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Strategic Intelligence Analysis in The Integration of National Defense Components to Counter The Threat of Nuclear Terrorism in Indonesia

M. H. Rajagukguk[1*], B. Gunawan[2], M. Santoso[3], B. M. Ratmono[2]

[1] *Master of Medical Intelligence Program, College of Medical Intelligence, Indonesia,*
[2]*State Intelligence Agency, South Jakarta City, Special Capital Region of Jakarta, Indonesia*
[3]*Research Organization for Nuclear Energy (ORTN), National Research and Innovation Agency (BRIN), Jl. Tamansari 71, Bandung, 40132, West Java, Indonesia*

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ABSTRACT

The development of nuclear science presents multifaceted benefits across diverse sectors, including energy, health, construction, agriculture, and food production. However, the proliferation of nuclear technology introduces the complex challenge of dual-use, encompassing both constructive applications and potential misuse for nefarious purposes such as terrorism. Indonesia, like many nations, faces this dual-use dilemma, necessitating robust defense mechanisms to safeguard against nuclear terrorism threats. This study aims to investigate and enhance Indonesia's defense system against nuclear terrorism by emphasizing integration and strategic intelligence within its defense components. The primary objective is to analyze the integration and coordination mechanisms among the main, supporting, and reserve components of Indonesia's defense system to strengthen strategic analysis and intelligence efforts in combating nuclear terrorism threats. Through a qualitative research methodology employing an analytical approach, data collection encompasses expert interviews, observations, and an extensive literature review. The study identifies various threat risks and potential initiators of nuclear terrorism attacks, highlighting the critical role of integrated defense components in addressing these threats effectively. Findings reveal the indispensable roles of the main, supporting, and reserve components in executing intelligence functions, including investigation, security, and information gathering, to mitigate the threat of nuclear terrorism. Despite their distinct roles, these components require seamless integration and coordination to maximize strategic analysis efforts and intelligence sharing. The research identifies several constraints hindering the effective implementation of integration and strategic intelligence within Indonesia's defense components. These constraints necessitate targeted improvements to enhance the nation's capability to mitigate the threat of nuclear terrorism effectively. In conclusion, this study underscores the significance of integration and strategic intelligence within Indonesia's defense system to confront the evolving threat landscape of nuclear terrorism. By addressing research gaps and proposing actionable recommendations, this research contributes to strengthening Indonesia's defense posture against nuclear terrorism, thereby ensuring national security and global stability.

INTRODUCTION

Research on the threat of nuclear terrorism has become a major concern for many scientists and policymakers around the world [1-3]. In recent decades, this research has shown an escalation of concerns over the potential misuse of nuclear technology by terrorist groups. The increasing use of nuclear power for peaceful purposes such as power generation and cancer treatment, as well as the risks associated with the dual use of nuclear technology [4-7]. They note that while the benefits of nuclear technology are significant, the risk of its misuse for terrorism purposes is also growing [8-10]. Research by several investigator has highlighted the

*Corresponding author.
E-mail address: haratuarajagukguk@gmail.com
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need for coordinated international efforts to address the threat of nuclear terrorism [11-13]. They emphasized the importance of multilateral agreements such as the International Convention on the Suppression of Acts of Nuclear Terrorism (ICSANT) in providing a legal foundation for global cooperation in preventing and countering such threats. Indonesia, as mentioned in the research by Trajano and Caballero-Anthony (2020) has committed to countering the threat of nuclear terrorism by ratifying ICSANT and engaging in prevention efforts undertaken by the international community [14]. Challenges remain in implementing the policy, especially in expanding the definition and scope of relevant laws. This research aims to explore effective prevention strategies and strengthen international cooperation in addressing the threat of nuclear terrorism.

This research aims to investigate the challenges and opportunities in efforts to prevent nuclear terrorism in Indonesia, with the main objective of improving understanding of the factors that influence the effectiveness of prevention efforts. Previous studies have highlighted the importance of a comprehensive understanding of the risks and threats of nuclear terrorism as well as appropriate strategies for addressing them [11,15]. A better understanding of these factors can help in identifying more effective strategies to address such threats. For example, Brustlein et al. (2021) show that international cooperation and increasing the capacity of states to detect and respond to the threat of nuclear terrorism are key to reducing the risk [16]. This research also includes an analysis of the integration of state defense components in dealing with the threat of nuclear terrorism. Previous research has highlighted the importance of integration between various agencies and institutions in responding to terrorism threats, including integration between police, military, and intelligence agencies [17-19]. This research examines the implementation of strategic intelligence in the national defense component. Previous research has shown that effective intelligence can be an invaluable tool in detecting and preventing terrorist attacks [20]. Taking these findings into account, this research aims to develop relevant recommendations for the strategic implementation of intelligence and integration of national defense components in countering the threat of nuclear terrorism in the future. This is in line with the findings of previous research that highlighted the importance of concrete and targeted policy recommendations to improve responses to the threat of terrorism [21].

The limitation of this research focuses on the implementation of national defense policy related to managing the threat of nuclear terrorism in Indonesia, with a focus on threat analysis, national defense, and intelligence strategy. Although this research highlights challenges in policy implementation, the role of civil society in preventing nuclear terrorism is also an important aspect that can be further explored.

