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Policy and Guidelines on Nuclear Disaster Threat Management in Indonesia: Comparing Expectation and Reality

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Abstract

The research analyzed policies and guidelines for dealing with nuclear disaster threat in Indonesia within a collaborative approach. A case study qualitative method was used to explore and analyze the nuclear disaster threat policy and guidelines in Indonesia. The research was based on LIPI-UNESCO/ ISDR indicators on natural disaster preparedness and IAEA parameters on nuclear emergency preparedness requirements). Results showed that policies and guidelines on dealing with nuclear disaster threat in Indonesia are still deficient (34.1%); and there is no synergy and integration of policies and guidelines on preventing nuclear emergency between nuclear technology users and nuclear energy regulators on one hand and disaster management policies and guidelines at the local and national government level. Thus, enhancing policies and guidelines on dealing with nuclear disaster threats, there is need for National Disaster Management Agency (BNPB) to undertake collaborative governance policies with related ministries/ agencies, facilitate the integration of nuclear hazard regulations into disaster management regulations, and facilitate the establishment of national nuclear disaster management organizations.

Keywords: *disaster; guide; nuclear; policy; preparedness; threat*

INTRODUCTION

In 2015, the Organization for Economic Cooperation and Development (OECD) Council, issued a recommendation on the governance of critical risk, advising its member states to establish and promote a comprehensive, all-hazards and transboundary approach to state risk governance that serves as a foundation for enhancing national resilience. Acknowledging the importance of the all-hazard approach, the IAEA (2015) recommended the integration of a nuclear emergency management system into an all-hazard emergency management system. An example of the events of September 11, 2001, as well as the spread of anthrax virus, and a mouth and nail disease epidemic in the United Kingdom, raised awareness of the United States government about the importance of preparedness and response capability to deal with all types of disaster threats (Annelli, 2006). Disaster risk management should be integrated since the risk itself has become integrated in the sense of "systemic" in the modern world (Wisner, 2011). Having lessons learned from Fukushima nuclear disaster in Japan in 2011, the ambiguous role of private companies and government agencies during the crisis was the main cause of a weak nuclear disaster emergency response in Fukushima (Funabashi & Kitazawa, 2012).

Nuclear technology is in use in various sectors in Indonesia. Data from the Nuclear Energy Regulatory Agency (BAPETEN) as of August 13, 2019, there were 12,496 licenses of nuclear energy issued in the country to several uses of nuclear energy including, 6,721 licenses in the field of medicine; 5,754 licenses in industry; and 21 licenses in nuclear installations.

While Indonesia has not yet had an event falls into nuclear accidents category, in its nuclear emergency report database, BAPETEN contains records of some past incidents that involved the use of nuclear energy in medical and industrial fields (BAPETEN, 2015) (BAPETEN, 2016). While past nuclear energy related incidents have had no serious impact on local communities, including the recent radiology energy dissipation incident at Batan Indah Housing in South Tangerang City (Info BAPETEN, 2020; Press Releases BATAN, 2020; Tempo.Co, 2020; Kompas.com, 2020), Indonesia need to take important lessons from nuclear disaster cases that occurred in other countries on how to develop and establish sound and effective policies and guidelines to anticipate the eventuality of a nuclear disaster threat. This is also important as an integral part of enhancing the country's national resilience and national security.

Besides, the latest challenges relate to the plan to develop an Experimental Power Reactor in Puspiptek area, Serpong. The main aim of the reactor development is to conduct research and development of nuclear technology in the energy sector in furtherance of the overarching goal of improving the quality of Indonesian human resources in the field of nuclear energy one of the sources of new and renewable energy. BATAN al-

ready has a license for the reactor site issued by BAPETEN (No. 001 / IT / Ka-BAPETEN / 23-I / 2017 concerning Non-Commercial Power Reactor License, dated January 23, 2017. The reactor is aimed at serving as both a power plant reactor and an experimental heat process application reactor as part of equipping Indonesian human resource with knowledge and expertise in nuclear technology. Thus, while nuclear energy use as a source of energy has the potential to contribute to improving the welfare of Indonesians, the potential negative impact its misuse or failure may have on community and national healthy and security should be anticipated by the government, business sector, and community. The research is based on a case study in South Tangerang City, which is the largest nuclear facility in Indonesia. Nuclear energy use has radiation risk hazards. In that backdrop, this research investigated the status and developments of policies and guidelines on nuclear disaster management preparedness in Indonesia.

