Course Learning Outcomes for Unit VII

Upon completion of this unit, students should be able to:

5. Examine emerging technologies related to fire protection.
   5.1 Discuss the characteristics of stationary fire pumps.
   5.2 Identify pump drivers, components, and accessories common to the installation of fire pumps.
   5.3 Describe considerations of surge protection for the installation of fire pumps.

Course/Unit Learning Outcomes	Learning Activity
5.1	Unit VII Lesson Unit VII Course Project
5.2	Unit VII Lesson Unit VII Course Project
5.3	Unit VII Lesson Report: *Data Assessment for Electrical Surge Protection Devices: Phase 1 Final Report* Unit VII Course Project

Reading Assignment

In order to access the following resource, click the link below.

Read Chapter 2 of the report titled *Data Assessment for Electrical Surge Protection Devices: Phase 1 Final Report*.

Davis, E., Kooiman, N., & Viswanathan, K. (2014). *Data assessment for electrical surge protection devices: Phase 1 final report* (Project No. 1ELD62001.001). Retrieved from https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/RFDataAssessmentforElectricalSurgeProtectionDevices.ashx?la=en

Unit Lesson

Fire Pumps

Fire pumps are a critical and vital component of numerous water-based fire protection systems. Over several decades, fire pumps have been providing water flow and pressure for water-based fire protection systems. In the *Crosby-Fiske-Forster Handbook of Fire Protection* (8th ed.), Crosby, Fiske, Forster, and Moulton (1935) noted that fire pumps are used to supply water for automatic sprinklers, standpipes, and hydrants.

Fire pumps have not changed much over the decades of delivering water flow and pressure to water-based fire protection systems. Fire pumps use the same sources of water today as they did in 1935. Drivers, control devices, and jockey pumps were part of the components of fire pumps in 1935, as well as today. Crosby et al. (1935) listed fire pumps as centrifugal fire pumps, rotary fire pumps, and steam fire pumps (piston driven by steam). Today, steam fire pumps are no longer utilized. In 1935, there was a strong emphasis stating that fire pumps must be listed by Underwriters Laboratories (UL) and Factory Mutual Laboratories, and this remains the same today.

One of the most critical and vital components for fire pumps then and today is adequate water and power supply. Today, the fundamentals of fire pump design remain relatively unchanged, taking water and boosting the pressure to meet the pressure and water flow demands of the water-based fire protection system. The drawback to this is if the public or private water system cannot deliver adequate water to the fire pump. The National Fire Protection Association (NFPA) 20: *Standard for the Installation of Stationary Fire Pumps for Fire Protection* states that all fire pumps must be tested weekly or monthly based on the type of driver used in the system (Klaus, 2013). Testing of fire pumps is critical to ensure they are ready to provide the needed water flow and pressure in the event of a fire.

Fire pump assembly components: A stationary fire pump has several significant components that perform as a unit. In addition to the fire pump, there are drivers; control devices; jockey pumps; and additional components, such as fittings, valves, and devices.

Drivers (pump drivers): A driver connects to the fire pump and provides the mechanical power to turn the pump. Today, the first choice during the design phase of fire protection systems is an electric motor. Fire pump drivers must be listed and meet the performance characteristics determined by UL and the National Electrical Manufacturers Association.

Control devices: A control device senses the loss of pressure in the system and sends an electric signal engaging the driver. In the control panel, there are two positions: manual and automatic. The manual position allows the fire pump to be operated in the event that the automatic pump-start failed.

Jockey pump: Pressure fluctuation and loss is common to any water-based fire protection system, and these fluctuations or loss of pressure could cause the pump to unnecessarily start and stop. In order to manage the pressure loss, a smaller pump, which is called the jockey pump, is installed to maintain the pressure. Jockey pumps are a small electric motor that boosts and maintains the system. When the demand for water flow is beyond the capabilities of the jockey pump, the main fire pump will then activate.

Points to Ponder Scenario

In the distribution warehouse, the fire pump was located in an area that was out of the way and most workers did not even know there was a fire pump. The fire pump was a foreign-made fire pump that was not part of the specifications listed in the design of the fire protection system. The fire pump complied with foreign regulations and international codes of practice similar to the NFPA. In addition, the fire pump met International Organization for Standardization's ISO 9001: 2008 specifically for centrifugal pumps and jockey pumps used in automatic water-based sprinkler installations. However, the foreign-made fire pump was not UL approved. The pump met compliance with the engineer's design specifications and calculations outlined on the shop drawings. However, once the fire pump was installed, the inlets for the water lines on the suction side required elbows to connect to the potable water source. In addition, butterfly valves and pressure regulating devices were used 10 feet from the fire pump suction flange. The control values were not properly labeled and none of the values were clearly identified. In addition, the relief valve was eliminated during installation. After the fire, investigators noted that the fire pump had not been tested since installation, and there were no records of any maintenance being performed. When power was restored to test the fire pump, an electrical surge from the power distribution grid occurred damaging the electric motor. In addition, the electric motor for the fire pump was not properly grounded, and the surge protector used did not comply with UL Standards nor was it authorized to bear the UL mark, which is a UL holographic label.

