



# Ethics and risks in sustainable civilian nuclear energy development in Vietnam

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**ABSTRACT:** Vietnam is a vibrant and emerging South East Asian economy. However, the country faces a challenging task in meeting rising energy demand and the need to securitize energy while addressing the negative environmental impact of fossil fuel utilization. Growing concerns about sustainable development have led Vietnam to develop civilian nuclear energy for electricity generation. Nuclear power is widely recognized as a clean, mature and reliable energy source. Its inclusion in Vietnam's energy mix by 2030 is expected to supplement other energy sources from fossil fuel, hydropower plants, renewable resources and energy imports. Despite strong reservations in the aftermath of the Fukushima disaster, Vietnam has pursued its national nuclearization program. Civilian nuclear energy development has been widely regarded as a controversial issue, although it is intended for peaceful purposes and as a solution for long-term energy security. Anxiety over nuclear safety measures, inadequate nuclear regulatory mechanisms, lack of institutionalized radioactive waste management, the threat of nuclear accident, theft and terrorism, and nuclear proliferation have marred public perception. The apprehension towards nuclear energy development has raised serious questions on the ethics and risks of the technology. Using a qualitative approach of reviewing published scholarly research, we investigated the ethical and risk issues that manifest in civilian nuclear energy development in Vietnam. Our findings reveal that the conundrum of civilian nuclear energy revolves around balancing energy security, environment preservation and societal well-being with ethical and risk predicaments of nuclear energy.

**KEY WORDS:** Vietnam · Civilian nuclear program · Sustainable energy · Ethics · Risks

## 1. INTRODUCTION

Rapid industrialization, along with population growth, high electrification rate and urbanization, has resulted in mounting pressure on energy demand and supply in Vietnam. The usage of electricity to support national development is expected to triple by 2030 (WNA 2016). However, the state faces challenges in current energy sources such as volatility and high prices of fossil fuel, the vulnerability of hydropower during dry seasons, dependence on energy imports, degradation of the environment

through the utilization of fossil fuel and construction of hydropower plants, emission of large amounts of greenhouse gases and early stages of development in renewable energy for large-scale electricity generation. These concerns may undermine the assurance of sustainable growth, as the state has been experiencing an electricity shortfall of 3% every year since 2006 (Thuy 2011). The energy predicament has compelled Vietnam to develop civilian nuclear power to ensure sustainable economic growth with minimum impact on the environment. Widely regarded as an alternative source of clean and reliable

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energy, nuclear power addresses the dual objectives of strengthening energy security and mitigating climate change effects.

Despite Vietnam's peaceful intention of developing nuclear power to meet long-term energy demand, complex ethical and risk concerns exist between energy requirements and environmental well-being, societal health and national security. Nuclear energy is the most controversial energy affecting emerging economies such as Vietnam. The contention is further exacerbated as developed nations such as Germany and Switzerland have opted to completely phase out nuclear power in their energy mix by 2022 and 2034, respectively, in the aftermath of the Fukushima accident (Peimani 2012). However, other countries' mixed positions regarding nuclear energy development have propelled a global debate on the technology (Goodfellow et al. 2015). Hence, the proposition of nuclear power plants (NPPs) is highly contested, in spite of the potential benefits derived from the technology. The risks and ethical concerns led the Vietnamese government to reconsider the adoption of nuclear energy in 2016 (Nguyen & Minh 2016).

The need to ascertain the ethical and risk aspects of nuclear technology is vital, as it is often associated with destructive capabilities harmful to society, the environment and the state. As much as the development of nuclear power is anticipated to diversify the state energy mix, policymakers need to understand the social and environmental impacts of executing nuclear technology for civilian purposes. The inclusion of nuclear power in the energy portfolio strengthens the state's energy security and is essential to the national energy policy landscape (Selvakkumaran & Limmeechokchai 2016). As such, an unbiased view must be adopted to ensure that economic and ethical aspects are given due consideration.

Hence, we examined the ethical and risk perspectives of Vietnamese civilian nuclear energy development that go beyond the technology itself. The primary research question that we aimed to answer is to what extent ethics and risk concerns manifest in sustainable civilian nuclear energy development in Vietnam. We investigated 3 main areas of responsibility in nuclear energy development: (1) the possibility of nuclear accidents, theft and terrorism; (2) the handling and disposal of high-level radioactive waste; and (3) the threat of nuclear proliferation caused by developing sensitive fuel-cycle technology, particularly uranium enrichment and used fuel reprocessing (E&R).

## 2. LITERATURE REVIEW

To examine the ethical and risk perspectives of the development of civilian nuclear energy in Vietnam, we extensively reviewed the relevant literature (from scholarly publications and reports) on Vietnam's civilian nuclear energy pursuit. We primarily relied on secondary data and used a qualitative approach to analyze the emerging issues in civilian nuclear energy development in Vietnam. We conducted a literature search in the Scopus database using 5 main key words: 'Vietnam', 'civilian nuclear program', 'sustainable energy', 'ethics' and 'risks'. From the literature search, 3 main themes were identified: (1) nuclear accidents, theft and terrorism; (2) management of nuclear radioactive waste; and (3) threat of nuclear proliferation.

