

# ***Evaluation and Mitigation of Fire Hazard in Traditional Fishing Vessel Port***

## ***A Case Study: Bajomulyo Fishing Port – Juwana, Pati- Central Java***

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**Abstract:** Pati is a district of Central Java which is known as highly developed fishery industry, especially in the district of Juwana that located in the north coast of Java. In Juwana, there is also a large fishing port named Pelabuhan Perikanan (PP) Bajomulyo. The construction of fishing vessel in PP Bajomulyo is dominated by wood structure with fiberglass in her outermost layer. Nowadays, fishing vessels have been using diesel engines as the main prime mover, generator to generate electricity and freezer equipment for freezing the fish. With the large number of combustible materials on fishing vessels, the danger of fire is the greatest hazard that might lead to loss of life and property. A series of fire loss of fishing vessels has occurred in PP Bajomulyo. The loss of property reached tens of billions and some of the victims were injured. This study aims to evaluate potential of fire on fishing vessels in PP Bajomulyo. The study was conducted with qualitative data analysis with the expected results are to prepare preventive actions and fire hazard mitigation. The conclusions of this study can be utilized by governments, stakeholders and local fishermen to prevent life and financial losses and effective mitigation due to fire accident.

## **1. Introduction**

Pati is a district of Central Java which is known as highly developed fishery industry, especially in the district of Juwana that located in the north coast of Java. In Juwana, there is also a large fishing port named Pelabuhan Perikanan (PP) Bajomulyo.

Activities of fishing vessel in PP Bajomulyo including:

- Loading supply to expedite its operational activities such as fuel oil, lubricating oil, fresh waters, and food stock.
- Departure and arriving of vessel and including berthing of vessel
- Unloading the captured fish
- Repair and maintenance of fishing vessel

“Fishing vessel” means any vessel used or intended to be used for the commercial exploitation of living marine resources, including mother ships and any other vessel directly engaged in such fishing operations [1].

Considering technologies used and operational, fishing vessel in PP Bajomulyo is categorized as traditional fishing vessel. Based on a rough estimation, the number of fishing vessels in PP Bajomulyo reaches approximately 1 units. The number of moored fishing vessels reached its peak when Ramadan approached and commemorated Idul Fitri.

Nowadays, fish catchment area in Pati is growing far. From before around Java Sea, extends to the sea area of Arafura, Natuna, and Ambon known to be rich in fish. Based from information above the fishing vessel owners are beginning to modernize the technology for their fishing vessel. Fishing vessels have been using diesel engines as the main prime mover, generator to generate electricity and freezer equipment for freezing the fish.

The construction of fishing vessel in PP Bajomulyo is dominated by wood structure with fiberglass in her outermost layer. Merbau and Bangkirai are type of the wood material that makes up the fishing vessel structures. Merbau is used as vessel hull/body, whereas Bangkirai is utilized as supper structure. To prevent intrusion of sea water via pore of the wood, outermost of the vessel is layered with fiberglass. Based on mentioned above, with the large number of combustible materials on fishing vessels, danger of fire is the greatest hazard that might lead to loss of life and property.

A series of fire loss of fishing vessels has significantly occurred in PP Bajomulyo. In 2015, 6 unit of fishing vessel were on fire. No detailed casualty report in this accident but it is believed that the loss reached billion [2]. Similar event occurred in 2017. There were 2 fire losses at adjacent times. The first accident on June 14, 2017, five vessels mooring in the port of Juwana were on fire [3]. There were no casualties in this incident, but the loss reached billions of rupiah. Second accident is happened on July 17, 2017, on a larger scale by burning 14 vessels. There were three victims who suffered serious burns and had to be rushed to the hospital. The estimated loss reached tens of billions of rupiah [3]. From above occurrences the loss of property reached tens of billions and some of the victims were injured. Commercial fishing is considered as one of the world’s dangerous occupation [4]. Based on global perspective, the International Labor organization (ILO) estimates around 24,000 deaths and 24 million non-fatal injuries occurs annually in fishery [5].

This study aims to evaluate potential of fire on fishing vessels in PP Bajomulyo. The study was conducted with qualitative data analysis with the expected results are to prepare preventive actions and fire hazard mitigation. This topic is very important to be elaborated due to fire safety issues are becoming seriously attention in Pati. Moreover, research on traditional fishing vessel is infrequent. The conclusions of this study can be utilized by governments, stakeholders and local fishermen to prevent life and financial losses and effective mitigation due to fire accident.

