Southern Asian Strategic Study: Nuclear Security Regime Resilience

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ABSTRACT

This study examines the resilience of nuclear security regimes (NSRs) in Bangladesh, India, Indonesia, Malaysia, Pakistan, Philippines, Thailand, and Vietnam. The NSRs focus on preventing, detecting, and responding to unauthorized acts involving nuclear or radioactive materials and associated facilities. The resilience of NSRs relies on the governance supporting them, including legislative and regulatory frameworks, international cooperation, risk-based approaches, incident response capabilities, and measures for sustaining the NSR.

Specifically, this study identifies functions that facilitate contextual understanding, development and learning, resource coordination, external awareness, and effective communication within the NSR. Communication plays a crucial role, including top-down communication on policies, bottom-up communication on security issues, and internal communication on performance and coordination. The study also examines potential drivers for changes in nuclear infrastructure, external stressors, and geopolitical influences that could impact NSRs. These perturbations include regional environmental impacts, political climate, tensions related to the South China Sea, evolving power infrastructure needs, security threats from non-state actors, and influences from China and Russia.

Addressing the identified gaps and weaknesses in each country's nuclear security regime would contribute to enhancing their overall resilience. This may involve developing comprehensive risk assessment frameworks, strengthening physical protection measures, improving law enforcement preparedness, and ensuring a holistic approach to nuclear security. By addressing these gaps, these countries can strengthen the resilience of their nuclear security regimes and ensure the safe and secure use of nuclear materials and facilities.

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ACRONYMS AND DEFINITIONS

Abbreviation	Definition
AEC	ASEAN Economic Community
ASEAN	The Association of Southeast Asian Nations
ASMR	Advanced Small Modular Reactor
BRI	Belt and Road Initiative
BWR	Boiling Water Reactor, a type of NPP
CAT	Category
CPPNM	Convention on the Physical Protection of Nuclear Material
DBT	Design Basis Threat
GDP	Gross Domestic Product
GICNT	Global Initiative to Combat Nuclear Terrorism
HALEU	High Assay Low Enriched Uranium
IAEA	International Atomic Energy Agency
ICONS	latest International Conference on Nuclear Security
ICSANT	International Convention for the Suppression of Acts of Nuclear Terrorism
INFCIRC	IAEA Information Circulars
ISIS	Islamic State
ITDB	IAEA Incident and Trafficking Database
MC&A	Material Control and Accounting
NPP	Nuclear Power Plant
NSR	Nuclear Security Regime
NTI	Nuclear Threat Initiative
PHWR	Pressurized Heavy Water Reactor, a type of NPP
PWR	Pressurized Water Reactor, a type of NPP
UNSCR 1540	United Nations Security Council Resolution 1540
VVER	Water Water Energy Reactor (Russian designed PWR with a horizontal steam generator)
WINS	World Institute for Nuclear Security

1.   INTRODUCTION

This study aims to examine the resilience of nuclear security regimes (NSRs) in Southern Asia, considering the impact of changing nuclear infrastructure, external stressors, and geopolitical influences. Resiliency, in this study, considers both the ability to persist as well as adapt in the event of internal or external changing conditions – perturbations. For this study, we have leveraged existing publications, such as the Nuclear Threat Initiative (NTI) [1], to outline the current robustness of a country's NSR and the potential near term internal or external changing conditions. Based on an analysis of these publications, our research team defined a level of resilience and provided a summary of strengths and gaps of the existing NSR.   Country specific analysis is available upon request.

Nuclear security focuses on preventing, detecting, and responding to unauthorized acts involving nuclear or radioactive materials and associated facilities. The resilience of NSRs relies on the resilience of their governance, which encompasses legislative and regulatory frameworks, international cooperation, risk-based approaches, incident response capabilities, and measures for sustaining the NSR[2].