In addition to the Scopus search, other data sources include the World Nuclear Association (WNA), International Atomic Energy Agency (IAEA), US Energy Information Administration, Asia Pacific Energy Research Centre (APEREC), Association of Southeast Asian Nations (ASEAN), United Nations (UN), United Nations Educational, Scientific and Cultural Organization (UNESCO) and Nuclear Energy Institute (NEI). We also gathered statistics and information on nuclear energy from national agencies and ministries such as the Vietnam Ministry of Foreign Affairs, Institute for Atomic Energy Vietnam (VINATOM) and Vietnam Agency for Radiation and Nuclear Safety (VARANS). These data are publicly available and officially verified. Collectively, the literature reviewed provides insight to explore the complexity inherent in the phenomenon of civilian nuclear energy used towards achieving sustainable development.

## 3. FINDINGS

### 3.1. Nuclear accidents, theft and terrorism

In contrast to the multifaceted ethical issues involving modification of DNA and use of animals for experimentation, nuclear atoms and nuclear fission processes do not include such complexity in their ethical predicaments. However, the application of nuclear technology for the generation of energy leads to specific disputable risks and ethics concerns, as discussed herein.

#### 3.1.1. Risk of nuclear accident and theft

Since the inception of civilian nuclear power in the 1950s, there have been substantial security and

safety measures in place to minimize the risk of nuclear incidents. Nonetheless, overheated nuclear reactors, malfunctioning cooling systems and other related structural breakdowns may cause leakage of hazardous and radioactive materials into the surrounding areas (Tabak 2009). More importantly, these fissile materials could be intentionally smuggled out of a nuclear facility. These incidences would result in radiation leakage that could cause harmful consequences to society, the environment, the state and internationally since radioactive contamination can transcend borders. Although radiation leakage is subjected to ethical calculation, studies have shown that the magnitudes and probabilities of leakages are inconclusive (UNESCO 2012). Nevertheless, the likelihood of nuclear accidents and theft has positioned NPPs as an ethical and risk issue. The potential of these incidences occurring despite the benefits of sustainable energy development illustrates the principle of no acceptable risk. This principle states that risk can never be 'totally acceptable' since adverse effects require due attention as a trade-off to achieve certain benefits.

Although Vietnam's pursuit of nuclear energy development is entirely for peaceful purposes, scholars have anticipated that fissile materials are susceptible to being illegally acquired from nuclear energy facilities to create nuclear weapons or sub-nuclear weapons such as radiological dispersion devices ('dirty bombs') (Reiter 2013). Moreover, advancements in proliferation-resistant nuclear technologies do not necessarily curtail nuclear theft, as these prevention measures and technology require high investments. Thus, the risk of nuclear theft is still non-zero. From another perspective, the success of proliferation-resistant technologies would alleviate the sense of insecurity and anxiety regarding NPP development in Vietnam.

### 3.1.2. Possibility of nuclear terrorism

As the leading nuclear aspirant in the Southeast Asia region, the construction and operation of Vietnam's NPPs could inevitably be the center of nuclear insecurity. With safety and security mechanisms lacking complete adherence to IAEA requirements, the acquisition of nuclear materials by non-state actors for malicious purposes is not unlikely. Since the nuclear regulatory body of Vietnam, VARANS, is not entirely independent from the Ministry of Science and Technology (MoST), there exist possibilities that the former cannot fully monitor nuclear facil-

ities (Mochizuki & Ollapally 2016, Ness & Gurtov 2017). The institutional conflict in areas of responsibility between VARANS and MoST could exacerbate the risk of nuclear terrorism.

Vietnam's challenge in managing nuclear security is compounded by the trans-border nature of nuclear material. The salient nature of fissile material is evident in a statement made by Mohamed ElBaradei, director-general of the IAEA: 'Nuclear components designed in one country could be manufactured in another, shipped through a third (which may have appeared to be a legitimate user), assembled in a fourth, and designated for eventual turnkey use in a fifth' (ElBaradei 2004). This shows that international trade in nuclear material could expand the risk to other parts of the world. Vietnam is also susceptible to risk in transportation of nuclear materials passing through the vital sea lanes, since open waters cannot be tightly guarded by maritime enforcement (Caballero-Anthony et al. 2014).

