAE's case can be compared to the regional nuclear newcomers (Saudi Arabia, Egypt, Jordan, and Turkey), as nuclear Middle East specific topic studying the reasons for accepting or rejecting the NGS. Since the nuclear energy renascence has been shifting to the East in the last 15 years. Potential future research

can have a few themes that are specific to Asia, such comparison of the UAE versus Arab countries, central and East Asian countries, and the Middle Eastern region including Iran and Turkey. Moreover, the study can be taken on a global level comparing all countries that have signed the 123-agreement and study their conditions and what similarities can be found and sacrifices in comparison to the UAE.

6.3 Recommendations

The agreement has a clause stating that it can be considered for further negotiations in case another country in the region has got a better deal. The researcher recommends that in case of further negotiation need to be established, a comprehensive study has to be done on the cost/benefit of removing restrictions against enrichment and reprocessing. Specifically, in case the UAE needs to pursue a full nuclear fuel cycle and penetrate the fuel supply market, will it be feasible economically the UAE?

If there is a potential Gulf Cooperation Council (GCC) fuel enrichment facility, for example, the uranium ores can be mined in Saudi (or Jordan), and initially processed in the kingdom. Then can be enriched in the UAE as Low Enrich Uranium (LEU) which typically is pressurized water reactor fuel. The distribution in GCC can make it a world powerhouse for nuclear fuel. In that case, negating the NGS to remove or reduce the restrictions would be a worthwhile endeavor. UAE's decision to voluntarily relinquish its enrichment and reprocessing program has enhanced its non-proliferation reputation; however, this aspect needs to be re-evaluated to better decipher the consequences of international cooperation if a country goes on the full nuclear fuel cycle.

6.4 Research Reflection

The value of this research would have been more significant if I was able to reach more former employees that worked on the nuclear deal back in 2008-2009. A notable example is the former Director-General of FANR, William Travers. In addition, I would like to have interviewed government officials from the US that were part of forming the agreement. Lessons learned out of this work are that interviewees need to be approached at the very beginning when forming the research topic, as interviews took longer than planned to schedule due to the unavailability and cancellation of some interviewees which, in some cases, may jeopardize the results of the research.

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8. Appendix

8.1 Interview guide

Interview (Semi-structured) guideline:

Questions as below:

1. *Why was the UAE so intent on acquiring nuclear energy while alternative fossil fuel is available?*

2. *What (in your opinion) were the main reasons to have the 123 nuclear agreement deal (as known as the Nuclear Gold Standard) with the United States?*

3. *Do you believe with further negotiations pre-2009 would have allowed the UAE to secure a less restrictive nuclear agreement?*

4. *What are the main challenges that the nuclear gold standard poses for the UAE?*

5. *Can you give a specific example on how the UAE cooperated with the financial, technical and other challenges imposed by the nuclear gold standard?*

6. *Was there any form of objections among domestic stakeholders in the UAE to the NGS prior to it being adopted? If so, to what extend were these objections?*

7. *Why do you think other nuclear newcomers have not agreed to the nuclear "Gold Standard"?*

8. *As UAE a nuclear newcomer, what advantages does the UAE with its NSG have over other countries that only have the "classic" 123 agreement?*

9. *What do you think was the largest sacrifice the UAE made by accepting the nuclear gold standard? And was the sacrifice worth it?*

10. *if Iran did not have an ongoing nuclear program, would the UAE have accepted the NGS?*

11. *In your opinion, if other GCC countries or Jordan develop nuclear energy programs without the NGS, would the UAE seriously consider reviewing its NGS?*

12. *How important was it for the UAE to include the prohibitions about reprocessing and enrichment its legislative system? Was it more important for foreign or domestic stakeholders?*

8.2 Human Subject Ethics Approval

جامعة خليفة
Khalifa University

07 April 2022

Mohamed Almansoori, Masters student, International and Civil Security Department
100057668@ku.ac.ae

Protocol Title:	UAE's acceptance of the Nuclear Gold Standard
Protocol #:	H22-004
Funding Source	None
IRB Review Date:	07/04/2022
Effective Date:	07/04/2022
Expiration Date:	06/04/2023
IRB Review Type:	Expedited
IRB Review Action:	Approved

Dear Mohamed,

On 07/04/2022 after review of your application the Institutional Review Board of Khalifa University of Science and Technology has approved the above referenced submission. **Please note that the approval for this protocol will lapse on 06/04/2023**

This approval includes the following:

- Revised KU IRB Application
- Revised Consent Form Ver. 2
- Thesis proposal

The following determinations were made:

- The risk determination is no greater than minimal risk

Sincerely,

Signed by:Lama Omar Jamhawi
Signed at:2022-04-07 11:16:54 +04:00
Reason:I approve this document. Lama O

Lama Omar Jamhawi

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Manager, Research Compliance & Training
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Chair, Research Ethics Committee
Faculty, Biomedical Engineering