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Ready for Nuclear Energy?: A Policy Review of the Philippines' Nuclear Energy Plan and Participation in the ASEAN Network of Regulatory Bodies on Atomic Energy

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Cover Page Footnote

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Ready for Nuclear Energy?: A Policy Review of the Philippines' Nuclear Energy Plan and Participation in the ASEAN Network of Regulatory Bodies on Atomic Energy

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Abstract

Recently, the Philippines has been demonstrating its interest in using nuclear energy, including addressing issues and gaps in its nuclear energy preparations, several of which fall under nuclear security, nuclear emergency preparedness and response, and regulatory capacity. This article argues that the ASEAN member states' growing regional cooperation in nuclear safety and security, spearheaded by the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM), can have a strong positive impact on the Philippines' nuclear energy preparations. ASEANTOM's regional activities and projects can help the Philippines address some of the current critical gaps and issues in its nuclear energy preparatory plans. But there are still limitations to how much regional cooperation can impact the Philippines' nuclear power preparations. This article is not only just about the Philippines and its plan to use nuclear energy, but also about ASEAN cooperation in nuclear safety, security, and emergency preparedness and response.

Keywords: nuclear energy, nuclear security, Philippines, ASEANTOM, ASEAN, regional cooperation

I. Introduction

The Philippines has been recently demonstrating its interest in tapping into nuclear energy as a long-term option for power generation. The need for additional reliable power sources has increased with the projected growth of the Philippine economy and its population. Additionally, worsening environmental problems, associated with overreliance on fossil fuel and other traditional sources of energy in the country, is generating a strong demand for a cleaner and more sustainable alternative sources. The Department of Energy (DOE) of the Philippines announced that nuclear energy might be included in the country's energy mix by 2027, if the government finally issues the national position on using nuclear power [1]. The DOE considers nuclear energy a long-term energy option, and its strategy includes

strengthening the country's energy security through the diversification of energy sources (mostly low-carbon), as the Philippines moves toward the transition to cleaner and more sustainable energy. The Philippine Nuclear Research Institute (PNRI), has the dual mandate to regulate and promote peaceful uses of nuclear energy. Its director, Dr. Carlo Arcilla, asserted that the fastest way to tap nuclear power is by reviving the mothballed 621-megawatt Bataan Nuclear Power Plant (BNPP), for which the Philippine president also ordered a review to determine if it is still safe and can be rehabilitated [2].

As a founding member of the Association of Southeast Asian Nations (ASEAN), the Philippines is represented by the PNRI in the association's primary driver of regional nuclear cooperation, the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM). It was established in 2013 to bolster nuclear safety, security, and emergency preparedness and response by enhancing cooperation among agencies regulating the use of nuclear technology. The Philippines actively participates in the capacity building projects, workshops and annual meetings of ASEANTOM. In 2017, PNRI successfully hosted the 4th Annual ASEANTOM Meeting and Technical Session on Nuclear Security in the Philippines [3].

The peer review report of the Integrated Nuclear Infrastructure Review (INIR) Mission sent by the International Atomic Energy Agency (IAEA) to the Philippines in 2018, official government reports, and presentations by relevant Philippine government officials have identified critical gaps and issues in the country's nuclear energy preparatory plan. Several of these issues fall under nuclear security, nuclear emergency preparedness and response, and regulatory capacity. This article argues that the ASEAN member states' growing regional cooperation in nuclear safety and security, spearheaded by the ASEANTOM, can have a strong positive impact on the Philippines' nuclear energy preparations. ASEANTOM's regional activities and projects can help the Philippines address some of the current critical gaps and issues in its nuclear energy preparatory plans. The INIR Mission Report also offers specific recommendations to effectively address those issues. The Philippines' active participation in regional cooperation in nuclear safety and security can enhance its capacity to realize those recommendations. But there are still limitations to how much regional cooperation can impact the Philippines' nuclear power preparations.

In this context, this article has four key objectives. First, it explores what motivates the Philippines to consider nuclear energy. Second, it examines the gaps and limitations in the Philippines' nuclear energy preparations in terms of the need to enhance regulatory capacity, nuclear security, and nuclear emergency preparedness and response. Third, it presents how ASEANTOM-led regulatory regionalism and cooperation can help the Philippines deal with the gaps and limitations. Fourth, it discusses the limitations of the impact of ASEANTOM's regional work on the Philippines' nuclear energy preparations.

This article is therefore not only just about the Philippines and its plan to use nuclear energy, but also about the growing regional cooperation in nuclear safety, security and emergency preparedness, and response in Southeast Asia, driven by ASEANTOM. As a contribution to energy research, the study addresses a key research gap: there have not been many academic and policy studies on the Philippines' nuclear energy plan, as well as the links between the Philippines' nuclear energy preparatory plan and the impact of regional nuclear cooperation or regulatory regionalism through ASEANTOM.

The author conducted documentary analysis and critically reviewed key official documents such as the Report of the INIR Mission to the Philippines (2018), PNRI's Annual Reports, DOE's Nuclear Energy Program in the Philippine Energy Plan 2018-2040, official reports of Philippine government agencies, ASEANTOM documents on regional projects, ASEANTOM's Work Plan, and reports from international organizations such as the IAEA and the European Commission. This article also includes analysis of presentations and speeches delivered by Filipino officials and ASEANTOM representatives in public webinars, seminars, intergovernmental meetings, and Track 1.5/2 workshops and meetings on nuclear issues that the author attended. Discussions during these meetings, which involve nuclear experts and

officials from Asia, including Southeast Asia, serve to highlight the achievements, challenges, and emerging priority areas in the region and the Philippines which form the basis for some of the observations presented in this article.

II. Why the Philippines Considers Nuclear Power

As the Philippines decides whether to officially add nuclear energy into the energy mix, the country has been actively addressing, albeit gradually, gaps that the INIR Mission identified. This is due to the fact that despite the absence of an operable nuclear power plant in the country, addressing such gaps and issues is still critically needed, given that the Philippines is benefitting from other peaceful uses of nuclear technology, including radioactive materials. Though it has Southeast Asia's first and only nuclear power plant, the Bataan Nuclear Power Plant, the plant has never been operated. The government is currently considering whether or not it can be rehabilitated in order to be safely operated [2].

