

Fire Detection System – Auto Start Fire Pump when Manual Call Point Activated

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Abstract - All seaworthy vessels must comply with SOLAS Chapter II-2 under the International Code for Fire Safety System (FSS Code) and be equipped with a reliable Fire Extinguishing System. In the event of an emergency during a voyage, only the ship's crew is available to combat any uncontrollable fire, as assistance from the shore is not feasible when the vessel is far from land. The existing fire extinguishing system design is not equipped with an Auto-running of the Emergency Fire Pump or the Fire Pump in the event when a manual call point is activated. To solve this problem, the vessel's fire systems would need to have a design that incorporates the Fire Control Panel, Manual Call Points, Fire Pump and Emergency Fire Pump in an integrated parallel arrangement with the control of microcontroller. This arrangement allows the Fire Pump or Emergency Fire Pump to run automatically when a Manual Call Point is activated.

Keywords: Auto Start, Fire Detection System, Fire Pump, Integrated Parallel System, Manual Call Point (MCP)

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1.0 INTRODUCTION

All vessels must be equipped with a fixed fire extinguishing system that complies with applicable standards. The SOLAS Chapter II-2, under the FSS Code, outlines standards for vessel fire pump systems. According to these standards, the primary equipment includes the main fire pump and the emergency fire pump. However, current designs of fire extinguishing pump systems, as discussed in relevant journals, have a significant weakness: the main fire pump and emergency fire pump are not integrated with the fire detection panel. This paper proposes a solution to this issue by introducing a system where, upon activation of a manual call point (based on its location), either the main fire pump or the emergency fire pump will automatically start and pressurize the fire line. This integration aims to reduce the response time in the event of a fire (Samosir, 2021).

2.0 PROCEDURAL

The PIC16F84A Microcontroller will be connected to the existing Fire Alarm Control Panel, creating a link between the Manual Call Points to the Main Fire Pump & Emergency Fire Pump based on the location of the fire onboard the ship. Fig. 1 shows the Flow Chart of the Main Fire Pump or Emergency Fire Pump upon activation of the MCP. This is achieved using several existing and additional components, which include an LCD Screen, LED Warning Lights, and Buzzers to complete a circuit that achieves the intended function.

By including these components, the effectiveness of the Fire Detection System is believed to be enhanced to allow all crew to muster and prepare themselves for firefighting, while the fire pump is primed and ready for immediate use as required, without worrying about the risk of obstructions or lack of manpower within the Roving Team to prepare the fire line for use. As an example, Fig. 3 shows an excerpt from the Seri Ayu Machinery Operating Manual which incorporates the Main Fire Pump

and Emergency Fire Pump to the Fire Control Panel. the flowchart outlines a fire monitoring and response system that incorporates both manual and automated processes to detect and address fire incidents. The process begins by checking if the manual bypass is activated; if so, the system relies on manual controls, and the MCP (Manual Call Point) is checked for activation. If the MCP is triggered, fire panels in the affected location (engine room or outside) detect the fire, print a report, and activate fire alarms, lamps, and either the emergency or main fire pumps. If the MCP is not activated, the system remains in normal condition or identifies a system fault, recommending the replacement of the MCP. In case of manual bypass with activation, fire alarms and lamps are controlled manually, and pumps switch to manual mode. This structured approach ensures efficient detection, alerting, and mitigation of fire-related incidents while addressing potential system faults.

