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EVALUATION OF DISASTER PREPAREDNESS LEVEL OF OIL COMPANY (A CASE STUDY OF PERTAMINA REFINERY UNIT IN WEST PAPUA PROVINCE, INDONESIA)

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ABSTRACT

Disaster preparedness is necessary and imperative in Indonesian territory since many natural hazards are found. There has already been a series of research focusing on disaster preparedness in Indonesia, especially in residential and school community objects. However, there are limited researches directed to a company and in eastern part of Indonesia. Therefore, research that is about the disaster preparedness level of a company in Pertamina Refinery Unit in Kasim, Sorong, West Papua, Indonesia is very important, and it is presented herein. This paper is limited to earthquake disaster that is the major hazard in the area.

Descriptive method was applied by using a survey as a tool to complete this study. Slovin formula was used to sampling the objects that consisted of 1 management sample, 30 officer samples, and 23 refiner samples. In addition, framework assessment proposed by LIPI–UNESCO/ISDR was implemented in this study, covering five critical preparedness factors as the evaluation parameters.

The evaluation was targeted to the management of the employees, officers, and employees of the refiners, and also to several main simple buildings to determine the index value of disaster preparedness. The evaluated index value of the company community is 65.95 which is included in the category of Moderate Level in Disaster Preparedness. Moreover, the result of the evaluation of structure in the company showed that the structures are low vulnerable, and need only minor upgrading to reach a fully prepared level of earthquake disaster. The result of this study might be used as a preparedness insight of the management of Pertamina, a national energy company owned by Indonesia, regarding the disaster safety regulation, and also as an additional study source to disaster research in eastern part of Indonesia.

Keywords: Company; Disaster; Earthquake; Preparedness level; Structure

1. INTRODUCTION

Indonesia is known as one of the most natural-hazard-prone countries in the world. It is located at the intersection of three crustal plates and has 129 active volcanoes within the ring of fire which is under constant threat of seismic activities like volcano eruptions and earthquakes (FEMA, 2002; Sarwidi, 2015; Widodo, 2013). The map of seismic hazard of Indonesia is shown in Figure 1. In addition, Indonesia has a huge number of industry factories, including oil refinery units which are vulnerable to disasters. An explosion or fire is likely to occur due to the disaster that might threaten Indonesian people (World Disasters Report 2010 in Road, 2011).

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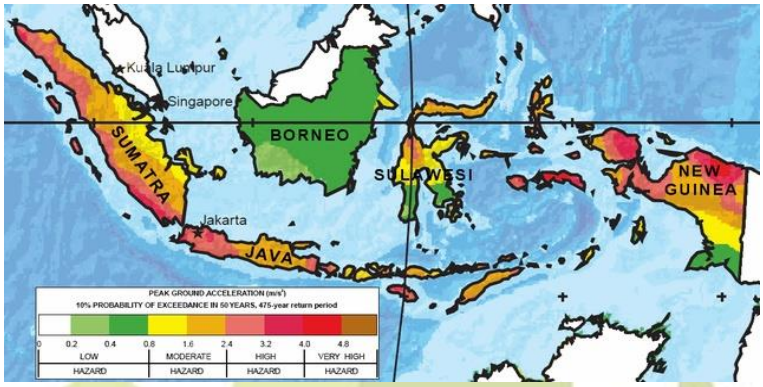

Figure 1. Indonesia Seismic Hazard Map
(Retrieved from http://f.tqn.com/y/geology/1/S/b/j/1/indonesiaeqmap.png)

Regarding disaster research, there is a series of research that was conducted to enrich the knowledge in disaster risk reduction (DRR). Three examples related to this study were accomplished by Pramesti (2011), Wantoro (2013) and Arifin (2014). The study in 2013 and 2014 were done in Yogyakarta, Indonesia for two Disaster Preparedness Schools (SSBs). The study shows that the two SSBs were not fully prepared toward potential natural hazards in their areas. The two educational institutions are in the west part of Indonesian territory. However, the disaster research of a company is hardly found, especially in eastern part of Indonesia, and at the same time many companies need a series of research as a reference for their disaster safety regulation. Meanwhile, Pertamina as a national energy company in Indonesia is one of the most vital companies for the country which has many offices and buildings in every province in Indonesia that are probably vulnerable to disasters.