Moreover, nuclear plant facilities and infrastructure are also vulnerable to terrorist attacks. This may result in leakage of toxic radioactive materials and waste to nearby areas. Concerns about nuclear terrorism increased following the September 11, 2001, attack on the World Trade Center in New York (USA), in particular regarding the potential risk of malicious intrusion into nuclear power stations and facilities (Bahgat 2011). The attack therefore prompted a shift in the focus of nuclear safety from avoiding radiation exposure for workers and the general public to the vulnerability of nuclear violence initiated by non-state actors. As such, Vietnam's development of a nuclear power program for peaceful use in the absence of concrete nuclear security architecture provides an atmosphere conducive for the possibility of nuclear terrorism.

### 3.1.3. International co-operation in nuclear accidents, theft and terrorism

The threat of illegal acquisition of nuclear material by non-state actors in the Southeast Asia region is not unfounded. The exposure of the Pakistan-based Abdul Qadeer Khan network that exploited Malaysia's infrastructure to produce nuclear centrifuge components destined for Libya reveals that the quest for nuclear material among terrorist groups does exist (Albright & Hinderstein 2005). Although the case of the nuclear centrifuge may have been attributed to a weakness in Malaysia's export control system, the threat of terrorism and its harmful consequences in the region cannot be ruled out. The arrest

of an individual in Thailand who attempted to sell dangerous cesium-137 further augments the risk of poor security of high-level radioactive materials in Southeast Asia (Andreoni & Ferguson 2003). The trade of nuclear weapon components in the region, such as the case of Malaysia and Thailand, indicates the potential nuclear insecurity risk that Vietnam may face in the future as civilian nuclear energy development advances. Hence, Vietnam has a crucial need to enhance its nuclear security mechanism to prevent and detect sabotage, unauthorized access and acquisition, and other malicious acts involving nuclear material, radioactive waste and nuclear facilities.

According to Kazi (2015), the risk of nuclear terrorism in Asia is relatively high compared to other regions in the world. The probability of nuclear attacks is unpredictable in terms of timing, location and target. However, the consequences of those attacks vary from political backlash, economic regress, social hazards and diplomatic tension to environmental degradation that could either be localized or cross-border depending on the severity of the attack. Hence, the pursuit of civilian nuclear energy in Vietnam necessitates adequate safety measures to manage nuclear materials, secure nuclear facilities from illegal acquisition and attacks, and implement emergency response procedures in the event of a catastrophe. However, all of these security aspects are currently not at par with IAEA standard requirements.

The concern about nuclear accidents, theft and terrorism is alleviated, to a certain extent, by measures undertaken at the international level. The state's adherence to the Southeast Asian Nuclear-Weapon-Free Zone Treaty (SEANWFZ) subjects its nuclear program to rigorous safety assessment, as evident by 2 sessions of the IAEA Integrated Nuclear Infrastructure Review in 2009 and 2012, respectively, for the protection of health and minimization of danger to life and property (Caballero-Anthony et al. 2014, Starz & Lecossois 2014). As required by the treaty, Vietnam has made nuclear safety assessments available to other signatories when requested, and has provided notifications of nuclear incidents.

In addition to the normative security framework of SEANWFZ, the obligation of Vietnamese leaders to ensure nuclear safety and security was stipulated during the 2012 Phnom Penh Declaration on ASEAN: One Community, One Destiny. The government had agreed to 'develop a coordinated ASEAN approach that would contribute to global undertakings to improve nuclear safety, in cooperation with the IAEA and other relevant partners, as well as promote and

uphold IAEA standards of safety and security in the development of nuclear energy for peaceful use' (ASEAN 2012). Moreover, the involvement of VARANS in the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM) in the promotion of safe, secure and peaceful use of nuclear energy shows the commitment of Vietnam toward international nuclear security by sharing best practices, technical collaborations, confidence-building mechanisms, nuclear emergency preparedness and response, and nuclear radiation monitoring (Nian & Chou 2014).

Moreover, voluntary partnership of Vietnam in the Global Initiative to Combat Nuclear Terrorism (GICNT) reveals the government allegiance in prevention, deterrence and response towards unauthorized access of nuclear materials and harmful actions towards nuclear facilities (NTI 2015). Vietnamese participation in the European Union's Initiative on Centres of Excellence on Chemical, Biological, Radiological and Nuclear Risk Mitigation and Nuclear Security Summit (NSS) indicates the state's sincere cooperation with international partners in the quest to secure nuclear materials and prevent nuclear smuggling (NSS 2016).

The state's accession to the Convention on the Physical Protection of Nuclear Material (CPPNM) in 1980 and ratification of 2012 CPPNM amendments stipulates the government's intent to abide by the only international legally binding undertaking in the area of physical protection of nuclear material and nuclear facilities in aspects of domestic use, storage and transport (IAEA 2017). In addition to CPPNM, Vietnam's accession to the United Nations International Convention for the Suppression of Acts of Nuclear Terrorism in 2016 further reinforces the state's ethical measures in prevention of illegal possession and use of radioactive material as well as damage of nuclear facilities by non-state actors that could manifest into a global threat of nuclear terrorism (UN 2017). The state has also demonstrated responsibility in notifying any nuclear accident via an emergency response mechanism through the accession of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency in 1987. Hence, Vietnam's implementation of its obligations under international treaties on nuclear safety and security shows the state's conformance to multilateral instruments.