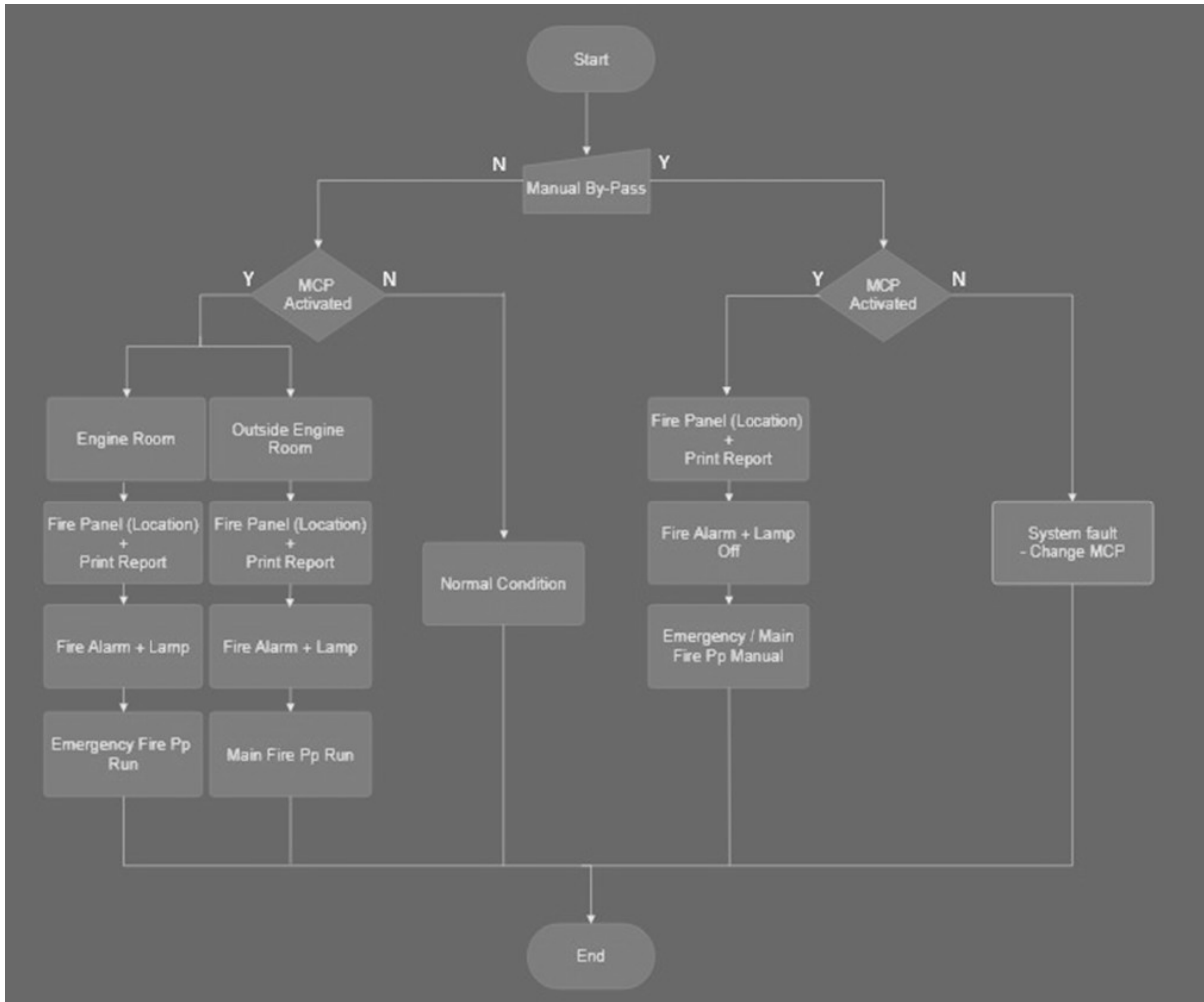


Fig. 1. Flow Chart of the Main Fire Pump

Table 1 below demonstrates the system's capability to respond appropriately to fire incidents at specific locations or simultaneously across multiple areas, ensuring comprehensive fire safety and alert mechanisms.

Table 1. Truth Table showing the operation of the system

Input		Output				
MCP Activation Point Deck	MCO Activation Point ER	Emergency Fire Pump	Main Fire Pump	Siren + Light	AHU + Fire Doors	LCD Display
0	0	0	0	0	0	0
1	0	0	1	1	1	1
0	1	1	0	1	1	1
1	1	1	1	1	1	1

The system's response to different input conditions is based on the activation of Manual Call Points (MCP) on the deck and in the engine room (ER). Depending on the input, the system activates the appropriate fire pumps (Emergency or Main), triggers alarms (Siren + Light), closes safety mechanisms (AHU + Fire Doors), and updates the status on the LCD display. The table ensures clarity in how the system responds to fire incidents in specific locations or simultaneously across multiple areas.

The Fig.2 below illustrates the fire detection and response system with integrated control for alarms and fire pumps. It uses multiple microcontrollers (PIC16F84A) to process input signals from various sensors and switches, including bypass and location selectors, which determine the activation points (engine room or outside). The Fire Detection Panel Display provides real-time status updates on the system's operation. Relays (RL1, RL2, RL3) control the activation of fire alarms, alarm column lamps, and fire pumps (Main and Emergency). The buzzer and lamp provide audible and visual alerts in case of fire detection. This system ensures efficient monitoring, alerting, and action for fire incidents in designated areas.