This research contributes to previous knowledge and practices on policies and guidelines on nuclear disaster emergency prevention and management. Indonesia lacks an effective nuclear disaster threat management regime because the country does not have a nuclear disaster management organization, policies and guidelines on nuclear disaster threat management are lacking, not incorporated and translated policies and guidelines on disaster management at the local government and central government levels, absence of nuclear disaster management systems, unclear allocation of funds for nuclear disaster threats at both local government and at national government levels, and absence of policies and guidelines on radiation protection strategies and nuclear disaster emergency response. Research findings, thus, break the mold by tackling an issue that while crucial for national energy security, has issues that still need resolving. Developing a collaborative governance framework that involves all key stakeholders at the local and national government is proposed as imperative for improving the country's preparedness for nuclear disaster that will arise either because of misuse of nuclear materials or failure of nuclear reactors and nuclear use cases arising from technical factors and negligence.

Disaster preparedness policies and guidelines are concrete efforts to carry out disaster preparedness activities. Policies are outlined in various forms, but are more meaningful if they are regulations such as decrees or regulations accompanied by clear job descriptions. Meanwhile, operational guidelines are required to ensure optimal policy implementation (LIPI-UNESO/ISDR, 2006). Since disaster management is a multi-agency activity (Maarif, 2006), nuclear disaster management policy is a collaborative policy that involves collaboration of existing resources, from business sector, local governments, and the central government. Due to limited capabilities, resources and networks to support the implementation of the

nuclear disaster management policy, the government has forged collaboration arrangements with various parties. Collaboration is initiated with the goal of overcoming limited capacity, resources and networks of each component that are key to successful achievement of the set goals (Purwanti, 2016). Meanwhile, collaborative governance concept is to analyze the potential and benefits of involving various parties in supporting policies and guidelines on nuclear disaster threats in Indonesia.

In Indonesia, regulation of disaster management is stipulated in Act Number 24 / 2007 on Disaster Management. Meanwhile, the regulation specifically on nuclear disaster management is in Chapter V, of the Government Regulation No. 54 / 2012 on Nuclear Installation Safety and Security: Nuclear Emergency Preparedness and Response. However, the Government Regulation does not specifically address nuclear disasters. Besides, Presidential Instruction No. 4/ 2019 on Capacity Enhancement in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Chemical, Biological, and Nuclear Emergencies explains role of ministries/ agencies on issues of disease outbreaks, global pandemics, and chemical, biological, and nuclear emergencies is another regulation relating to disaster emergency preparedness, prevention, and mitigation.

Besides being useful, nuclear energy also has the problem of radiation hazards to workers, society and the environment if it is not controlled properly. According to the IAEA & OECD (2013), nuclear accidents are events that cause significant impact on individuals, environment, or facilities, including lethal effects for individuals, release of large radioactivity into the environment, and melting of the reactor core. Some of the previous nuclear disasters reported include, the Nuclear power plant (NPP) disaster at Three Mile Island (TMI, USA), on March 28, 1979 (Shelton, 1984) (Miller, 1994); NPP disaster at Chernobyl, Ukraine, on April 26, 1986 (Baresford, et al., 2016); Radiological disaster at Goiania, Brazil in 1987 (Roberts, 1987); and NPP disaster at Fukushima, Japan, on March 11, 2011 (IAEA, 2015).

Advancements in science and technology in chemistry, biology, radiology, nuclear and explosives (CBRNE) and in transportation and information communication equipment has increased the mastery, use, and dissemination of CBRNE science and technology for human welfare. Nonetheless, the use and dissemination of science and technology has also increased threats to community security and safety. This at a time when Indonesia still faces terrorism and radicalism threats. Such condition makes Indonesia highly vulnerable to the misuse of CBRNE technology if it is not controlled properly in accordance with applicable regulations and procedures (Kemhan, 2015). The misuse of nuclear technology or nuclear technology failure has the potential to trigger a nuclear disaster. A nuclear disaster is a threat be-

cause of the potential of causing disruption to national security, community, national and environmental security. One of the approaches of enhancing national resilience, preventing crises and maintaining national security is adopting a comprehensive, multi-hazards and trans-boundary hazard risk reduction approach to country risk management (OECD, 2015).