The Vietnamese government's cooperation with international partnerships, adherence to multilateral-based conventions and continuous efforts in adher-

ing to intergovernmental organization standard requirements in nuclear safety and security are indicators of observance of the principle of non-maleficence. This principle in which no harm is inflicted to others is significant in assuaging public fear and apprehension towards nuclear technology. However, from an ethical standpoint, liabilities such as the cost of environmental damage and radiation effects on human health in the event of a nuclear attack have yet to be quantified; hence, they remain as 'external costs'.

Nonetheless, the effectiveness of these security frameworks and international cooperation depends on the extent to which Vietnam addresses critical nuclear energy infrastructure issues during the early stages of NPP development. These major nuclear infrastructure issues such as unavailability of competent expertise in nuclear science and technology, insufficient funding, inadequate nuclear safety mechanism and partially independent nuclear regulatory and governance framework can increase the likelihood of nuclear accident, theft and terrorism. Collectively, these domestic concerns could pose challenges to ASEAN norms if they remain unaddressed.

### **3.2. Management of nuclear radioactive waste**

#### **3.2.1. Handling and disposal of high-level radioactive waste**

The handling and disposal of high-level radioactive waste, also known as spent/used reactor fuel, is one of the most challenging issues in the nuclear power industry. Failure to address the disposal of high-level nuclear waste even among countries operating NPPs should serve as a critical lesson for Vietnam. Nevertheless, Vietnam has not adopted an institutionalized nuclear disposal policy and infrastructure as part of its nuclear power development program (Caballero-Anthony et al. 2014, Nikitin et al. 2014). As such, Vietnam has not adhered to standard requirements by the IAEA that obligate states to address nuclear radioactive waste even before commissioning NPPs (Amano 2015).

The absence of a final repository facility for high-level radioactive waste in Vietnam is an area of serious concern from an ethical perspective. Although developed nations such as France, Sweden and Finland have developed deep geological disposal sites as a permanent solution for radioactive waste, these are not anticipated to be available until after 2020

(Amano 2015). In addition, most waste management decisions adopted in these countries do not incorporate social uncertainties, and even when included, social risk perceptions are often subjective. This was demonstrated by a detailed study conducted in France, the UK and South Korea on long-term radiation waste management (Rao 2008). Thus, as a newcomer in civilian nuclear energy development, Vietnam lacks rational and ethical radioactive waste management strategies compared to other nuclear-enabled countries.

The unavailability of an institutionalized nuclear waste management system is evident, as spent fuel will be sent to Russia for reprocessing once the NPP is commissioned. However, the processed waste will be returned to Vietnam to be temporarily stored in a makeshift storage area for at least 30 yr whilst studies on permanent disposal mechanisms are undertaken (Vi 2014). The isolation of nuclear waste for a prolonged period has led to ethical issues regarding justice to posterity or intergenerational justice (Taebi & Kloosterman 2008). Moreover, mining of uranium (a non-renewable resource) for nuclear power production could result in depletion of energy sources in the future. Hence, the complete cycle of nuclear fuel consisting of uranium mining, processing, fabrication and waste disposal would affect the interest of future generations whilst attesting to prevailing nuclear safety concerns among the current generation. Further compounding these ethical concerns is the relatively low level of public awareness on nuclear waste disposal (UNESCO 2012). The lack of available information has misled the public on the implications of nuclear waste, which has prevented people from developing well-informed decisions that would influence their freedom of choice.

As long as storage is not designed specifically to accumulate radioactive waste securely for an extended time, it could lead to possible radiation leakage to surrounding areas. These affected areas would remain radioactive for many years. Most significantly, there is concern from an ethical standpoint that weaker segments of society, such as children, are more vulnerable to harm from radiation. Hence, a temporary storage facility for radioactive waste has potential detrimental effects on intergenerational equity, as radiation leakage would affect the health of future generations.

Moreover, it is also anticipated that intragenerational inequity will exist in Vietnam. This may occur as a specific section of society would benefit from clean electricity via nuclear power, while at the same time, other communities will be exposed to the dirty



and hazardous effects of the waste disposal mechanism. Furthermore, the 'non-quantified' costs of environmental damage and health hazards of high-level radioactive waste leakage are regarded as externalities. As such, it is a challenge to conduct risk assessment in civilian nuclear development programs, as there is a lack of concrete data covering all aspects. Thus, the principle of quantification where possible is not fulfilled.

