

## DESIGN OF HAZARDOUS WASTE STATION IN XYZ RADIOACTIVE INDUSTRY

**Stacia Dea Prameswari, Muhammad Aang Nurhadi, Nabila Ardiana, Irfan Rizaldi, Mutiara Octaviani, I Wayan Koko Suryawan, Betanti Ridhosari**

Program Studi Teknik Lingkungan, Fakultas Perencanaan Infrastruktur, Universitas  
Pertamina

Email: staciadeaprameswari@gmail.com

### ABSTRACT

*A hazardous waste station must be designed following Regulation of the Minister of Environment and Forestry Number P.12 of 2020 concerning the Storage of Hazardous Waste so as not to cause environmental impacts. The purpose of this design is to improve the design criteria for the hazardous waste station in accordance with applicable regulations. The type and volume of hazardous waste storage have jerry can shape in 60 and 30-liter volumes, HDPE drum, and pallet. Each container is equipped with a symbol and label. Hazardous liquid waste and hazardous solid waste are designed with the dimensions of 10.66m x 8.2m and 8.65m x 8.2m. Each is equipped with coordinate, spill kit, fire extinguisher, pallet, shower & eyewash, and container. The new design of hazardous waste selected has met the requirements in the regulation, safe from outside interference and environmental impacts.*

**Keyword:** Waste Station, Hazardous waste, design, regulations

### INTRODUCTION

Indonesia as one of the developing countries, indeed, continues to spur economic growth to increase development. In spurring economic growth, of course, supported by the development of science and technology. It brings change and causes the impact of the amount increasing of waste produced. One of the increasing amounts of waste is hazardous waste (Suryawan et al., 2019). Based on Government Regulation No. 101 of 2014, Hazardous waste can be defined as the residue of businesses and/or activities that contain hazards. Based on the characteristics of hazardous waste, some of them are toxic, explosive, flammable, dangerous, corrosive,

irritant, oxidizing, and infectious (Malayadi, 2017).

XYZ Radioactive Industry is one of the beneficiaries of nuclear power in the field of research, development, and technology utilization. Hazardous waste is commonly found in industrial activities, but the XYZ Radioactive Industry is one of the producers of hazardous waste. In conducting research, development, and utilization of nuclear technology, XYZ Radioactive Industries also produces hazardous waste with non-radioactive waste. This hazardous waste will harm health and pollute the environment if not manage with good management (De Echave et al., 2018; Pearce et al., 2016).

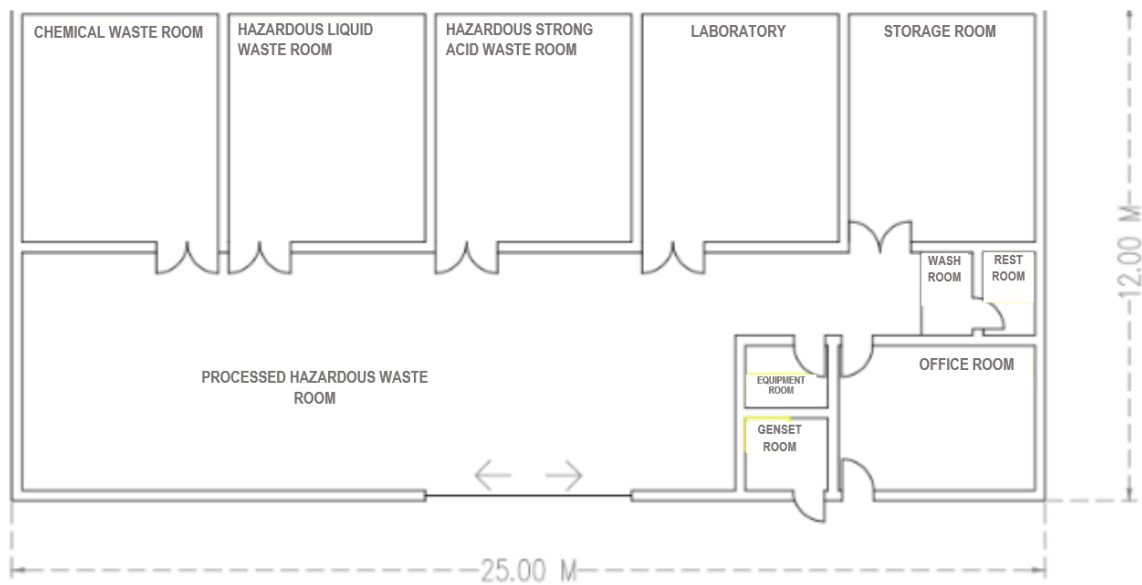
Based on Government Regulation Number 101 of 2014, hazardous waste management is an activity that includes transportation, utilization, processing, and/or pile up. The hazardous waste management carried out by XYZ Radioactive Industry starts from reduction, reuse, storage, and transportation conducted by a third party. XYZ Radioactive Industry implements hazardous waste management based on Government Regulation Number 101 of 2014 to reduce environmental pollution and the causes of health problems.