This research, focusing on understanding and handling the threat of nuclear terrorism in Indonesia, holds important relevance in the context of national and global security. Nuclear terrorism poses a complex and serious threat to world peace, with potentially devastating impacts [22,23]. In addressing this issue, an inclusive approach involving civil society is vital. Previous studies have highlighted the importance of civil society engagement in efforts to prevent nuclear terrorism. Research by several investigators shows that the active participation of civil society can strengthen the nuclear security system by detecting and reporting suspicious activities as well as promoting transparency and accountability in the management of nuclear materials [24,25]. In addition, an in-depth evaluation of existing policies is essential to identify weaknesses and shortcomings in the regulatory framework and law enforcement related to nuclear security. Research by Van Metre et al. (2021) and Padoani (2020) emphasized the need for increased government capacity in responding to the threat of nuclear terrorism, including improved training for security officers and the development of cross-agency coordination mechanisms [26,27]. Cross-border learning about best practices from other countries is also a key component in efforts to prevent nuclear terrorism [3,28]. Several best practices that can be adopted from the experiences of countries such as the United States, Russia, and Israel in managing nuclear terrorism risks, including sophisticated early detection systems and close international cooperation have been identified [29-32]. By combining an inclusive approach involving civil society, an in-depth evaluation of existing policies, and cross-border learning on best practices, this research has the potential to make a significant contribution to global nuclear terrorism prevention efforts.

METHODOLOGY

In this research methodology, data collection was conducted over five months from February to June 2022 in various strategic locations in Jakarta, including BIN Headquarters, Army Headquarters, Navy Headquarters, Police Headquarters, Bakamla

Headquarters, and several other government offices and other related institutions. This research employs a qualitative design with an analytical approach to understand the implementation of intelligence strategies in the integration of national defense components related to the threat of nuclear terrorism in Indonesia [33].

Primary data was obtained through in-depth interviews, observations, and consultations with relevant experts, while secondary data was obtained through reviewing research-related documents. A total of 21 resource persons from various related institutions, including key figures in the field of intelligence and national defense, were involved in this research.

The data collection process was carried out carefully from various sources to ensure the validity of field data [34]. Primary data were obtained through in-depth interviews with directly involved informants, using a specially designed open-ended questionnaire [35-37]. The data analysis process involves data processing and organization, overall understanding of the data, segmentation of sentences into categories, description of information, application of a narrative approach, and interpretation of data for the implementation of strategic intelligence to counter the threat of nuclear terrorism [38].

Data validity checks are carried out using four criteria, namely credibility (internal validation), transferability (external validation), dependability (reliability), and confirmability (objectivity) [39-41]. Data triangulation is done through various techniques and data sources, including in-depth interviews with various informants, as well as reference checking and consultation to maintain data validity and reliability [42,43]. External validity was ensured by compiling detailed interview transcripts, while the objectivity of the research was measured through the agreement of various parties to the research results [44-46].

RESULTS AND DISCUSSION

Results

Risk analysis of nuclear terrorism threat in Indonesia

Through research that combines interview methods and literature studies, it was found that three main categories of nuclear terrorism threats have significant potential in Indonesia. First, the direct risk comes from the use of nuclear weapons, which has the potential for great damage and terrifying terror impact. Second, there is the risk of theft of nuclear materials for explosive weapons purposes or their misuse by terrorist groups. Third, threats arise through physical or cyber attacks on nuclear facilities, which can result in the release of radioactive material into the environment. The research also identifies several groups of actors as potential initiators of nuclear terrorism attacks, including insiders with direct access to nuclear facilities, terrorist groups focused on acquiring nuclear materials, hackers driven by various motivations, criminal organizations, and even states engaged in nuclear attacks against other countries [47-49]. Although Indonesia is relatively safe from recorded nuclear terrorism, the country faces potential threats through its nuclear technology, such as research reactors and the use of nuclear technology in various sectors [50-52]. While the likelihood of the use of nuclear material as a weapon of terrorism remains low, the risk of smuggling material from nuclear facilities, both raw materials and waste, remains significant [1,53,54]. Therefore, it is recommended that the Indonesian government remains vigilant against the potential threat of nuclear terrorism, focusing on monitoring potential initiators of nuclear terrorism attacks. This effort aims to prevent the threat of nuclear terrorism attacks in Indonesia, ensure security, and maintain the sustainable use of nuclear technology in various sectors.

The role of national defense components in confronting the threat of nuclear terrorism

The results show that the integral role of Indonesia's defense and security institutions in dealing with the threat of nuclear terrorism has been revealed. Indonesian National Army (TNI), through various aspects of prevention, prosecution, and recovery, is involved in addressing this potential threat. Koopsusgab, as part of the TNI, has a role in surveillance, early detection, and handling of potential terrorism cases [55]. Indonesian National Police (Polri) has a strategic role in maintaining public security, and the Gegana Unit of Polri's Korbrimob is actively improving its capabilities in dealing with nuclear hazards [56]. Indonesian State Intelligence Agency (BIN) carries out its role in early detection and prevention, while the National Defense Council of the Republic of Indonesia (Wantannas) sets national security policy and identifies risks related to nuclear technology [57]. Other institutions such as Indonesian Marine Security Agency (Bakamla), National Counterterrorism Agency of the Republic of Indonesia (Bakamla), National Innovation Research Agency (BRIN), Nuclear Energy Regulatory Agency (Bapeten), State Cyber and Crypto Agency (BSSN), and Defense University of the Republic of Indonesia (Unhan) also

have important roles in monitoring, handling, and understanding the threat of nuclear terrorism to maintain national security, safety, and preparedness.