The governance supporting NSRs is based on communication, coordination, and other enabling functions that ensure effectiveness. This study specifically focuses on functions that facilitate contextual understanding of nuclear security, promote development and learning, coordinate resources for day-to-day operations, enhance external awareness, and enable effective communication within the regime. This includes various forms of communication, such as top-down communication on policies and directional changes, bottom-up communication on security issues, and internal communication on performance, resource needs, and coordination across all elements of a country's NSR[3].
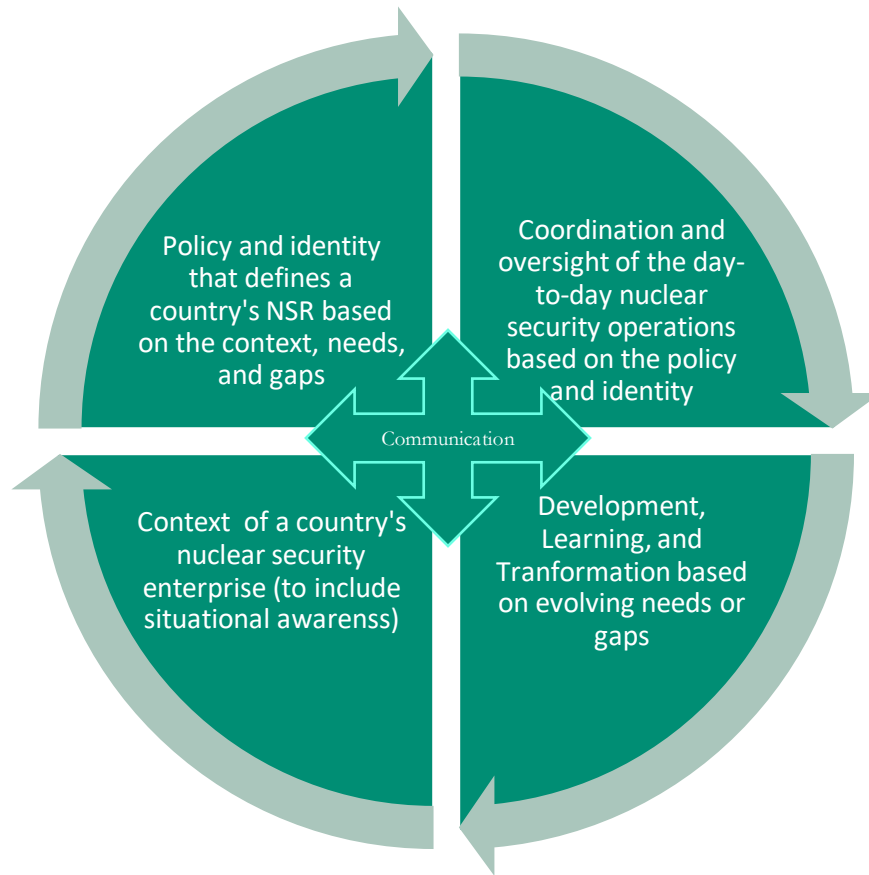
Figure 1 Conceptual NSR Governance Graphic

In this study, our focus was on identifying the drivers that contribute to changes in nuclear infrastructure, non-state threats, and geopolitical issues in the country and region. We aimed to define potential perturbations that could have an impact on Nuclear Security Regions (NSRs). Specifically, these perturbations encompassed various factors, including regional environmental impacts, the political climate within each country, tensions related to the South China Sea, evolving power infrastructure needs, security threats from non-state actors, and the specific influences of China and Russia. By considering these factors, we gained valuable insights into the challenges and vulnerabilities that may affect the resilience of NSRs in the countries under study.

2.   REGIONAL SUMMARY

Southern Asia is a geographic region defined in the scope of this study to include South Asia, as defined by the World Bank [4], and a selection of countries that are in East Asia and the Pacific region. The specific countries include Afghanistan, Pakistan, India, Nepal, Bangladesh, Myanmar, Lao, Cambodia, Thailand, Vietnam, Singapore, Malaysia, the Philippines, Brunei Darussalam, and Indonesia.