In the implementation of hazardous waste storage, XYZ Radioactive Industry has limited space in the waste station when the hazardous waste generated exceeds the capacity that can be accommodated by the waste station. Thus, it makes different types of waste placed in the same block. Hazardous waste of the XYZ Radioactive Industry continues to grow every day and if not handled properly it will damage the environment. It can be said that Hazardous Waste Management of the XYZ Radioactive Industry in 2016-2018 to be deficient in addressing the capacity of hazardous waste. Then in addition there are some hazardous waste stored with several containers contaminated with radioactive waste, because of the hazardous waste stored with radioactive waste (Susan et al, 2016). It is not in accordance with Government Regulation Number 101 of 2014. Thus, the design of the hazardous waste station is required following Government Regulation Number 101

of 2014 regarding Regulation of the Minister of Environment and Forestry P.12 of 2020 concerning Storage of Hazardous Waste. It was focus on redesign Waste Station building of Hazardous Waste in XYZ Radioactive Industry and complete units or components which does not yet follow Minister of Environment Number 14 of 2013 and Regulation of the Minister of Environment and Forestry Number P.12 of 2020.

### **DESIGN METHOD**

The design method was based on direct field study results. The design was based on secondary data obtained directly from the company. In the design process of a hazardous waste station building, attention to conditions is needed before designing to determine the right alternative. Figure 1 is a description of the existing condition of the hazardous waste station in the XYZ Radioactive Industry. The layout of the hazardous waste station located in the XYZ Radioactive Industry shows that there are 3 hazardous waste station rooms by its characteristics, separated by the walls in each room and lab room. Moreover, in the hazardous waste station building, the activity is still merged with another some worker members activities, which can be seen from the office rooms placed inside the hazardous waste station building. Then, in the old hazardous waste station building, there is no emergency exit, only the exit access is in the office room.



**Figure – 1:** Existing Layout of Hazardous Waste Station

Based on Figure 2, shows that the amount of waste varies, and each year the waste is placed in a different container. Waste containers' shape varies, from HDPE drums to jerry cans packaged in 20 liters, 25 liters, 30 liters, and 60 liters. In 2016, waste was dominated by the inorganic liquid waste in 60-liter jerry cans. Then in 2017, the amount of waste dominated by organic liquid type in 20-liter jerry cans and

organic solid-type waste as much as 42 HDPE drum. In 2018, the amount of waste is dominated by the organic liquid waste in jerry cans and organic solid waste in the HDPE drum. Generally, the type of waste packaging is dominated by jerry cans and the ratio of the waste amount from year to year for some waste has too far away gap.