Integration of national defense components in facing the threat of nuclear terrorism

The results of this research reveal that the TNI Zeni Unit has managed to form effective partnerships with other defense components, especially in the context of personnel training. By identifying two main categories of training, namely graded training ranging from basic to technical Nuclear, Biological, and Chemical (Nubika), and non-graded training including position tests and individual expertise, it is evident that through various training programs, such as technical investigation, shooting, decontamination, and Platoon Nubika, they managed to improve their capabilities in dealing with the threat of nuclear terrorism. Polri has also proven capable of integrating with defense components in tackling nuclear terrorism, particularly through joint training with the Nuclear Engineering Department at Gadjah Mada University. Brimob Polri is actively expanding the understanding and skills of its personnel to face and address the impact of such threats. In the realm of nuclear terrorism-related intelligence, BIN effectively played a role by working with BRIN to build nuclear chemistry expertise at the State Intelligence School. They also led efforts to investigate and analyze nuclear radiation threats, enhancing not only nuclear security but also cross-agency cooperation. National Defense Council of the Republic of Indonesia (Wantannas) demonstrated an effective structure in integrating national defense components, creating a platform for cross-agency collaboration to strengthen national security-related policies, particularly nuclear threat-related issues. Bakamla successfully established effective synergy with BNPT in countering nuclear terrorism, enhancing maritime territorial security as well as personnel capacity in addressing nuclear radiation hazards in Indonesian waters. BNPT, as the national program coordinator for counter-terrorism, plays a crucial role in bringing together institutions and communities to confront nuclear terrorism, focusing on deradicalization, counter-radicalization, and prevention through technology. BRIN successfully initiated training and national strategies to address the threat of terrorism, including nuclear, through effective coordination with various components of national defense as well as the wider community.

Fig. 1. Simulation of counterterrorism measures at RSG GA Siwabessy nuclear facility.

Figure 1 shows a simulation of counter-terrorism measures at the RSG GA Siwabessy Nuclear Facility [58]. This simulation depicts a scenario outlining the steps taken to address the threat of terrorism at the facility. Through this figure, it can be observed how various security and law enforcement units work together to protect the facility from potential terrorist attacks. The image provides a visual depiction of the coordination and strategies implemented in maintaining the security of the nuclear facility.

The research focuses on designing a national training scenario depicting a nuclear terrorism situation. The research refers to the IAEA guidelines for improving national defense preparedness [59-61]. One example is the simulation of handling terrorism threats at the RSG GA Siwabessy Nuclear Facility [62]. The information system protection and security efforts undertaken by BRIN and BSSN aim to protect nuclear facilities from cyberattacks with robust and standardized networks and prevent espionage. Bapeten and ORTN BRIN also engage in collaboration to improve information system security, avoiding cyber espionage through reliable software updates. Their strategic cooperation, especially in IRSRR for Kartini Reactor, utilizes the Internet Reactor Laboratory to operate the reactor in real-time. Despite having different roles, Bapeten and ORTN BRIN managed to overcome the challenges faced, strengthening their relationship for the advancement of nuclear technology. They realized the importance of synergy in supporting the development of nuclear technology in Indonesia. Through integration with BRIN, BSSN is responsible for maintaining the cybersecurity of nuclear reactor facilities. They utilize a layered system, early detection, and provide alerts to BATAN to perform manual actions to secure the system, preventing an operational takeover of the facility. The University of Defense also plays an important role with its cyber lab, which aims to protect the network security systems of government facilities. Their collaboration with the Ministry of Defense allows the IDU to actively

contribute to responding to the threat of nuclear terrorism in Indonesia.

Strategic intelligence implementation in national defense components to counter the threat of nuclear terrorism

The results of this research reveal that the implementation of intelligence strategy in the national defense component, particularly in the Indonesian National Army (TNI), has proven effective in dealing with the threat of nuclear terrorism. The TNI Strategic Intelligence Agency (BAIS TNI) plays a key role in organizing an efficient intelligence function, demonstrating its success through careful implementation [63]. In dealing with the potential threat of nuclear terrorism, TNI carries out the strategic role of BAIS TNI's Medical Intelligence Unit (Satintelmed). Satintelmed is actively involved in the detection of potential threats, including the nuclear threat represented by Nubika, in all areas guarded by TNI personnel. This approach allows for quick and accurate identification of nuclear terrorism threats at various regional levels. This research also highlights the application of the intelligence function to TNI human resources through the profiling process. Profiling is conducted to identify TNI members who may be exposed to radicalism or have thoughts that are contrary to the ideology of Pancasila [64,65]. This profiling effort enables the identification of potential threats from within the TNI, which can be addressed immediately to ensure the security and integrity of the organization.

In the context of the Indonesian National Police Security Intelligence Agency, the Indonesian National Police (Polri) plays a major role in conducting nuclear threat investigations with nuclear terrorism assessment expertise [55]. Polri not only mobilizes the public and expert figures to support national defense but also ensures careful management of sensitive information related to nuclear materials, preventing misuse by personnel [66].