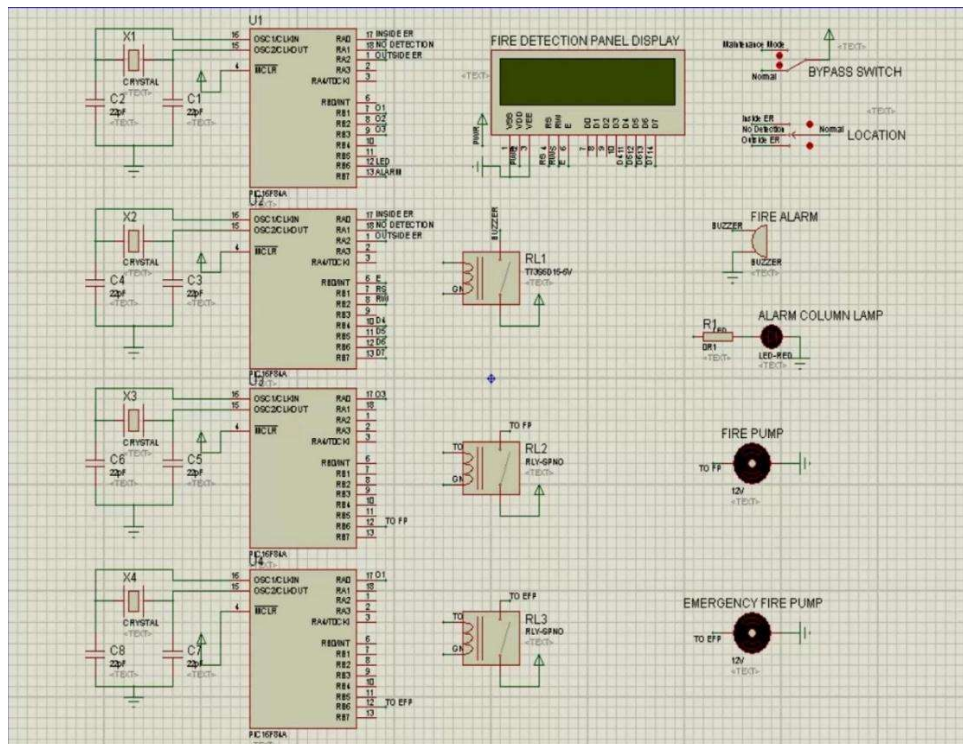


Fig 2. circuit of the Fire Detection System

The Fig.3 below depicts a centralized fire detection and alarm system integrated with multiple panels and devices for comprehensive monitoring and response. The BS-320M Central Unit connects to the ship's supply, providing power to various loops, detectors, and control panels (F.C.S. and C.C.S.). It interfaces with other systems via Modbus for serial communication. Detector loops (e.g., Loop 1 to Loop 9) monitor different zones for fire or smoke, while outputs trigger alarms, fans, or system responses such as stopping ventilation or activating fire alarms. The system ensures reliable communication, with CAT 5 cabling linking information panels and controlled delay mechanisms for emergency actions. This setup provides a robust safety system tailored for shipboard environments.