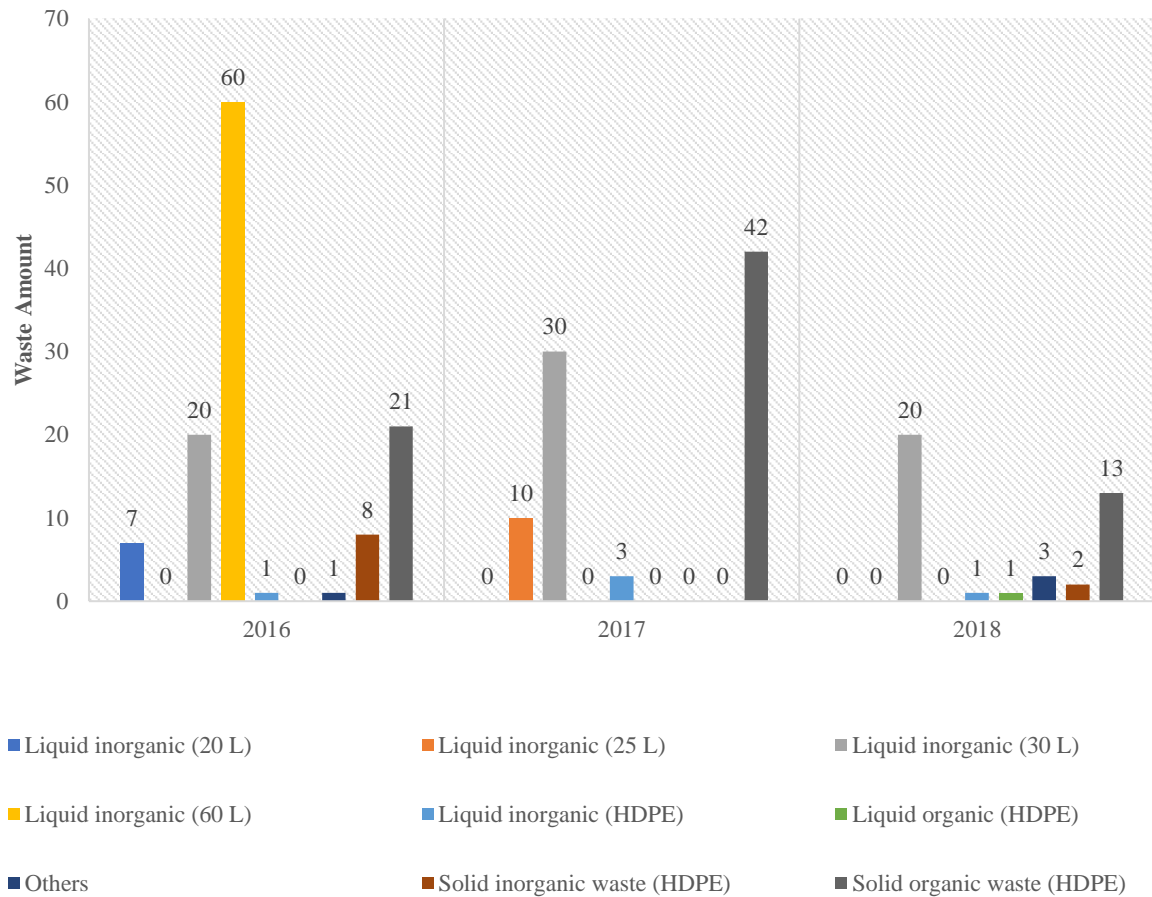


Figure – 2: The Comparison of Total Waste in 2016-2018

**Design of New Hazardous Waste Station**

From the size of one pallet used, it can accommodate 9 jerry cans in size of 60 liters. In this calculation, the assumptions are standardized in the type and size of jerry cans and HDPE drums to be the design reference. These are the assumptions used in determining the number of pallets:

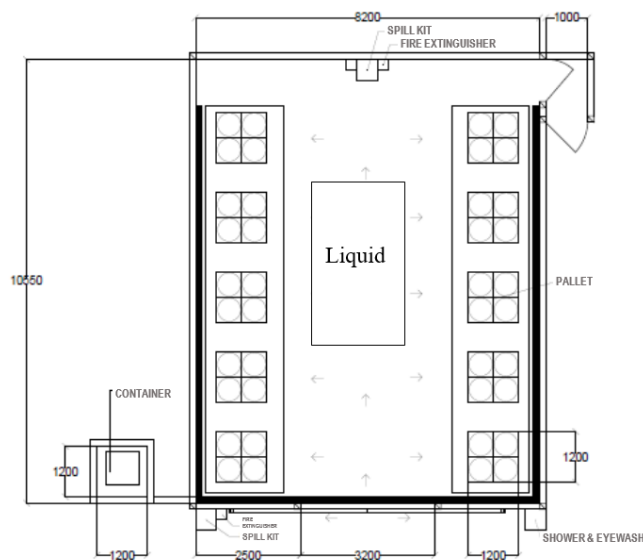
- a. Jerry can size of 60 liters, Height: 65 cm, Width: 32 cm
- b. Jerry can size of 30 liters, Height: 44 cm, Width: 29 cm
- c. HDPE Drum Size, Height: 125 cm, Diameter: 58 cm
- d. Pallet Size, Length: 1200 cm, Width: 1200 cm