Vietnam's non-adherence to IAEA principles on radioactive waste management and associated inter-generational equity violates Principles 4 and 5. Principle 4 states that 'radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today', and Principle 5 states that 'radioactive waste shall be managed in such a way that will not impose undue burdens on future generations' (IAEA 1995, p. 3). Hence, the unavailability of long-term disposal sites and lack of a comprehensive plan for managing radioactive waste reflects Vietnam's current deficit in the ethical obligation to posterity, which could potentially jeopardize the protection and well-being of future generations.

### 3.2.2. International view and commitment to management of nuclear radioactive waste

Although high-level radioactive waste management is not available domestically, the Vietnamese government has demonstrated its international commitment to radioactive waste management. These commitments are manifested through the accession of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. However, the provisions for handling and disposal of nuclear waste are not included in the existing 2008 Atomic Energy Law. Hence, the absence of domestic regulations would hinder the implementation of the Joint Convention. The provisions in the Joint Convention have been recommended to be included in the law (Vi 2014). Furthermore, Vietnam has demonstrated compliance with the Bangkok Treaty provision that prohibits the disposal of radioactive materials on sea, land and atmosphere (ASEAN 1995). Nevertheless, measures required to ensure the safe disposal of radioactive waste according to IAEA standard procedures have not been implemented yet (ASEAN 1995, Caballero-Anthony et al. 2014).

There is a dire need for Vietnamese policymakers to formulate and implement strategies to create

greater transparency in radioactive waste management. The ethical implications of nuclear waste disposal mechanisms on human life and the environment need to be examined to protect the safety of present and future society members. The ethical principles of informed consent and informed choice include considering the rights and interests of all parties, and the right to self-determination based on scientific data. This would allay public apprehensions on the harm and danger associated with nuclear waste management and disposal (UNESCO 2012).

## 3.3. Threat of nuclear proliferation

### 3.3.1. Development of sensitive fuel cycle technology

There is an intimate association between nuclear energy and nuclear weapons as nuclear science and technology used to generate electricity could be manipulated for military use. The dual-use nature of nuclear technology that could manifest into a threat of proliferation poses an ethical dilemma that does not arise in other energy sources. There is a constant fear among policymakers worldwide over the expansion of nuclear power technology among non-nuclear weapon states (NNWSs). Vietnam is not an exception to this worrisome situation, as history has demonstrated that nuclear weapons programs have often developed under the guise of peaceful nuclear programs (Fuhrmann 2009). Despite promises that a new generation of nuclear reactors can reduce the risk of nuclear proliferation, the expansion of nuclear power does not fundamentally assuage global anxiety about the dangers of nuclear weapons (APERC 2007, Lee et al. 2015).

Overreacting to nuclear proliferation may inhibit Vietnam from exercising its sovereign right to pursue nuclear power for civilian purposes. The ethics of dual use of nuclear technology in Vietnam is debatable. However, the Vietnamese government has expressed its intention towards peaceful implementation of nuclear power. The aspiration is evident in Article 12 of the 2008 Atomic Energy Law that prohibits the state from 'researching, developing, manufacturing, trading in, transporting, transferring, storing, using or threatening to use nuclear or radiation weapons' (ILO 2008, p. 4). The provision of Article 12 in the law indicates Vietnam's stance on its non-proliferation obligations, albeit with implementation delays in adhering to IAEA guidelines (Viet News 2011).

As a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), Vietnam validates the benign usage of nuclear energy in accordance with Article IV that provides 'inalienable right of all Parties to the Treaty to develop, research, production and use of nuclear energy for peaceful purposes without discrimination' (UN 1995). Vietnam's commitment to NPT supports the '3 pillars of nuclear energy development— non-proliferation, disarmament and peaceful use' (Kuppuswamy 2006, p. 142). The central bargain of the NPT is that 'the treaty should embody an acceptable balance of mutual responsibilities and obligations of the nuclear and non-nuclear powers' by which nuclear energy developed for peaceful purpose is in exchange for NNWSs' commitment not to obtain and manufacture nuclear weapons (Jayaprakash 2008, p. 43). In essence, Vietnam is treaty-bound towards nuclear non-proliferation.

Nevertheless, the negative perception and fear regarding nuclear power are attributed to the development of sensitive fuel-cycle technology such as E&R that produces latent nuclear weapons capability. Although E&R is the most ethically controversial process in the nuclear fuel cycle, the capacity falls under NPT's peaceful use of nuclear technology. Therefore, the deployment of E&R technology is permitted when developing civilian nuclear energy. As such, Vietnam's decision to retain E&R capacity does not contravene NPT provisions. If the state decides to pursue E&R technology in the future, it is not considered morally objectionable since other nuclear-enabled states such as the USA and Russia use the technology as an energy securitization measure (Timbie 2008). However, Vietnam could pose a potential proliferation risk in the future if the decision to proceed with E&R is made.