The National Intelligence Agency (BIN) has proven to consistently apply a strategic intelligence approach in dealing with the threat of nuclear terrorism. Through its investigation, mobilization, and security functions, BIN proactively detects potential threats from internal and external sources, strengthening efforts to prevent nuclear terrorism.

The National Resilience Council (Wantannas) conducts strategic intelligence efforts involving leaders of relevant institutions, strengthens joint efforts in maintaining national resilience, designs national policies, and reports them to the President for immediate implementation.

The Republic of Indonesia Marine Security Agency (Bakamla) has successfully implemented an effective intelligence strategy in the territorial waters, including investigation, mobilization, and security functions. Bakamla actively conducts surveillance of suspicious vessels, detects radiation from radioactive materials, and cooperates with other government agencies for law enforcement against illegal vessels.

The National Counterterrorism Agency (BNPT) focuses on deradicalization and counter-radicalization in tackling the threat of nuclear terrorism. BNPT successfully identified the motivation and ideology of potential acts of nuclear terrorism through in-depth investigations of terrorism convicts, ex-convicts, and terrorism group networks.

The National Research and Innovation Agency (BRIN) designed an effective physical and information protection strategy for nuclear facilities in Indonesia [67]. The concept of layered protection involves security posts with 24-hour surveillance, random patrols, and information security to prevent cyberattacks and misuse of access by human resources that could potentially threaten national security [68]. This approach emphasizes BRIN's role in protecting nuclear facilities from various threats, including potential terrorist attacks.

Figure 2 shows the security post in the RSG GA Siwabessy Nuclear Facility area [69]. This security post is designed to monitor and control access to the nuclear facility. It can be seen that this security post is equipped with a fence and other security systems to control the traffic of vehicles and people entering the area. The existence of this security post demonstrates the importance of security efforts around nuclear facilities to prevent potential threats or unauthorized access [70].

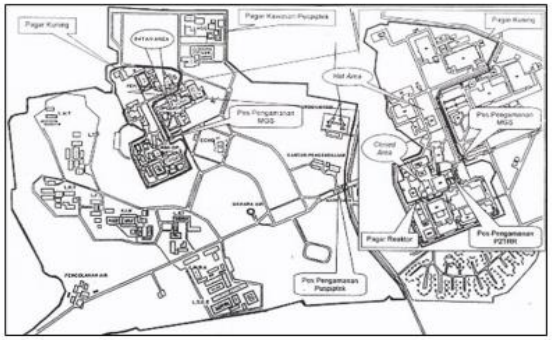

Fig 2. Security post at the RSG GA Siwabessy nuclear facility area.

Based on the research results, the Nuclear Energy Regulatory Agency (Bapeten) has successfully implemented an intelligence strategy to protect the country from the threat of nuclear terrorism. They conduct investigations through nuclear technology inspections, implement security policies at facilities, and collaborate with other government agencies. The National Cyber and Crypto Agency (BSSN) is also effective in applying intelligence principles, such as mapping online conversations related to nuclear threats and detecting cyberattacks on nuclear infrastructure. The Defense University (Unhan) also plays a role by utilizing cyber laboratories, involving civil society in national defense, and implementing a cyber backup system to protect government networks. The results of the research confirm the great contribution of these three institutions in keeping the country safe from the threat of nuclear terrorism through effective intelligence strategies.

Implementation of international cooperation in addressing the threat of nuclear terrorism

The results confirmed that the cooperation program between the United States (US) and Russia successfully established an effective strategy for preventing nuclear terrorism by raising awareness of the threat. Collaboration between terrorism, nuclear security, and intelligence agencies and experts helped formulate a joint strategy to address potential nuclear attacks by terrorist groups [71,72]. It is evident that this cooperation not only enhances joint assessments of potential threats but also supports cross-sector cooperation to prevent nuclear attacks by terrorist groups. The results revealed Russia's important role in the development of nuclear technology, with uranium conversion infrastructure and uranium enrichment capacity reaching a significant percentage globally [73,74]. Cooperation between Indonesia and Russia, especially through Rosatom, has also proven to provide great benefits in the construction of Nuclear Power Plants (PLTN) in Indonesia, as well as strengthening Indonesia's nuclear industry with modern and sustainable technology [75]. This shows that international cooperation in dealing with nuclear threats is not only important in building trust and improving defense capabilities but also supports the country's industrial and technological growth.

Recommendations for the implementation of strategic intelligence and integration within national defense components in confronting the threat of nuclear terrorism

Based on the results of the research, it was found that the implementation of intelligence and integration strategies in 84 national defense components to address the threat of nuclear terrorism faces several obstacles. These obstacles include the need to improve integration between components, the need for a centralized coordinator and clear legal references, improvement of detection facilities, enhancement of personnel knowledge, socialization of technical guidelines, understanding of perpetrators' motivations, budget optimization, and integration between military units and researchers. As recommendations from this research, focus needs to be given to several key aspects.

First, a centralized coordinator and strict legal references are needed to ensure that each component performs its role without overlap or egocentricity. Second, the national defense component must increase efforts to investigate and detect the threat of nuclear terrorism, both from abroad and within the country. Third, it is necessary to increase the utilization of nuclear radiation detection facilities to support investigation efforts. Fourth, it is important to optimize the budget for developing physical and cyber security systems at nuclear facilities. Fifth, integration between military units and researchers should be improved, through knowledge exchange and cooperation in preparedness. Terrorist profiling, deradicalization efforts, and cooperation between institutions such as TNI, Polri, BIN, Wantannas, Bakamla, BNPT, BRIN, Bapeten, BSSN, and IDU are essential to address the threat of nuclear terrorism. By implementing these recommendations, it is hoped that the performance of each component of national defense can be strengthened in dealing with these threats.