Was the fire pump installation in accordance with the NFPA? Should an inspector have realized the elbows, butterfly valves, and pressure regulating devices were an issue in performance? Should they have noted the fire pump was not UL approved? According to Klaus (2013), NFPA 25 standards do not require inspectors to understand the design and adequacy of fire protection systems to include the fire pump. Inspectors are required to identify operational problems when inspecting the system. Klaus (2013) does state that if inspectors have specific knowledge of a system and recognize a problem in design, then they must recommend a hazard evaluation. In addition, butterfly valves and other devices within 50 feet of the suction flange can decrease performance. The reason stated is these devices can create excessive turbulence, leading to pump cavitation and the loss of pressure.

Electrical Surge Damage

In the scenario, an electrical surge occurred and damaged the fire pump when the power was restored after the power outage. Electrical surges can damage various electronics critical to fire protection systems like computers, phones, phone lines, and fire alarm control units (FACUs). Some of the causes of electrical surges could be the electrical distribution system is not grounded or surge protection devices are not installed properly. In addition, surges could occur from lightning, utility switching, or other sources, so surge protection devices should be used for residential and commercial/industrial structures. According to Klaus (2013), the industry standards provide limited guidance on what is an acceptable level of protection. A study by the NFPA Fire Protection Research Foundation concluded that 12% of the fire pumps tested had damage due to voltage surges (Davis, Kooiman, & Viswanathan, 2014). The authors noted that surges damage motor windings in fire pumps, shortening the motor's life. Control devices are at risk for damage from surges, altering the capacity of the system and making them ineffective during a fire. Davis et al. (2014) warn that surge protection must be properly sized and installed in order to protect the device and that there are four types of surge protection devices (SPD) listed in UL 1449. The types are dependent on the location within in the system and the type of internal protection provided.

- Type 1: SPDs are permanently connected between the secondary line and the line side of the equipment.
- Type 2: SPDs are permanently connected on the load side of the equipment and located at the branch panel.
- Type 3: SPDs are installed at the point of utilization that is at least 30 feet from the electrical service panel.
- Type 4: SPDs are components and assemblies that are factory installed into electrical distribution equipment and require additional overcurrent protection (Davis et al., 2014).

NFPA 70, which is the *National Electrical Code*, covers electrical safety in residential, commercial, and industrial occupancies. The code also covers safety involving electrical wiring, overcurrent protection, grounding, and installation of equipment, as well as facilitates the safe installation of electrical wiring and equipment. Brakhage, Abrams, and Fortney (2016) warn that a disadvantage with electrical pump drivers is the reliability during power outages related to storms, transformer or substation failure, and power line damage. Even with the disadvantage, electrical pump drivers are still used in most fire protection system designs.

Conclusion

Although there are new and different types of fire pumps, over the decades, they have not changed in their function of boosting pressure and supplying water. Since 1935 and before, fire pumps have been a critical and a vital component of water-based fire protection systems. The selection, installation, and maintenance of fire pumps are also critical and could mean the difference in a devastating fire for life safety and property as seen in the scenario.

In many instances, electrical surge protection devices could have mitigated damage or even loss to equipment. It is critical that surge protection devices are used on all electrical fire protection equipment and appliances. NFPA 70: *National Electrical Code* covers the installation of SPDs and electrical distribution equipment.

References

Brakhage, C., Abrams, A., & Fortney, J. (Eds.). (2016). *Fire protection, detection, and suppression systems* (5th ed.). Stillwater, OK: Fire Protection Publications.

Crosby, E. U., Fiske, H. A., Forster, H. W., & Moulton, R. S. (1935). *Crosby-Fiske-Forster handbook of fire protection* (8th ed.). Boston, MA: National Fire Protection Association.

Davis, E., Kooiman, N., & Viswanathan, K. (2014). *Data assessment for electrical surge protection devices: Phase 1 final report* (Project No. 1ELD62001.001). Retrieved from https://www.nfpa.org/-/media/Files/News-and-Research/Resources/Research-Foundation/Research-Foundation-reports/Electrical/RFDataAssessmentforElectricalSurgeProtectionDevices.ashx?la=en&hash=F3B04EB52D4235D7EC64F51F47378B14FB0A8B00

Klaus, M. J. (2013). *Water-based fire protection systems handbook* (4th ed.). Quincy, MA: National Fire Protection Association.

Suggested Reading

In order to access the following resources, click the links below.

You are encouraged to review the standard for the installation of stationary pumps for fire protection including the new rules that specifically address fire pumps.

Divine, T., & Semien, W. (2017). NFPA 20: Changes to the fire pump standard. Retrieved from https://www.controleng.com/single-article/nfpa-20-changes-to-the-fire-pump-standard/1ae4ce95f972bc9d47685427db8f1722.html

In order to view National Fire Protection Association (NFPA) standards, each student must register for a free account with the NFPA. Please review the video tutorial on gaining access to the NFPA website and how to access the NFPA codes there.

Locating and Using NFPA Standards Tutorial: http://libguides.columbiasouthern.edu/nfpastandards

Click here to access the transcript for the tutorial above.

National Fire Protection Association. (n.d.). *Standard for the installation of stationary pumps for fire protection* (NFPA Standard No. 20). Retrieved from https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=20

Pennel, G. (2012, April). *Fire pump field data collection and analysis* (Aon FPE Project No. 1811001-000). Retrieved from https://www.nfpa.org/-/media/Files/News-and-Research/Archived-reports/rffielddatacollection.ashx?la=en