The design of the new waste station shows the separation of the rooms between Hazardous liquid wastes. It is intended to separate each

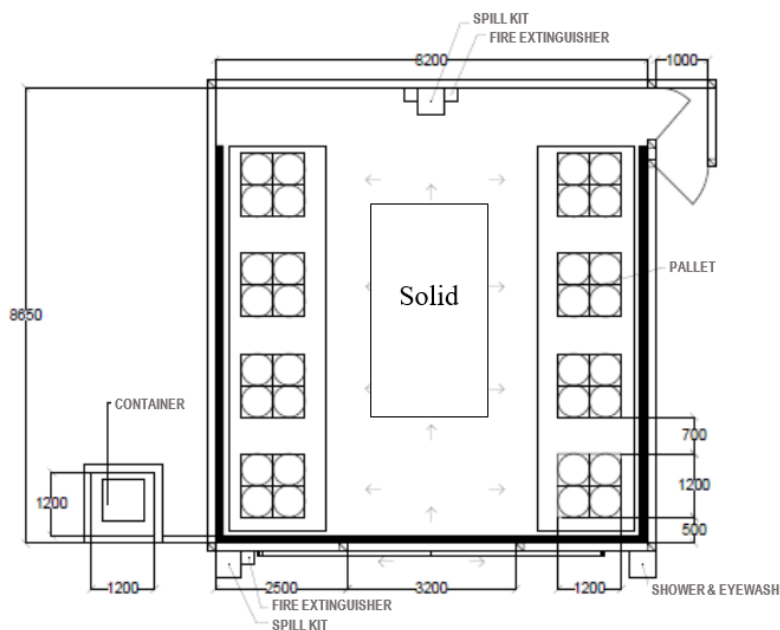
waste character. The new waste station is also equipped with coordinates, spill kits, fire extinguisher, pallet, shower & eyewash, and container. The container must be designed as much as possible including the leak channeling system and must be detected in real-time (Crowther et al., 2018). The distance between the pallets is made at a distance of 70 cm following Minister of Environment and Forestry Number P.12 of 2020. Then created a distance between pallets with the building’s wall of 50 cm so that the dimensions of the new hazardous liquid waste station amounts to 10.66 m x 8.2 m (Figure 4).The design of the new waste station shows the room separation between Hazardous solid wastes. It is intended to separate each waste character. The new waste station is also equipped with coordinates, spill kits, fire extinguisher, pallet, shower & eyewash, and

container. The distance between the pallets is made at a distance of 70 cm in accordance with Minister of Environment and Forestry Number P.12 of 2020. Then the distance between the pallets and the walls of the building was made at 50 cm so that the dimensions of the new hazardous solid waste station were 8.65 m x 8.2 m (Figure 3 and Figure 4). Hazardous waste produced has a harmful characteristic to the environment, which means every room not only

equipped with coordinate but also equipped with symbols, labels, and hazardous waste MSDS. The definition of environmental impact by Yilmaz et al., 2017 is an impact that considers elements that are vulnerable to the environment including water bodies, agricultural areas, coastal areas, and forest land which are located within a certain bandwidth around hazardous waste producers.