Nuclear disaster management policies and guidelines are also needed as an effort to bolster Indonesia's plan and preparation to use nuclear energy for electricity purposes. During the 2019 DPD-DPR RI Joint Session, convened in the DPR/ MPR Building, Senayan, Jakarta, on August 16, 2019, the Chairperson of the regional representatives' council (DPD) underscored the importance of developing alternative energy, including nuclear energy expressed support for the construction of nuclear power plant (NPP) in Bengkayang Regency, West Kalimantan Province and other locations in other districts/ cities in Indonesia (Kompas.id, 2019). A day earlier, on August 15, 2019, a Memorandum of Understanding (MoU) was signed between the National Nuclear Energy Agency (BATAN) and PT. Indonesia Power that signaled cooperation of the two institutions in the utilization of nuclear technology in the energy sector. The scope of cooperation includes, conducting feasibility studies on the use of nuclear energy for electricity generation, and the possibility of using thorium, uranium, and other radioisotopes in batteries (Sindonews.com, 2019).

METHODS

The research was based on a qualitative research design that used a case study of Indonesian government policy and guidelines on nuclear disaster threat in Indonesia. Case studies are common in evaluation research where researchers develop in-depth analysis of a case (Cresswell, 2016). The primary and secondary data obtained portrayed the picture of current condition relating to the policy and guidelines. Interviews and direct observation techniques were used to collect primary data.

The selection of informants was based on purposive sampling technique, which was implemented with the need to ensure variety which according to Creswell (2016) strengthens coherence and research results validity research. Informants in this research included BNPB officials (Deputy for Systems and Strategies, Director of Preparedness, Deputy Director of Prevention, Head Section for Equipment Preparation, and Steering Element); BAPETEN officials (Deputy for Licensing and Inspection, Deputy for Nuclear Safety Assessment, Director of Technical Support and Nuclear Emergency Preparedness, and Head of Sub Directorate for Nuclear Emergency Preparedness); BATAN officials (Head of the Multipurpose Reactor Center (PRSG)), and Head of the Center for Information Utilization and Nuclear Strategic Areas (PPIKSN)); and South Tangerang City Local Disaster Management Agency (BPBD) official (BPBD Secretary). Meanwhile, collecting secondary data in-

volved conducting desktop study of previous literature, theories in textbooks, legislation, official reports, and complementary data from informants to support opinions and perspectives made. Data collection occurred during September - November 2019 period.

Data source triangulation technique was used to validate the data obtained (Sugiyono, 2016). Data analysis was based on an interactive data analysis technique that was developed by Miles, Hubberman and Saldana (2014). The technique involves conducing data analysis contemporaneously, concurrently and continuously during the data collection process from the start to the end or until data saturation point was reached.

Data obtained was afterwards compared with the policy and guideline indicators on dealing with nuclear disaster threats, which were derived from the natural disaster preparedness parameters. The parameters were developed by LIPI-UNESCO/ ISDR (2006). Meanwhile, Indonesian government policies and guidelines on nuclear emergency preparedness were compared with IAEA (2015) requirements with respect to that issue. Table 1 presents the result of the comparison. The assessment was based on the following criteria:

1. Less (0-34%), if the perception of interviewees and observation result showed that indicators were not met;
2. Sufficient (35-68%), if the perception of interviewees and observation result showed that some indicators were met; and
3. Good (69-100%), if the perception of interviewees and observation result showed that most or all indicators were met (Djaali & Mulyono, 2000).

FINDING AND DISCUSSION

Table 2 (appendix) shows a recapitulation of the research analysis results based on data obtained. The result showed that policies and guidelines on dealing with nuclear disaster threat in Indonesia were still deficient or lacking (34.1%). Based on research results, it is evident that both at the nuclear technology user (in this case BATAN, Serpong) and nuclear energy regulator (BAPETEN), have in place policies and guidelines on nuclear hazards and on preventing nuclear emergency. Nevertheless, such policies and guidelines have not been synchronized with or integrated and translated into disaster management policies and guidelines at the local government level (in this case BPBD South Tangerang) and at the national government level (BNPB).