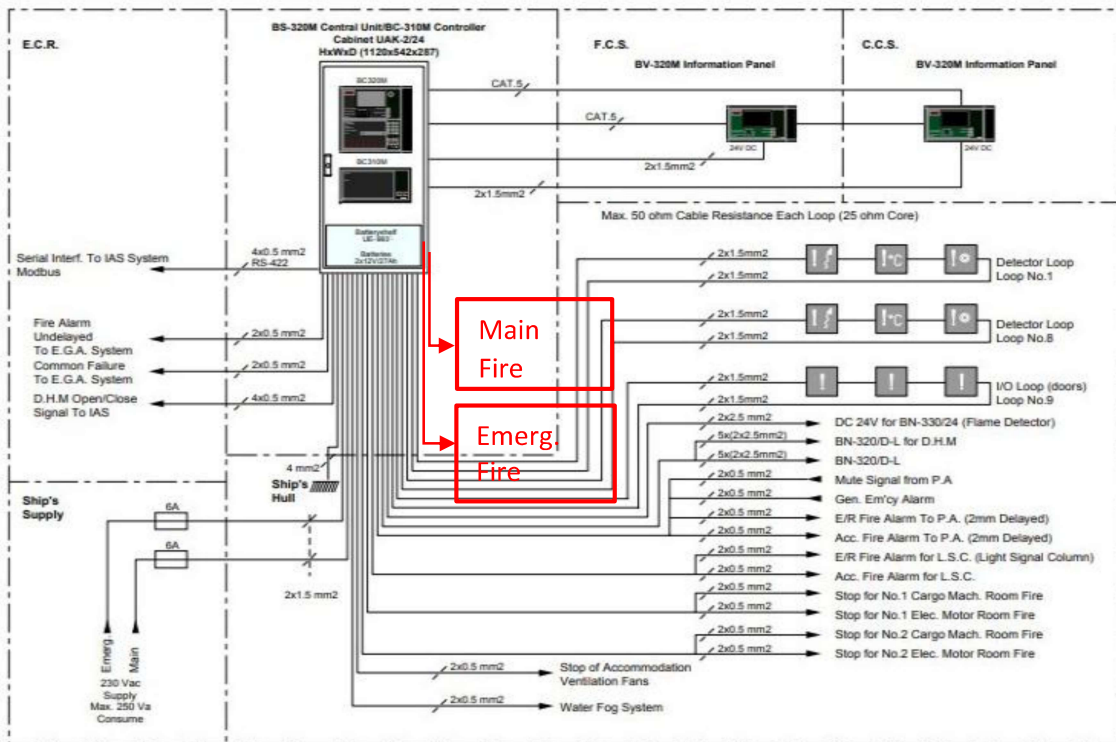


Fig. 3 Fire Alarm Panel of Seri Ayu

4.0 OUTPUT

Based on the output simulated, it was discovered that the design successfully performs the following actions to achieve the intended result to create a more fire detection system onboard ship. The design activates the fire pump or emergency fire pump upon activation of Manual Call Point (MCP) to avoid delays in the pressurization of the fire line for use, prevent loss of time during emergencies, prevents the possibilities of obstacles affecting the effectiveness of firefighting effectiveness, to provide a safer guideline for firefighting onboard ship and to highlight the importance of ensuring the fire line is ready for use at a moment's notice.

Marine fire pumps, as a primary source of fire extinguishing, provide the water to extinguish any fire in a ship. These pumps carry seawater or foam to put out the fire quickly before it gets out of hand. Initial findings show that there are no automatic controls for the primary fire system onboard vessels. Water would have to be directed to the fire manually in the event of an emergency, through fire hydrant and hoses, pressurized by fire pumps. (Company, 2020) For vessels with Fixed Fire Fighting Systems that operate on hyper mists of a Fresh Water extinguishing medium, this method only covers certain critical areas. It is an independent system but readily integrated with the Fire Detection Panel, unlike the Fire Pump system.

In the event of fire, current vessel fire detection panels include isolating ventilation at accommodation, galley equipment, fire alarm and accommodation fire door. With the incorporation of the system, the user-friendliness of the Fire Fighting System onboard vessels can be enhanced in line with the FSS Code.

Manual Call Points (MCPs) are crucial components of any building's fire detection system. MCPs serve several vital functions, including:

- Sounding the alarm to warn everyone inside about a potential fire hazard
- Promptly starting the evacuation process
- Triggering the alarm if the automated detection system is not working
- Alerting the fire alarm control panel to the location of the fire
- Informing the fire services about the fire, either manually or automatically
- Engaging the smoke management system

(Evacuator Site Alarms, 2021)

With the introduction of the system, the MCP then adopts an additional function of starting the Fire Pumps to further enhance the standards of safety on board ship.

From a regulatory standpoint, articles that mention firefighting standards insist that the primary purpose of establishing a separate Code (FSS Code) was to distinguish between carriage and other statutory requirements, which appropriately belong in the Convention and are intended for the Administration, and purely technical provisions. These technical details are better placed in the Code, allowing equipment manufacturers, system engineers, and others to apply them in a more user-friendly manner. (IMO, International Maritime Organization, 2021)

5.0 DISCUSSION AND CONCLUSION

With the implementation of the design to the Fixed Fire Fighting System, fire-fighting safety standards will be improved in ways that will greatly benefit the shipping industry. The design itself potentially creates a more reliable, and accurate, response time-to-action ability that will ensure the water pressures in the fire lines are ready for use when required. A vessel's existing Fire Detection Panel can be integrated with the Fire Pump and Emergency Fire Pump by activating the Manual Call Points (MCP). The system not only serves as a function to pressurize the fire line automatically, but also ensures no unforeseen circumstances occur in the absence of the Roving Team. It also allows the Main Fire Pump or Emergency Fire Pump to start automatically with the MCP activated in case a location becomes difficult to access during an emergency.

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