DISCUSSION

The findings of the research, which combines interview methods and literature studies on the threat of nuclear terrorism in Indonesia, revealed that three main categories of nuclear terrorism threats have significant potential. First, there is the direct risk of the use of nuclear weapons, which can produce large and terrifying destructive impacts. Second, the threat comes from the potential theft of nuclear materials for explosive weapons purposes or their misuse by terrorist groups. Third, threats arise from physical or cyber attacks on nuclear facilities, which can lead to the release of radioactive material into the

environment. These findings are in line with previous research that highlights the importance of identifying the different types of nuclear threats that can arise, whether through the use of nuclear weapons, misuse of nuclear materials, or attacks on nuclear facilities [72,76]. These categories are considered significant due to their potential to cause widespread damage and dire impacts on public safety and security and the environment.

Based on the results of research integrating interview methods and literature studies, several groups of actors were identified as potential initiators of nuclear terrorism attacks. These include insiders with direct access to nuclear facilities, terrorist groups focused on acquiring nuclear materials, hackers driven by various motivations, criminal organizations, and even states involved in nuclear attacks against other countries. Previous research has also highlighted the important role these groups play in countering the threat of nuclear terrorism. For example, research by [77-79] shows that terrorist groups oriented toward acquiring nuclear materials often have access to black markets and illegal networks to acquire nuclear materials. Meanwhile, research by [80,81] highlights how hackers with political or economic motivations can exploit security gaps in nuclear systems to steal information or damage infrastructure. The implication of these findings is the importance of close surveillance and cross-agency cooperation in monitoring the activities and impeding the efforts of these groups in planning and executing nuclear terrorism attacks.

Although Indonesia has not officially recorded nuclear terrorism, previous research has shown that the country remains vulnerable to the threat of nuclear terrorism [51]. The results of the research, which integrates interview methods and literature studies, confirm that Indonesia has the potential threat of nuclear terrorism through the use of nuclear technology in various sectors, such as research reactors and other uses of nuclear technology. In addition, previous research also identified the risk of smuggling nuclear materials from nuclear facilities, both in the form of raw materials and waste, which can be utilized for terrorism purposes [82]. While the likelihood of nuclear material being used as a weapon of terrorism is still considered low, the risk of smuggling and misuse of nuclear material remains significant [83]. Therefore, although there is no official record yet, the Indonesian government needs to remain vigilant against the potential threat of nuclear terrorism and take appropriate preventive measures to maintain national security.

Based on the results of the research, there are several obstacles and constraints faced in the implementation of intelligence and integration strategies in Indonesia's national defense component in facing the threat of nuclear terrorism [84,85]. Previous studies have shown that one of the main obstacles is the need to improve integration between defense components to ensure optimal synergy in answering the threat [86]. Effective coordination between various institutions, such as TNI, Polri, BIN, and other related agencies, is also a major challenge in ensuring harmony in efforts to prevent and counter terrorism [87]. Limited human resources and budget are also factors that complicate the implementation of this strategy, thus requiring optimization of the allocation of available resources and funds. The importance of an in-depth understanding of perpetrators' motivations as well as monitoring the development of nuclear terrorism technology and tactics also points to the need to increase the capacity of detection personnel and facilities [88].

The recommendations of this research can be considered as a strong foundation to strengthen the performance of each component of national defense in facing the threat of nuclear terrorism in Indonesia. Referring to previous research findings by Christensen et al. (2015) highlighting the importance of effective coordination between various defense and security agencies in dealing with the threat of terrorism, the recommendations underline the need for a centralized coordinator and clear legal references [89]. Doyle (2011) also shows that strong integration between national defense components is critical to optimizing responses to terrorism threats [90]. Therefore, implementing these recommendations will provide a stronger framework for each national defense component to collaborate more effectively in detecting, preventing, and mitigating the threat of nuclear terrorism. In addition, recommendations to improve the utilization of nuclear radiation detection facilities, optimize the budget for the development of physical and cyber security systems at nuclear facilities, and strengthen integration between military units and researchers are also in line with the emphasis of the National Defense Strategy [88,91,92] to the importance of improving investigation and detection capabilities against the threat of nuclear terrorism.

Collaboration between the United States (US) and Russia has a significant role in dealing with the threat of nuclear terrorism in Indonesia [93]. Previous research shows that international cooperation on nuclear security can raise awareness of the threat and formulate joint strategies to prevent nuclear attacks by terrorist groups [94]. In the

Indonesian context, this cooperation has important impacts on national defense and the nuclear industry. First, through this cooperation, Indonesia can obtain a joint assessment with partner countries regarding the potential threat of nuclear terrorism and strategies to deal with it, thus strengthening national security. Second, collaboration between the US and Russia in the development of nuclear technology can support the development and management of nuclear infrastructure in Indonesia, such as Nuclear Power Plants (PLTN), and strengthen Indonesia's nuclear industry with modern and sustainable technology. Thus, this international cooperation is not only important to strengthen Indonesia's national defense from the threat of nuclear terrorism, but also to support the progress and sustainability of the nuclear industry in Indonesia. These questions can open an in-depth discussion about the research results and their implications for prevention and countermeasures against the threat of nuclear terrorism in Indonesia.