The decision to retain the option to develop sensitive parts of the fuel cycle in the future was made as part of Vietnam's national sovereignty right (WNA 2020). Primarily decided to alleviate the risk of technology denial, the choice to maintain the E&R capacity could reduce the potential consequences of long-term energy dependency on nuclear fuel suppliers such as Russia (Dahl 2010). By developing its enrichment capacities, Vietnam can effectively securitize its energy. Furthermore, the choice to retain E&R capability may be attributed to its high cost, as suggested by Vuong Huu Tan, president of the Vietnam Atomic Energy Institute, who said 'Vietnam does not plan to enrich uranium, which is a very sensitive issue' (NTI 2015). Additionally, the motive to retain the right to develop E&R capacity may also be due to

uranium ore deposits in the northern and central region, estimated at 660 million pounds (300 million kg), that could be explored further (US Energy Information Administration 2016).

However, the current mechanism of providing nuclear fuel to Vietnam in return for a commitment to forgo E&R capabilities has led to the ethical question of selective technology sharing. The dominance of knowledge discriminates developing states through a continuous monopoly over nuclear technology know-how in developed countries (UNESCO 2012). Further ethical concerns arise as to whether nuclear energy cooperation genuinely enhances energy security or simply redirects Vietnam's future energy dependencies from fossil fuel-producing countries to nuclear fuel-producing countries. Hence, the ethical debate between states' rights to nuclear technology and fears of nuclear proliferation is an ongoing conundrum (Williams & Wolfsthal 2005).

### 3.3.2. Vietnam's sovereignty right in E&R

The potential of uranium enrichment has led Vietnam to undertake measures to render it more proliferation-resistant. As one of the most contentious aspects of nuclear energy, the ethical issue on uranium enrichment revolves around the possibility of producing nuclear weapons. Nonetheless, this ethical concern was relieved by the government's decision to convert the Dalat nuclear research reactor from using highly enriched uranium (HEU) to low enriched uranium (LEU). The announcement made at the NSS in 2010 indicates the state's peaceful intention of developing nuclear energy for civilian purposes (Podvig 2012).

Based on the Global Threat Reduction Initiative framework, the conversion to LEU in December 2011 demonstrated Vietnam's commitment to peaceful use of nuclear energy development. By June 2013, the final 16 kg of Vietnam's HEU stock was returned to Russia (Dahl 2013, Nian & Chou 2014). Hence, Vietnam is completely HEU-free (NSS 2016). Since potential theft of HEU could result in the fabrication of dirty bombs, conversion to LEU eliminates the risk of spreading and usage of those nuclear devices (Ferguson 2003). The act of removing its weapons-usable nuclear stock is central to strengthening nuclear non-proliferation measures and safety mechanisms in the region.

In addition to the uranium conversion procedure, Vietnam had established the legal framework for nuclear commerce with the USA through the 123

Nuclear Cooperation Agreement signed on 6 May 2014 (Institute of Atomic Energy Vietnam 2014). Unlike the USA–United Arab Emirates 123 Agreement, the superpower did not impose a 'gold standard' provision on Vietnam that would prohibit the latter from pursuing indigenous uranium enrichment or plutonium reprocessing capabilities (Grossman 2012). The US act of negotiating the agreement provision on a case-by-case basis could be attributed to Vietnam's decision not to commence uranium enrichment. The non-inclusion of the provision in the 123 Agreement supports Vietnam's right to all nuclear technology capabilities within the peaceful nuclear fuel cycle as per NPT guidelines for NNWSs. However, in addition to the 123 Agreement, Vietnam signed a non-binding memorandum stressing that the state does not intend to seek E&R capabilities (World Nuclear News 2014). The provision of nuclear development assistance from Russia and the USA to Vietnam fulfils the principle of universality and satisfies the ethical obligation of justice between nuclear-advanced countries and nuclear-aspirant states.

The reprocessing of used/spent nuclear fuel is another alternative to the long-term storage of radioactive waste. Although efficient used/spent fuel reprocessing is likely to increase the amount of usable nuclear fuel, reprocessing has been criticized as being expensive, posing security threats, harming the environment and not eliminating the need for geological repositories (WNA 2009, UNESCO 2012). The risks associated with reprocessing facilities are evident in several nuclear crises, including the environmental disaster of the West Valley (New York) reprocessing facility in the USA, a fuel leak from the Sellafield THORP reprocessing plant in the UK and cost overruns of the Rokkasho reprocessing plant in Japan (Public Citizen 2010). As such, Vietnam's decision to maintain its sovereignty right in E&R capacity requires the state to consider the potential likelihood of damaging consequences from reprocessing facilities.

### 3.3.3. International view and commitment to nuclear non-proliferation and disarmament

Unlike China and North Korea in Northeast Asia and India and Pakistan in South Asia, Vietnam in the Southeast Asia region does not regard nuclear weapons as crucial for national security (Tan 2008). Moreover, Vietnam and other states in the region have decided to create a nuclear-weapon-free zone which was demonstrated by establishing SEANWFZ as a cooperative norm under ASEAN in 1995 to rein-

force the Zone of Peace, Freedom and Neutrality. Also known as the Bangkok Treaty, the treaty aimed to prevent nuclear proliferation from Northeast Asia and South Asia to Southeast Asia (Simon 2007).