As the Philippine government actively studies the introduction of nuclear energy in the country, two key bodies have been created to spearhead the preparation for nuclear power. In 2017, the Nuclear Energy Program Implementing Organization (NEPIO) was created as a part of the DOE to coordinate the necessary steps and preparatory measures pertaining to nuclear power. Crucial achievements of NEPIO and DOE are (1) the IAEA's successful peer review mission in 2018 to assess the 19 nuclear infrastructure issues that the country needs to address before embarking on nuclear energy project; (2) the Integrated Work Plan that is currently being developed and will serve as a guiding document to systematically organize cooperation activities with IAEA on nuclear infrastructure development; and (3) a pre-feasibility study on Small Modular Reactor deployment in an industrial zone in northern Philippines [4, 5]. In October 2019, the DOE received the INIR Mission report, which provides evaluations and recommendations that would further help the Philippines address the 19 infrastructure requirements needed before embarking on a full nuclear energy program [6].

In July 2020, Philippine President Rodrigo Duterte issued an executive order which mandated a study on the national position on a nuclear energy program, and created the Nuclear Energy Program Inter-agency Committee (NEPIAC) to conduct such study and recommend further actions, including the possibility of the rehabilitation of the BNPP [7]. In December 2020, NEPIAC submitted its nuclear power plan and recommendations to the President.

Proponents of nuclear power, even those within the government, cite one major reason in favor of nuclear power is the need to find a new energy source as the Malampaya natural gas field will be depleted by 2025. The Malampaya natural gas field is the second biggest source of electricity, or about 23% of the country's power supply, supplying the main island of Luzon, where the national capital Metro Manila is located [8]. The absence of a replacement base-load power source could threaten energy security, and might lead to possible rotational power interruptions. Nuclear proponents have pointed out that with the country's pledge to the Paris Agreement, including a recent moratorium on building new coal-fired power plants [9], and the limitation of renewables despite recent attempts to expand its share, there is still a need for a reliable, base-load power source, and that can be from nuclear energy [10]. Dr. Arcilla, a strong proponent of nuclear power and the director of nuclear regulatory agency (PNRI), pointed out that potential alternatives to Malampaya, such as nuclear and renewables, are not contradictory but instead complementary, as nuclear energy is clean with no greenhouse gas emissions and also complements renewable sources such as wind and solar [2]. Meanwhile, DOE Secretary Alfonso Cusi argued that while the Philippines strongly supports clean energy transition, instead of imposing a carbon tax, the country is exploring nuclear power as a new energy source [11].

In addition, proponents contend that nuclear energy can decrease the high cost of electricity in the country, which has the most expensive electricity in the whole of Asia. A median Filipino family pays

more than 10% of its monthly income for electricity. Dr. Arcilla claimed that “[n]uclear power will especially spare the poorest among the Filipinos who are the ones actually allotting the lion’s share of their income just for electric bills” [12]. Secretary Cusi claimed that nuclear power is the best option for the country to bring down the cost of power [11]. However, it has not actually been clear as to how much the impact would be of upfront nuclear energy investments costs on the electricity costs.

Energy and climate security experts in the Philippines strongly recommended that in order to simultaneously address the twin issues of energy security challenges and reducing carbon emissions, the country has to diminish its overdependence on a single, imported resource, coal and pursue energy diversification by enlarging the share of low-carbon, clean energy sources [13]. From the DOE’s perspective, addressing both energy security and climate change provides an opportunity for a sustainable transition to clean energy, which includes nuclear power [5].

According to the government’s energy planning study, which includes Philippine energy mix scenarios until 2050, a sustainable scenario option that introduces nuclear power by 2030 draws a more diversified energy mix as compared to business-as-usual scenarios that exclude nuclear energy. Without nuclear power, there will be higher LNG importation and increased dependence on imported sources, impacting the country’s energy security. The study also shows that nuclear power can be introduced by 2027 [5].

The public seems to agree with nuclear proponents. A survey conducted in 2019 showed that 79% of the respondents were in favor of the rehabilitation of the mothballed BNPP. In a separate question of whether or not the Philippines should build a new nuclear power plant, 65% of the respondents supported this idea [2, 5].

The Philippines is also considering small modular reactors (SMRs), including floating ones, given its archipelagic nature. Secretary Cusi said that the possibility of deploying an SMR in the country might come sooner, given the development of SMR models that are apt for the for island-provinces and areas outside the main grid [14, 15]. In 2019, the DOE, along with the Korea Hydro and Nuclear Power (KHNP), conducted a Pre-Feasibility Study on the possibility of SMR deployment in the Cagayan Economic Zone, a growing industrial enclave in northern Philippines [5].

In 2019, Russia and the Philippines also signed an agreement on nuclear energy cooperation to explore the possible construction of nuclear power plants, including floating nuclear reactors, by ROSATOM in the Philippines. Apart from Cagayan, other island provinces that expressed interest in hosting future SMRs include Sulu in the southern Philippines and Palawan [2].

III. Framework of Analysis: Regulatory Regionalism

This article uses the concept of regulatory regionalism to explain how the Philippines’ participation in ASEANTOM has aided it in addressing some of the key preparatory issues that the INIR Mission identified.

Regulatory regionalism, as defined by Tubilewicz and Jayasuriya, is “the development of regional regulatory frameworks networks and processes within the political and policy-making institutions of national governments” [16]. Jayasuriya argues that regulatory regionalism depends more on the active involvement of relevant national agencies that have regulatory functions rather than on global treaties or international organizations for regulatory enforcement [17]. Jordana argues that regulatory agencies have become key regional actors, often utilizing high visibility and adequate technical resources to influence national policy making, while also collaborating with similar institutions in other countries [18]. Jayasuriya contends that regulatory regionalism is not only designed to address conventional issues of economic and trade integration, but also seeks to manage and coordinate the effective regulation of a

broad range of transnational non-traditional security issues through regional partnerships and networks deploying informal and/or non-legally binding mechanisms [19]. This framework is particularly relevant to the study of burgeoning cooperation among the nuclear regulatory agencies in Southeast Asia through the ASEANTOM, and the impact on individual countries.