## 2. Fire

### 2.1. Nature of Fire

A fire is a combustion process, or a chemical process by which a combustible material is decomposed by reacting with oxygen (oxidation) while liberating heat and light. Moreover, fire generates smoke too that considered as toxic particle [6].

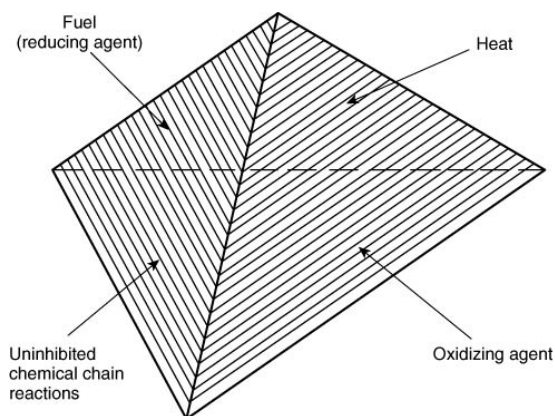


Figure 1: Element of Fire

National Fire Protection Association (NFPA) [7] identifies the needed elements of fire, namely the fire triangle, which identifies:

- fuel (any kind of combustible materials that will burn)
- heat (responsible for initial ignition and maintain steady fire)
- Air (air contains approximately 21% oxygen. Fire needs 16% oxygen)

Three elements above must exist to produce a fire. Fire will burn and the most known method to extinguish fire is to eliminate part of the element.

Along with the development of knowledge and study, fire specialists introduced the new element named chemical chain reaction to reveal fire. Chemical chain reaction is an exothermic reaction that produces energy to produce ignition. Clean agent halon is usually used to stop and break the chain reaction. The concept of the fire triangle is replaced by the fire tetrahedron.

## 2.2. Stage of Fire

By the most standard, there are 4 stages of fire. These stages are incipient, growth, fully developed, and decay [7][8]. The following is a brief overview of each stage:

- Incipient: 3 fire elements mix together in a sustained chemical reaction. At this point, a portable fire extinguisher can be used to restrict the fire.
- Growth: fire burns combustible material, and the heat increases. Convection and radiation create and ignite more surfaces. Potentially cause trapped, injured, or death to both victims and firefighters.
- Fully developed: all combustible materials are fully ignited. At that moment, the hottest flame is produced and very dangerous for human life.
- Decay (Burnout): significantly decreased level of oxygen or amount of combustible material causing fire outages.

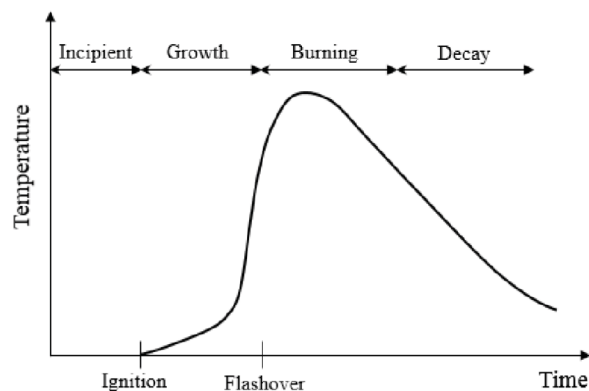


Figure 2: Stage of Fire

In the picture above we also found the terminology of flashover. Flashover is occurred when temperature in a room reaches a level where simultaneous ignition of all combustible in those room occurs (i.e. 300 degree Celsius). The whole room gets engulfed in the fire. Therefore, the absence of effective fire suppression in incipient stage and growth stage leads fire spread out and fully developed.

## 2.3. Fire Prevention and Fire Protection

The essential meaning of fire prevention and fire protection are different. Fire prevention is intentionally to eliminate opportunity of a fire being started. In order to start, every fire demand a primary heat source, a primary fuel source, and something to bring them together [7]

Prevention may take place through successful activity on the heat source, the fuel source, or the behavior that brings them together [7]. Housekeeping programs and inspection programs are simple way that can be created in the working are to prevent fire. Housekeeping can remove unwanted accumulation of combustible material and heat sources. Inspection program is very useful to identify fire-ignition and fuel hazard, then take relevant decision to eliminate them.

To create impressive fire prevention, it needs vigilance, action and cooperation. The example of vigilance is regular inspection of workplace to identify hazard of fire. Action is required to fixing hazardous condition by provide standard operating procedure (SOP) of work, set up the standard storage and air ventilation system for combustible liquid material, create the maintenance procedure to prevent fire from electrical and mechanical equipment. Mutual effort between employers and employee is playing a vital role to ensure understanding of their common interest in fire prevention.