The government's accession and ratification of the international treaty on nuclear-weapon-free zones demonstrate its commitment to peace and stability through effective monitoring of its civilian nuclear development program. Vietnam's nuclear energy program adheres to Articles 4 and 5 in the treaty since nuclear materials and facilities within the territory are used exclusively for peaceful application. As such, the decision to develop or acquire nuclear weapons (if any) would violate Vietnam's commitment to SEANWFZ. Moreover, Vietnam and other Southeast Asian countries have collectively made a conscious assurance to exercise strategic restraint to ensure that the region is a nuclear-weapon-free zone. Nevertheless, Vietnam has commented on the lack of commitment among ASEAN states in pursuing a more proactive non-proliferation agenda in addition to their allegiance to SEANWFZ (Institute of International Relations 2005). Hence, Vietnam recognizes the need for a benign security condition conducive to global nuclear non-proliferation and disarmament.

In addition to security cooperation, Vietnam's development of conventional military capabilities, economic interdependence with other countries and dependence on alliance arrangements with major powers such as the USA and China further reduces the need to develop military use of nuclear energy (Alagappa 2003). The internal shortcomings faced by Vietnam in the development of civilian nuclear energy, such as inadequate and incompetent human resources in nuclear science and technology, lack of access to essential technologies and infrastructures, and insufficient funding, are significant hurdles in the development of nuclear weapons. These impediments, coupled with existing community-based normative commitment and lack of security concern, have contributed to Vietnam's non-nuclear militarization and non-proliferation stance.

Further to the self-renunciation of nuclear weapons through the SEANWFZ framework, Vietnam has attended the Asian Senior-Level Talks on Non-Proliferation since 2003. The participation demonstrates Vietnam's active engagement to prevent the proliferation of weapons of mass destruction (Bolton 2004). The conducted talks held on 31 January 2017 emphasized the significance of the collective non-proliferation commitment in the region. Some of the issues highlighted during the talks were North Korea's repeated



nuclear tests and ballistic missile launches, implementation of UN Security Council resolutions (UN-SCRs), strengthening export control, enforcement of counter-proliferation efforts including country-specific measures to promote the implementation of UN-SCR 1540 and the Proliferation Security Initiative (PSI), strengthening of IAEA Safeguards and universalization of IAEA Additional Protocols to encourage nuclear security (Ministry of Foreign Affairs of Japan 2017). The consultative 'ASEAN way' style of interaction facilitates discussion on politically sensitive and controversial issues of nuclear energy, which is in contrast to the sense of distrust in ASEAN Regional Forum and Asia-Pacific Economic Cooperation security discussions (Ogilvie-White 2006, Tan 2008).

The fact that civilian nuclear technology can be extended for military purposes has increased proliferation concerns in recent years. Nevertheless, Vietnam's long-term plan to develop civilian nuclear energy is unlikely to raise suspicions about nuclear proliferation. Vietnam has consistently demonstrated its firm stance in opposition to nuclear weapons and constant engagement in the non-proliferation regime and disarmament diplomacy (Ogilvie-White & Rublee 2012).

Vietnam's willingness in demonstrating its non-proliferation credentials is apparent through various official statements on the right of NNWS to develop nuclear energy for peaceful purposes. Additionally, the government further influences other states to sign and ratify the Comprehensive Nuclear Test Ban Treaty while stressing the obligation of states to fulfil the commitment made during the 2000 and 2010 NPT Review Conference (Vietnam Ministry of Foreign Affairs 2005, NTI 2008). The state's successful quest for a non-permanent seat on the UN Security Council in 2008–2009 serves as a stepping stone to establish Vietnam's nuclear engagement and diplomacy as well as to increase confidence from the international community in its ability to implement peaceful nuclear energy technology. Furthermore, signing the Additional Protocol in November 2006 proves that Vietnam is resolute towards an intrusive monitoring system in the spirit of abiding with NPT (Ogilvie-White & Rublee 2012). Vietnam has also agreed to join the US-led PSI despite reservations about joining an ad hoc group external to the purview of the UN (Malley & Ogilvie-White 2009).

The firm position in nuclear non-proliferation and disarmament is attributed to the Vietnamese Communist Party leadership acknowledgement that nuclear energy could increase proliferation and terrorism risk (Ogilvie-White 2014). Most importantly,

the measures taken indicate that Vietnam is bound by its international commitment. Although Vietnam has demonstrated its dynamic non-proliferation and disarmament diplomacy, the state has not supported a multilateral fuel cycle proposal that is regarded as a significant measure to establish a nuclear-weapon-free world (Ogilvie-White & Rublee 2012). This may be related to the state's unwillingness to forgo its E&R capability necessary to develop sensitive parts of the fuel cycle if the state decides to do so in the future.