History shows that Indonesian people have suffered due to many disasters such as reported by BAPPENAS (2006) and BNPB (2010). Disaster preparedness knowledge and earthquake engineering are necessary for Indonesia (Dyer et al., 1999). Measuring disaster preparedness level is very crucial to anticipate future disasters. At the same time, Pertamina also needs to measure its employee's level of disaster preparedness including the resistance of its buildings (Waluyo, 2011). This study evaluates the company's disaster preparedness level to earthquake hazard that covers community elements and its simple brick masonry buildings. This paper is limited to the preparedness to the major hazard in the area, namely earthquake disaster.

2. METHODOLOGY

The method of this study was a descriptive research which used a survey as a tool to accomplish this study. Descriptive method is used as a procedure to solve problems that have been investigated by describing the situation of the research subject or object at the moment, based on the facts in real condition (Nawawi in Wantoro, 2013). The research object was the Refinery Unit of Pertamina located in Kasim, Seget District, Sorong, West Papua Province, Indonesia or simply called Pertamina Kasim.

Purposive sampling was implemented by selecting the subject based on certain objectives; not by status or location. This method was used due to several considerations, such as limitation of time, energy, and funding that made the writers unable to use too many samples. An advantage of this method is that the writers can precisely select the data source that fits with the study variable (Arikunto in Wantoro,

2013). Therefore, the determination of the number of sample was Slovin's formula (Surjono et al., 2014).
The Slovin's formula is written as:

$$n = N / (1 + Ne^2) \quad (1)$$

Where:

n = Number of samples,
N = Total population, and
e = Error tolerance.

In this research, the collected data, both from field surveys or literature study, were processed and analyzed in a quantitative way, and they were combined with a qualitative way as additional information for the results. Index analysis in this research was applied to measure the preparedness level of disaster in Pertamina Kasim. Index is a number that can be compared one another that contains information of certain characteristic in the same or different time and places. In order to make it simpler and more understandable, index value will be timed by hundred. According to UNESCO-ISDR and LIPI (2006, in Surjono et al., 2014), index value in a research consists of index of each parameter i.e. knowledge and attitude of disaster (*KA*), emergency planning (*EP*), warning system (*WS*), policy statement (*PS*), resource mobilization capacity (*RMC*) in each source of the survey data which will be calculated using these equations:

$$KA\ Index = 0.6\ KA2\ Index + 0.4\ KA3\ Index \quad (2)$$

$$PS\ Index = PS1\ Index \quad (3)$$

$$EP\ Index = 0.61\ EP1\ Index + 0.3\ EP2\ Index + 0.09\ EP3\ Index \quad (4)$$

$$WS\ Index = 0.57\ WS1\ Index + 0.29\ WS2\ Index + 0.14\ WS3\ Index \quad (5)$$

$$RMC\ Index = 0.6\ RMC1\ Index + 0.3\ RMC2\ Index + 0.1\ RMC3\ Index \quad (6)$$

$$Total\ Index = 0.5\ KA\ Index + 0.1\ PS\ Index + 0.23\ EP\ Index + 0.07\ WS\ Index + 0.1\ RMC\ Index \quad (7)$$

In equations (2) to (7), numbers after the symbols of the parameters are associated with the evaluated components namely: 1 is the company as institution, 2 is the officers, and 3 is the refiners.
In addition, this study also discussed the evaluation of simple housing and office building at the research object. This used the evaluation form of simple brick masonry building which is commonly used to measure one of the vulnerabilities of community to earthquakes (Satyarno, 2011).

3. RESULTS AND DISCUSSION

The study subject of the disaster preparedness of Pertamina Kasim covered the evaluations of (1) the community of the company and (2) the simple buildings of the company. Company community evaluation covered three subjects i.e. Management, Officers, and Refiners using the developed instrument. The samples out of population were 1 manager out of 4, 34 officers out of 54, and 22 refiners out of 36, by total of 53 out of 94. The instrument consisted of C1 Questionnaire (company as an institution), C2 Questionnaire (officers), and C3 Questionnaire (refiners). The following explanation is the results by applying equations (1) to (7), accompanied by the discussion. In order to

give a better explanation, similar works for two SSBs (Disaster Preparedness Schools) by Wantoro (2013) for SMKN Berbah and Arifin (2014) for SMPN2 Cangkringan were briefly compared to this work. In addition, the simple building evaluation was done using a form that was observed and filled by the procurement supervisor at the location. More detailed explanation can be explored in Perkasa (2015).