**Figure – 3:** The new design of the hazardous liquid waste station



**Figure – 4:** The new design of the hazardous solid waste station

### Hazardous Waste Storing

Hazardous waste storing that has been characterized under the nature and character of hazardous waste, are stored in hazardous waste containers such as HDPE drums with a size of 200 liters (Figure 5). Size of 200-liter HDPE drum is 60 cm x 125 cm. Thus, 56 drums for solid waste and 32 drums for liquid waste are needed in the waste station.

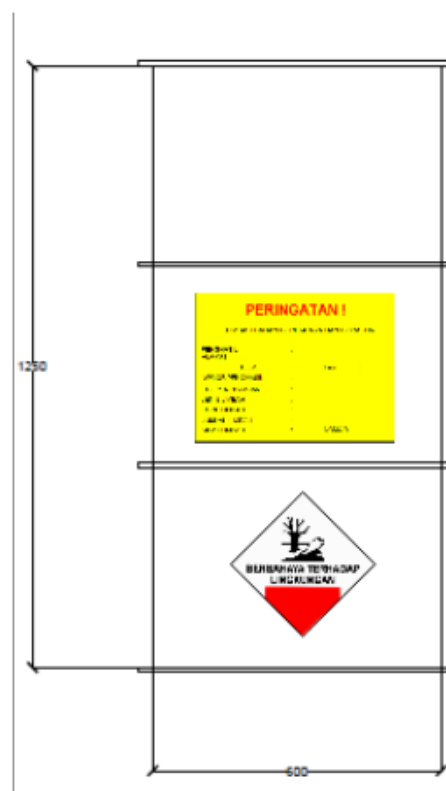
Hazardous waste labels are specific information for storing hazardous waste. Following Regulation of Minister of Environment No. 14 of 2013 the minimum size of the labels are 15 cm x 20 cm. The hazardous waste label contains the producer information, address, producer number, packaging date, the type of waste, waste code, amount of waste, and characteristics of waste. The hazardous waste label is then affixed to the hazardous waste container such as a drum.

One of the symbols of hazardous waste used for the XYZ Radioactive Industry is that it is harmful to the environment. This symbol is used because hazardous waste in the XYZ Radioactive Industry will potentially pollute the environment if not handled properly. Hazardous waste generated from XYZ Radioactive Industry has characteristics of both organic and inorganic solid, also organic and inorganic liquid. Therefore, hazardous waste XYZ Radioactive Industry has hazardous characteristics to the environment and included in category 1.

### Storage Duration of Hazardous Waste

Before the hazardous waste is stored in the hazardous waste station of XYZ Radioactive Industry, characterize the hazardous waste is needed in the laboratory of XYZ Radioactive Industry. Hazardous waste which already has the characteristics and nature of hazardous waste, then, is stored in the waste station according to their nature and characteristics. To be saved hazardous waste will be placed into the hazardous waste container and given it the information in the form of labels and symbols like in Figure 5. Hazardous waste storage in XYZ Radioactive Industry is in accordance with

Government Regulation no. 101 of 2014, which has a period of 180 days to hazardous waste that produced less than 50 kg/day. Hazardous waste, which the characteristics are already known, is stored for 180 days before taken by a third party to be processed and utilized.



**Figure – 5:** HDPE Drum Containers with Hazardous Waste Labels and Symbols

### CONCLUSION

The hazardous waste station in the XYZ Radioactive Industry often results in excess storage capacity and some of its building components that do not comply with the proper regulations. In all alternative solutions to problem-solving, the chosen one is an alternative one, the construction of the new hazardous waste station with a design of the closed building with the consideration that the storage capacity of the hazardous waste is met, safe from outside disturbances, the impact of hazardous waste storage risks disturbing the surrounding environment (water, soil, air), updating the previously existing systems, affordable operating and maintenance costs, and security management system. Construction of

hazardous waste station located next to the old building of hazardous waste station with distances of the hazardous waste station from a public facility is  $\geq 50 \text{ m}^2$ . Calculation of waste design conducted with 2016, 2017, and 2018 data consideration so that it takes 8 pallets for liquid waste and 14 pallets for solid waste. The land area used for the construction of the new hazardous liquid waste station is 10.66m x 8.2m and the new hazardous solid waste station is 8.65m x 8.2m.

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