Based on lessons learned from the Fukushima nuclear disaster, IAEA No. GSR Part 7 (2015) recommends the development and integration of a nuclear emergency preparedness program that should be into an all-types of hazards preparedness program. When natural and nuclear disasters occurred almost simultaneously in Japan in 2011 the management of natural disasters and nuclear disasters were treated separately. Consequently, there weren't arrangements and coordination to respond to such events (IAEA,

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Table 1. Policy and Guideline Indicators on Dealing with Nuclear Disaster

LIPI-UNESCO/ISDR Preparedness Parameters	IAEA No. GSR Part 7 Requirements	Indicators
Policy and Guide: • Types of preparedness policies to anticipate disasters, such as: disaster management organizations, emergency response action plans, disaster warning systems, community education, and fund allocation. • Relevant regulations. • Relevant guides	• Emergency management system (requirement 1 • Protection radiation strategy (requirement 5 • International assistance (requirement 17) • Nuclear emergency termination (requirement 18)	There are regulations/ policies/ guides regarding nuclear disaster management organization, nuclear emergency response action plan, nuclear early warning system, resource mobilization, and public education. There is a nuclear disaster management system. There is nuclear disaster preparedness fund allocation. There is radiation protection strategy policy during nuclear disaster. There are other supporting policies (strategic plan, MoU, etc.). There is policy/ guide/ regulation for requesting/ providing international assistance in the event of a nuclear disaster. There is mechanism to terminate nuclear disaster emergency response.

Source: LIPI-UNESCO/ISDR (2006); IAEA (2015); Modified by Researchers (2019)

2015). To that end, nuclear emergency preparedness should be incorporated and integrated into an all-hazards emergency management system (IAEA, op. cit., para 4.3). In Indonesia, disaster management is still generic for all types of hazards, which may explain why to date, BNPB/ BPBD does not have any regulations/ policies/ guidelines that specifically address or tailored toward nuclear disasters.

search results showed that the use of nuclear technology is spread nearly in all parts of the country (Table 3, 4 and 5).

Data in Table 4 and 5 show the reality that radioactive substance utilization varies across provinces. In Table 4, DKI Jakarta and Central Java Provinces have more radioactive substances use cases in the medical field than other provinces. In Table 5, West Java, Banten, Riau, East Kalimantan and East Java Provinces have more radioactive use cases in industry than other provinces.

Table 3. Nuclear Material Uses in Indonesia

Province	Number of Facility	Number of License	Utilization
West Java	1	2	Non power reactor
D.I Yogyakarta	1	6	Non power Reactor, research and development
Banten	6	26	Non power reactor, storing, research reactor fuel element production, radiopharmaceutical and radioisotope production, and research and development
DKI Jakarta	1	1	Research and development
Total License		35	

Source: BAPETEN, 9 October 2019

Table 4. Radioactive Sources Uses in Medical (Radiotherapy)

No	Province	Number of Facility	Number of Radioactive Source	Utilization
1	Bali	1	2	Brachytherapy, teletherapy
2	D.I Yogyakarta	1	2	Brachytherapy
3	DKI Jakarta	4	23	Brachytherapy, teletherapy
4	West Java	3	6	Brachytherapy, teletherapy
5	Central Java	4	16	Brachytherapy, teletherapy
6	East Java	2	4	Brachytherapy, teletherapy
7	East Kalimantan	1	1	Brachytherapy
8	Lampung	1	1	Brachytherapy
9	Riau	1	1	Brachytherapy
10	North Sulawesi	1	1	Teletherapy
11	West Sumatera	2	2	Brachytherapy, teletherapy
12	South Sumatera	1	1	Teletherapy
13	North Sumatera	2	4	Brachytherapy
	Total	24	64	

Source: BAPETEN, 9 October 2019

To that end, the attention on preparedness to deal with nuclear disaster threats should be paid to those provinces that have high radioactive substance use cases.

Unfortunately, local governments capability in anticipating nuclear disaster

threat is still extremely limited. Based on the case study in South Tangerang City, ample evidence pointed to the reality that BPBD and BNPB surprisingly presumed that preparedness efforts for dealing with nuclear disaster threats is the responsibility of nuclear technology users. This is in line with national legislation and international standards and protocols to that effect. This is evident in the IAEA Safety Fundamentals (2006) that states that "*The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks*", and article 28, Act No. 10 / 1999 on Nuclear Energy, states that, *"the nuclear installation operator shall be liable for nuclear damage suffered by the third party that is resulted from any nuclear incident that occurs in that nuclear installation"*

However, if a disaster affects the community, according to article 5, Act No. 24 / 2007 on Disaster Management that stipulates that, *"local government and government are those who are responsible for organizing the disaster management"*. Thus, the local government and the central government should also have in place preparedness capacity to deal with nuclear disaster threats within their jurisdictions. Preparedness is required for the local government and the central government to have the capacity to prevent the deterioration of a nuclear emergency condition into a nuclear disaster. BNPB is the national coordinator for disaster management in Indonesia. According to Act No. 24 / 2007 on Disaster Management, and Presidential Regulation No. 4 / 2019 on Capacity Enhancement in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Chemical, Biological, and Nuclear Emergencies, BNPB is entrusted with the key and crucial role of coordinating national resources in a planned, integrated, and comprehensive manner to dealing with disaster threats in Indonesia.