Figure 2 Map highlighting the countries defined in the Southern Asian region

Among the countries in the region, Pakistan, India, Bangladesh, Thailand, Vietnam, Malaysia, the Philippines, and Indonesia have nuclear infrastructure. These eight countries will be the focus of this study.

The region as a whole is undergoing significant changes in power dynamics and infrastructure needs, primarily driven by factors such as economic growth, urbanization, and regional integration. Countries like India and the member states of the Association of Southeast Asian Nations (ASEAN) are emerging as major economic players, reshaping the regional landscape. This economic growth has resulted in increased energy demands and infrastructure requirements throughout the region. Southern Asia, in particular, has witnessed a surge in energy consumption due to rapid urbanization and economic expansion. To meet the rising demand, there is a pressing need for additional power generation capacity. In response to these challenges, there is a growing emphasis on diversifying energy sources and promoting sustainable development. Renewable energy sources, such as solar,

wind, and hydroelectric power, are being explored as alternatives to traditional fossil fuel-based generation. Additionally, enhancing energy efficiency has become a priority to ensure optimal utilization of resources.

Currently the region produces only 65% of the power it consumes, with around 40% of that power coming from renewables and the rest from traditional power (coal, petroleum, or natural gas). Less than 1% of the region's powers is supplied by nuclear power [5]. The region also accounts for roughly 10% of the world's carbon emissions [6]. Currently, there are 64 operational nuclear fuel cycle facilities and 16 under construction in the region. These include nuclear power plants (pressurized water reactors (PWR), pressurized heavy water reactors (PHWR), and boiling water reactors (BWR)), fuel fabrication facilities, pilot scale reprocessing facilities, enrichment facilities, and research reactors [7]–[9].

There is a growing recognition of the need for sustainable infrastructure development in Southern Asia. Efforts are being made to incorporate environmental considerations, environmental resilience, and social inclusivity into infrastructure projects to ensure long-term sustainability and minimize environmental impacts. Cross-border infrastructure projects, such as energy pipelines, transportation corridors, and economic zones, are being developed to enhance regional cooperation, trade, and connectivity. These projects require collaboration among countries to address regulatory, financing, and geopolitical challenges.

Within Southern Asia, several countries can be considered economically strong, while others may face challenges in terms of economic development. It is important to note that economic strength can vary based on factors such as GDP, GDP per capita, economic growth rates, and various socio-economic indicators [10]. India, Indonesia, and Malaysia can be considered among those economically strong. As one of the fastest-growing major economies globally, India has a diverse economy, including sectors such as information technology, services, manufacturing, and agriculture. It has a large consumer market and is a hub for technology and innovation. With a large population and abundant natural resources, Indonesia has experienced steady economic growth. It has a diverse economy, including sectors such as manufacturing, mining, agriculture, and services. Malaysia has a diversified economy, with strong manufacturing, services, and tourism sectors. It is known for its exports of electronics, palm oil, and petroleum products.

It is important to note that economic strength can fluctuate over time, and each country has its unique strengths, challenges, and development trajectories. Additionally, other countries in the region, such as Thailand, Vietnam, and the Philippines, have varying degrees of economic strength and development.

Southern Asia also has significant levels of poverty and income inequality. Limited access to basic services, education, healthcare, and employment opportunities can create social tensions and hinder development efforts. Additionally, the region is highly vulnerable to the impacts of environmental change, including rising temperatures, changing rainfall patterns, increased frequency of extreme weather events, and sea-level rise. These changes can have severe consequences for agriculture, water resources, ecosystems, and human settlements. Specifically, Southern Asia faces water scarcity and food security challenges. These issues are compounded by deforestation, land degradation, air and water pollution, and loss of biodiversity, which are significant environmental stressors in the region. These issues impact ecosystems, natural resources, and human health [10].