3.1 Preparedness Level of Company Community

The preparedness level of the company is an image of how good the overall company is able to cope with the threats from disaster, which is based on three components of company management, officers of the company, and refiners of the company. The preparedness level was based on five parameters i.e. Knowledge and Attitude (*KA*), Policy (*PS*), Emergency Planning (*EP*), Warning System (*WS*), and Resource Mobilization Capacity (*RMC*) in the company. Utilizing equations (1) to (7), the values of the indexes of the parameters can be calculated and the overall preparedness level of the institution can be seen in Table 1.

Table 1 Overall Preparedness Level of Pertamina Kasim

No.	Parameter	Index	Preparedness Level
1.	Knowledge and Attitude (*KA*)	69.56	Moderate
2.	Policy (PS)	83.89	High
3.	Emergency Planning (*EP*)	63.02	Moderate
4.	Warning System (*WS*)	52.33	Low
5.	Resource Mobilization Capacity (*RMC*)	46.22	Low
	Index Value	**65.95**	**Moderate**

The result of the study shows that the overall preparedness level of Pertamina Kasim is in Moderate Category; with the value of the overall index is 65.95. This result is affected by the good values of *PS*, *KA*, and *EP* indexes. However, Pertamina Kasim has low values of *RMC* and *WS* indexes.

When the study result in Table 1 was paralleled with the results of the evaluation of SMKN Berbah (Wantoro, 2013) and SMPN2 Cangkringan (Arifin, 2014), a uniform pattern was detected, where the values of *KA*, *PS*, and *EP* indexes are higher than those of *WS* and *RMC* indexes.

The values of *PS* indexes of all the three studies are excellent. Although the indication of the policy of Pertamina Kasim is better than that of SMKN Berbah, the policy of Pertamina Kasim is still less favorable than that of SMPN2 Cangkringan. Therefore, Pertamina Kasim policy needs to be improved to better support the disaster preparedness.

Associated with Knowledge and Attitude (*KA*), knowledge in the disaster of the community of Pertamina Kasim is generally much higher than that of SMKN Berbah and SMPN2 Cangkringan. Exploring the results in a more detail, Pertamina Kasim community more intensively obtains about matters related to disaster issues from the radio and television as compared to SMKN Berbah and SMPN2 Cangkringan communities, especially when compared to the component of students from both schools.

Related to the Emergency Planning (*EP*), Pertamina Kasim has been in the moderate level of disaster preparedness. However, the preparedness level is still in low position by pointing to the values of *EP* index. In fact, the *EP* of Pertamina Kasim community is

still far lower than the *EP* of SMKN Berbah and SMPN2 Cangkringan communities. It shows that socialization activities related to disaster emergencies in Pertamina Kasim are still relatively insufficient. Thus, information dissemination and technical preparations to support disaster emergency activities in Pertamina Kasim need to be improved.

In the review of the Warning System (*WS*) index, it is low in Pertamina Kasim, meaning that it is in a low level of preparedness. However, the index value of *WS* for Pertamina Kasim is much higher than those of two schools. Consequently, this *WS* issue needs to be socialized more intensively to the public.

For the *RMC* index, Pertamina Kasim community has an index value much lower than the indexes of the two school institutions. Simulation and exercises are more rarely done by Pertamina Kasim community compared to the communities of both schools. In other words, both schools have a lot of extra-curricular activities in addition to intra-curricular lessons that favor the increase in mobility capabilities of the institutions. Therefore, a series of training and disaster rescue simulation needs to be done more often for Pertamina Kasim community.

The following explanation is the results of this study along with a more in-depth discussion that includes the preparedness level of the evaluated components, namely the company as institution, the officers, and the refiners which contribute to the overall preparedness index of the company.

3.1.1 Company Preparedness Level

Company preparedness level which represents the company as an institution (C1) is a merger of four preparedness parameters i.e. Policy, Emergency Planning, Warning System, and Resource Mobilization Capacity. Making use of equations (1) to (7), the index values of the parameters can be calculated and the preparedness level of Pertamina Kasim as an institution (C1) can be identified as seen in Table 2.

A common pattern in this study was also detected in the results of other related studies (Wantoro, 2013; Arifin, 2014). The value of the indexes of *PS* and *EP* are higher than those of *WS* and *RMC*.