Research results identified one key problem in the area of nuclear disaster management, which is that Indonesia does not have a regulation on nuclear disaster management organization. This is despite the fact that BAPETEN developed the concept of the organization as far back as 2007, in a process that involved all relevant ministries/ agencies (Figure 1). Thus, in accordance with BNPB Chairman Decree No. 3 / 2016 on Disaster Emergency Management Command System, what is required is to synchronize the concept of the organization with the disaster management organization or command structure. This is because BNPB/ BPBD holds the responsibility of coordinating disaster management. The implication is that to be effective, BNPB/ BPBD must be the coordination entity of the disaster management organization as well as actors on the ground. To that end, all actors identified in the national nuclear emergency response organization should be synchronized within BNPB/ BPBD command structure (Figure 1).

Table 5. Radioactive Sources Uses in Industry

No	Province	Number of Radioactive Source
1	Aceh	54
2	Banten	682
3	Bengkulu	2
4	D.I. Yogyakarta	16
5	DKI Jakarta	341
6	Jambi	213
7	West Java	847
8	Central Java	87
9	East Java	505
10	South Kalimantan	60
11	Central Kalimantan	19
12	East Kalimantan	615
13	North Kalimantan	164
14	Kepulauan Bangka Belitung	2
15	Kepulauan Riau	310
16	Lampung	7
17	NTB	34
18	NTT	3
19	Papua	155
20	Papua Barat	73
21	Riau	636
22	South Sulawesi	34
23	Central Sulawesi	81
24	Southeast Sulawesi	5
25	North Sulawesi	8
26	West Sumatera	14
27	South Sumatera	228
28	North Sumatera	57
	Total	5.252

Source: BAPETEN, 9 October 2019

Presidential Instruction No. 4 / 2019 on Capacity Enhancement in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Chemical, Biological, and Nuclear Emergencies, vests the Head of BNPB with the responsibility of carrying out coordination and implementation functions prior to disaster and post-disaster as well as command functions during non-natural disaster emergencies involving disease outbreaks, global pandemics, and chemical, biological, and nuclear emergencies, which may have domestic and global impact. In addition, the appendix to the Presidential Instruction states that BNPB serves as the coordinator for the implementation of the action plan that relates to:

1. Technical field preparedness the priority action of which entails carrying out an examination of emergency re-

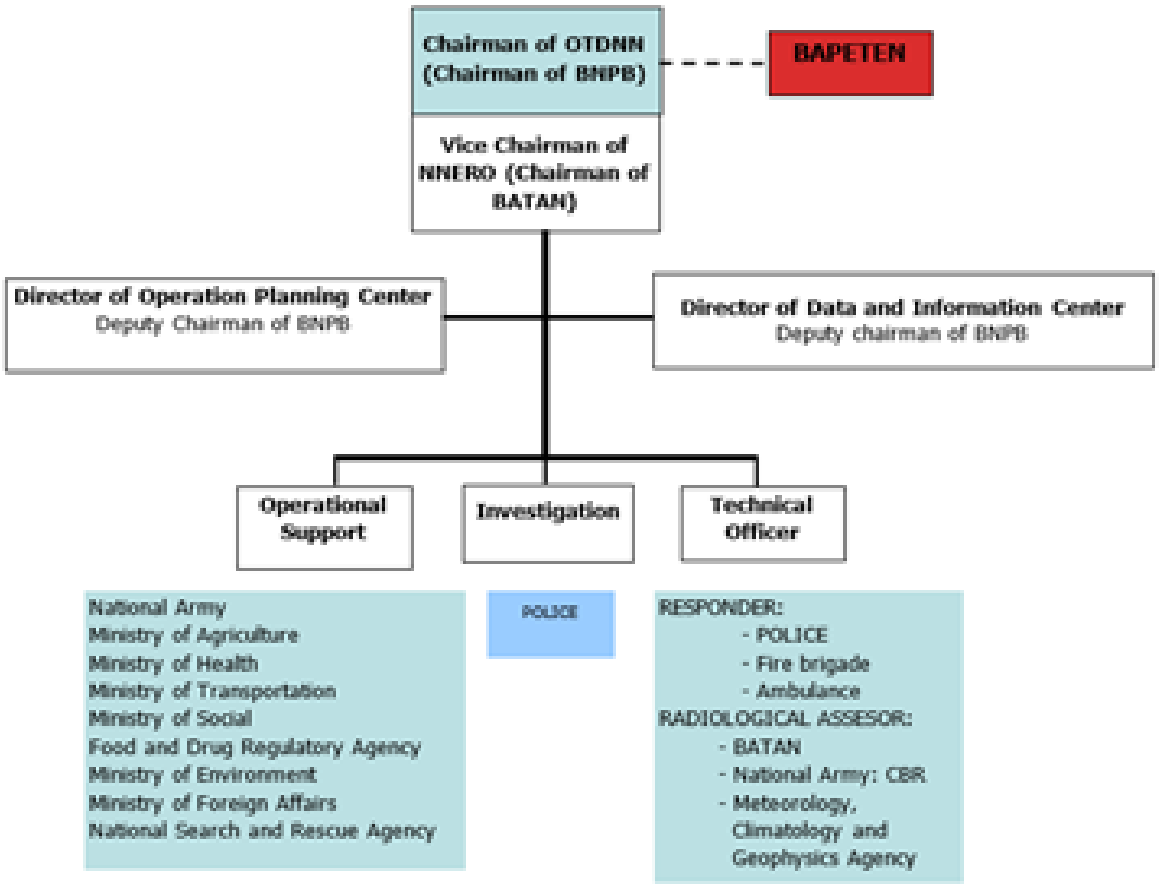

Figure 1. National Nuclear Emergency Response Organization (NNERO)

sponse contingency plans to deal with disease outbreaks, global pandemics, and chemical, biological, and nuclear emergencies; and

2. Technicalities that relate to the early warning system, the priority action being the development of an integrated early warning system.

Article 66, of the government regulation No. 54 / 2012 on Nuclear Installation Safety and Security, mandates BNPB with the task of developing a national nuclear disaster preparedness program. In preparing the program, BNPB coordinates with nuclear technology users, BAPETEN, as well as other related ministries/ agencies.

Research findings showed that the Presidential Instruction No. 4 / 2019 on Capacity Enhancement in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Chemical, Biological, and Nuclear Emergencies has not been fully implemented. The regulation, which is relatively new, still awaits implementation, while deliberations that are involving BNPB and other relevant ministries/ agencies. Nonetheless, the fact that government regu-

lation No. 54 / 2012 on Nuclear Installation Safety and Security has only been implemented at nuclear technology user level, nuclear technology users already have adopted policies and guidelines on nuclear emergency response organization, nuclear emergency response action plans, nuclear early warning system, resource mobilization and public education for communities living in proximity to their facilities. The policies and guidelines should be part and parcel of integral and inseparable from the requirements of the licensing process for using nuclear technology. However, the government regulation in question has not been implemented at both the local government and national government level. Moreover, there are no policies and guidelines on nuclear disaster management organizations, nuclear emergency response plans, nuclear early warning system, resource mobilization and community education on nuclear disaster neither at both the local government and national government level.

Findings also showed that Presidential Instruction No. 4 / 2019 on Capacity Enhancement in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Chemical, Biological, and Nuclear Emergencies, nuclear early warning entrusts with all such tasks and responsibility to BAPETEN, the realization of such responsibilities on the ground has not fulfilled expectations. This is reflected by the reality that despite in 2013, BNPB and BAPETEN signed a memorandum of understanding (MoU) on exchanging information on nuclear disasters, the MoU has since expired and has not been renewed. Renewal of the MoU is required to ensure continual and smooth collaboration between BNPB and BAPETEN.

As part of the drive to implement the Presidential Instruction as well as develop big data capacity on disaster hazards, BNPB collaborated with BAPETEN in the development of a Multi Hazard Early Warning System (MHEWS) grand design. The grand design is an effort to achieve the global target number seven within the Sendai Framework for Disaster Risk Reduction (SFDRR) (2015 -2030), inter alia, the availability and access to multi-hazard early warning systems, assessment and disaster risk information. The concept of the grand design identifies ministries/ agencies entrusts BAPETEN, BMKG and BNPB with the responsibility of nuclear hazard early warning including Big Data can generate new insights or create new value in ways that change organizations and relationships among stakeholders. Its revolution revolves around the value attached to data itself, and how it is put to use, rather than as a machine revolution that computes the data (Nisa', Rusfian, & Zaenab, 2018). Currently, nuclear hazard early warning system has not been integrated into a national data platform, which currently is still under discussion between BNPB, BAPETEN and other related ministries/ agencies that are party to the MHEWS concept.