Policy networks of functionally specific agencies have become key tools of regulatory regionalism as they facilitate regional collaboration between agencies [17]. Jordana claims that regulatory governance networks led to the cultivation of informal mechanisms of regional cooperation, or socialization of regulatory norms, beyond state institutions and regional summits. Regional networks and forums can enhance regulatory governance through stronger coordination, norms socialization, and information sharing. These contributions of various regional networks and forums working in a similar field may enable regulatory convergence through norms and best practices nurtured by collaborative initiatives [18].

The primary outputs of regulatory regional networks and forums are “(1) events and meetings; (2) data for benchmarking; (3) public pronouncements; (4) material for stakeholders; (5) capacity building for professional staff; (6) best practices, procedures and rules; (7) regulatory network news; and (8) technical studies” [20]. With these outputs, regulatory regional networks can advance norm- and agenda-setting, consensus building, policy coordination, knowledge production, exchange, and dissemination [18].

In their study on the emergence of regulatory regionalism through regional networks, Fernández-i-Marín and Jacint Jordana find that transnational engagements among state actors from the same region serve as a powerful vehicle of regulatory agency socialization within regions [21]. In Southeast Asia, these transnational interactions and collaborations could include workshops, meetings, technical regional projects, and capacity building assistance, which are significant in establishing regional norms in ASEAN, covering nuclear safety and security.

Through norm socialization mechanisms embedded in the regulatory regional networks, their joint activities and common stance may strongly impact the development of domestic policies [22]. Adherence to global conventions, best practices in security management, and procedures for establishing policy instruments exemplify norms and models circulating within such regional mechanisms, which are then adopted and institutionalized by national governments [18]. The agenda and norms set by ASEANTOM confirm scholars’ perceptions of the positive impact of regulatory regionalism on shaping shared norms in the peaceful use of nuclear energy. Through the network with their consensus building practices, coordination, knowledge production and sharing, and capacity-building, the Philippines can take advantage of the growing regulatory regionalism in Southeast Asia as it addresses preparatory issues with a view to safely and securely tap nuclear power for electricity generation.

One excellent model of regulatory regionalism is the European Atomic Energy Community (Euratom) which was established in 1957 with the signature of the Euratom Treaty by six founding countries (Belgium, France, Germany, Italy, Luxembourg and the Netherlands). While ASEANTOM’s Term of Reference is not legally binding, EURATOM is based on one of the three main founding treaties of the EU. As discussed in the following sections, ASEANTOM’s activities are currently limited to several technical capacity-building projects and workshops. But in the case of EURATOM, it effectively regulates the European civil nuclear industry, which produces almost 30% of the EU’s energy. Euratom ensures the strictly regulated movement of nuclear goods, supports research in nuclear technology, promulgates standards and regulations for the safety and security of nuclear materials, and regulates the supply of the isotopes deployed in medicine [23].

Essentially, Euratom is in charge of all nuclear governance matters in the EU, while ASEANTOM does not yet have such a broad mandate in Southeast Asia. Euratom’s work safeguards nuclear materials and technology, facilitates investment, research and development, and ensures equal access to nuclear

supplies, as well as the correct disposal of nuclear waste and the safety of operations. Remarkably, Euratom is partaking in harnessing nuclear fusion technology which could potentially generate abundant zero-carbon sustainable energy in the future. In terms of organizational structure, while ASEANTOM is simply a network of regulatory bodies in ASEAN without its own secretariat, Euratom is an intergovernmental body, governed by key EU's institutions (Commission, Council, and under the jurisdiction of the European Court of Justice) [23]. As regulatory cooperation in ASEAN progresses steadily in the coming years, it would be beneficial for the ASEANTOM to closely examine what it can emulate from the Euratom model of regulatory regionalism, and what can be adapted considering the Southeast Asian context, norms, and principles. Ongoing joint projects between the European Commission and ASEANTOM can serve as a pathway in this regard. One clear lesson from Euratom is having a mandate for verification, inspection, and peer review missions, which currently is not institutionalized in ASEAN's key documents, principles, and structure.

IV. ASEANTOM and Southeast Asian Nuclear Cooperation

ASEAN is an intergovernmental regional organization composed of 10 Southeast Asian countries (see Table 1). Established in 1967, ASEAN facilitates regional cooperation in Southeast Asia to effectively address the region's political, security, economic, and sociocultural issues, maintain peace and stability, and collectively engage extra-regional players in the Asia-Pacific and beyond. In 2012, leaders of the ASEAN member states agreed to form the ASEANTOM. In 2013, ASEANTOM was formally established with the adoption of its Terms of Reference. It is composed of nuclear regulatory agencies from the 10 ASEAN member states (see Table 1).

Table 1. Members of ASEANTOM [24]

ASEAN member state	Regulatory Agency
Brunei	Radiation Safety and Quality Unit Energy Department, Prime Minister's Office
Cambodia	Office Nuclear Safety, Security and Safeguards, Ministry of Mine and Energy
Indonesia	Nuclear Energy Regulatory Agency (BAPETEN)
Laos	Department of Science, Ministry of Science and Technology
Malaysia	Atomic Energy Licensing Board (AELB)
Myanmar	Division of Atomic Energy, Ministry of Education/ Myanmar Nuclear Regulatory Commission
The Philippines	PNRI
Singapore	Radiation Protection and Nuclear Science Department (RPNSD), National Environment Agency
Thailand	Office of Atoms for Peace (OAP)
Vietnam	Vietnam Agency for Radiation and Nuclear Safety (VARANS)

ASEANTOM was designated as a sectoral body under the ASEAN Political-Security Community by ASEAN state leaders in December 2015, and has been contributing to regional cooperation on the peaceful use of nuclear energy in Southeast Asia since. It facilitates sharing of best practices and experiences, assists ASEANTOM members with enhancing their regulatory frameworks, and boosts capacity building through technical collaboration with other international organizations (e.g., IAEA and European Commission) [25]. Through ASEANTOM, nuclear regulatory bodies collectively enhance

cooperation and develop capacities on nuclear safety, security, emergency preparedness and response. According to the ASEANTOM Work Plan 2018-2022, it has ongoing projects, workshops and meetings on regulatory capacity, nuclear security, and emergency preparedness and response [26]. Since its establishment in 2013, ASEANTOM has achieved key milestones in providing significant capacity building programs and raising the level of knowledge and expertise of key stakeholders. These milestones are discussed in the next section, highlighting how the Philippines has participated in and benefited from ASEANTOM's regulatory regionalism initiatives.