The region has faced significant threats from terrorist organizations and extremist ideologies. Groups such as ISIS, Al-Qaeda, and their affiliates have carried out attacks, leading to concerns over radicalization, cross-border movements, and the potential for violence. Southern Asia faces challenges related to cross-border crime, including drug trafficking, human trafficking, and illegal fishing. These activities undermine security, governance, and economic development in the region. Criminal networks exploit weak governance, corruption, and porous borders, posing security threats and undermining the rule of law. The South China Sea and the Strait of Malacca are vital maritime routes, making maritime security a significant concern. Issues such as piracy, armed robbery at sea, illegal fishing, and territorial disputes impact regional stability, trade, and freedom of navigation. The increasing reliance on digital technologies has also exposed the region to cybersecurity threats [11].

Southern Asia has several ongoing territorial disputes, such as the India-Pakistan conflict over Kashmir, the India-China border dispute, and maritime disputes in the South China Sea. These conflicts pose challenges to regional stability and can lead to tensions between countries. Focusing on India and China, the two countries have engaged in military standoffs and clashes, leading to heightened tensions and concerns over regional stability. The long-standing conflict between India and Pakistan continues to impact regional geopolitics. Issues such as cross-border terrorism, territorial disputes (particularly over Kashmir), and water-sharing agreements have strained relations between the two countries. Territorial disputes over the South China Sea involving China, Vietnam, the Philippines, Malaysia, Brunei, and Taiwan have been a major geopolitical issue. These disputes center around competing claims over islands, reefs, and maritime boundaries, leading to tensions and concerns over freedom of navigation and resource exploration.

Several countries in the region have experienced internal conflicts and insurgencies, such as the Philippines and Thailand. These conflicts have social, political, and economic implications, leading to displacement, human rights concerns, and challenges to governance.

Southern Asia is witnessing a power competition between India and China, often referred to as the "India-China rivalry." This competition encompasses various aspects, including economic influence, military capabilities, and strategic partnerships, and has implications for the broader regional dynamics. The region's strategic location, natural resources, and economic potential have made it a focal point for influence and competition between these and other powers (e.g., Russia and the U.S.) [12].

Regional organizations such as ASEAN play a crucial role in promoting security cooperation and dialogue among member states. Efforts to enhance regional security frameworks, intelligence sharing, and joint exercises are ongoing to address common security challenges. Southern Asia has witnessed the emergence of various regional connectivity initiatives, such as China's Belt and Road Initiative (BRI) and India's "Act East" policy. These initiatives aim to enhance infrastructure development, trade, and connectivity, but also raise questions about economic influence and strategic interests. Maintaining unity and addressing internal challenges, such as differing perspectives on the South China Sea disputes and human rights issues, are ongoing concerns for ASEAN member states. Southeast Asia has witnessed economic integration efforts, such as the ASEAN Economic Community (AEC) and various free trade agreements. Balancing economic interests, addressing trade imbalances, and ensuring inclusive growth are ongoing challenges for the region.

In the context of this study, the resilience of Nuclear Security Regimes (NSRs) is evaluated based on their proximity to ideal indices, utilizing values from NTI [1]. These indices reflect several key aspects:

- The sufficiency of a country's legislative and regulatory frameworks to support an NSR
- The level of international cooperation on NSR topics and measures
- The completeness of a country's security risk assessments, including their design basis threat
- The adequacy of current security measures at nuclear sites
- The ability to detect and respond to security incidents at nuclear facilities
- The overall security culture within the country

The robustness of an NSR is defined not only by its proximity to these ideal indices but also by an evaluation of the governance structures that support the NSRs. This evaluation focuses on methods of communication, coordination, and other enabling functions that ensure effectiveness. Resilience is assessed based on how these methods are expected to respond to internal and external perturbations, reflecting a country's commitment to valuing its NSR. A holistic perspective is essential, encompassing internal awareness, external awareness, and forward-looking considerations to enhance the overall resilience of the NSR.