CONCLUSION

This research identifies four forms of nuclear terrorism threats in Indonesia, including the use of nuclear weapons, theft of nuclear materials, physical attacks on nuclear facilities, and cyber attacks. Potential actors include insiders, terrorist extremist groups, hackers, criminal organizations, and even the state. In responding to this threat, national defense components, such as TNI, Polri, BIN, and others, collaborate with the implementation of intelligence strategies as an integrated effort to build a national defense against nuclear terrorism. Cooperation between national defense components is key in responding to the complexity of these threats.

To maximize the implementation of intelligence strategy and the integration of national defense components, some suggestions can be proposed. First, it is necessary to maximize integration between national defense components to improve coordination and effectiveness of responses to threats. Second, it is important to realize the existence of a centralized coordinator who can firmly integrate each component of national defense. The establishment of clear regulations as a legal reference needs to be done to support the implementation of integration between national defense components. Improving the quality and quantity of supporting facilities, along with increasing the insight of national defense component personnel, can be an important step in strengthening defense against the threat of nuclear terrorism.

The socialization of clear technical instructions regarding the separation mechanism between aspects of nuclear research and security is expected to avoid misunderstandings. In addition, maximum efforts are needed in the observation and deradicalization of terrorist groups, while optimizing the budget to improve the security system of vital objects and nuclear facilities.

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AUTHOR CONTRIBUTION

The primary authors of this paper include Michael Haratua Rajagukguk, retired Police General Prof. Dr. Budi Gunawan, S.H., M.Si, Prof. Dr. Muhayatun Santoso, and Police Brigadier General Dr. Barito Mulyo Ratmono, S.H., S.I.K., M.Si. All authors have thoroughly reviewed and endorsed the final iteration of the paper.

REFERENCES

1. A. W. Ajlouni, M. M. Alnairi, K. S. Albarkaty *et al.*, J. Radiat. Res. Appl. Sci. **16** (2023) 100572.
2. A. M. Pluta and P. D. Zimmerman, Surv. **65** (2023) 55.
3. E. O. Onyeanu, E. M. Ikechukwu, A. T. Ahmed *et al.*, Int. J. Innov. Sci. Res. Technol. **8** (2023) 2585.
4. W. J. Nuttall, Nuclear Renaissance: Technologies and Policies for the Future of Nuclear Power, 2nd ed, CRC Press, Boca Raton, Florida (2022).
5. G. Halkos and A. Zisiadou, J. Risk Financial Manag. **16** (2023) 45.
6. W. Allison, Confidence in Nuclear Energy, Note 37, The Global Warming Policy Foundation, London (2023) 10.
7 M. Z. Teshome, Eur. J. Law Polit. Sci. **2** (2023) 20.
8 M. F. Bastug and I. Onat, Oxford Research Encyclopedia of Criminology & Criminal Justice, Oxford (2024).