Meanwhile, IAEA No. GSR Part 7 (2015) requires governments to develop a radiation protection strategy policy during a nuclear emergency/ disaster. The dose value/ dose rate that is used as references to determine, among others:

1. when to take nuclear emergency response measures to prevent severe deterministic effects and to reduce stochastic effects of radiation;
2. procedures for emergency response workers health monitoring;
3. radiation protection for emergency workers;
4. the effectiveness of the emergency response actions have been taken; and
5. termination of the emergency response measures.

Relating to the same development, government regulation No. 54 / 2012 on Nuclear Installation Safety and Security, articles 76-77 stipulates that the following dose rate values that can be used as reference to declare a nuclear emergency conditions, namely:

1. Provincial-level nuclear emergency is determined if a dose rate of 5 microSievert/ hour or more is ascertained for 10 minutes or more at the site boundary, and/ or an abnormality in radioactive emissions with concentrations of air activity equal to or exceeding a dose rate of 5 microSievert/ hour at the site boundary detected from the normal discharge path; and
2. National-level nuclear emergency is determined if a dose rate of 500 microSievert/ hour or more is ascertained for 10 minutes or more at the site boundary, and/ or an abnormality in radioactive emissions with concentrations of air activity equal to or exceeding a dose rate of 500 microSievert/ hour at the site boundary detected from the normal discharge path.

However, the references values and the level of nuclear emergency as presented above have not been synchronized with the BNPB's policy on declaring disaster emergency status. Article 2 of BNPB Chairman Decree No. 3 / 2016 on Disaster Emergency Management Command System, states that: *"the implementation of disaster emergency response is carried out based on principle of prioritizing the active role of the regency/ city government"*. The provincial and central government are expected to support and assist the regency/ city government in carrying out such activities. In addition, the regulation delineates three levels disaster emergency status into regency/ city disaster, provincial disaster, and national disaster.

Findings showed that while regulations on nuclear disasters have been issued, they have not been synchronized with disaster management regulations. Specifically, policies and guidelines on dealing with nuclear disaster threats in Indonesia are still woefully lacking. BATAN and BAPETEN have developed and adopted enough guidelines on nuclear hazards and have sufficient resources to deploy in preventing nuclear

emergencies, other related agencies such as BNPB and BPBD have very limited guidelines and resources to deal with nuclear disaster threats. To that end, the research recommends BNPB in its capacity as the coordinator of disaster management in Indonesia to develop and establish a strategic policy for nuclear disaster threat, as well as mobilize all the resources to create a collaborative governance for nuclear disaster management.

One institution cannot handle such complex issues as disasters. Therefore, there is need for synergy and collaboration on nuclear disaster management policy among the relevant ministries/ agencies, local governments, and nuclear technology users. Through collaboration, relevant ministries/ agencies can identify their weakness and advantages in nuclear disaster management, reach consensus on tasks, authority and responsibilities, develop clearer allocation of tasks, authority and responsibilities that will strengthen the policies and guidelines on dealing with nuclear disaster threats. Ratification of the MoU between BNPB and BAPETEN in 2013 was a real example of a collaborative effort. Ansell and Gash (2007) argues that collaborative governance is a new strategy in governance that brings together various stakeholders in the same forum to make joint decisions that are based on consensus. Collaborative governance is an instrument that can be used to overcome a problem through shared or collective problem ownership. Stakeholders have different perspectives to a problem, which may create difficulties in reaching common understanding of a problem. Nonetheless, the availability of a legal framework that is integral to the collaborative governance arrangement, can foster and facilitate the involvement of all stakeholders at local government and national government levels in finding solutions to problems that affect local and national governments (Muhammad, Warsito, Pribadi, & Nurmandi, 2017).

Within the context of collaborative governance, BNPB should facilitate and foster the establishment of a nuclear disaster management network in a multi-stakeholder organizational forum. The forum will serve as a medium to reach consensus with respect to tasks, authority and responsibility among relevant ministries/ agencies; should be convened regularly and involve designated participants/ occupations. The idea is to ensure continuity of information exchange among relevant agencies /ministries, which can foster complementing information and knowledge as well as strengthen respective capabilities. Hopefully, this research contributes to the emergency of a new solution on policies and guidelines on nuclear disaster management in Indonesia. Nuclear disaster management is a multi-agency activity, which makes collaboration among stakeholders imperative as it helps to offset resource weaknesses in one ministry/ agency with resource and capability strengths that obtain in other ministries/ agencies.