V. Key Areas for Further Action in the Philippines' Nuclear Plan and the Role of ASEANTOM

As both the INIR Mission Report and Philippine officials have stated if the country decides to introduce nuclear energy in the foreseeable future, it must first address critical issues and challenges. In this section, this article focuses on three key areas: the need to improve regulatory capacity building, nuclear security, as well as emergency preparedness and response. These are also the priority areas of ASEANTOM in its Work Plan. This article therefore discusses how ASEANTOM's work suits the Philippines' nuclear energy preparations here.

A. Improve Regulatory Capacity and Framework

One crucial role of the State is to establish and maintain a comprehensive legal and regulatory framework that can foster a strong national nuclear safety and security regime. It is important to point out that nuclear safety and security fall primarily under national responsibility. The State, through its legal and regulatory framework, governs the (1) duties, responsibilities, and rights of stakeholders in the nuclear field; (2) implementing guidelines for all nuclear facilities; and (3) regulatory control measures such as inspections and enforcements [27].

More importantly, establishing an independent nuclear regulatory body is crucial in developing a robust nuclear safety and security regime. Having an independent regulatory body guarantees that regulatory oversight measures are enforced without pressure from promoters of nuclear technology, including government agencies, as well as interests that may undermine nuclear safety and security. Both the 1994 Convention on Nuclear Safety and the IAEA General Safety Requirements mandate the creation of a strong independent regulatory body [28].

In the case of the Philippines, officials clearly recognize that having a regulatory body that also promotes nuclear energy is a fundamental challenge to nuclear energy preparations in the country. Currently, the PNRI has a dual but contradictory mandate of regulating the use of nuclear power for peaceful applications and promoting its uses, including other nuclear technology applications. One regulatory official noted that this arrangement must be amended even before the country embarks on the goal of nuclear power. The INIR Mission's report recommends that the Philippines must institutionalize a legal and regulatory framework that guarantees and governs national commitment to safety, security and non-proliferation, including the creation of an independent regulatory agency. It is important to emphasize that the current nuclear laws are already outdated, two of which were passed in 1957 and 1968, and both necessitate major amendments, as they are not aligned with current global nuclear safety and security conventions. As the PNRI itself wants to be freed from its conflicting mandate of regulating and promoting nuclear technology, its officials are actively endorsing a proposed legislation, the Comprehensive Atomic Regulation Act, particularly the creation of an independent Philippine Atomic Regulatory Commission [29]. However, this proposed legislation is still pending in the Philippine Congress and therefore poses a challenge to the country's preparatory steps [15]. As it appears that it is not yet one of Congress's priorities in its legislative agenda, one way to encourage legislators to finally tackle and pass it is if the President tags it as one of the priority bills. With the official adoption of a

national position on nuclear energy, it may send a clear message to the next Congress, after the 2022 national elections, to take action on pending proposed legislative bills on a comprehensive nuclear law.

The Philippines also needs to boost the capacity of its regulatory staff to uphold nuclear safety and security. The INIR mission strongly recommended that the country needs to ensure that its future independent regulatory body would have sufficient staff, funding, and powers to perform their duties. Such a body must be able to implement an inspection and enforcement mechanism to effectively regulate the nuclear power program [6]. However, the Philippines does not actually need to start from scratch in terms of creating a future regulatory body. The PNRI, which has been collaborating with global and regional institutions, has already created robust capacity-building initiatives. PNRI's regulatory capacity building is crucial for two reasons, detailed below.

First, adequate regulatory capacity ensures effective oversight and enforcement of nuclear safety, safeguards and security regulations. In this regard, the PNRI regularly conducts inspections and audits of radioactive materials, facilities, and activities. The PNRI works with the US Department of Energy's Office of Radiological Security team in inspecting and enhancing the security systems of both medical and research facilities with radioactive materials. For effective implementation of the country's Integrated Nuclear Security Support Plan (INSSP), the PNRI organizes coordination meetings with security and law enforcement agencies, particularly in the context of a prospective nuclear energy program. The PNRI also works with the IAEA in assessing the effectiveness of Radiation Portal Monitors in key national ports as part of initiatives to prevent the illicit trafficking of unauthorized nuclear and radioactive materials [29].

Second, a proactive and competent regulatory body can provide regular trainings to other law enforcement agencies and frontliners for the comprehensive execution of regulations. In this regard, the PNRI hosts several nuclear safeguards and security training courses and workshops for the NEPIO, DOE, military, police, and other government agencies. These courses and workshops are focused on boosting awareness about respective roles in the nuclear security and safeguards regime and strengthening their technical capabilities to detect, prevent, and respond to illicit access, use, and transport of nuclear and radioactive materials [29]. It has also recently established its Nuclear Security Training Room for Capacity Building of Stakeholders involved in nuclear security law enforcement, offering hands-on use of radiation detection equipment for nuclear and other radioactive materials for border protection [30].

While it is evident that the PNRI's is expanding its regulatory capacity, the introduction of the nuclear power program will pose additional responsibility for the regulator. The country's NEPIO acknowledged that there would be a need for additional human resources and training in safeguards, including for the regulatory body and the future NPP owner/operator. Therefore, it is pertinent that one of the crucial suggestions of the INIR Mission's report is for the PNRI to identify foreign regulators and organizations that can further lend assistance to the PNRI or the future Philippine Atomic Regulatory Commission and forge stronger collaboration. The PNRI informed the INIR mission team of its strong collaboration with the IAEA at the global level, as well as the ASEANTOM at the regional level [6].

Since the Philippines needs to ramp up its regulatory capacity, the country certainly benefits from burgeoning regulatory regionalism and cooperation that ASEANTOM facilitates. For instance, in terms of safeguards capacity, the PNRI plans to increase the number of its safeguards staff from four to 10 if the nuclear power program proceeds. In addition, its staff are studying standard safeguards practices in the context of regulating NPPs through State System Accounting and Control of Nuclear Material training courses and cooperation with ASEANTOM [6].