Considering the presented regional challenges, the varying robustness and resilience of the NSRs in Southern Asian countries can have several implications. In the following figure (Figure 3) we present a summary of our analysis considering the robustness of a country's and the resilience of this regime to potential perturbations in the near team. Our evaluation is based on a scale where ideal robustness and resilience would reflect a value of 1.
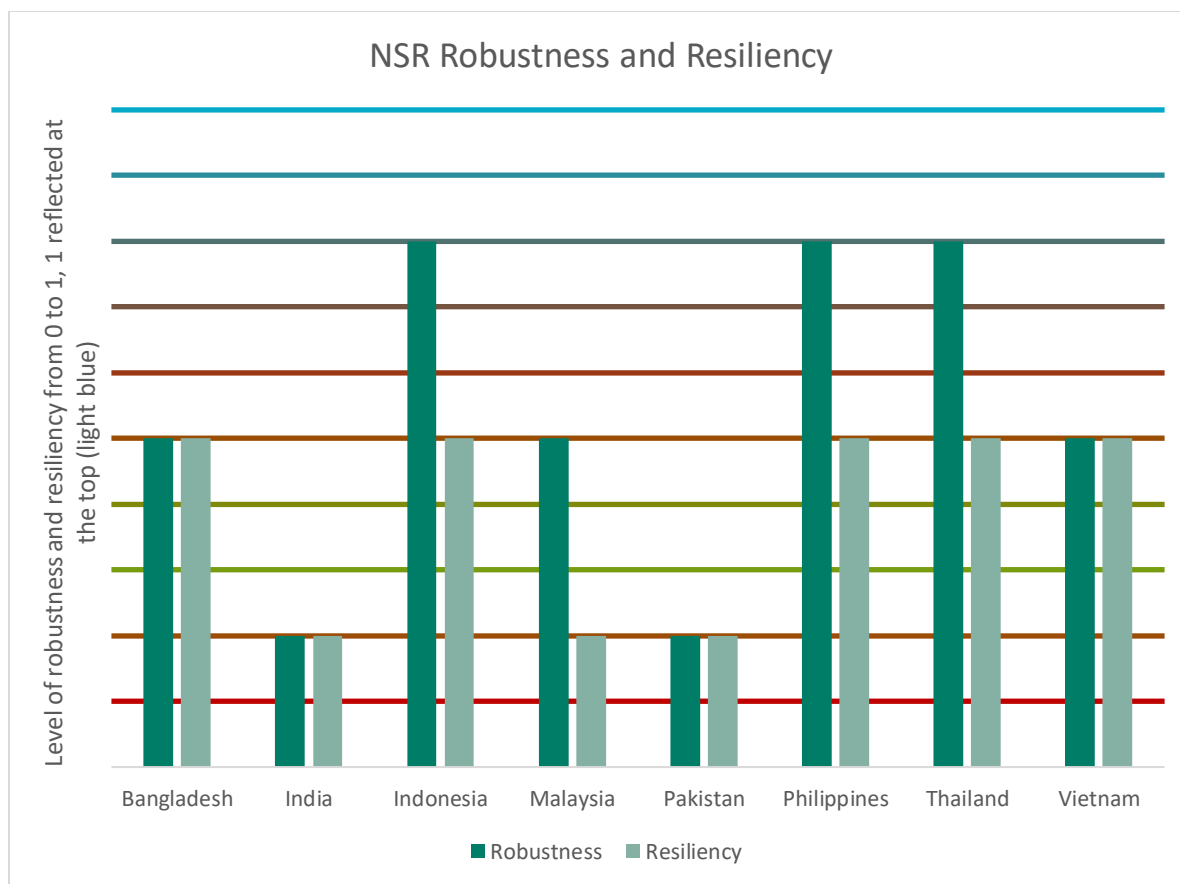
Figure 3 Level of the robustness and resilience of a country's NSR governance where highest possible value reflect the ideal