9. F. K. Ata, *Nuclear Security: Weapons and Feaceful Uses in Term of Security*, in: Security Studies: Classic to Post-Modern Approaches, Lexington Books, Lanham, Maryland (2023) 261.
10. C. S. Adigwe, N. R. Mayeke, S. O. Olabanji *et al.*, Asian J. Econ. Busin. Acc. **24** (2024) 289.
11. M. A. Alkış, Int. J. Nucl. Secur. **7** (2022) 17.
12. S. Kleinert, The Grand Unified Theory of Nuclear Terrorism Response, APSA Preprints. https://preprints.apsanet.org/engage/api-gateway/apsa/assets/orp/resource/item/65b865b366c13817298a6b6a/original/the-grand-unified-theory-of-nuclear-terrorism-response.pdf. Retrieved in February (2024)
13. C. Ejova, CES Work. Pap. **2** (2023) 173.
14. J. C. Trajano and M. Caballero-Anthony, Int. J. Nucl. Secur. **6** (2020) 8.
15. S. Nair, A. Pluff and C. McAllister *et al.*, The Threat from Within: An Overview of the Domestic Violent Extremist Threat Facing U.S. Nuclear Security Practitioners, Stimson Center, Washington, D.C. (2023) 1.
16. C. Brustlein, Strategic Risk Reduction Between Nuclear Weapons Possessors, Institut Français des Relations Internationales (IFRI), Paris (2021) 11.
17. L. E. Wilson, M. P. Kessler, J. Ellis-Smith *et al.*, WIREs Forensic Sci. **2** (2020) e1358.
18. P. F. Walsh, Intell. Natl. Secur. **32** (2017) 548.
19. S. M. S. Kabir, Basic Guidelines for Research: An Introductory Approach for All Disciplines, Book Zone Publication, Cittagong **4** (2016) 168.
20. K. A. Duncan, *The Role of Intelligence in the Prevention of Terrorism (Early Warning – Early Response)*, in: Handbook of Terrorism Prevention And Preparedness, International Centre for Counter-Terrorism (ICCT), Den Haag (2020) 620.
21. M. Phelps, J. Secur. **34** (2021) 599.
22. J. Johnson, N. Ritchie and M. Kupriyanov, Federal Ministry for European and International Affairs Department for Disarmament, Wina (2023) 116.
23. V. Narang and S. D. Sagan, *The Fragile Balance of Terror: Deterrence in the New Nuclear Age*, Cornell University Press, New York (2023) 270.
24. M. Bunn and N. Roth, *The Past and Potential Role of Civil Society in Nuclear Security*, in: International Conference on Nuclear Security, IAEA, Wina (2020) 1.
25. S. Nair, C. McAllister, A. Trentham *et al.*, Bias in Nuclear Security Implementation: Solutions to Identify Threats and Strengthen Security Culture in the United States, Stimson Center, Washington, D.C (2023) 1.
26. L. Van Metre, Responding to Violent Conflicts and Humanitarian Crises: A Guide to Participants, Springer Nature , Cham (2021) 89.
27. F. Padoani, Int. J. Nucl. Secur. **6** (2020) 5.
28. H. Niittymäki, Highlights of International Cooperation for Safety, Security and Safeguards in 2023, Säteilyturvakeskus (STUK), Helsinki (2024).
29. S. Bar, Compar. Strategy **39** (2020) 321.
30. A. Polyakov, Russian-American Nuclear Nonproliferation Dialogue: Lessons Learned and Road Ahead, Springer Nature, Singapore (2022) 235.
31. R. F. S. Budi and Suparman, Atom Indones. **46** (2020) 1. (in Indonesian)
32. R. Weitz, M. Hoell, K. Isozaki *et al.*, Strengthening International Cooperation in Managing China-Related Proliferation Challenges, Hudson Institute, Washington, D.C. (2023).
33. G. R. Gibbs, The SAGE Handbook of Qualitative Data Analysis, SAGE Publications Ltd, London (2014) 277.
34. G. Guest, E. E. Namey and M. L. Mitchell, Collecting Qualitative Data: A Field Manual for Applied Research, Sage Publications, Inc., California (2013).
35. S. S. Puleh, E. A. Ikwara, S. Namutebi *et al.*, BMC Health Serv. Res. **23** (2023) 394.
36. N. Osborne and D. Grant-Smith, Methods in Urban Analysis, Springer, Singapore (2021) 105.
37. A. L. P. Carvajal and R. D. Sanchez, Int. J. Open-access, Interdiscip. New Educ. Discov. (iJOINED ETCOR) **3** (2024) 380.
38. M. Abdalsalam, C. Li, A. Dahou *et al.*, CMES **138** (2023) 1427.
39. N. Nasir and S. Sukmawati, Edumaspul: Jurnal Pendidikan **7** (2023) 368. (in Indonesian)

40. N. Singh, M. Benmamoun, E. Meyr *et al*., Int. Mark. Rev. **38** (2021) 1289.
41. O. C. Enworo, Qual. Res. J. **23** (2023) 372.
42. A. M. Solarino and H. Aguinis, J. Manag. Stud. **58** (2021) 649.
43. T. Phuthong, TEM J. **12** (2023) 1142.
44. A. V. Güntner, A. L. Meinecke and Z. E. Lüders, Leadersh. Q. **34** (2023) 101751.
45. S. Sumrin and S. Gupta, *Establishing Validity and Reliability in Case Study Research Projects*, in: The Routledge Companion to Marketing Research, Routledge, London (2021) 119.
46. J. Liff, N. Mondragon, C. Gardner *et al.*, J. Appl. Psychol. **109** (2024) 921.
47. C. J. Thompson, J. P. Thompson, and M. A. Burgman, Conserv. Biol. **17** (2003) 901.
48. G. Bunn, C. Braun, A. Glaser *et al.*, Sci. Glob. Secur. **11** (2003) 85.
49. E. B. Montgomery, Nuclear Terrorism: Assessing the Threat, Developing a Response, Center for Strategic and Budgetary Assessments (CSBA), Fairfax, Virgina (2009) 1.
50. M. Caballero-Anthony, A. D. Cook, J. C. I. Trajano *et al.*, The Sustainability of Nuclear Energy in Southeast Asia: Opportunities and Challenges, S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University, Singapore (2014) 1.
51. N. Busch, Contemp. Secur. Policy **23** (2002) 19.
52. D. S. Wisnubroto, K. Khairul, F. Basuki *et al.*, Heliyon **9** (2023) e15685.
53. G. R. Eppich, Bull. At. Sci. **76** (2020) 263.
54. M. J. Hashmi and A. Ahmed, J. Glob. Peace Secur. Stud. **3** (2022).
55. Y. Djuyandi, H. Casnoto, M. N. Iriansyah *et al.*, Kurd. Stud. **11** (2023) 1709.
56. R. A. Zulfikar and B. Erlina, J. Manag. Bus. Soc. Sci. **1** (2023) 136.
57. L. Wahjudin, JISIP 7 (2023) 3357. (in Indonesian)
58. S. H. Sumantri, S. Maarif, B. A. Yulianto *et al.*, Int. Rev. Manag. Mark. **9** (2019) 57.
59. D. Shull, Experiences of Member States in Building a Nuclear Security Infrastructure for New Nuclear Power Programmes, Lawrence International Atomic Energy Agency (IAEA), Vienna (2023).
60. D. Apriliani, S. Maarif and H. Heridadi, *The Conception of National Nuclear Emergency Preparedness System from the State Defense Perspective*, in: Proceedings of the 6th International Symposium on Current Progress in Mathematics and Sciences 2020 (ISCPMS), AIP Conf. Proc. 2374 (2021) 060010-1.
61. S. S. Saindane, S. Murali, S. D. Dhole *et al.*, Radiat. Prot. Environ. **44** (2021) 47.
62. I. Soeparna and J. Tanega, Yuridika **37** (2022) 317.
63. M. Suharmono, Akim and A. Sudirman, Cent. Eur. J. Int. Secur. Stud. **13** (2019) 65.
64. I. Wardana, Using Social Network Analysis to Inform an Effective Approach to Counter Radical Islamic Groups In Indonesia, Ph.D. Thesis, Naval Postgraduate School, Monterey, California (2022).
65. N. K. Bintarsari, Countering Terrorism in Indonesia: A Study of Policy in Counter-Terrorism Measures of the Indonesia National Counter-Terrorism Agency (Badan Nasional Penanggulangan Terorisme/BNPT), Ph.D Thesis, The State University of New Jersey, 2022
66. A. Paripurna, The Use of Intelligence in Indonesian Counter-Terrorism Policing, Ph.D. Thesis, University of Washington, 2017.
67. A. Mardha, A. Mardhi, T. Asmoro *et al.*, *Nuclear Security Policy Challenges and Strategies in The Serpong Nuclear Area: A Regulatory Review*, in: International Conference on Nuclear Science, Technology, and Applications – ICONSTA, AIP Conf. Proc. **2967** (2024) 150005.
68. K. J. Hayward and M. M. Maas, Crime Media Cult. **17** (2021) 209.
69. A. C. Syuryavin, S. H. Lee and N. S. Syam, J. Nucl. Sci. Technol. **57** (2020) 1131.
70. G. Chapman, R. Earnhardt, C. Hobbs *et al.*, J. Sci. Secur. Stud. **10** (2021) 123.
71. F. Lentzos, M. S. Goodman and J. M. Wilson, Intell. Natl. Secur. **35** (2020) 465.
72. A. Adami and R. Bakhshi, Q. J. Polit. Stud. Islam. World **9** (2021) 75.
73. T. Meyer, Resour. Policy **86** (2023) 104318.
74. E. Brutschin, *Chapter 20: A new hope for nuclear*, in: Handbook on the International Political Economy of Energy and Natural Resource, Edward Elgar Publishing, Cheltenham **(**2023) 372.