In order to address human resource capacity issues in Southeast Asia, ASEANTOM conducts expert missions/exchange programs, workshops, and technical cooperation projects with international organizations. Since ASEANTOM members do not have first-hand experience in safeguards regime in the

context of a nuclear power program, these workshops and meetings allow countries such as China, Japan, South Korea and the US, which all have robust nuclear energy programs, to share their good practices in safeguards and offer technical cooperation projects with Southeast Asian countries, including the Philippines [31].

The Philippine regulatory body likewise actively participates in ASEANTOM's capacity-building activities for nuclear safety and security regulation. One important regional project is the ASEANTOM-IAEA Regional Project on Nuclear Security (2018-2020). This project was intended to strengthen ASEANTOM members' regulatory capacities for licensing, inspection, and enforcement for the security of radioactive materials and associated facilities. Its regional activities included national training courses and technical visits. The Philippines hosted the ASEANTOM-IAEA regional training course on licensing inspection for radioactive material in Manila in April 2018. Joined by participants from member states including Philippine regulatory officials, the course tackled the vital aspects of a security inspection program for nuclear and radioactive materials and facilities. The Philippines has indeed directly benefitted from this ASEANTOM-IAEA project, and its regulatory staff has shared what they have learned to other security bodies, such as the police and the military [26, 29, 32].

ASEANTOM also organized the Regional Workshop on Licensing of Small Modular Nuclear Power Plants in 2017 [33]. As the Philippines continues to consider SMR technology, this workshop would be very helpful for its regulatory body, should it need to broaden its regulatory licensing framework for future SMRs. However, this workshop was held only once and with countries in the region seriously considering SMRs, ASEANTOM should facilitate more of these regional workshops.

B. Enhance Nuclear Security

The IAEA defines nuclear security as “the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities” [27]. In the Philippines, nuclear security is extremely relevant given the robust use of radioactive materials for various peaceful applications, even with the absence of an operating nuclear power reactor. As previously mentioned, the PNRI actively collaborates with external organizations to enhance its ability to enforce nuclear security regulations, and offers trainings to stakeholders involved in the nuclear security regime. Nonetheless, with the possibility of operating NPPs in the future, the Philippines would need to expand its nuclear security regulatory framework and enforcement capability to effectively cover nuclear power facilities and nuclear materials, not just radioactive materials that are used for non-power applications.

The INIR Mission's report encourages the Philippines to assess and improve the national coordination mechanisms and existing frameworks for nuclear security to meet the needs of the nuclear power program [6]. The country's INSSP was reviewed in 2021, including the impact of possible use of nuclear power in the future [34]. NEPIO also created its own Technical Working Group for Nuclear Security, whose personnel have attended various nuclear security training courses and workshops from the Korea Institute of Nuclear Non-proliferation and Control (KINAC) and the PNRI's Nuclear Security Support Center. It would be ideal to expand this technical working group and NEPIO to include key officials from other government agencies that have relevant nuclear security responsibilities, such as the Bureau of Customs, police, the CBRN unit of the military, and the Philippine Coast Guard [6].

With the Philippines' need to expand nuclear security capacity building through a national nuclear energy program, how does the country's participation in ASEANTOM and growing regulatory regionalism help meet this need? ASEANTOM serves as a facilitator between ASEAN and external partners (non-ASEAN countries and global/regional bodies) concerning nuclear security capacity building assistance. ASEANTOM has identified nuclear security as a crucial regional agenda, given the importance of improving nuclear security capacity and awareness among state and non-state stakeholders in Southeast

Asia. Since its establishment in 2013, ASEANTOM has conducted a series of capacity building programs aimed at boosting cooperation among ASEAN member-states and strengthening their collective and individual nuclear security capacities. These include joint cross-border nuclear security exercises in their maritime and land borders, done by regulatory and law enforcement officers in ASEAN, in order to prevent and investigate illicit use of and trafficking in nuclear and radioactive materials [31]. This is especially relevant for the Philippines because the provinces that may want to host future SMRs are located near the country's porous maritime borders. Palawan remains vulnerable to potential terror attacks, such as those in previous decades by extremist groups based in the southern Philippines. The Sulu province still is a hotbed of the dreaded Abu Sayyaf group and home base of loose pirate groups. The country's maritime security concerns, such as piracy, the presence of terrorist groups, unsecured maritime borders, smuggling, hijacking, and territorial disputes, could all pose serious security threats to floating reactors.

This issue could certainly be partially addressed by the Philippines' 2018 tabletop trilateral exercise with Malaysia and Indonesia on detection and response to nuclear security incidents in their maritime borders. Additionally, its participation in nuclear security simulation exercises among ASEAN security officers with the assistance from the European Commission in 2016 would further help to address these issues. These exercises promoted the harmonization and exchange of good practices among the region's key nuclear security actors. It tested the internal (i.e., inter-agency) and external (i.e., regional/international) communication and coordination mechanisms, which have been identified as key challenging issues in nuclear security detection [35, 36]. These issues were also detected by the INIR Mission sent to the Philippines. Therefore, these exercises can help boost nuclear security coordination mechanisms. The Philippine police, the military, the PNRI, and other law enforcement officers deemed these exercises to be effective training modalities [35].

Currently, the PNRI is also an active participant of the ongoing training project between ASEANTOM and the U.S. National Nuclear Security Administration (NNSA), known as the Exercise Development Training Series. Launched in 2019, the regulator-led project seeks to enhance members states' capabilities to prevent, counter, and respond to acts of radiological and nuclear terrorism. The series includes a training workshop and at least four exercises, which cover topics like material theft, smuggling, and incident response. It also involves a train-the trainer exercise equipping the regulators with the fundamental skills required to plan, conduct, and evaluate their own exercises and to provide detailed instructions on how to lead nuclear security tabletop exercises. A kick-off workshop and two training events have already been conducted until the COVID-19 pandemic has stalled the implementation [37, 38]. ASEANTOM and the IAEA have been conducting regional workshops on "Security Management and Security Plan on Radioactive Materials and Associated Facilities," highlighting the region's increased attention to the security of nuclear and radiological materials and relevant facilities. It also worked with South Korea, Taiwan, and Japan in organizing the "Regional Workshop on Capacity Building and Strengthening the Nuclear and Radiation Safety and Security Network in the ASEAN Region," facilitating sharing of knowledge and regulatory experiences in safety and security among ASEAN regulators and trainers from these three non-ASEAN countries [31].