#### 4. DISCUSSION

The nuclear disaster at Japan's Fukushima-Daiichi plant has brought the nuclear debate back to the forefront, which has prompted many countries to rethink the future prospect of nuclear power (Taebi & Roeser 2015). Nonetheless, while Japan has attempted to limit its nuclear energy exploits to avoid further catastrophic disasters, some countries have expressed an interest in expanding or introducing nuclear energy. In the case of Vietnam, civilian nuclear power can generate energy which is critical for sustainable development. The right to sustainable energy is considered a fundamental ethical right (UNHCHR 2006, UNESCO 2012). As a source of sustainable energy, nuclear power enables the generation of electricity that supports future energy demand.

In spite of nuclear technology generating clean and reliable energy, this article reveals that the ambivalence of civilian nuclear power continues to exist as ethical dilemmas and risk concerns prevail. Since the consequences of nuclear incidents can be grave, it has created a certain level of apprehension and anxiety despite its rare occurrence. The Fukushima nuclear disaster has further accentuated existing public fear about nuclear energy development and prior perceptions about radiation and health risks. Issues such as uranium extraction and toxic radioactive waste disposal further heighten the sense of distrust towards nuclear technology. As such, policy-makers need to be impartial in evaluating the complex set of issues, benefits and risks of nuclear energy development, especially in quantifying external costs. The unbiased assessment is an indicator of ethical maturity.

The arguments on nuclear security have rejected the notion that nuclear energy would inevitably result in catastrophic effects. This is attributed to the measures taken to increase the safety of nuclear sites such as improvement of the structure and internal

system of reactors, general procedures on safety regulations and proliferation-resistant technologies. Nevertheless, these measures do not necessarily mean that nuclear sites are completely safe, and any nuclear meltdown or mishaps can be prevented. Adopting new safety steps will inevitably reduce the likelihood of damage and its severity level in critical situations.

However, the non-existent institutionalized radioactive waste management could be a potential concern in the future as it affects the interest of succeeding generations. Proper disposal of high-level radioactive waste cannot be regarded as unique to Vietnam, as other states with advanced nuclear power facilities have yet to find a suitable solution with broad social and political acceptance. While the risk of improperly designed radioactive waste disposal mechanisms is minimal compared to nuclear reactor accidents or nuclear proliferation, it still warrants emphasis from policymakers.

Although Vietnam has made a substantial effort in non-proliferation and disarmament engagement to reassure the international community that its nuclear intentions are benign, the move to retain E&R capability has raised a certain level of cautiousness. Despite the assurance that E&R capability is meant for strengthening energy security in the long term, the potential for nuclear breakouts cannot be wholly disregarded, as future national and international security dynamics could alter the current stance. Currently, there is no indication that Vietnam intends to build nuclear military capability. However, increasing threat from China may ignite the development of nuclear arms to protect the security of Vietnam (Thranert 2015). In spite of the uncertainties in security dynamics, Vietnam has stated strong opposition to nuclear weapons, demonstrated willingness to prove its non-proliferation credentials and is actively engaged in disarmament diplomacy. The signing of numerous international conventions and participation in many international cooperation activities implies the state's commitment towards nuclear deterrence. This shows that Vietnamese policymakers have generally adhered to the ethical principle of avoiding harm through their opposition to nuclear weapons.

It is clear that the debate over the use of nuclear power for civilian purposes is deeply divided. The civilian use of nuclear energy encompasses complex issues that extend well beyond the technicalities of power supply. The risk of nuclear power, for example, must be weighed against renewable sources and fossil fuels. Evaluating energy mixes thus necessi-

tates a long-term perspective and the development of scenario analyses (Hillerbrand & Peterson 2014). Similarly, energy officials in Vietnam must reconcile ethical and socio-economic considerations in making decisions regarding nuclear energy.

## 5. CONCLUSION

It is undeniable that the development of nuclear energy is associated with multifaceted ethical and risk considerations. Hence, the Vietnamese administration decided to halt the nuclear energy program in 2016. However, the decision may be temporary, as recent developments reveal deliberation among policymakers to reconsider nuclear energy as a long-term energy security measure. The reconsideration of nuclear power was made to address the rise in energy imports amidst low fossil fuel reserves and fully optimized hydropower potential. This signals the potential and significance of nuclear power in meeting the growing demand for energy to sustain socio-economic development.

Through it all, our research accentuates that absolute benefit without potential risk is a myth, especially in terms of absolute security. There is a need for the state to balance energy security, environmental preservation and societal well-being with ethical and risk challenges of nuclear energy. With that in mind, the prospect to abolish nuclear technology in the foreseeable future cannot be ruled out completely.

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