### 3. Risk Assessment

#### 3.1. General

Risk is defined as likelihood x consequence [9]. The process of risk assessment is to identify the hazard(s) and then assess the likelihood (likelihood) and consequence of the hazard occurring. The likelihood of a fire occurring is linked to the hazards that may cause ignition combined with the presence of fuel and oxygen. Risk assessment is now a proven technology for operators to address larger hazards in a structured manner, and to ensure risks have been to reduce to appropriate levels cost effectively

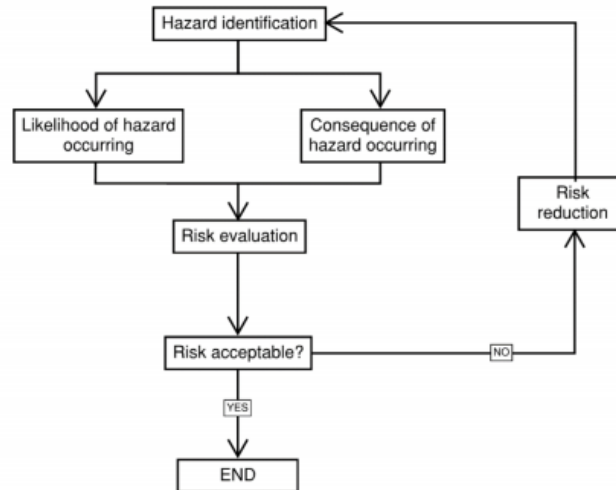


Figure 3: General approach to risk assessment

#### 3.2. Hazard Identification

A hazard is defined as a situation with a potential for causing harm to human safety, the environment, property or business. It may be a physical situation (e.g. a shuttle tanker is a hazard because it may collide with the production installation), an activity (e.g. crane operations are a hazard because the load might drop) or a material (e.g. fuel oil is a hazard because it might catch fire). In practice, the term “hazard” is often used for the combination of a physical situation with particular circumstances that might lead to harm, e.g. a shuttle tanker collision, a dropped load or a fuel oil fire. The essence of a hazard is that it has a potential for causing harm, regardless of how

likely or unlikely such an occurrence might be. Hazard identification (HAZID) is the process of identifying hazards, which forms the essential first step of a risk assessment. There are two possible purposes in identifying hazards:

- To obtain a list of hazards for subsequent evaluation using other risk assessment techniques. This is sometimes known as “failure case selection”.
- To perform a qualitative evaluation of the significance of the hazards and the measures for reducing the risks from them. This is sometimes known as “hazard assessment”. The same techniques can be used for both, but the emphasis and conclusions will be different. [10]

## 4. Material and Method

### 4.1. Description of Case Studies

This study aims to evaluate potential of fire on fishing vessels in PP Bajomulyo. The study was conducted with qualitative data analysis with the expected results are to prepare preventive actions and fire hazard mitigation. A request letter accompanied by an introduction letter to vessel owners was used to get the permission to conduct the survey in their vessels. The vessels involved in the survey mixed from several company or individual business. The fishing vessels involved in the study can be seen in the table below

Table 1: The Fishing Vessel Involved in This Study

No.	Name of vessel	Type of vessel	YOB	GT
1	KM. 1	Purse Seine	2003	70
2	KM. 2	Purse Seine	2008	66
3	KM. 3	Purse Seine	2010	86
4	KM. 4	Purse Seine	2016	100
5	KM. 5	Purse Seine	2012	131

### 4.2. Methods and Techniques

Risk assessment can be applied in approaches described as Qualitative, Semi-Quantitative and Quantitative [10]. In this study, the author use qualitative risk assessment. The inputs for a qualitative risk assessment are typically:

- Identification of the premises and people at risk;
- Identification of the fire hazards;
- Assessment of the fire hazard likelihood; and
- Assessment of the fire hazard consequence.

To enrich the risk assessment, physical observations and inspections by predesigned fire safety assessment, literature/document (inspection/maintenance reports, improvement orders) and; interviews to vessel managers, crews and professionals in the fishing vessel sector were used in data collection. Each fire protection systems were checked or inspected against requirements of the national laws and safety standards to determine its sufficiency and/or suitability. National laws can

refer to Non-Convention Vessel Standard Indonesia, while safety standards refer to National Fire Protection Association (NFPA).

## **5. Material and Method**

The analysis is based on the results of the observations or inspections of the various potential of fire and fire hazard mitigation. Potential of fire is described by fire element

### **5.1. Evaluation Fire Element in Fishing Vessel**

First fire element that we analyze is fuel. We found solid fuel exist in fishing vessel through wood and fiberglass structure, whereas liquid fuels consist of Diesel oil, Gasoline, Solvents, Liquefied Petroleum Gas (LPG). We found that the storing of liquid fuels are not meet safety standard.