Given that the PNRI is the primary training body in the area of nuclear security in the Philippines, these regional projects would definitely boost its capacity to effectively train security and law enforcement agencies in nuclear security detection and response. The PNRI's participation in these ASEANTOM-led regional activities would facilitate knowledge transfer, including good practices and approaches to security challenges, from fellow ASEANTOM regulators, EU, the IAEA and the U.S. to Philippine stakeholders in the future nuclear power industry, such as the NEPIO and regulatory officers. This is also strong evidence of regulatory regionalism's growing impact in nuclear security. In light of the potential nuclear energy project, the capacity-building gaps in the Philippines' regulatory body, as well as in

relevant agencies, could be significantly or fully addressed by the PNRI's collaborative engagement with fellow ASEANTOM regulators and growing regulatory regionalism in Southeast Asia.

C. Nuclear Emergency Preparedness and Response

Another significant area of concern the INIR Report identified is the assessment of existing emergency preparedness and response arrangements for the nuclear power program. It accentuates that NEPIO has not yet assessed existing arrangements against the requirements of its future nuclear power project and therefore encouraged it to do so [6]. This article notes that a nuclear or radiological emergency can be initiated and/or affected by conventional emergencies, natural events/disasters, security incidents, and/or big national or global health crisis [39]. In the context of the Philippines, natural hazards/events that regularly hit the country such as earthquakes, volcanic eruption, typhoons and tsunamis, can pose safety challenges to its future NPPs if there is weak regulatory governance, which could lead to a large-scale nuclear emergency. Nuclear security challenges because of the presence of non-state armed groups could also lead to emergencies if those groups manage to sabotage nuclear facilities and materials.

The PNRI has already established the foundation of the national nuclear emergency preparedness and response framework. In 2000, it developed the National Radiological Emergency Preparedness and Response Plan (RADPLAN), which established a national and coordinated emergency response capability for nuclear and radiological emergencies. The RADPLAN specifies roles and responsibilities of participating agencies and mandates them to develop and maintain their own plans, in coordination with the Office of Civil Defense and PNRI. The RADPLAN designates PNRI to coordinate the nuclear emergency response. Together, the country's disaster management coordinating council and the PNRI are currently revising that response to meet the standards set by the IAEA Safety Standards Series on Preparedness and Response for a Nuclear or Radiological Emergency [29].

It is crucial that the Philippines strengthens its nuclear emergency preparedness and response capability. PNRI researchers determined that despite having no NPP facilities currently in operation, the Philippines is still at risk of possible contamination from the radioactive releases of nuclear emergencies that may happen in the Asia-Pacific region. It is in proximity to the countries operating NPPs, particularly mainland China and Taiwan. They also noted that due to the country's geographical location, the Philippines is regularly hit by strong typhoons, storms, and seasonal monsoons, which may spread nuclear fallout onto its environment in the event of a nuclear emergency. Moreover, the possible rehabilitation and operation of the BNPP is another crucial reason for a higher level of preparation. It is located 100 km away from Metro Manila, the nation's economic and political center, which is within one of the BNPP's off-site emergency zones. Manila has a population of more than 12 million and necessitates "baseline radioactivity data to ensure a well-established radiation protection program in preparation for possible nuclear and radiological emergencies" [40].

The PNRI is currently spearheading the enhancement of the country's nuclear emergency preparedness and response through regularly conducting several training courses on nuclear or radiological emergency preparedness and response. These training courses are geared towards PNRI experts, medical doctors and hospital paramedics and first responders from the police, military and other agencies representing the local disaster risk reduction, and management offices. To monitor the radiation level in various parts of the country, the PNRI is implementing the "System for On-line Monitoring of Environmental Radiation" (SOMER), which includes installation of radiation monitoring stations and helps the agency to determine whether the emergency preparedness and response needs to be activated [29]. The INIR Mission noted that there were 14 monitoring stations being built throughout the country in cooperation with the IAEA [6].

While these initiatives from the PNRI clearly indicate that it recognizes the importance of setting up an emergency preparedness and response framework even without an operable NPP, this framework has not

been institutionalized through law. Moreover, it has yet to be either fully integrated with the country's national disaster preparedness and response framework, or confidently implemented by relevant agencies, including the NEPIO. It is still uncertain whether the country's front-line agencies with emergency response responsibilities and health care system can fully prepare for and respond to the consequences of a nuclear fallout within the country's jurisdiction. Regardless, nuclear and radiological emergencies cannot be solely and exclusively addressed by a country on its own. Its cooperation with its neighboring countries is essential to effectively prepare for and respond to these emergencies. After all, it is important to reduce potential risks and mitigate potential damage as the impact of a nuclear accident or sabotage might be widespread, transboundary, and indiscriminate, as well as harmful to food and water sources, public health, and the environment.

With regional cooperation, ASEAN's member states, including the Philippines, can strengthen their emergency preparedness and response capability. ASEANTOM has identified nuclear emergency preparedness and response as among its core priorities. This priority comes in light of the lessons from the Fukushima accident in 2011, the future plans of several ASEAN countries to build their own NPPs, and the presence of NPPs near the region's borders, particularly, Vietnam's border with China and Myanmar's border with Bangladesh, which is building its first NPP. As stipulated in its Work Plan, ASEANTOM has ongoing emergency preparedness and response regional projects with the EU and the IAEA [26]. These projects are essential at both national and regional levels to protect the people and the environment in case of nuclear or radiological accidents. A majority within ASEAN has determined that a regional approach to nuclear emergency preparedness and response would complement national frameworks and capabilities [41].