75. M. A. Rahmanta, A. C. Adhi, H. B. Tambunan *et al*., Energies **16** (2023) 8089.
76. A. S. Krass, P. Boskma, B. Elzen *et al.*, Uranium Enrichment and Nuclear Weapon Proliferation, Taylor & Francis, Oxfordshire, (2020).
77. M. Kibaroglu, *Countering WMD Terrorism Good Practices for Safeguarding The CBRN Material*, in: Good Practices in Counter Terrorism, Centre of Excellence Defence Against Terrorism (COE-DAT), Ankara (2021).
78. M. L. Moal, Contemp. Challenges **1** (2020) 43.
79. E. Coetzee, Between Promise and Peril: African Security in the 21st Century, Institute for African Studies of the RAS, Moscow (2023).
80. M. Lehto, *Cyber-Attacks Against Critical Infrastructure*, in: Cyber Security: Critical Infrastructure Protection, Springer International Publishing, Cham (2022) 3.
81. N. Katagiri, Int. Rev. Law Comput. Technol. **37** (2023) 274.
82. International Atomic Energy Agency (IAEA). Combating Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6 Vienna (2007).
83. R. Chesney, Loy. L.A. Int'l & Comp. L. J. **20** (1997) 29.
84. I. Gindarsah and A. Priamarizki, *Politics, Security and Defense in Indonesia: The Pursuit of Strategic Autonomy*, in: Indonesia's Ascent: Power, Leadership, and the Regional Order, England (2015) 130.
85. N. Asmoro, Marsetio, S. Zuhdi, J. Posit. Sch. Psychol. **6** (2022) 955.
86. M. A. Hikam, Global: Jurnal Politik International **17** (2015) 1. (in Indonesian)
87. E. Setyanto, Jurnal Strategi Pertahanan Darat, **8** (2022) 41. (in Indonesian)
88. National Research Council (NRC), Natl. Acad. Press (2002) 52.
89. T. Christensen, P. Lægreid and L.H. Rykkja, Int. Rev. Adm. Sci. **81** (2015) 352.
90. Department of Defense (DoD), Technology Readiness Assessment (TRA) Deskbook, Deputy Under Secretary of Defense for Science and Technology (DUSD(S&T)), Washington, D.C. (2005).
91. National Research Council, Performance Metrics for the Global Nuclear Detection Architecture: Abbreviated Version, The National Academies Press, Washington, D.C (2013) 1.
92. J. Doyle, Nuclear Safeguards, Security and Nonproliferation: Achieving Security with Tekhnology and Policy, Elsevier, Amsterdam (2011) 1.
93. A. Khlopkov, D. Konukhov, B. Lee *et al*., U.S.-Russian Partnership for Advancing a Nuclear Security Agenda, Center for Nonproliferation Studies (CNS), Vienna (2012).
94. S. Moore and K. Pease. Police J. **97** (2023) 541.