Table 2. Preparedness Level of Company (C1)

No.	Parameter	Index	Preparedness Level
1.	Policy (*PS*)	83.89	High
2.	Emergency Planning (*EP*)	69.17	Moderate
3.	Warning System (*WS*)	54.55	Low
4.	Resource Mobilization Capacity (*RMC*)	48.33	Low
	Index Value	**67.93**	**Moderate**

The condition of the policy of the company (*PS*) was discussed in the previous section of Preparedness Level of Company Community. The most important role of institutions in improving disaster preparedness is through the creation of policies that support the preparedness. That way, things that are much more technical will follow automatically. Pertamina Kasim policy has not been maximum. It is indicated from the index value that is still less favorable than that of SMPN2 Cangkringan. Thus, Pertamina Kasim policies could be revised to the maximum.

Related to the Emergency Planning (*EP*), Pertamina Kasim as an institution is already in the moderate level of preparedness. In fact, the index value of the *EP* of Pertamina Kasim community is still far lower than those of SMKN Berbah and SMPN2 Cangkringan with reference to the indexes. It shows that the socialization activities

related to disaster emergencies in Pertamina Kasim are still relatively low. Therefore, information dissemination and technical preparations to support emergency activities in Pertamina Kasim need to be improved further.

In the reviewed Warning System (*WS*), the index of Pertamina Kasim as an institution has a value which is only slightly higher than its overall index. Consequently, the low index value of *WS* for Pertamina Kasim an institution also contributed to the overall *WS* index value which is in the low level of preparedness. The low index value of *WS* can actually be more easily upgraded through institution rather than through other Pertamina Kasim components.

For the Resource Mobilization Capacity (*RMC*), the index of Pertamina Kasim as institution also has a value that is only a slightly different compared to the overall index value of Pertamina Kasim. Therefore, the low value of the overall index of *RMC* is also due to a lower contribution of *RMC* index value of Pertamina Kasim as an institution. Insufficient value of *RMC* index can actually also be easily upgraded through the institution of Pertamina Kasim compared to the other components of Pertamina Kasim.

3.1.2 Preparedness Level of Officers

Officer preparedness level is the union of four preparedness parameters i.e. Knowledge and Attitude, Emergency Planning, Warning System, and Resource Mobilization Capacity. Employing equations (1) to (7), the indexes of the parameters can be calculated and the preparedness level of officers (C2) can be defined as seen in Table 3.

Again, a regular pattern in this study was also detected in the same way as the results of other related studies, namely the evaluation results of SMKN Berbah and SMPN2 Cangkringan where the index values of *PS* and *EP* are higher than those of *WS* and *RMC*.

Related to the Emergency Planning (*EP*), the index value of the officer component of Pertamina Kasim is less than 60, categorized as a low level of preparedness. However, the preparedness is close to the category of medium preparedness referring to the value of *EP* index. In fact, the index value of *EP* of Pertamina Kasim officers is far lower than those of SMKN Berbah and SMPN2 Cangkringan. In addition, it shows that insufficient socialization activities related to disaster emergencies in Pertamina Kasim is one of the main causes. Therefore, information dissemination and technical preparations to support emergency activities for the officers in Pertamina Kasim need to be enhanced in the future.

Table 3. Preparedness Level of Officers (C2)

No.	Parameter	Index	Preparedness Level
1.	Knowledge and Attitude (*KA*)	69.53	Moderate
2.	Emergency Planning (*EP*)	54.94	Low
3.	Warning System (*WS*)	44.42	Low
4.	Resource Mobilization Capacity (*RMC*)	39.03	Low
	Index Value	**63.65**	**Moderate**

In the reviewed Warning System (*WS*), the component index of Pertamina Kasim officers has a value which is significantly lower than the overall *WS* index value of Pertamina Kasim. Thus, the low index value of *WS* for Pertamina Kasim officers also strongly contributes to the overall *WS* index value which is in the level of low preparedness. The low index of *WS* may be more difficult to upgrade through the officer component of Pertamina Kasim rather than through institution.

For the Resource Mobilization Capacity (*RMC*), the index value of the officer component indicates that it needs much effort to rise to moderate level. Thus, the low overall index value of *RMC* is also due to strong contribution of *RMC* index value of Pertamina Kasim for the component of officers. *RMC* problem can actually be upgraded through a series of meeting for the dissemination and practice related to disaster mobility to the officers.