With the IAEA's support, ASEANTOM launched a regional project on Supporting Regional Nuclear Emergency Preparedness and Response in the ASEAN Region in 2016. This project aims to establish a regional environmental radioactivity database, provide technical assistance to member-states, and advance a more systematic regional response for radiological emergencies. The rationale behind this is that most of the ASEAN countries have limited expertise and techniques for monitoring radiation and dose assessment as a preparation for nuclear or radiological emergency [42]. ASEANTOM and the IAEA also completed the technical report titled, A Review of the Nuclear and Radiological Hazard Assessment in ASEAN. This regional study is extremely important in identifying potential radiological and nuclear hazards that can be found in all ASEAN member states. Meanwhile, since 2014, the EU has been assisting ASEANTOM, through the European Commission, on an emergency preparedness and response project. This project is focused at developing a regional platform for decision-making and coordination during a nuclear or radiological emergency. Its outputs include the Feasibility Study on Enhanced Regional Cooperation on Nuclear Emergency Preparedness and Response in ASEAN, the Action Plan for Implementing the ASEAN Strategy for Regional Cooperation on Radiological and Nuclear EP&R, technical support for decision-making, and an ASEAN Early Warning Radiation Monitoring Network, which is equipped with a regional data exchange platform, launched in 2020. Under this project, the EU funds the region's radiation monitoring stations with equipment in most of the developing Southeast Asian countries. Through this regional online platform, ASEAN member states can "have more rapid and informed response from the exchange, in real time, of information from national radiation monitoring networks" while "reducing costs from sharing expertise, methods, training, equipment and facilities at a regional level and avoiding needless duplication"[41].

The Philippines directly benefits from these ASEANTOM projects. In the 2016 Kuala Lumpur workshop, which was organized by the European Commission and which I attended, ASEANTOM members, particularly the Philippines, emphasized the importance of the EU's support. ASEANTOM members highlighted that the EU's technical and funding support could boost their emergency preparedness and response capability by addressing challenges, such as their inadequate funding and resources, lack of monitoring equipment, and knowledge-technical gaps. The PNRI representative confirmed that the EU's

support to ASEANTOM, as well as sharing its experience in regional preparedness and response could complement and strengthen the Philippines' initiatives and help the country to implement its projects [43].

Meanwhile, the results of the ASEANTOM-IAEA hazard assessment would enable the Philippines to come up with a graded approach to the preparation of proportionate emergency arrangements, with identifying hazard types and their potential consequences. Furthermore, based on the hazards and potential consequences, the Philippines can develop and optimize protection strategies and other response actions, especially in the context of an accident at its future NPPs. The hazard assessment can also verify the country's selection of potential nuclear sites and potential hazards (if any) that need to be considered. So far, the Philippines already has a geohazard assessment map, encompassing hydro-meteorological, seismic/earthquake, and volcanic hazards that are present in every province, town and city [44]. The Philippines can use the ASEANTOM-IAEA nuclear hazard study as an additional assessment tool which can be juxtaposed with the existing national hazard map. This would be greatly informative in the country's assessment of its emergency preparedness and response arrangements, which the INIR Mission pointed out as lacking.

An ASEANTOM project document notes that prior to the start of these regional projects, the Philippines already had some equipment for radiation measurement but still had limited expertise on emergency arrangements. Although there were measurement technologies for normal times, the country either had inadequate access or no access to the software which provides immediate calculations, depending on the phase of the accident [45]. But, after the implementation of ASEANTOM's technical projects with the EU, the Philippines benefitted from the project on Decision Support System (DSS), called ARGOS, which can be useful for crisis and emergency management for incidents with chemical, biological, radiological, and nuclear (CBRN) releases. One PNRI report highlights that it will be crucial in the country's real-time preparations in case of a large emergency [29]. Furthermore, because it is part of the early warning radiation monitoring network, coupled with the ASEAN-Radiation Data Exchange Platform, the Philippines would be able to quickly and easily exchange information with its regional neighbors. This information includes a prediction of radioactive plume dispersion, as well as the estimated amount of radioactivity in the environment in case of an emergency, either from its own NPPs or from other countries in Southeast Asia.

VI. Limitations of the Impact of Regulatory Regionalism and Cooperation on the Philippines' Nuclear Energy Preparations

As demonstrated in the previous sections, the collaboration among regulatory bodies of ASEAN, including sharing of experiences, good practices, resources and expertise, is a clear indication of the burgeoning regulatory regionalism on nuclear energy. It has significantly helped the Philippines address some of the key preparatory issues that the INIR Mission identified. In terms of regulatory capacity building and building awareness on the importance of nuclear security, safety, and emergency preparedness and response, the impact of regulatory regionalism through ASEANTOM's activities on the Philippines' nuclear energy preparations is crucial. However, there are still several preparatory issues which regulatory regionalism would not significantly contribute to. Basically, such issues will fall under the exclusive area of the Philippines; only through its domestic processes and governance mechanisms such preparatory issues would be effectively addressed.

One key area of concern that the INIR Report identified is the need to pass a Comprehensive Nuclear Law. The Comprehensive Nuclear Regulation Act, still pending in the Philippine Congress, pushes for the creation of a unified independent regulatory body consistent with international standards for the

regulation of all practices and facilities involving nuclear and other radioactive materials, facilities, and radiation generating equipment. The bill contains provisions on radiation protection, emergency preparedness and response, transportation of radioactive material, import and export of nuclear and other radioactive material, management of spent fuel and radioactive waste, safeguards, physical protection and security, and civil liability for nuclear damage [6]. The country needs to pass this important bill before the it even embarks on its nuclear energy program. It will replace outdated nuclear regulation laws and executive orders, in view of the country's consideration of operating NPPs. It will also push the country to complete its ratification of key global nuclear treaties and conventions.

The country's record of ratifying nuclear treaties is patchy and incomplete, thereby creating loopholes in the country's nuclear safety and security framework (see Table 2).