Among the countries in the region, Indonesia, the Philippines, and Thailand have stronger and more robust nuclear security regimes compared to others. This positions them as potential regional leaders in promoting best practices and cooperation in nuclear security. They have the opportunity to share their expertise, provide training, and collaborate with other countries to enhance the overall security posture in the region. However, it is important to note that these countries currently have a limited nuclear infrastructure. As a result, the resilience of their NSRs against possible regional and country perturbations is at a moderate level. While their existing nuclear security regimes are robust, changes in their nuclear infrastructure or an increase in threats could challenge the adequacy of their current resilience.

To maintain a high level of resilience, these countries will need to continuously adapt and strengthen their nuclear security regimes in response to evolving circumstances. This includes addressing any changes in their nuclear infrastructure and ensuring that their security measures remain effective against emerging threats. By doing so, they can maintain their leadership role in promoting nuclear security best practices and cooperation in the region:

- Based on the current infrastructure, the robustness of Indonesia's nuclear security regime is considered adequate, that is, the country has established organizations and regulatory frameworks to ensure nuclear security. However, there are resilience gaps due to limitations

in the country's perspective and approach to nuclear security. Specifically, there are limitations in the situational understanding of regional threats and their potential impact on existing nuclear infrastructure – gaps in the security risk assessment and design basis threat. These gaps need to be addressed to enhance the overall resilience of Indonesia's NSR.

- Similarly, the Philippines' nuclear security regime is deemed adequate for the current level of infrastructure. Specifically, the country has made good international and legal commitments, as well as voluntary commitments to nuclear security. However, there are gaps in the regulatory frameworks and the implementation of physical protection measures that need to be addressed, particularly as changes in the infrastructure occur. The regime has some ability to adapt in the near term, but improvements are necessary to ensure long-term resilience.

- In the case of Thailand, the robustness of its nuclear security regime is also considered adequate for the current infrastructure, that is, the country has established organizations and regulatory frameworks to ensure nuclear security. However, similar to the Philippines, there are gaps within the resilience of Thailand's NSR that may pose potential issues in the future. These gaps include weaknesses in risk assessment, implementation of physical protection measures in response to threats and infrastructure changes, and law enforcement preparedness. Addressing these gaps will be crucial to enhance the overall resilience of Thailand's NSR.

Countries with weaker nuclear security regimes, such as India and Pakistan, face greater vulnerabilities to security threats, including unauthorized access to nuclear materials or facilities. This vulnerability has regional implications, as the security of one country's nuclear assets can impact the security of neighboring countries.

- In the case of India, the resilience of its nuclear security regime is limited. While there are strengths in terms of established organizations and regulatory frameworks, there are gaps that need to be addressed. These gaps include shortcomings in risk assessment, physical protection measures, and a holistic perspective on nuclear security. Enhancing these aspects is crucial to strengthen the overall resilience of India's nuclear security regime.

- Similarly, the resilience of Pakistan's nuclear security regime is uncertain. While there are elements of an integrated approach, such as protective forces and personnel reliability programs, concerns arise regarding the capacity of the state and the influence of geopolitical factors. These factors raise questions about the practical resiliency of Pakistan's nuclear security regime. Addressing these concerns and strengthening the regime's capacity is essential to enhance its resilience.

Given the notable nuclear infrastructure in both India and Pakistan, it is imperative for these countries to prioritize and invest in strengthening their nuclear security regimes. This includes addressing gaps in risk assessment, physical protection measures, personnel reliability, and overall capacity. By doing so, they can mitigate security threats and contribute to regional stability and confidence in nuclear security.

- The resilience of Bangladesh's nuclear security regime is considered moderate. The country has made positive progress in enhancing its regulatory framework for nuclear security. However, there are areas that require further development, such as risk assessment and physical protection measures. Addressing these gaps will be crucial to enhance the overall resilience of Bangladesh's nuclear security regime.