CONCLUSION

Policies and guidelines on dealing with nuclear disaster threats in Indonesia are categorized as lacking (34.1%). The assessment was based on indicators of policies and guidelines on dealing with nuclear disaster threats which were based on LIPI-UNESCO/ ISDR (2006) natural disaster preparedness parameters and IAEA (2015) nuclear emergency preparedness requirements. Findings showed that Indonesia does not have a nuclear disaster management organization, absence of nuclear disaster management systems, unclear allocation of funds for nuclear disaster threats at both local government and at national government levels, and lack of policies and guidelines on radiation protection strategies and nuclear disaster emergency response. Findings showed that policies and guidelines on preventing nuclear emergencies/ disasters have been established at the level of nuclear technology users and nuclear energy regulator, but have neither been synergized with nor integrated into disaster management policies and guidelines at local government and national government level. Consequently, regulations relating to nuclear disaster have not been implemented in their entirety.

To enhance the effectiveness of policies and guidelines on dealing with nuclear disaster threats, the research recommends BNPB, as the coordinator of disaster management in Indonesia, to establish collaborative governance policies with ministries/ agencies that are relevant to nuclear disaster management, facilitate the integration of nuclear hazard regulations into disaster management regulations, and facilitate the establishment of national nuclear disaster management organizations.

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Appendix

Table 2. Recapitulation of Policies and Guidelines on Dealing with Nuclear Disaster Threats in Indonesia (Based on Data Compilation during September to November 2019)

Indicator	Data obtained	Category			Assessment
		Lack	Sufficient	Good	
There are regulations/ policies/ guides regarding nuclear disaster management organization, nuclear emergency response action plan, nuclear early warning system, resource mobilization, and public education.	Disaster management regulations are generic for all hazards including nuclear hazard. Hence, BNPB does not have policies/ guides for nuclear disaster.		40		Lack (24%)
	Regulation on nuclear disaster preparedness and response already in place that is Government Regulation (GR) No. 54 of 2012 concerning Nuclear Installation Safety and Security. BNPB/ BPBD has yet to implement GR.	20			
	BNPB/ BPBD does not have preparedness programs on dealing with nuclear disaster threats.	0			
	The nuclear disaster management organization has been conceptualized by BAPETEN. Nevertheless, the concept has not been synchronized with BNPB/ BPBD disaster management organization protocols.	20			
	The nuclear early warning system is at BAPETEN. Mechanism for disseminating nuclear early warning information is still under discussion with BNPB.		40		
There is a nuclear disaster management system.	The nuclear disaster management system has not been formally established.	0			Lack (0%)
	The nuclear disaster hazard management has not been integrated into an all hazards disaster management system at BNPB as the coordinator for disaster management in Indonesia.				

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There is nuclear disaster preparedness fund allocation.	The preparedness fund in BNPB/ BPBD is generic for all hazards. Current priority is on natural disasters.		50		Lack (25%)
	BNPB/ BPBD does not have program or activity related to nuclear hazards.	0			
There is radiation protection strategy policy during nuclear disaster.	Justification for declaring a nuclear emergency is explained in GR No.54 of 2012 concerning Nuclear Installation Safety and Security. Yet, it has not been synchronized with the policy/ guide commonly used by BNPB / BPBD for declaring a disaster emergency condition.	20			Lack (20%)
There are other supporting policies (strategic plan, MoU, etc.).	BNPB and BAPETEN have signed a MoU on cooperation in nuclear emergency preparedness and response in 2013.			100	Sufficient (50%)
	The MoU has been expired since 2019 and has not been extended/ renewed yet.	0			
There is policy/ guide/ regulation for requesting/ providing international assistance in the event of a nuclear disaster.	Explained in GR No. 23 of 2008 concerning Participation of International Institutions and Foreign Non-Government Institutions in Disaster Management.			100	Good (100%)
There is mechanism to terminate nuclear disaster emergency response.	There are no written policies/ guidelines regarding mechanisms to terminate nuclear disaster emergency response at the national level. Based on interviews with it transpired that BNPB will coordinate with BAPETEN on this issue. BAPETEN has technical guidelines on the criteria used to terminate nuclear emergencies, which is an adoption of IAEA standards.	20			Lack (20%)
Average Value of the Policy and Guide					Lack (34,1%)

Source: Processed by researchers (2019)