Table 2. Status of Ratification of Key Nuclear Conventions by the Philippines [46–48]

Treaty/Convention	Status of Ratification
Treaty on the Non-Proliferation of Nuclear Weapons	Ratified
Treaty on the Prohibition of Nuclear Weapons	Ratified
Safeguards Additional Protocol	Ratified
Convention on Physical Protection of Nuclear Materials (CPPNM)	Ratified
2016 CPPNM Amendment	Ratified
Nuclear Terrorism Convention (ICSANT)	Signed only
Comprehensive Nuclear Test-Ban Treaty (CTBT)	Ratified
Convention on Nuclear Safety (CNS)	Signed only
Joint Convention on Spent Fuel and Radiological Waste	Signed only
Convention Early Notification of a Nuclear Accident	Ratified
Code of Conduct on the Safety and Security of Radioactive Sources (Political Commitments/non-legally binding)	Political commitment registered

The INIR Mission recommended that the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, as well as the Amendment to the Convention on the Physical Protection of Nuclear Material all be ratified. These are all important treaties that need to be included in domestic legislation, especially if NPPs are planned to be built.

In this regard, ASEANTOM would not be able to direct the Philippines to ratify such treaties because of the ASEAN's principle of non-interference in the domestic affairs of any member state, particularly legislative processes. ASEANTOM members can only encourage fellow members to accede to these treaties through their joint statements, workshops, meetings, and partnership with the IAEA. Additionally, the Philippines is not only the only member that that has an incomplete ratification record in Southeast Asia, as there are also several others that need further encouragement. Beyond ratification, one critical step is to ensure the translation of these conventions into local nuclear law/s, and enhanced coordination between different Philippine agencies concerning their implementation. Clearly ASEANTOM's clout is no longer relevant in this area.

Another limitation involves nuclear waste management. The anti-nuclear energy movement in the Philippines is pushing the nuclear waste that the NPP would generate as an important campaign issue. It does not help that the country is not a state party to the radioactive waste convention. In Congressional hearings on nuclear energy plan, for instance, anti-nuclear organizations such as Greenpeace would cite the unresolved issue of nuclear waste disposal and the danger being posed to communities and the environment [49]. The INIR Mission also strongly recommended that “the NEPIO should consider disposal options for radioactive waste arising from the operation and decommissioning of the nuclear power plant” [6]. Even without an NPP, the Philippines already generates radioactive waste from medical, research, and industrial activities. While the PNRI has strict regulations to govern the safe and secure management of radioactive waste, the country’s current capabilities are limited to the management of unused sealed radioactive sources and institutional radioactive waste [6]. However, PNRI officials such as Director Arcilla clarified that the Philippines has the technology to drill deep boreholes in an isolated island in the country, where nuclear waste from future NPPs can be safely and securely buried [2].

In this regard, the Philippines has the sole prerogative to choose the repository technology for nuclear waste management; ASEANTOM has no impact in this area. ASEANTOM has not prioritized nuclear waste management in its regional work plan. Since its establishment, there have been no major workshops and projects on nuclear waste management. Therefore, ASEANTOM regulatory regionalism would not be able to impact the issue of nuclear waste in the Philippines.

As mentioned earlier, SMR is perceived to be ideal for isolated Philippine regions that are not connected to the main grid, according to nuclear promoters in the country. One scenario being considered is that should the Philippines decides to pursue nuclear energy, and even deploy SMRs in the future, other Southeast Asian countries may do so as well. In this regard, an important issue is the need to update existing regulatory and legislative frameworks on the peaceful use of nuclear energy in the region. This issue pertains to the safety and security of emerging SMRs using generation IV designs, i.e., thermal-neutron, molten-salt or gas (rather than water) cooled reactors, which are promoted to be safer, more secure, proliferation-resistant, and cheaper than conventional NPPs. However, without any concrete case of commercial SMRs ready to be deployed, licensing and regulatory best practices for this technology would remain abstract. This presents both as a challenge and an opportunity to the Philippine regulatory framework as it needs to be updated so it can adapt to this new reactor technology. Regulatory cooperation in ASEAN has not yet comprehensively covered SMR technology. There has been no official conversation yet within ASEANTOM, through their annual meetings, workshops and projects, as to the impact of SMR on nuclear regulation in the region as well as how they can collaboratively build up their competence in monitoring SMR and regulating it, should any of the member states (like the Philippines) decide to build one. The Philippines and the rest of ASEANTOM should closely monitor and actively study the potential impact of SMRs on their regulatory frameworks and practices. What regional collaborative projects would they need to build up their competence in regulating SMRs?

VII. Conclusion

As discussed in this article, there are certain challenges to nuclear energy preparations of the Philippines, due to inherent issues of capacity building and outdated legal/regulatory frameworks. Nevertheless, ASEANTOM’s ongoing work and commitment to impactful regional cooperation in nuclear energy issues will serve to promote regulatory regionalism at both national and regional levels. The Philippines, being a founding member and proactive participant of ASEANTOM, stands to gain from the growing regulatory regionalism and collaboration, as it addresses the challenges to its preparations for nuclear power through the network’s projects, as well as engagements with international organizations and extra-regional actors.

With the transboundary risks of nuclear accidents, radiological emergencies, or nuclear security incidents ever present, ASEAN member states should further advance regulatory regionalism through their nuclear regulatory bodies by collectively building the necessary skills and mindsets that will discourage complacency and promote critical thinking in using nuclear energy, including in the Philippines. However, this article shows that there are still limitations to the extent of ASEANTOM's impact on the Philippines' nuclear power plans. Nuclear energy development remains a state-led initiative and a national responsibility. Preparatory issues, such as domestic legislation of a new nuclear law, ratification of nuclear conventions, management of nuclear waste, and regulation of a new reactor's technology are not within ASEANTOM's mandate. Furthermore, ASEANTOM itself remains a young regional body, without an enforcement mandate similar to Euratom's. It has yet to address sustainability issues concerning its projects. These issues include whether ASEANTOM would be capable of being the lead driver of regional nuclear governance and be able to address the issue of sustainability of current funding, financial, and technical assistance mechanisms, after the conclusion of its projects with extra-regional states such as the US and international organizations.

Nevertheless, the nature of regional cooperation on nuclear capacity building taking place in Southeast Asia certainly provides a good foundation to assist member states interested in nuclear power, such as the Philippines. Conversely, the Philippines's decades-long experience in both the peaceful use of nuclear technology for various applications and in the preparation of possible use of nuclear power would definitely expand and deepen ASEANTOM's regulatory regionalism and cooperation.

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IX. Competing Interests Statement

No competing interests to declare

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