- In the case of Malaysia, the robustness of its nuclear security regime is also considered moderate. However, there are areas that reflect less resilience in the face of internal or external challenges. Gaps exist in risk assessment, international legal commitments, and physical protection measures. Addressing these gaps is necessary to enhance the overall resilience of Malaysia's nuclear security regime.
- Similarly, Vietnam's nuclear security regime demonstrates a moderate level of resilience. The country has established organizations and international legal commitments to nuclear security. However, there are gaps in risk assessment, physical protection measures, and a comprehensive perspective on the regime. Strengthening these aspects will be essential to enhance the overall resilience of Vietnam's nuclear security regime.

For Bangladesh, Malaysia, and Vietnam, it is important to prioritize the development and improvement of their nuclear security regimes. This includes addressing gaps in risk assessment, physical protection measures, and international legal commitments. By enhancing the resilience of their nuclear security regimes, these countries can better safeguard their nuclear assets and contribute to regional and global nuclear security efforts.

3.   CONCLUSION

The overall robustness and resilience of nuclear security regimes in Southern Asia play a crucial role in contributing to regional stability. Effective nuclear security measures are essential for preventing the unauthorized acquisition or use of nuclear materials by non-state actors, thereby reducing the risk of nuclear terrorism and promoting a safer environment. The varying levels of resilience among these regimes highlight the importance of international cooperation in strengthening nuclear security. Countries with more robust systems can collaborate with those facing challenges to enhance their capabilities through capacity-building initiatives, information sharing, and joint efforts.

The perception of nuclear security regimes in the region significantly impacts international confidence in the safety and security of nuclear activities. Nations with stronger regimes are likely to enjoy greater trust from the international community, positively influencing their nuclear energy programs, collaborations, and investments in the sector. Therefore, the implications of the differing robustness and resilience of nuclear security regimes underscore the necessity for cooperation, continuous improvement, and capacity-building to ensure the safety and security of nuclear materials and facilities.

To address these challenges, we recommend the following actions:

- Strengthen Regulatory Frameworks: Countries should develop comprehensive regulatory frameworks that align with international standards to enhance the effectiveness of their nuclear security regimes.
- Enhance Capacity Building: Investment in training programs for personnel involved in nuclear security management is essential to improve their ability to respond to potential threats.
- Foster International Cooperation: Engaging in collaborative efforts to share best practices, resources, and knowledge in nuclear security will help address common threats and vulnerabilities.
- Develop Material Risk Assessment Frameworks: Establishing robust material risk assessment frameworks will enable countries to evaluate and mitigate potential security risks associated with nuclear materials and facilities.

For the specific countries included in this study we would suggest the following:

- Bangladesh: Focus on developing comprehensive regulatory frameworks and investing in training programs for nuclear security personnel.
- India: Establish robust material risk assessment frameworks and engage in collaborative efforts with neighboring countries and international organizations.
- Indonesia: Leverage emerging technologies for enhanced monitoring and detection capabilities, while promoting public awareness of nuclear security issues.
- Malaysia: Develop and regularly update incident response protocols and support research initiatives focused on innovative nuclear technologies.
- Pakistan: Invest in training and technical expertise to strengthen nuclear security management and implement comprehensive material risk assessment frameworks.

- Philippines: Establish comprehensive regulations for nuclear activities and utilize advanced technologies for monitoring and analysis.
- Thailand: Increase public engagement regarding nuclear security and develop clear incident response protocols.
- Vietnam: Create a dedicated nuclear security law incorporating design basis threats and focus on building technical expertise and regulatory oversight.

By implementing these recommendations, Southern Asian countries can enhance the resilience and effectiveness of their nuclear security regimes, ensuring the safe and secure utilization of nuclear energy while contributing to regional and global stability.

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