Second is heat. The source of heat can be found through main engine, auxiliary engine, machinery, cooking equipment, electrical and lighting equipment, hot work and smoking. Generally, hot surface of engine and machinery is properly insulated with asbestos and aluminum foil. Electrical and lighting installation are not meet safety standard. Hot work and smoking are considered as serious aspect in fishing vessels because involves open flame. Welding, soldering and cutting are examples of hot work. It is performed during repair and maintenance of fishing vessel. No hot work permit and smoking regulation in all vessel.

Third is oxygen. The presence of oxygen is cannot eliminated in normal situation.

### **5.2. Evaluation of Fire Prevention and Protection in Fishing Vessel**

Based on our interview and inspection, fire prevention in fishing vessel is not formally programmed by the owner. Housekeeping program is conducted by crew to remove accumulation of trash. Inspection program is performed by on shore staff but focused to machinery and equipment only. It was noted that no regular fire training held for crew.

The fire protection of a ship is accomplished by so-called active and passive methods [11]. First, include fire extinguishing appliances and media use. No fixed fire protection available on board. From 5 visited fishing vessels, only 3 fishing vessel provided with 2-4 portable fire extinguisher. The type is dry powder with size vary from 2.5 – 3 kg. The passive methods are connected with restricted use of flammable materials, they determine the construction of the ship's bulkheads, separation of spaces with fire-resisting bulkheads and decks, fire protection of evacuation roads and division into main vertical zones However, no passive fire protection available in vessel.

### **5.3. Evaluation of Fire Prevention and Protection in the Port**

There was no fire hydrant or public supply available in the port. There is only small portable pump that modified become fire pump in case of fire. No detailed information gathered regarding the capacity and head of the pump.

Accessibility is also play important role to support fire suppression activity. The nearest public fire brigade is located in Pati. The public fire brigade is approximately 16 km distant from the port. The response time is about 30 minutes. We evaluate that some fishing vessels are moored in area that public fire brigade unable to reach because the road is inaccessible. To anticipate those situation, local government provide firefighting ship in Silugonggo River. However, detailed of ship particular could not be collected at the day of our visiting.



## 6. Material and Method

In conclusion, it is evaluated that fire safety in fishing vessel in PP Bajomulyo Pati need to be improved.

Fire safety and awareness must be implemented to all stakeholder to understand the risk of fire and mitigations [12]. The policy of fire safety must have objectives to prevent the occurrences of fire and explosion, reduce the risk to life, vessel itself, cargo and environment.

To prevent the occurrences of fire and explosion, ship's owners and crews must implement control of fire element. Liquid fuel must be stored properly and keep away from heat source. In respect of electric installation, it is recommended to provide proper installation to avoid short circuit, overload and spark that may lead into occurrence of fire or explosion. Smoking must be prohibited in area that presence of fuel or flammable liquid. Designated area for smoking must be provided. Hot work is cause on the latest fire occurrence in PP Bajo Mulyo. It is recommended that hot work must be conducted in with hot work permit system. Hot work permit system includes a step-by-step check list for hot work fire safety and serves as a reminder to welder of their fire prevention responsibilities before, during, and after any hot work is conducted. To prevent spread of fire when fire occurrences caused by hot work, repair and maintenance of vessel recommended to conducted in separate area.

Reducing the risk to life, vessel itself, cargo and environment caused by fire can be implemented through emergency organization and training. A basic emergency organization should be established with immediate effect at the working area. It should consist of the following positions each with a designated alternate:

- Person-in-charge
- Notify i.e. person/s to call fire department in the event of an emergency
- Fire-fighting team trained in the use of fire extinguishers and hydrant hoses and is responsible for fighting incipient fires

A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method, and shall be trained to recognize and avoid potential hazards present with respect to that equipment or work method. Training programs and procedures shall be reviewed and updated at least annually

Although fire and explosion prevention is applied, as anticipation when fire occurs, it is recommended that vessel may equipped with fire protection system. Fire protection system consist of fire detection, alarm and suppression [13]. We are also recommended to provide hydrant and hose connection in port. To ensure the fire protection system is ready for emergency regular recorded fire safety inspections should be conducted. Items checked should include fire extinguishers, hydrant hoses, storage of flammable liquids, smoking regulations, hot work procedure and general housekeeping [14]. The Inspection, maintenance programs and testing should be based to develop the concepts of reliability analysis and prediction of the fire safety.

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