3.1.3 Preparedness Level of Refiners

Refiner preparedness level is the combination of four preparedness parameters i.e. Knowledge and Attitude, Emergency Planning, Warning System, and Resource Mobilization Capacity. Using equations (1) to (7), the index values of parameters can be calculated and the preparedness level of officers (C3) can be seen as shown in Table 4.

Table 4 Preparedness Level of Refiners (C3)

No.	Parameter	Index	Preparedness Level
1.	Knowledge and Attitude (*KA*)	69.61	Moderate
2.	Emergency Planning (*EP*)	48.25	Low
3.	Warning System (*WS*)	59.63	Low
4.	Resource Mobilization Capacity (*RMC*)	55.11	Low
	Index Value	**66.23**	**Moderate**

As it has been predicted by referring to some previous related studies, an ordinary pattern in this study was also identified; two lessons from the evaluation results of SMKN Berbah and SMPN2 Cangkringan also state that the values of the indexes of *PS* and *EP* are higher than those of *WS* and *RMC*.

Concerning the Emergency Planning (*EP*), the index value of the component of Pertamina Kasim refiners is far below 60, categorized as low level in preparedness. In fact, the level of EP of Pertamina Kasim officers is far lower than those of SMKN Berbah and SMPN2 Cangkringan with reference to the index values. It shows that little socialization activities related to disaster emergencies to the refiners of Pertamina Kasim is also the cause. Thus, information dissemination and technical preparations to support emergency activities for the refiners in the Pertamina Kasim need to be better enhanced in the future.

In an evaluation of the Warning System (*WS*), the index of the Pertamina Kasim for the component of refiners has a value which is sufficiently higher than the component index of Pertamina Kasim officers. The low index value of *WS* for Pertamina Kasim institution could be raised by the preparedness of refiners. The *WS* index of the refiner component only needs a slight upgrade to reach the moderate level of preparedness.

Related to the Resource Mobilization Capacity (*RMC*), the index of the refiner component of Pertamina Kasim indicates that it also needs a slight attempt to increase to moderate preparedness level. It shows that the low overall index value of *RMC* has been lifted by the contribution of *RMC* index value of Pertamina Kasim for the component of refiners. *RMC* problem can actually also be easily upgraded through a series of gathering for the propagation and simulation related to disaster mobility to the refiners.

3.2 Evaluation of Simple Brick Masonry Structures

The office and houses of Pertamina Kasim were evaluated for the earthquake resistant of the structures by a simple method. The evaluation forms were filled out after directly observing the building and checking the engineering data of the buildings as well as the

master plan. More detailed evaluation procedures in calculating the structural score for the simple masonry brick buildings can be explored in Satyarno (2011). The evaluated structural objects were the Main Office, Kasuari Mess, and Merpati Mess. The calculation result from the simple buildings shows a positive result, with a total score of 95.00 out of 100 for the Main Office. The score for both Kasuari Mess and Merpati Mess are 92.50, which makes 93.75 for the average score as shown in Table 5.

Table 5 Evaluation Result of Simple Building Evaluation (Brick Masonry)

No.	Answer	Main Office	Kasuari Mess	Merpati Mess
1.	'Yes'	36	35	35
2.	'No'	0	1	1
3.	'Insufficient'	4	4	4
	Total	95.00	92.50	92.50
	Average		93.75	

From the scores, the simple buildings are considered to be sufficiently resistant to earthquake. However, referring to the filled forms of Satyarno (2011) in combination with the general concept of simple masonry houses such as detailed by Sarwidi & Associates (2007), it can be seen that to reach the score of 100, an additional minor upgrade is needed. The upgrade may consist of adding more column reinforcement length to the foundation bands and putting anchorage reinforcements of masonry wall to the columns. A more detailed explanation can be explored in Perkasa (2015).

5. CONCLUSIONS

The evaluation result of the company disaster preparedness of Pertamina Kasim used two approaches i.e. human resources ability and simple building evaluation which are concluded as follow.

1. The disaster preparedness of the Pertamina Refinery Unit in Kasim is in Moderate Level Category with an overall index value of 65.95.
2. The evaluation of simple brick masonry buildings of Pertamina Kasim office and houses shows positive results with an average capacity score of 93.75 from the total score of 100. This is categorized as low vulnerable structures, and the structures require only minor upgrading to reach a fully prepared level of earthquake disaster.

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